PARADOXOSOMATIDAE FROM BORNEO (DIPLOPODA, POLYDESMIDA)

BY

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INTRODUCTION

In comparison with the numbers of Paradoxosomatidae*) known to occur in Java or Sumatra, remarkably few species of this family have been recorded from Borneo. In all, the faunistic list of the island included the following species:

- Orthomorpha beaumontii (Le Guillou)
- Orthomorpha coarctata (Sauss.)
- Orthomorpha rotundata Att.
- Orthomorpha borneona Att.
- Pratinus fasciatus (Att.)
- Euphyodesmus gracilis Att.
- "Strongylosoma" nodulosum Att.

Of these species, O. beaumontii was described in 1841 in a way which rendered its identity and relationship largely a matter of speculation. Similarly, "S." nodulosum, because of having been based on a female specimen, always remained a species of doubtful status. O. coarctata, finally, is a circumtropical ubiquist, which probably does not belong to the autochthonous fauna of the island. In reality, therefore, there remained but five species to show us the particularities of the Paradoxosomatid fauna of Borneo.

That this small number of species represented a negligible portion of the local fauna was revealed to me by the study of a rather large amount of material of Paradoxosomatidae from Borneo which I found in various lots of unidentified millipedes received in loan from the Museums of Bogor, Leiden, and Stockholm. The collections under consideration cover the eastern, central and western parts of Borneo and were made in particular by Dr. A. W. Nieuwenhuis, in the course of several Dutch Borneo Expeditions of some sixty years ago, by Dr. E. Mjöberg during the middle twenties and, more recently, by Mr. A. M. R. Wegner. For the loan of these valuable collections I am very much indebted to the authorities of the above mentioned Museums, and in particular to Miss A. M. Buitendijk † (Leiden), Mr. L. J. M. Butot (Bogor) and Dr. R. Malaise (Stockholm).

My thanks are also due to Dr. M. Vachon (Paris) for enabling me the re-examination of the type specimen of Orthomorpha beaumontii.

The present study not only multiplies the number of known species but also shows that Borneo has a Paradoxosomatid fauna which, although having general

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*) The name Paradoxosomatidae Daday, 1889, has priority over Strongylosomatidae, Cook, 1895.
southeast Asiatic features, is characterized by a large percentage of endemic genera. In fact, the examination of the material under report has revealed the existence of several generic categories not recognised previously. Especially the species hitherto referred to *Orthomorpha* upon closer study have proved to belong to various groups of questionable interrelationship. In order to arrive at a better taxonomy, it has been deemed necessary to separate generically these groups from *Orthomorpha*.

The possibility that some of the proposed generic names in the future will prove to have only subgeneric value has, of course, to be left open. For the present it seems better to refrain from a more refined taxonomy in a group where so many forms apparently await discovery.

For similar reasons I have abstained from using a trinary nomenclature. In general, the decision by previous authors on what constitutes a subspecies appears to have been influenced by the degree of morphological differentiation rather than by genetic and geographical coherence. In the present paper several instances can be found where morphologically very similar forms occur in one locality. Not seldom the differences between such forms, to be looked upon as "good" species, are less significant than those between two forms which may represent geographically vicarious populations. I have mentioned, as a rule, the possibility of sub-specific relationship where necessary.

With the present additions the list of Paradoxosomatidae of Borneo reads as follows:

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Descriptions

Kalimantanina gen. nov.


Segments moderately (♀) or rather strongly (♂) constricted. Prosomites with fine cellular structure, somewhat dull. Waist of moderate width, strongly longitudinally ribbed in the dorsal half of the segments, finely and rather widely striate in the ventral half dorsad of the sternal level. Metatergites shining, hairless or with few hairs, without sculpture. Transverse furrow distinct but not very deeply impressed, finely longitudinally striate, present from the 5th segment onwards. Pleural keels well developed in a number of segments in the anterior half of the body.

Lateral keels rather weakly developed, posteriorly rounded on nearly all segments and projecting behind the posterior margin of the metasomite only in the 2nd segment, or, eventually, also very slightly in the 18th and 19th segments. Keels of 2nd segment well below the level of those of the next segment.

Sternites with moderately to well developed cross-impressions, longer than wide (♂) or about as long as wide (♀), rather weakly to moderately setiferous. Sternite of 5th segment of ♂ with a well developed, distally laminate process between the anterior legs. Sternite of 6th segment of ♂ somewhat modified: only its anterior part somewhat raised above the ventral surface of the metasomal ring. Sternite of 7th segment of ♂ with on each side a latero-anterior sub-longitudinal ridge-like protuberance. Sternite of 8th segment of ♂ not modified. Legs rather long; the distal part of the tibiae and the tarsi of at least some of the anterior legs of the ♂ with brushes.

Gonopods with coxa of moderate size, straight-cylindrical, with the distal end slightly bent caudad; latero-anterior side of the distal end with a setiferous area. Prefemur somewhat elongate, almost in one line with the femur and laterally well demarcated from that joint, the demarcation oblique on the longitudinal axis of the femur. Femur straight, well developed, about as long as coxa or somewhat longer. Postfemur not demarcated. Spermal channel running more or less straight along the anterior or medio-anterior side of the femur towards the base of the solenomerite. Solenomerite long, flagelliform, arising from the anterior side of the distal end of the femur. From the medio-anterior side of the femur, more or less near the base of the solenomerite, or from the solenomerite itself, directly mesad of the course of the spermal channel, arises a rather long, lanceolate or spiniform process. Tibiotarsus springing from the posterior side of the distal end of the femur, well developed, distinctly demarcated from the femur. Tibiotarsus consisting of a simple, more or less circular solenophore without accessory processes, curving into a posterior direction. Both lamina medialis and lamina lateralis well developed, sheathing the solenomerite for its greater part.

Type-species. — Kalimantanina ruficeps spec. nov.

Range. — Borneo.

Number of species. — Five.
Remarks. — In a previous paper (JEEKEL, 1953), in connection with the
description of a new species, I have discussed already the heterogeneity within
the genus Sundanina Att. In particular I then questioned the dominant taxonomic
value previously attributed to the presence of one or more femoral processes in
the gonopods of the species of that genus. When the general structure of the
gonopods is taken into consideration, fundamental diversities are encountered
which seem to exclude the possibility that the species of Sundanina really represent
a monophyletic unity.

On account of the presence of a femoral process the species of Kalimantanina
could have been referred to Sundanina in the broad sense of Attems. However,
pending a revision of the latter genus it seems more convenient to separate at
once the homogeneous group of presently described Bornean species. As a matter
of fact, there seems to exist no particular relationship between Kalimantanina and
any of the known species of Sundanina. The genus is, however, closely related to
Borneonina gen. nov.

Key to the species. — In general morphology the species of Kalimantanina are
extremely similar. For their separation we have to rely mainly on the characters
of the male gonopods.
1. Femoral process of gonopods arising well proximad of the base of the
solenomerite and projecting scarcely distad of the base of the tibiotarsus ........
.................................................. K. decolorata spec. nov.
— Femoral process arising from the base of the solenomerite, or from the
solenomerite proper .................................................. 2
2. Dorsum and sides of the somites black; head and anal valves of a contrasting
reddish brown colour .................................................. 3
— Dorsum and sides of the somites black, except the lateral keels and an area
dorsad of these which are white. Head and anal valves not contrasting in
colour ................................................................. 4
3. Femur of gonopods about as long as the coxa. Femoral process arising from
the solenomerite. Tarsal brushes of the ♂ absent in the legs of the posterior
half of the body .................................................. K. ruficeps spec. nov.
— Femur about one and a half times as long as coxa. Femoral process arising
just proximad of the base of the solenomerite. Tarsal brushes of the ♂ absent
only in the last two pairs of legs .................. K. birtitarsus spec. nov.
4. Femur of gonopods about as long as the coxa. Femoral process spiniform.
White area above the lateral keels about as broad as the keels ........
................................................................. K. albomigra spec. nov.
— Femur about one and a half times as long as coxa. Femoral process lanceolate.
White area dorsad of the lateral keels only half as wide as the keels ........
................................................................. K. ocellata spec. nov.

Kalimantanina ruficeps spec. nov.

Material. — East Borneo: Pajan River (Coll. Dr. E. Mjöberg, Mus. Stock-
holm), 2 ♂, (2 ♀).

Colour. — Head reddish brown, very dark in the vertigial part. Antennae
brownish yellow, the 6th joint growing very dark, almost blackish brown, towards
the end. 7th joint also very dark, but the distal portion and the 8th joint whitish. Collum and subsequent segments black, the poriferous keels very dark brown around the pore. Ventral portion of somites brownish gray. Sternites and legs dirty pale yellow. Anal segment black, the tail growing brownish yellow towards the end. Valves and anal scale reddish brown.

Width. — Holotype δ 2.5 mm, other δ 2.6 mm; ♂ 3.2 mm and 3.4 mm.

Head and antennae. — Labrum narrowly and moderately emarginate. Clypeus rather weakly convex, moderately impressed towards the labrum. Lateral sides hardly emarginate. Surface of head shining, with some irregular wrinkles. Clypeal part of headplate rather dispersedly setiferous, a few bristles on the frontal part and two on the vertex. Antennal sockets separated by slightly more than the diameter of one socket or by about three fifths of the length of the 2nd antennal joint. Postantennal groove shallow, the wall in front moderately prominent. Vertex moderately convex, not demarcated from the frontal area. Sulcus moderately impressed, with some transverse wrinkles, reaching downward to about the upper level of the sockets. Antennae not particularly slender. Length of joints decreasing very slightly from the 2nd to the 5th, the 6th joint somewhat more distinctly shorter than the 5th, about two thirds of the length of the 2nd. Joints of subequal width, the 6th very slightly thicker than the others. Antennal joints moderately to rather densely setiferous.

Collum. — (fig. 1—2). Slightly narrower than the head, subsemicircular in dorsal outline. Anterior border evenly rounded, posterior border widely and rather weakly emarginate. Lateral sides rather widely rounded. Surface smooth and shining, longitudinally as well as transversely moderately convex; a few hairs may be present. Lateral and latero-anterior border with a fine marginal rim, gradually disappearing towards the middle of the anterior border.

Body segments. — Metatergites mostly hairless. Transverse furrow present up to the 17th segment, extending laterad to about halfway the dorsal delimitation of the lateral keels in most segments. Sides rugulose and dispersedly granulate up to the 4th segment, only weakly rugulose from the 5th segment onwards. Pleural keels present up to the 7th segment, totally absent from the 8th segment onwards. Up to the 4th segment these keels are represented by complete ridges which are posteriorly produced into a well developed angular lappet projecting behind the posterior margin of the somites. From the 5th segment onwards the pleural keels are present only on the posterior half of the segments and the posterior lappet becomes smaller, projecting very slightly behind the margin of the somite in the 5th segment only.

Lateral keels. — (fig. 1—4). 2nd segment somewhat wider than the collum. The keels anteriorly somewhat shouldered at the base, the anterior and posterior edges rounded, the posterior edge projecting slightly behind the border of the segment. Marginal rim rather weakly developed. 3rd and 4th segments of subequall width, slightly narrower than the 2nd. The keels anteriorly widely, posteriorly somewhat more narrowly rounded, ventrally demarcated only in their posterior half. 5th segment distinctly wider than the 4th. Keels from the 5th segment onwards anteriorly and posteriorly widely rounded, especially in the poreless segments. Poriferous keels somewhat more prominent. Only in the 18th and 19th segments the keels have a minute acutely angular posterior edge, which, however,
does not project behind the margin of the segments. Dorsal furrow of keels narrow, not reaching the waist. Seen from the lateral side the poreless keels have their dorsal margin slightly concave, the poriferous keels are somewhat convex. Poreless keels ventrally demarcated only near the posterior end, poriferous keels in the posterior half. Pores lateral, in a slight excavation, somewhat more near the ventral demarcation of the keels.

Sternites and legs. — Sternites of middle segments one and one third times as long as broad, rather weakly setiferous. Cross impressions rather wide, not sharply impressed. Sternite of 5th segment with a parallel-sided process directed cephalo-ventrad and projecting slightly before the anterior border of the sternite. End of process rounded and indistinctly bilobate by a very weak median incision, the anterior side densely set with short bristles. Behind the process a rather deep transverse furrow; between the posterior legs a normal longitudinal impression. Sternite of 6th segment posteriorly not raised above the ventral level of the metasomite; the anterior portion widely transversely concave and slightly longitudinally convex. Legs (fig. 5) moderately too, in tarsi, rather densely setiferous. Tarsi and distal end of tibiae of the anterior legs with ventral brushes, which are rapidly thinning out in the subsequent legs and are absent in the legs of the second half of the body. Length of joints: \(3 > 6 > 5 > 4 = 2 > 1\).

Anal segment. — Tail rather broad at its base, dorsoventrally rather thick, of moderate length. The sides rather strongly and straight converging; before the end a well developed lateral setiferous tubercle, the end truncate and scarcely emarginate. Anal segment with a very slight transverse depression at the base of the tail. Ventral side of tail somewhat concave. Valves with narrow rims, the setae on small tubercles. Scale triangular, the end truncate, the sides weakly concave. The setiferous tubercles at the posterior edges rather close to each other, projecting very weakly.

Gonopods. — (fig. 6). Femur of about the same length as the coxa. Femoral process \((p)\) spiniform, arising from the solenomerite. Tibiotarsus relatively well developed, curving somewhat mesad and caudad, then proximad, and, finally, somewhat laterad.

Female. — In the tube containing the males of \(ruficeps\) and the holotype of \(ocellata\) there were two female specimens, obviously belonging to \(Kalimantanina\) and with some doubt referable to the former of the two species. These two \(♀\) differ from the \(♂\) of \(ruficeps\), aside from the usual secondary sexual characters like the modifications of the sternites of the anterior segments, the brushes of the legs, etc., in the following particulars. Colour either faded or not fully developed: except for a very fine black middorsal stripe, entirely pale brownish yellow. The antennae have the distal half of the 6th and the proximal part of the 7th joint dark brown. Antennae somewhat more slender than in the \(♂\), the 6th
joint being as wide as the proximal joints. Body segments comparatively less constricted in the waist, resulting in a more robust aspect of the animals. Pleural keels as in the ♂, but missing from the 7th segment onwards. The lateral keels are somewhat more prominent than in the ♂; the posterior edges of the keels of the 17th segment are minute but acutely angular. Sternites about as long as broad. Legs scarcely more slender than in the ♂.

**Kalimantanina hirtitarsus** spec. nov.

Material. — East Borneo: without nearer location (Coll. Dr. E. Mjöberg, Mus. Stockholm), 1 ♂ (holotype).

Differing from *ruficeps* in the following characters.

Colour. — On the whole a little darker, probably because of a somewhat better

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Fig. 7—8. *Kalimantanina hirtitarsus* spec. nov. — 7: tibia and tarsus of the leg of the 7th segment of the holotype ♂. 8: right gonopod of the holotype ♂, medial view
state of preservation. In the body segments only the venter is brownish gray. The end of the tail dark brown.

Width. — 3.1 mm.

Head and antennae. — Vertigial sulcus running downward nearly to the lower level of the antennal sockets.

Sternites and legs. — Legs (fig. 7) with tarsal and distal tibial brushes rather dense, gradually thinning out in the legs of the second half of the body, but absent only in the two ultimate pairs.

Gonopods. — (fig. 8). Femur about one and a half times as long as coxa. Femoral process serrulate, arising from the base of the solenomerite. Tibiotarsus relatively smaller than in ruficeps, curving medio-distal, caudad and a little proximal, and finally, latero-distal. Lamina medialis with an anterior emargination.

Female. — Unknown.

Remarks. — On the whole this species is so similar to ruficeps, that it might as well be regarded as a geographical race of the latter. However, as compared to the other species of the genus the differences in the gonopods of ruficeps and hirtitarsus are quite significant, and a specific treatment seems fully justified.

Kalimantanina ocellata spec. nov.


Differing from ruficeps in the following characters.

Colour. — Head very dark brown, with only the labral area somewhat paler. Antennae dark castaneous, the distal part of the 7th and the 8th joints whitish. Groundcolour of collum and body segments very dark brownish gray to black. Lateral sides of collum and of the metasomites of the subsequent body segments with rather large, rather sharply demarcated, white spots, comprising the lateral keels and an area dorsad of these of about half the dorso-ventral width of a poriferous keel. Medial side of these spots rounded. Ventral side of body segments dark. Sternites yellowish; the legs brownish yellow, with the tarsi in the distal half shading to dark brown. In a few pairs of anterior legs the dark colour extends over the whole length of the tarsus and over the distal portion of the tibia. Anal segment dark brownish gray to black, valves and scale paler brown.

Width. — Holotype 3.2 mm, paratypes ♂ 3.0, 3.4 and 3.4 mm; allotype ♀ 3.8 mm.

Head and antennae. — Frontal area of head sometimes demarcated from vertex by a weak depression. Vertigial sulcus running downward to about the upper level of the antennal sockets, or continued below that level by a slight longitudinal impression.

Collum. — Posterior border at each side dorsad of the lateral roundings with a weak notch.

Body segments. — Pleural keels present up to the 7th segment, almost completely absent on the 8th. The posterior lappets projecting behind the posterior margins up to the 6th segment.

Lateral keels. — (fig. 9). Somewhat more prominent than in ruficeps or bir-
titarsus; the keels of the poreless segments have the posterior edges distinctly more narrowly rounded, they are ventrally demarcated in their posterior half. Keels of the 18th and 19th segments as in ruficeps.

Sternites and legs. — Sternites one and a half times longer than broad. Cross-impressions somewhat deeper. Sternal process of 5th segment with the sides weakly converging in the distal direction. Brushes of tibiae and tarsi as in hirtitarsus: absent only in the last two pairs of legs.

Anal segment. — Sides of tail somewhat less converging distally; the end somewhat more distinctly emarginate.

Gonopods. — (fig. 10). Femur about one and a half times as long as coxa, widening distad. Femoral process arising from the base of the solenomerite, elongate, laminate and more or less curving in a spiral. Tibiotarsus curving medio-distad, caudad and finally laterad and a little distad.

Female. — In the 5th to the 7th segments the pleural keels are somewhat less strongly developed than in the ♀. Sternites slightly longer than broad. The legs comparatively a little shorter than in the ♀.

Fig. 9—10. Kalimantanina ocellata spec. nov. — 9: left side of the 10th and 11th segments of the holotype ♂, dorsal view. 10: right gonopod of the holotype ♂, medial view
Remarks. — The gonopods in the three male paratypes are almost identical with those of the holotype. The telopodite, however, is slightly tortuous towards the lateral side, so that the femoral process slightly projects caudad of the femur.

Kalimantanina albonigra spec. nov.


Differing from ruficeps in the following characters.

Colour. — As in ocellata, but the white lateral spots of the collum and metasomites are comparatively larger and embrace the keels and an area dorsad of these of about the dorso-ventral width of a poriferous keel. Legs paler: yellowish white.

Width. — Holotype 2.9 mm, paratype 2.7 mm.

Head and antennae. — Vertigial sulcus running downward to just below the upper level of the antennal sockets.

Collum. — Posterior border dorsad of the lateral roundings very weakly emarginate.

Body segments. — Pleural keels as in ocellata.

Fig. 11. Kalimantanina albonigra spec. nov. — right gonopod of the holotype ♂, medial view. (The solenomerite has moved out of its natural position). Fig. 12. K. decolorata spec. nov. — right gonopod of the holotype ♂, medial view
Lateral keels. — As in \textit{ocellata}.

Sternites and legs. — Sternites and sternal process of the 5th segment as in \textit{ocellata}. Brushes of tibiae and tarsi as in \textit{hirtitarsus} and \textit{ocellata}.

Anal segment. — Tail as in \textit{ocellata}.

Gonopods. — (fig. 11). Femur and coxa of subequal length. Femoral process arising from the basal part of the solenomerite proper, spiniform. Tibiotarsus curving medio-distad, caudad and, finally, cephalo-proximad and somewhat laterad.

Female. — Unknown.

Remarks. — A similar remark as was made regarding the relationship between \textit{ruficeps} and \textit{hirtitarsus} applies to \textit{ocellata} and \textit{albonigra}. These two species also are very similar in colour and general morphology, although the gonopods are differing importantly. In this respect it is interesting to note the similarity of the gonopods of \textit{albonigra} and \textit{ruficeps}, two species otherwise rather disjunct.

A form closely related to \textit{albonigra} was represented in the collection by a single male specimen from East Borneo (Coll. Dr. E. Mjöberg, Mus. Stockholm). It has a width of 2.3 mm, thus being considerably smaller than \textit{albonigra}, and differs furthermore in the gonopods. In these the femur is relatively smaller than in \textit{albonigra} and the tibiotarsus is making a wider curve. The rather poor state of preservation of the animal and the absence of an exact locality renders a description of this form useless.

\textbf{Kalimantanina decorolata} spec. nov.


Differing from \textit{ruficeps} in the following characters.

Colour. — Possibly faded or not fully developed. Entirely pale brownish yellow. In the holotype only the 6th and a part of the 7th joints of the antennae dark brown. The paratype has the proximal joints also brown.

Width. — Holotype 2.9 mm, paratype 3.0 mm.

Head and antennae. — Vertigial sulcus running downward to just below the upper level of the antennal sockets.

Collum. — As in \textit{albonigra}.

Body segments. — Pleural keels as in \textit{ocellata}.

Lateral keels. — More prominent than in \textit{ruficeps} and thus more resembling those of \textit{ocellata} except that the lateral margins when seen from the dorsal side are somewhat less rounded. On the other hand the posterior edges are more pronounced and rather narrowly rounded; in the keels of the 18th and 19th segments the posterior edges are minutely angular and projecting a little behind the posterior margin of the segments.

Sternites and legs. — Sternites as in \textit{ocellata}; the sternal process of the 5th segment as in \textit{ruficeps} but more distinctly bilobate at the distal end. Brushes of tibiae and tarsi as in \textit{ocellata}.

Anal segment. — Sides of tail somewhat more concave at the base, scarcely converging in the distal part. The end more distinctly emarginate than in \textit{ocellata}. 

Gonopods. — (fig. 12). Femur about one and a half times as long as coxa. Femoral process elongate-laminate, slightly constricted in the middle, arising about halfway the femur and thus distinctly proximad of the base of the solenomerite. Tibiotarsus comparatively small, curving medio-distad, caudad, proximad, and, finally, cephalad and somewhat laterad.

Female. — Unknown.

Remarks. — Future collecting may show whether the specimen from Blu-u, which differs from the type specimen only by the colour of the antennae, belongs to a distinct subspecies.

Borneonina gen. nov.


Segments rather strongly constricted. Prosomites with fine cellular structure, somewhat dull. Waist rather broad, strongly longitudinally ribbed in the dorsal half, finely and rather widely striate in the ventral half dorsal of the sternal level. Metatergites shining, hairless or with very few hairs, without sculpture. Transverse furrow distinct but not deeply impressed, finely longitudinally striate, present from the 4th segment onwards. Pleural keels present on a number of anterior segments.

Lateral keels weakly developed, posteriorly rounded in nearly all segments projecting behind the posterior margin of the metasomite in the 2nd segment only. Keels of 2nd segment well below the level of those of the next segment.

Sternites longer than wide, scarcely to dispersedly setiferous, with moderately developed cross impressions. Sternite of 5th segment with a well developed, distally laminate process between the anterior legs. Sternite of 6th segment somewhat modified only in the posterior part. Sternite of 7th segment with on each side a latero-anterior sublongitudinal ridge-like protuberance. Legs rather long, without distinct tibial or tarsal brushes.

Gonopod-coxa of moderate size, straight-cylindrical, latero-distal surface with a setiferous area. Prefemur rather short, almost in one line with the femur and laterally well demarcated from that joint, the demarcation almost transverse on the longitudinal axis of the femur. Femur straight, well developed, somewhat longer than the coxa. Postfemur weakly demarcated. Spermal channel running straight along the medio-anterior side of the femur towards the base of the solenomerite. Solenomerite rather short, flagelliform, arising from the anterior side of the distal end of the femur. From the medio-anterior side of the distal end of the femur, mesad of the course of the spermal channel arises a rather long, lanceolate process. Tibiotarsus arising from the posterior side of the distal end of the femur, comparatively small, distinctly demarcated from the femur. Tibiotarsus consisting of a simple solenophore, straight with only the distal end curving a little cephalad. Lamina medialis and lamina lateralis both present, the latter more strongly developed than the former, sheathing the greater part of the solenomerite.

Type-species. — Borneonina retrorsa spec. nov.

Range. — Borneo.
Number of species. — One.

Remarks. — The general morphology of this genus is in close agreement with that of Kalimantanina. Borneonina is separated particularly because of the different shape of the tibiotarsus of the gonopods. In B. retrorsa the tibiotarsus is notably smaller than in Kalimantanina, and it is curved in a direction opposite to that found in the latter genus. There seems to exist no particular relationship between Borneonina and any of the previously described species of Sundanina.

Borneonina retrorsa spec. nov.


Colour. — Probably faded. Pale brownish yellow, with on each side on keel-level a continuous brownish longitudinal band of the width of the poriferous keels. There is also an indication of the presence of a continuous middorsal brownish band, apparently widest in the middle of the pro- and metasomites.

Width. — 2.1 mm.

Head and antennae. — Labrum narrowly and rather weakly emarginate. Clypeus moderately convex, moderately impressed towards the labrum. Lateral sides scarcely emarginate. Surface of head smooth and shining. Clypeus and frons rather dispersedly setiferous, vertex with two setae. Antennal sockets separated by slightly more than the diameter of a socket, or by three fifths of the length of the 2nd antennal joint. Postantennal groove shallow, the wall weakly prominent. Vertex moderately convex, not demarcated from the frontal area. Sulcus rather weakly impressed, reaching downward to the upper level of the antennal sockets. Antennae not particularly slender. Length of joints decreasing very slightly from the 2nd to the 6th, the 6th joint about three quarters of the length of the 2nd. Joints of subequal width, the 6th a little thicker than the others. Antennal joints moderately to rather densely setiferous.

Collum. — (fig. 13—14). Slightly narrower than the head, subreniform in dorsal outline. Anterior border very weakly rounded in the middle, somewhat more strongly so towards the sides. Posterior border widely and weakly emarginate, somewhat convex laterally. Lateral sides rather widely rounded, caudally with a weak indication of a blunt posterior edge. Surface smooth and shining, longitudinally as well as transversely moderately convex; a few hairs present. Lateral and latero-anterior border with a fine marginal rim, disappearing gradually towards the middle.

Body segments. — Metatergites mostly hairless. Transverse furrow present from the 4th to the 18th segment, but weakly impressed on the 4th. Furrow reaching to almost one third from the dorsal demarcation of the lateral keels in most segments. Sides somewhat rugulose and dispersedly granular up to the 4th segment, smooth and almost without wrinkles from the 5th onwards. Up to the 4th segment the pleural keels are well developed ridges, which are posteriorly produced into an angular lappet which projects weakly behind the posterior margin of the somites. On the 5th and the 6th segments there is only a very weak indication of the presence of pleural keels near the posterior margin of the somites.

Lateral keels. — (fig. 13—16). 2nd segment scarcely wider than the collum.
Fig. 13—18. *Borneonina retrorsa* spec. nov. — 13: left side of the head and the four anterior segments of the holotype ♂, lateral view. 14: left side of the head and the three anterior segments of the holotype ♂, dorsal view. 15: left side of the 10th and 11th segments of the holotype ♂, dorsal view. 16: the same, lateral view. 17: leg of the 7th segment of the holotype ♂. 18: right gonopod of the holotype ♂, medial view. p: femoral process; l: lamina lateralis; m: lamina medialis
The keels anteriorly somewhat shouldered at the base, the anterior and posterior edges rounded, the posterior edge projecting slightly behind the border of the segment. Marginal rim rather weakly developed. 3rd and 4th segments of sub-equal width, slightly narrower than the 2nd. The keels anteriorly widely rounded, posteriorly somewhat more narrowly rounded. Ventrally they are demarcated only in their posterior half. 5th segment distinctly wider than the 4th. Keels from the 5th segment onwards anteriorly and posteriorly widely rounded, especially in the poreless segments. Poriferous keels somewhat more prominent. In the posterior half of the body the posterior edges of the poriferous keels become slightly more prominent and in the 18th and 19th segments they are minutely rectangular. Dorsal furrow of keels narrow, not reaching the waist. Seen from the lateral side the poreless keels have their dorsal demarcation slightly concave, the poriferous ones are weakly convex. Poreless keels ventrally demarcated only near the posterior end, poriferous keels in the posterior half. Pores lateral in a slight excavation, a little more near the ventral demarcation of the keels.

Sternites and legs. — Sternites $11\frac{1}{3}$ × as long as broad, mostly sparsely setiferous. Cross impressions distinct but not deep. Process of the sternite of the 5th segment with the sides parallel at the base, slightly convergent in the distal half. The process directed cephalo-ventrad and projecting slightly before the anterior border of the sternite. End of process rounded and deeply incised medially, without a brush of short setae, but normally setiferous. Behind the process a rather deep transverse furrow; between the posterior pair of legs a normal longitudinal impression. Sternite of 6th segment with a wide cross impression, the longitudinal impression caudally widening triangularly. Sternite of 8th segment without particulars. Legs (fig. 17) rather long; weakly to, in tarsi, moderately setiferous. Anterior legs somewhat more densely setiferous but none of them with brushes.

Length of joints: $3 > 6 > 5 > 4 = 2 > 1$.

Anal segment. — Tail rather broad at the base, dorso-ventrally rather thick. The sides moderately converging, straight; before the end a well developed lateral setiferous tubercle. End of tail straight-truncate. Dorsal side of tail without a transverse depression, ventral side somewhat concave. Valves with narrow rims, the setae on small tubercles. Scale trapezoidal; the setiferous tubercles low and not projecting.

Gonopods. — (fig. 18). Femur about one and a half times as long as coxa. Lamina lateralis with an irregular margin.

Female. — Unknown.

Djakina gen. nov.


Segments rather weakly to rather strongly constricted. Waist distinctly ribbed. Metatergites shining, hairless, without sculpture. Transverse furrow present from the collum or from the 5th segment onwards. Pleural keels weakly developed in a few anterior segments.

Lateral keels weakly developed. Only those of the 2nd segment projecting slightly behind the border of the metasomite, and situated well below the level of those of the 3rd segment.
Sternites longer than or as long as wide, moderately to rather weakly setiferous, with moderately developed cross impressions. Sternite of 5th segment of $\delta$ without process. Legs of moderate length to rather long. At least a few of the anterior legs of the $\delta$ with tarsal brushes.

Gonopod-coxa rather long, straight-cylindrical, the latero-distal surface with a setiferous area. Prefemur somewhat elongate, slightly oblique on the axis of the femur and laterally well demarcated from that joint, the demarcation almost transverse on the longitudinal axis of the femur. Femur almost straight, well developed, somewhat shorter than the coxa. Postfemur not demarcated. Spermal channel running along the medial side of the femur towards the base of the solenomerite, the latter arising from the anterior side of the distal end of the femur. Solenomerite of moderate length, flagelliform. Tibiotarsus arising from the posterior side of the femoral end, moderately developed, distinctly demarcated from the femur. Tibiotarsus consisting of a simple solenophore curving widely in a posterior direction. Lamina medialis and lamina lateralis well developed, sheathing the solenomerite for its greater part. Lamina medialis with a laminate process just proximad of the terminal end of the tibiotarsus.

Type-species. — *Dajakina oculata* spec. nov.

Range. — Borneo.

Number of species. — Two.

Remarks. — The erection of this genus, which besides the type-species also includes *Orthomorpha rotundata* Att., may be regarded as a first step towards a subdivision of the species so far included in the genus *Orthomorpha* Bollm. into natural categories. These species all agree in having a relatively simple gonopod structure, in which, for instance, the tibiotarsus is represented by a solenophore without or with very small secondary processes.

The simple structure of the gonopods and the fact that the gonopod characters in this group obviously belong to the more stable, which are subject only to minor changes in the course of speciation, have somewhat obscured the heterogeneity of *Orthomorpha*. However, several generic categories may be recognised when non-gonopod characters as well as the smaller details of the gonopods, such as the course of the spermal channel, the development of the laminae medialis and lateralis of the tibiotarsus, etc., are taken into consideration.

A more extensive discussion on the mutual affinities of the species of *Orthomorpha* is given in connection with the redescription of *O. beaumontii* (Le Guillou).

The genus *Dajakina* may be distinguished by a combination of characters of which must be mentioned: the weakly developed lateral keels, the weakly developed pleural keels, the absence of a sternal process in the 5th segment of the male, the lack of a sharply demarcated postfemur in the gonopods, the what may be called "normal" development of the laminae medialis and lateralis of the tibiotarsus of the gonopods and the conformation of the tip of the tibiotarsus. Little can be said of the relationship of the genus, apart from the general remark that it belongs to the *Orthomorpha-Pratinus* complex. The peculiar emarginations of the posterior borders of the segments occurring in the type-species of the genus remind of a similar structure described for *Sundanina spini-
Fig. 19—23. *Dajakina oculata* spec. nov. — 19: antenna of the holotype ♂. 20: left side of the head and the three anterior segments of the holotype ♂, lateral view. 21: the same, dorsal view. 22: left side of the 10th and 11th segments of the holotype ♂, lateral view. 23: the same, dorsal view.
pleura Carl from Birma and Sundanina emarginata Jeekel from Tonkin. In particular S. emarginata seems to come rather close to D. oculata, in the shape of these emarginations as well as in characters of the gonopods. In fact, it may be more closely related to D. oculata than to the type-species of the genus Sundanina and may represent the nearest relative of D. oculata outside Borneo. On the other hand it seems to have sufficient characteristic features not to be united in the same genus with that species.

Key to the species. — Contrary to the condition in Kalimantanina or Arthrogo-
nopus, the species of Dajakina can hardly be separated on their gonopod characters. Other features, on the other hand, such as the shape of the lateral keels and various secondary sexual characters of the males provide ample possibilities for specific distinction.

1. Lateral keels of poriferous segments represented by low, more or less eye-
shaped protuberances which are sharply demarcated on all sides. Transverse
furrow of metatergites present from the collum to the 18th segment. Posterior
borders of the 8th to the 18th segments of the ♂ with emarginations in the
lower half of the sides and behind the sternites. Legs of the ♂, except the
last two pairs, with tarsal brushes. Width of ♂ 4.0 mm ..........................

... D. oculata spec. nov.

— Lateral keels of poriferous segments low but normally ridge-like, only dorsally
sharply demarcated by a furrow. Transverse furrow of metatergites present
from the 5th segment onwards. Posterior borders of segments not emarginate.
Tarsal brushes of ♂ present only in a few anterior pairs of legs. Width of
♂ 2.5 mm ............................................. D. rotundata (Att.)

Dajakina oculata spec. nov.

Material. — West Borneo: Sambas, October, 1893 (Borneo Exped., Coll. Dr.
Hallier, Mus. Leiden), 1 ♂.

Colour. — Possibly either faded or not fully developed: entirely pale brownish
yellow. The distal part of the 6th and the proximal part of the 7th joints of the
antennae dark brown.

Width. — 4.0 mm.

Head and antennae. — Labrum narrowly and rather deeply emarginate, tri-
dentate. Clypeus rather weakly convex, moderately impressed towards the labrum.
Lateral sides scarcely convex. Surface of head moderately shining, somewhat
irregularly rugulose in the clypeal part. Clypeal and frontal part of headplate
moderately to rather dispersedly setiferous, vertex with two bristles. Antennal
sockets separated by three quarters of the diameter of one socket, or by about one
third of the length of the 2nd antennal joint. Postantennal groove shallow, the
wall in front of it moderately prominent. Vertex moderately convex, demarcated
from the frontal area by a slight depression. Sulcus moderately impressed, with
some transverse wrinkles, reaching downward to just below the upper level of the
antennal sockets. (The lower end of the sulcus is marked by two minute con-
tiguous tubercles. However, this may be an anomalous structure since the frontal
area of the specimen studied was injured). Antennae (fig. 19) rather long, though
not particularly slender. Length of the 2nd to the 5th joints subequal, the 6th
joint notably longer. Width of the 2nd, 3rd and 4th joints subequal, the 5th joint somewhat narrower, the 6th conspicuously ventrally inflated. Antennal joints sparsely to moderately setiferous.

Collum. — (fig. 20—21). Narrower than the head, subreniform in dorsal outline. Anterior border weakly rounded in the middle, slightly more strongly so towards the lateral sides, laterally very weakly emarginate. Posterior border widely and very weakly emarginate in the middle, weakly convex towards the sides. Lateral sides rather widely rounded. Surface shining and somewhat uneven, a moderately impressed transverse furrow at one third from the posterior border. Surface hairless, weakly longitudinally and moderately transversely convex. Lateral and latero-anterior border with a fine marginal rim gradually disappearing towards the middle.

Body segments. — Rather weakly constricted. The waist rather narrow dorsally, somewhat widening laterally; dorsal half rather finely but distinctly longitudinally ribbed, ventral half, above the level of the sternites, finely striate. Prosomites

Fig. 24—25. *Dajakina oculata* spec. nov. — 24: leg of the 7th segment of the holotype ♂. 25: right gonopod of the holotype ♂, medial view; lamina lateralis; m: lamina medialis
with fine cellular structure, rather dull. Transverse furrow present on all segments up to the 18th, rather sharply and rather deeply impressed and in most segments almost reaching the dorsal delimitation of the lateral keels. Sides with fine and moderately dense granulation in all segments. Pleural keels up to the 4th segment represented by weak, curved, somewhat granular ridges on a slight swelling. On the 5th segment only a swelling is visible. From the 8th to the 17th segments, and also, though weakly, in the 18th segment, the posterior border of the metasomites in the ventral half of the sides as well as ventrally behind the sternites is rather strongly emarginate. As a consequence the posterior margin of these segments at the level of the stigmata appears rather strongly produced posteriorly, the produced part being somewhat inflated.

Lateral keels. — (fig. 20—23). 2nd segment distinctly wider than the collum. The keels anteriorly shouldered, their anterior edge rather widely, their posterior edges narrowly rounded; the posterior edge projecting a little caudad of the border of the segment. Marginal rim present only in the anterior half of the keels. 3rd and 4th segments of subequal width, distinctly narrower than the 2nd. The keels anteriorly somewhat more narrowly rounded than posteriorly. They are demarcated, dorsally only, by a narrow furrow. 5th segment distinctly wider than the 4th. Keels of poriferous segments represented by low eye-shaped protuberances, sharply demarcated on all sides. In posterior segments these protuberances become more elongate towards the anterior side. Pores lateral, in a slight excavation, almost in the middle of the keels. None of the keels angular. Poreless keels somewhat less prominent than the poriferous, represented by low, rather short longitudinal ridges, dorsally and ventrally demarcated by furrows, which do not reach the waist. Behind the keels some irregular wrinkles curving upwards.

Sternites and legs. — Sternites one and a half times longer than broad, moderately setiferous. Cross impressions well developed, rather wide, not sharply impressed. 5th segment without sternal process, but with a normal cross impression. Sternites of the 6th, 7th and 8th segments without particulars, except that in the 6th segment the sternite is slightly more concave between the posterior legs. Legs (fig. 24) of moderate length in the anterior part of the body, becoming distinctly more elongate in the posterior part. All legs distinctly incassate, rather weakly to moderately setiferous. Dense ventral brushes are present on the distal part of the tibiae and on the tarsi of most of the legs. Brushes, in particular those of the tibiae, thinning out in the legs of the posterior part of the body, almost absent in the legs of the 17th and completely absent in the legs of the 18th segment. Brushes consisting of typically penicillate hairs. Length of the joints of the legs: \(3 > 5 > 6 > 4 > 2 > 1\).

Anal segment. — Tail rather broad and thick and rather long. Sides not converging, even a little concave, before the end a weak lateral tubercle. End truncate and scarcely emarginate. No dorsal transverse depression at the base of the tail. Ventral side of tail hardly concave. Valves with narrow but rather high rims, the setae on small tubercles. Scale triangular, the posterior edge rounded, the sides almost straight. Setiferous tubercles low, not projecting.

Gonopods. — (fig. 25). Femur at the anterior side near the base with some notches. Tibiotarsus curving weakly in a posterior and somewhat medial direction. Female. — Unknown.
Remarks. — A species very closely related to *oculata* was represented by two female specimens from East Borneo: Blu-u, Mahakam River, November 1898 (Borneo Exped., Coll. Dr. A. W. Nieuwenhuis, Mus. Leiden). These females differ from *oculata* in particular by the shape of the lateral keels of the 2nd segment. In these the anterior edge is acutely angular, the lateral margin straight and the posterior completely absent. The two specimens are notably smaller than *oculata*, having a width of 3.3 mm and 3.1 mm, respectively. The antennal sockets are separated by somewhat more than the diameter of one socket. The antennae are of moderate length, the 6th joint has a quite normal shape. The transverse furrow is absent in the metatergites of the three anterior segments. The posterior borders of the segments lack the emarginations as described for *oculata*. The legs are of moderate length and width, and the tail is somewhat shorter than in *oculata*.

Considering the characteristic shape of the poriferous keels these female specimens must be closely related to *oculata*. It seems likely therefore that the peculiar structure of the 6th antennal joint, the emarginations of the posterior borders of the metasomites and the incrassate legs described here for *oculata* are secondary sexual characters of the male.

**Dajakina rotundata** (Att.)

1931 *Orthomorpha (O.) rotundata* Attems, Zoologica, Stuttg., vol. 30, fasc. 3/4, p. 116, fig. 175.
1937 *Orthomorpha (O.) rotundata*, Attems, Tierreich, vol. 68, p. 64, fig. 78.

**Distribution.** — West Borneo: Lebang Kara, Nanga Serawei.

Remarks. — The gonopods of this species, which was not represented in the collection under report, appear to be almost identical with those of *oculata*. Aside from some minor details they seem to differ only in the somewhat stronger curved tibiotalus and the comparatively slightly shorter femur. In view of these scarcely significant differences it is highly interesting to note the important dissimilarities in the external morphology of the two species.

*D. rotundata* is a much smaller species than *oculata*, the width being 2.5 mm, as against 4.0 mm. The antennae are said to be of moderate length and width; no statement was made on the structure of the 6th joint, so that this joint probably lacks the conspicuous inflation described for *oculata*. The lateral keels of the poriferous segments were described as being small, short and dorsally demarcated by a furrow, which is not conform with the peculiar structure in *oculata*. Furthermore, the transverse furrow of the metatergites is present only from the 5th to the 18th segments in *rotundata*. The characteristic emarginations of the posterior border of the metasomites are not mentioned in the description of *rotundata*. Finally, contrary to the condition found in *oculata*, the legs of *rotundata* are stated to be long and slender, with the tarsal brushes present only in the anterior legs.

In all, the differences between *oculata* and *rotundata* reveal to what remarkable extent the non-gonopod characters may diverge evolutionally, without this divergence being paralleled by an important structural alteration in the gonopods.
**Arthrogonopus gen. nov.**


Segments moderately (♀) to rather strongly (♂) constricted. Prosomites with fine cellular structure, somewhat dull. Waist of moderate width (♂) to rather narrow (♀), strongly longitudinally ribbed in the dorsal half, finely and rather widely striate in the ventral half dorsad of the sternal level. Metatergites shining, hairless or with very few hairs, without sculpture. Transverse furrow distinct but not deeply impressed, finely longitudinally striate, present from the 5th segment onwards. Pleural keels well developed on a number of anterior segments.

Lateral keels rather weakly developed. In nearly all segments posteriorly rounded or minutely angular in a number of segments of the posterior half of the body. Only the keels of the 2nd segment projecting behind the posterior margin of the segment; eventually also the keels of the 19th segment very slightly projecting behind the margin. Keels of 2nd segment well below the level of those of the next segment.

Sternite with moderately developed cross impressions, longer than wide (♂) or about as long as wide (♀), moderately to rather weakly setiferous. Sternite of 5th segment of ♀ with a well developed process between the anterior legs. Sternite of 6th segment of ♀ somewhat modified: a little excavated especially in the posterior part. Sternite of 7th segment of ♀ with on each side a weak callous protuberance before the gonopod opening. Sternite of 8th segment of ♀ without particulars. Legs rather long; without tibial or tarsal brushes in the ♀.

Gonopods with coxa of moderate size to rather small, almost straight-cylindrical; latero-anterior side of the distal end with a setiferous area. Prefemur rather short, slightly oblique on the longitudinal axis of the femur and laterally well demarcated from that joint, the demarcation almost transverse on the longitudinal axis of the femur. Femur almost straight, well developed, somewhat longer than the coxa. In the basal half the femur has two laminate crests on the medial side. Postfemur laterally sharply demarcated. Spermal channel running along the medial side of the femur. In the basal part it runs along the posterior laminate crest towards the posterior side of the femur; more distally it runs towards the anterior side of the femur. At the medio-posterior side of the distal end of the femur a small femoral process or knob may be present. Solenomerite of moderate length, flagelliform, arising from the medio-anterior side of the distal end of the postfemur. Tibiotarsus springing from the posterior side of the distal end of the postfemur, distinctly demarcated from that joint. Tibiotarsus moderately to rather weakly developed, consisting either of a simple semicircular solenophore without accessory processes or of a solenophore which on the lateral side gives rise to a comparatively well developed secondary process. Lamina medialis absent, lamina lateralis well developed. Solenomerite not sheathed by, but closely applied to the medial side of the tibiotarsus.

Type-species. — *Arthrogonopus edentulus* nov. spec.

Range. — Borneo.

Number of species. — Four.

Remarks. — Besides the three new species described in this paper, this new
genus also includes the one previously known as *Orthomorpha borneona* Att. These four species are even more disjunct from the group of typical species of *Orthomorpha* than the two united under *Dajakina*. They are characterised especially by the absence of a lamina medialis in the tibiotarsus of the gonopods, by the two laminate crests of the basal part of the femur of the gonopods and by the weakly developed lateral keels of the metasomites. In the structure of the tibiotarsus and its relationship to the solenomerite as well as in the weakly developed lateral keels the new genus approaches the Sumatran species of *Sundanina* and the species of *Opisthodolichopus* Verh. like *O. javanicus* (Att.), but *Arthrogonopus* may be distinguished from these by the sharply demarcated postfemur of the gonopods.

Key to the species. — The species of *Arthrogonopus* have a quite monotonous external morphology. The characters of diagnostic value are found mainly in the gonopods.

1. Colour of the last two pairs of legs not differing from that of the others.
   - Gonopods with a small process at the medio-posterior side of the distal end of the femur pointing mesad. Tibiotarsus with a secondary process arising from the lateral side ........................................... *A. bifidus* spec. nov.
   - Last two pairs of legs infuscate at least distad of the middle of the tibiae, the others brown only in the distal half of the tarsi. Gonopods without a femoral process, or with a very small knob at the medio-posterior side of the distal end of the femur. Tibiotarsus without a secondary process ......................... 2

2. Tibiotarsus of gonopods comparatively small, its greatest length about equal to two thirds of the length of the femur .......... *A. edentulus* spec. nov.
   - Tibiotarsus of gonopods larger, its greatest length about equal to that of the femur ................................................. 3

3. Posterior edges of the lateral keels from the 5th segment onwards rounded.
   - Terminal end of tibiotarsus of the gonopods relatively short, acutely angular in profile ........................................... *A. borneonus* (Att.)
   - Lateral keels of the segments of the posterior half of the body with minute acuminate posterior edges. Terminal lappet of tibiotarsus of the gonopods longer, rounded in profile ....................... *A. denticulatus* spec. nov.

**Arthrogonopus edentulus** spec. nov.


Colour. — Difficult to ascertain because of the generally rather poor state of preservation. In the holotype the head is castaneous, with the antennae very dark brown, almost black, only the distal part of the 7th and the 8th joint whitish.
Fig. 26—30. *Arthrogenopus edentulus* spec. nov. — 26: left side of the head and the three anterior segments of the holotype ♂, lateral view. 27: the same, subdorsal view. 28: left side of the 10th and 11th segments of the holotype ♂, dorsal view. 29: the same, lateral view. 30: sternal process of the 5th segment of the holotype ♂, lateral view.
Collum of a similar castaneous colour as the head. Subsequent body segments also castaneous, but soon growing darker and from the 5th onwards very dark brown to black, with the keels, in particular those of the poriferous segments yellowish brown to brownish yellow. Venter brown. Sternites yellowish brown to brownish yellow. Legs brownish yellow to yellow, the distal half of the tarsi a little darker brownish. The two last pairs of legs distal of the middle of the femur very dark brown or black. Anal segment brown, the tail entirely brownish yellow. Valves dark brown, scale pale brown. The other $\delta$ from Blu-u is much paler, being brown all over, but this may be due to preservation. The last two pairs of legs are yellowish, black only distal of the middle of the tibiae. The other specimens studied are mostly discoloured, but as far as could be determined their colour was similar to that of the holotype. The $\delta$ from S. Bilis is completely pale brownish yellow, and probably freshly moulted. The $\delta$ from Mt. Tilung seems to be well preserved. It has the head dark castaneous, darkest in the frontal area. The colour of the antennae is as described for the holotype. The collum and the subsequent body segments, including the lateral keels, are black. The venter dark brown to black, with the sternites more or less dark brown. The legs pale brown to yellowish, with the tips of the tarsi not notably darker. The last two pairs black distal of the proximal quarter of the femur. Anal segment black or very dark brown, only the scale paler brown.

Width. — Holotype $\delta$ 3.1 mm; other $\delta$ in the order of the above enumeration 3.2 mm, 3.1 mm, 3.0 mm, 3.2 mm, 3.1 mm; $\varphi$: 3.9 mm, 3.9 mm, 4.1 mm.

Head and antennae. — Labrum narrowly and moderately emarginate. Clypeus rather weakly convex, moderately impressed towards the labrum. Lateral sides weakly and widely convex, with a notch above the labrum. Surface of head shining, with some irregular wrinkles. Headplate rather densely to moderately setiferous in the clypeal and frontal regions, four setae on vertex. Antennal sockets separated by slightly more than the diameter of one socket or by about half the length of the 2nd antennal joint. Postantennal groove shallow, the wall in front moderately prominent. Vertex moderately convex, not or only very weakly demarcated from the frontal region. Sulcus rather weakly impressed, running downward to somewhat below the upper level of the sockets. Antennae slender. Length of joints: $3 > 4 = 2 = 5 > 6$, the 6th joint about as long as three quarters to two thirds of the 3rd. The 2nd, 3rd and 6th joints of subequal width, slightly thicker than the 4th and 5th. Antennal joints moderately to rather densely setiferous.

Collum. — (fig. 26—27). Distinctly narrower than the head, subsemicircular in dorsal outline. Anterior border very widely convex in the middle, somewhat more narrowly rounded towards the lateral sides, weakly emarginate or straight above the rounding of the lateral sides. Posterior border very weakly and widely emarginate in the middle, laterally slightly convex and very weakly emarginate or straight immediately above the lateral rounding. Lateral sides widely rounded. Surface smooth and shining, moderately convex, slightly more so towards the sides. A few setae may be present. Lateral and latero-anterior borders with a fine marginal rim, disappearing gradually towards the middle of the anterior border.

Body segments. — Metatergites with some sparse hairs, in particular in the anterior and posterior segments. Transverse furrow present up to the 18th, or, eventually, up to the 17th segment, in the majority of the segments reaching to
Fig. 31—32. *Artibrogonopus edentulus* spec. nov. — 31: leg of the 7th segment of the holotype ♂. 32: right gonopod of the holotype ♂, medial view. (The solenomerite has moved somewhat out of its natural position)

about halfway the dorsal delimitation of the lateral keels. Sides dispersedly granulate up to the 4th segment, smooth or very weakly wrinkled from the 5th onwards. Pleural keels present up to the 7th segment, obsolete from the 8th onwards. Up to the 4th segment they are represented by complete ridges which are produced posteriorly into a well developed angular lappet projecting behind the posterior margin of the somite. In the 5th, 6th and 7th segments the pleural keels are represented by a small triangular lappet near the posterior margin of the segments, which does not project behind that margin.
Lateral keels. — (fig. 26—29). 2nd segment distinctly wider than the collum. The keels anteriorly somewhat shouldered at the base, the anterior and posterior edges rounded, the posterior edge projecting slightly behind the border of the segment. Marginal rim present only along the anterior margin, laterally obsolete. 3rd and 4th segments of subequal width, somewhat narrower than the 2nd. The keels anteriorly and posteriorly widely rounded, ventrally scarcely demarcated. 5th segment distinctly wider than the 4th. Keels from the 5th segment onwards anteriorly widely rounded, the posterior edges rather narrowly rounded, in particular in the keels of the segments of the posterior half of the body, but in none of these angular. Poriferous keels somewhat more prominent than the poreless. Dorsal furrow of keels narrow, not reaching the waist. Seen from the lateral side the poreless keels have their dorsal margins slightly concave, the poriferous keels are somewhat convex dorsally. Poreless keels ventrally demarcated near the posterior end only, poriferous keels in the posterior half. Pores lateral, in a slight excavation, almost in the middle between the dorsal and ventral demarcations of the keels.

Sternites and legs. — Sternites one and a half times as long as broad, moderately setiferous. Cross impressions rather sharp. Sternite of 5th segment (fig. 30) with a thick process between the anterior legs, directed ventrad and somewhat cephalad and projecting very slightly before the anterior border of the sternite. Lateral sides of the process distinctly diverging in a distal direction. The end widely rounded. Anterior side with a dense brush of short setae at the distal end. The shape of the process appears to be somewhat variable. In some of the specimens it differs from that of the holotype in that, from a lateral view, the distal end may be somewhat more attenuate than illustrated. Sternite of 5th segment with a normal transverse furrow and a normal longitudinal furrow between the posterior legs. Sternite of 6th segment widely concave between the posterior legs, the coxae of which are somewhat more widely separated than those of the anterior pair. Transverse furrow almost obsolete, longitudinal furrow very wide. Legs (fig. 31) moderately setiferous, but the ventral side, especially of the proximal joints, rather densely setiferous. Last two pairs of legs distinctly longer than the preceding. Length of joints: \(3 > 6 > 5 > 4 > 2 > 1\).

Anal segment. — Tail of moderate length, rather thick at the base, of moderate width, the sides proximally rather strongly, distally more weakly converging. Before the end on each side a well developed setiferous tubercle. The end of the tail truncate and weakly emarginate, the two terminal tubercles weakly developed. Tail without distinct transverse depression at the base. Ventral side weakly concave. Valves with rather narrow and rather low marginal rims. Setiferous tubercles moderately developed. Scale subtrapezoidal or subtriangular, the end slightly convex, the sides almost straight. Setiferous tubercles moderately developed and not projecting.

Gonopods. — (fig. 32). Prefemur moderately developed. Femur without femoral process or knob. Tibiotarsus comparatively small, its greatest length about two thirds of the length of the femur. Tibiotarsus simple, without secondary process, the end acuminate.

Female. — The ♂ from Blu-u, although rather strongly discoloured, appears to agree in colour with the holotype. The two ♂ from Upper Mahakkam River have
the collum castaneous, infuscate in the middle and along the margins. The tail here is darker than in the holotype. Morphologically the ♀ differ particularly in being more robust than the ♂. The body segments are somewhat less strongly constricted and the waist is relatively a little narrower. The development of the pleural keels of the 5th, 6th and 7th segments is somewhat weaker, so that a triangular lappet is not distinct in these segments. The sternites of the middle segments are as long as wide to $11/3 \times$ as long as wide. The legs are slightly more slender; the pubescence, however, is practically similar to that of the legs of the ♂.

Remarks. — Variation of the specimens studied appears to be confined to the coloration and the shape of the sternal process of the 5th segment of the males. The taxonomic value to be attributed to these variations cannot be determined at present in view of the small amount of material studied and because of its rather poor condition. The gonopods of the males from different localities do not present appreciable differences.

Arthrogonopus denticulatus spec. nov.


Differing from edentulus in the following characters.

Colour. — The holotype has essentially the same colour as the holotype of edentulus, but the keels are black and the anal segment is castaneous. The other ♂ have the head castaneous, the collum either completely castaneous or castaneous with the margin and the middle infuscate. The subsequent segments are entirely black, except the brown venter. The sternites and legs are brownish yellow, the legs of the last two pairs black distad of the middle of the femur. Anal segment entirely castaneous.

Width. — Holotype ♂ 3.0 mm; other ♂ in the order of the above enumeration: 3.1 mm, 3.1 mm, 3.0 mm, 3.0 mm, 3.0 mm, 3.2 mm, 3.4 mm, 3.0 mm; ♀ 3.9 mm, 3.9 mm, 3.8 mm, 3.8 mm, 4.0 mm.

Body segments. — The transverse furrow of the metatergites extends slightly further laterad than in edentulus. Pleural keels of the 5th to the 7th segments not angular.

Lateral keels. — The posterior edges of the lateral keels are somewhat more narrowly rounded. From about the 12th or 13th segment these edges become angular and on subsequent segments (fig. 33) they are produced posteriorly in a minute, sharp point. The posterior edges of the keels of the posterior segments
Fig. 33—35. *Arthrogonopus denticulatus* spec. nov. — 33: left side of the 16th segment of the holotype ♂, dorsal view. 34: sternal process of the 5th segment of the holotype ♂, lateral view. 35: right gonopod of the holotype ♂, medial view. (The solonomerite has slightly moved out of its natural position)
are not projecting behind the margins of the metasomites, but in the 19th segment they may attain the margin.

Sternites and legs. — Sternite of 5th segment (fig. 34) with the process distally much more laminate than in edentulus. The lateral sides of the process almost parallel or diverging only very slightly in the distal direction. Sternite of 6th segment more concave between the anterior legs than in edentulus, scarcely raised above the ventral level of the metasomal ring between the posterior legs; the transverse and longitudinal furrows are almost obsolete. Legs, especially those of the anterior part of the body, somewhat more densely pubescent than in edentulus.

Gonopods. — (fig. 35). Prefemur rather strongly developed. At the medio-posterior side of the distal end of the femur a small knob. Tibiotarsus of moderate size, the greatest length about equal to that of the femur.

Female. — The coloration of the females is more variable than that of the males. Of four specimens from Blu-u, one has a colour similar to that of the males, two others have pale spots in the middle of the metatergites, whilst the fourth has the keels and the lateral sides pale, contrasting with the black dorsum. The ♀ from Gng. Kenepai appears to be almost completely discoloured. Morphologically the females differ from the males in a way very similar to that found in edentulus. The lateral keels in the posterior segments are not pointed caudally as strongly as in the males: really sharply pointed edges may be present only in a few segments.

Remarks. — The colour variations of this species as represented in the material under report are difficult to interpret. In part they seem to have been caused by the generally rather poor state of preservation. However, the coloration of this species and that of edentulus might be somewhat more variable than usually is the case. Without the study of freshly preserved material it is impossible to give an opinion on the systematic value of the variations.

The females of this species are very similar to those of edentulus. For the distinction one has to rely in the first instance on the shape of the lateral keels of the posterior segments. It is not possible to estimate the constancy of this character since both species apparently were found to occur in the same localities. It may be that some female specimens of denticulatus have been referred here to edentulus on account of the absence of distinctly pointed posterior edges in the lateral keels of the posterior segments.

Arthrogenopus borneonius (Att.)

1937 Orthomorpha (O.) borneona, Attems, Tierreich, vol. 68, p. 67, fig. 84.

Distribution. — West Borneo: Mandai River, Mt. Rajah, Sungei Malang

Remarks. — This species, of which I did not see any material, comes very close to denticulatus, in particular in the characters of the gonopods. However, the distal end of the tibiotarsus of denticulatus appears to be more elongate and is typically rounded, whereas in borneonius it is acuminate. The lateral keels in
borneonus are stated to be rounded posteriorly in all segments, which is certainly not the case in denticulatus. The relationship between borneonus and denticulatus may be of a subspecific nature.

**Arthrogonopus bifidus** spec. nov.


Differing from edentulus in the following characters.

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Fig. 36. *Arthrogonopus bifidus* spec. nov. — right gonopod of the holotype ♂, medial view; p: femoral process; s: secondary process of the tibiotarsus
Colour. — Head dark castaneous, darkest in the frontal area. Antennae also dark castaneous, with the tip of the 7th and the 8th joint white. Collum and body segments very dark brown to black, the venter dark brownish grey. Sternites brown to brownish yellow. Legs pale yellow to brownish yellow. Anal segment black, the valves brown, the scale pale brown.

Width. — 2.9 mm.

Body segments. — The transverse furrow of the metatergites extending a little more laterad than in edentulus. Pleural keels of the 5th to the 7th segments not angular, similar to those of denticulatus.

Sternites and legs. — Sternal process of the 5th segment similar to that of edentulus, but much more attenuate distally when seen from the lateral side. The process directed a little more strongly cephalad, the distal end therefore projecting somewhat more distinctly before the anterior border of the sternite. Sternite of the 6th segment as in denticulatus.

Gonopods. — (fig. 36). Prefemur rather strongly developed. Femur with a small femoral process at the medio-posterior side near the distal end, pointing mesad. The process is small, elongate triangular, about one and a half times as long as broad at its base. Tibiotarsus comparatively small, its greatest length about equal to two thirds of the length of the femur. From the lateral side of the tibiotarsus arises a laminate secondary process.

Female. — Unknown.

Remarks. — The close relationship between this species and the other species of Arthrogonopus is clearly demonstrated by the great similarity in the general morphology and particularly by the gonopod characters. A. bifidus, however, seems to be somewhat disjunct by the presence of a small femoral process and a secondary process in the tibiotarsus. The latter, which seems to have the function of keeping in place the distal end of the solenomerite, may be a derivate structure. Probably it is the homologue of the terminal end of the tibiotarsus in species like denticulatus and edentulus, and the condition might be seen as the result of a cleavage of the end of the tibiotarsus in the course of evolution.

Gigantomorpha gen. nov.


Segments moderately (♀) to rather weakly (♂) constricted. Prosomites shagreened or dull by a very fine cellular structure. Waist narrow, distinctly longitudinally ribbed or "beaded" in the dorsal half, smooth or finely striate in the ventral half dorsad of the sternal level. Metatergites dull or more or less shining, generally hairless, rugulose to subgranulose and with a transverse row of more or less distinctly developed granules along the posterior margin and some dispersed mostly very weakly developed granules in front of the transverse furrow. Transverse furrow distinct but not deeply impressed, finely longitudinally striate, present from the 4th or 5th segment onwards. Pleural keels present at least in the segments of the anterior half of the body, moderately to well developed in the anterior segments.

Lateral keels strongly to rather strongly developed, in all segments from the
2nd to the 19th with an angular, sometimes even spiniform posterior edge, which often projects behind the posterior margin of the segments. Marginal rim of keels narrow, in poriferous segments widening only in the area of the pore. Keels generally on a high level, sometimes, especially in the males, projecting somewhat above the middorsal surface of the metatergites. Keels of the 2nd segment either distinctly below the level of those of the next segment, or on the same level.

Sternites with rather weakly developed cross-impressions, somewhat longer than wide (♂), as long as wide (♂, ♀) or somewhat wider than long (♀), moderately setiferous. Sternite of 5th segment of ♂ with a moderately developed process between the anterior legs. Sternite of 6th segment of ♂ somewhat modified: raised above the ventral surface of the metasomal ring between the anterior legs only. Sternite of 7th segment of ♂ with on each side before the gonopod opening a rounded, somewhat granular process. Sternite of 8th segment of ♂ without modifications. Sternite from the 5th (♀) or from the 8th (♂) to the 17th segment with a more or less developed pointed cone near the base of each leg. Legs of moderate length to rather long. Brushes obsolete to very strongly developed on all joints distad of the coxa, present only in the ♂.

Gonopods with coxa of moderate size, almost straight-cylindrical; distal setiferous area well developed. Prefemur somewhat elongate, slightly oblique on the longitudinal axis of the femur and laterally well demarcated from that joint, the demarcation almost transverse on the femoral axis. Femur well developed, almost straight, somewhat longer than the coxa, narrowing distad. In the basal half the femur on its medial side with two more or less laminate crests. Postfemur laterally sharply demarcated. Spermal channel running along the medial side of the femur. In the proximal half it runs along the posterior laminate crest, or between the two crests, towards the posterior side of the femur, turning in the distal half towards the anterior side. Solenomerite of moderate length, flagelliform, arising from the medio-anterior side of the distal end of the postfemur. Tibiotarsus springing from the posterior side of the distal end of the postfemur, moderately developed, distinctly demarcated from the postfemur. Tibiotarsus consisting of a simple solenophore. Lamina lateralis well developed, lamina medialis developed only in the distal part of the tibiotarsus, where it gives rise to a more or less complicated laminate process. Tibiotarsus sheathing the solenomerite in its distal part only.

Type-species. — Gigantomorpha immanis spec. nov.
Range. — Borneo, Celebes.
Number of species. — Eight.

Remarks. — This genus, besides the new species described in the present paper, includes two species previously referred to Pratinus Att., viz., Pratinus fasciatus (Att.) from Borneo and Pratinus socialis (Carl) from Celebes. Like so many of the species brought under the generic heading of Pratinus by Attems in his monograph of the 'Strongyllosomidae' of 1937, these two only have a quite remote relationship with the type of that genus. As a matter of fact, Attems seems to have been ignorant of the true identity of Pratinus, for a species closely related to the type of that genus was described by him as Euphyodesmus greeni Att. in 1936. In 1941, in following Attems, also Chamberlin referred a typical
species of *Pratinus* to the genus *Euphyodesmus* and even went as far as creating a new subgenus for this species and *greeni*. In short the synonymy of *Pratinus* is as follows:

**Pratinus Att.**


Type-species. — *P. cervinus* (Poc.). There may be some controversy as to what species should be regarded as the type of *Pratinus*. The name quite obviously has been proposed as a substitute for *Prionopeltis*, judging from the indication "nom. nov.". However, Attems apparently overlooked the type designation by Pocock, which, as a matter of fact, is somewhat concealed in the text of Pocock's paper, and selected *planatus* as the type species of *Pratinus*, thus taking the first of the three original species of *Prionopeltis*. In view of the doubtless intention of Attems to substitute the name *Prionopeltis* rather than to erect a new genus, it seems best to revert to *cervinus* as the type of *Pratinus*.

**Range.** — Ceylon, Burma, Tenasserim, Andaman Is.


Thus *Pratinus* is restricted to the original concept of *Prionopeltis* with the addition of two misplaced species of *Euphyodesmus*. Its generic characters are to be determined yet, although it seems clear that the genus may be regarded as intermediate between *Centrodesmus* Poc. and *Orthomorpha* Bollm. From the latter genus *Pratinus* is distinguished by the strongly developed, horn-like lateral keels, the thin marginal rims of the keels and the remarkably condensed type of tibiotarsus of the gonopods. A sharply demarcated postfemur seems to be absent. The differences between *Pratinus* and *Centrodesmus*, especially the Indochinese species referred to that genus, are less obvious. The lateral keels in *Centrodesmus* are even more strongly developed than in *Pratinus*, but it remains to be seen whether or not this evolutionary tendency is of sufficient importance to justify a generic separation. Since, however, the Sumatran type-species of *Centrodesmus* was based upon a female specimen and its more important characters are unknown, a discussion on the status of the genus and its boundaries becomes rather useless.

Aside from the true species of *Pratinus* enumerated above, the following have been referred to the same genus in the "Tierreich": *P. fasciatus* (Att.), *P. socialis* (Carl), *P. flaviventer* (Att.), *P. tenuipes* (Att.), *P. levigatus* Att., *P. rotundicollis* Att., *P. tuberculatus* Att., *P. glandulosus* Att., *P. arboricola* Att. and *P. butteli* (Carl). Besides, the following species were enlisted as "unsichere Arten": *P. montanus* (Chamb.), *P. bicolor* (Carl), *P. baasti* (Humb. & Sauss.), *P. paviei* (Brol.), *P. beaumontii* (Att.), *P. clarus* (Chamb.) and *P. dasys* (Chamb.). All of these species, except the six mentioned hereafter, will be discussed under *Orthomorpha*.

As has been stated already, *P. fasciatus* (Att.) and *P. socialis* (Carl), for reasons to be given below, are referable to the new genus *Gigantomorpha*. *P. bicolor*
(Carl) and P. baasti (Humb. & Sauss.), both from New Zealand and both based upon female specimens, are certainly not referable to any of the genera treated in this paper. In fact, one may wonder whether their location in the family Paradoxosomatidae was correct. The presence of polygonal areas on the metatergites in the two species points in the direction of the Sphaerotrichopodidae, a family, in contradiction to the Paradoxosomatidae, rather well represented in the New Zealand fauna. My attempt to verify this question failed, inasmuch as the type specimens of the two species could not be found in the museums of Bern and Geneva (respectively Dr. W. Küenzi, 12.IV.1955, and Dr. H. Gisin, 27.V.1955, in litt.).

P. clarus (Chamb.) from the Fiji Is. and Samoa is doubtless to be regarded as a synonym of Chondromorpha xanthotricha (Att.), a species now known to have an almost world-wide range. P. dasys (Chamb.) from the Fiji Is. may be either a species of Chondromorpha or Anoplodesmus, possibly introduced from elsewhere.

Rather than to Pratinus, Gigantomorpha appears to be related to the group of species assigned in the present paper to Orthomorpha. The general gonopod-structure in Gigantomorpha is in close agreement with that of the typical species of Orthomorpha, such as O. weberi (Poc.), O. hydrobiologica Att., etc. Differences, however, are found in the presence of two laminate femoral crests, the somewhat different course of the seminal channel and the presence of a laminate or spiniform process at the distal end of the lamina medialis of the tibiotarsus in Gigantomorpha. Other characters for distinguishing this genus from Orthomorpha probably will be found in the shape of the marginal thickenings of the lateral keels of the metasomites, in the development of the pleural keels, in the sternites, legs, etc., but unfortunately many species of Orthomorpha are not sufficiently well described as regards these characters.

Attention may be drawn to the similarity in the structure of the femoral crests of the gonopods in Gigantomorpha and Arthrogonopus. This resemblance seems to indicate a certain degree of relationship between the two genera, but other characters, either of the gonopods or of the external morphology, show this relationship to be quite remote and fully justify a generic separation.

Among the species of Gigantomorpha are to be found the largest Paradoxosomatidae yet described. The fact that these giants remained undiscovered for such a long time, reveals once again the enormous amount of taxonomic work to be done on tropical millipedes.

Key to the species. — As in related genera, the gonopod characters in the genus Gigantomorpha offer few possibilities for the distinction of species. Characters of diagnostic value are found mainly in the shape of the lateral keels, the development of the pleural keels, the coloration, and various secondary sexual features of the males.

The present key pertains only to the species from Borneo. The single species known from Celebes needs a re-examination as regards several important characters.

1. Colour of body segments in both pro- and metasomites brown, without yellowish mid-dorsal spots or band. Lateral keels entirely yellow. Lateral sides of collum rounded, without an acute latero-posterior angle. Lateral keels of 2nd segment turned somewhat downwards, distinctly below the level of those of the 3rd segment. Proximal joints of the legs of the male normally setiferous,
the femora straight. Basal and distal lateral setiferous tubercles of the tail weakly developed, terminal tubercles well developed. Anal scale with the setiferous tubercles equalling or surpassing the middle of the posterior margin 2

— Colour different. Sides of collum with an angular latero-posterior edge. Lateral keels of the 2nd segment turned somewhat upwards, nearly at the same level as those of the 3rd segment. Proximal joints of the legs of the male, especially in the anterior half of the body, ventrally more or less densely setiferous, the femora distinctly arched. Either the basal or the distal lateral tubercles of the tail, or both, well developed; terminal tubercles more or less well developed. Anal scale with vestigial or weakly developed setiferous tubercles, which do not surpass the middle of the posterior margin ............................................. 3

2. Along the posterior margin of nearly all segments laterally and ventrally an irregular row of setae. Metatergites with rather small tubercles, of which there are eight to ten behind the transverse furrow. Pleural keels strongly developed, present up to the 17th segment. Lateral keels in none of the segments projecting dorsad of the middle of the metatergites. Width (♂, ♀) 5.0 to 5.4 mm ...........

.........................................................  G. trichopleura spec. nov.

— Posterior margin of segments without setae. Tubercles on metatergites larger, generally six behind the transverse furrow. Pleural keels somewhat less strongly developed, present up to the 14th or 15th segment. Lateral keels somewhat more strongly developed, slightly raised above the level of the middle of the metatergites in a few posterior segments of the male. Width (♂, ♀) 6.3 to 8.0 mm ...........................................  G. spinescens spec. nov.

3. Colour of body segments very dark brown to blackish, with the lateral keels and a rather narrow continuous middorsal band pale brownish. Femur of gonopods rather strongly constricted about halfway. Process of lamina medialis of the tibiotarsus rather weakly developed, acuminate. Terminal end of tibiotarsus finely bifid ...........................................  G. fasciata (Att.)

— Body segments without a continuous middorsal pale band. Femur of gonopods without a distinct constriction. Process of lamina medialis rather strongly developed, the end truncate. Terminal end of tibiotarsus a rounded or somewhat triangular lobe ......................................................... 4

4. Colour of body segments uniformly black, with only the marginal rim of the lateral keels near the posterior edges somewhat paler brown. Legs of the male with the proximal joints set with short curved setae, the femora somewhat arched .........................................................  G. aterrima spec. nov.

— Colour of body segments dorsally either pale brownish gray, or dark purplish brown with a large yellowish spot in the middle of the prosomites and yellow posterior edges in the lateral keels. Legs of the male with long erect setae, the femora more strongly arched ......................................................... 5

5. Lateral keels of male raised above the middorsal surface of the metasomites in the 3rd to the 19th segments. Legs of male slender, the proximal joints not strongly incrassate and their ventral pubescence not brush-like ...........................................  G. corinalata spec. nov.

— Lateral keels of male raised above the middorsal surface of the metasomites in the 17th to the 19th segments only. Legs of male rather strongly incrassate, especially the proximal joints. The ventral side of all joints distad of the
coxa with a dense brush-like pubescence

6. Colour of body segments dorsally dark purplish brown, a broad median spot on the prosome and the latero-posterior edges of the lateral keels yellow. Pleural keels disappearing in the 10th or 11th segment ... G. immanis spec. nov.
— Colour of body segments dorsally entirely pale brownish gray. Pleural keels disappearing in the 16th or 17th segment ........... G. pallida spec. nov.

Gigantomorpha immanis spec. nov.


Colour. — Head dark purplish brown, the clypeal area and a spot at the posterior border of each of the antennal sockets pale yellow. Antennae pale yellow to brownish yellow, the 6th joint infuscate towards the end, the 7th joint dark brown, its distal end and the 8th joint whitish. Collum dark purplish brown, the lateral keels and sometimes a weakly defined narrow band along the posterior margin pale yellow. Body segments of same dark groundcolour as the collum. A large middorsal spot on the prosome, the latero-posterior edges of the lateral keels and sometimes a weakly defined narrow band along the posterior margin of the metatergites pale yellow. Venter pale brownish, sternites and legs pale yellow. Anal segment dark purplish brown, the tail yellow, the margins of the valves and the scale pale brownish.

Width. — Holotype ♂ 7.2 mm; other ♂ in the order of the above enumeration 7.0 mm; 7.2 mm; 6.0 mm; 6.5 mm; 6.6 mm; 6.6 mm; 6.6 mm; ♀ 7.3 mm; 7.0 mm; 7.2 mm; 6.8 mm; 7.3 mm; 6.7 mm; 6.9 mm; 7.2 mm; juv. ♀ with 19 segments 4.6 mm.

Head and antennae. — Labrum moderately emarginate. Clypeus rather weakly convex, moderately impressed towards the labrum. Lateral sides widely and weakly convex, somewhat emarginate or straight near the labrum. Surface of headplate shining, slightly rugulose. Head moderately to rather dispersedly setiferous in the clypeal and frontal region, vertex with four, two, or without setae. Antennal
sockets separated by $11/3 \times$ the diameter of one of the sockets, or by about three quarters of the length of the 2nd antennal joint. Postantennal groove shallow, the wall in front moderately prominent. Vertex moderately convex, not or weakly demarcated from the frontal area. Sulcus moderately impressed, running downward to the upper level of the antennal sockets or just below that level. Sulcus with some fine transverse wrinkles. Antennae not particularly slender. Length of joints: $3 > 2 = 4 = 5 = 6$, or the 6th slightly shorter and about three quarters of the length of the 2nd. Joints of subequal width, only the 6th slightly thicker than the others. Pubescence of antennae moderate to, distally, rather dense.

Collum. — (fig. 37—38). Somewhat wider than the head, subtrapezoidal in dorsal outline. Anterior border very widely convex in the middle, somewhat more narrowly rounded towards the sides, lateral border almost straight. Posterior border scarcely emarginate in the middle, weakly convex more laterally; posterior border of lateral keels somewhat emarginate. Latero-posterior edge acuminate, almost rectangular. Surface shining, leathery rugulose, hairless, rather weakly convex. In the middle at about one third from the anterior border a weak transverse depression. Along the posterior margin some low, flat, large tubercles are indicated, generally represented by some rather coarse wrinkles. Lateral keels somewhat raised to a horizontal level. Latero-anterior border with a marginal rim ending posteriorly at some distance from the posterior border, gradually disappearing anteriorly towards the middle of the anterior border.

Body segments. — Metatergites leathery rugulose, shining, hairless. Along the posterior margin a row of generally six flat larger tubercles, which generally are weakly developed and often resemble coarse wrinkles. Tubercles in the anterior part of the metatergites vestigial. Transverse furrow present from the 5th to the 17th segments, generally reaching laterad to the base of the lateral keels and bifurcating there into two furrows or depressions, curving cephalad and caudad respectively. Sides rugulose, rather densely and minutely granular up to the 4th segment, more dispersedly granular from the 5th segment onwards. Pleural keels present up to the 9th or 10th segment, obsolete from the 10th or 11th. Up to the 4th segment they are represented by well developed, complete, granulate ridges which are posteriorly produced into a conical process projecting a little behind the posterior margin of the somites. From the 5th segment onwards the pleural keels are represented by a well developed swelling which is rather densely granulate above the anterior legs and a well developed pointed cone near the posterior margin of the segment, directed caudo-laterad and not projecting behind the margin. Both, swellings and cones, gradually diminish in size in subsequent segments.

Lateral keels. — (fig. 37—41). 2nd segment somewhat wider than the collum. The keels anteriorly somewhat shouldered at the base, the anterior margin rounded, the lateral margin a little emarginate in the middle, the posterior edge acutely angular and projecting rather strongly behind the posterior margin of the segment, the posterior margin straight. Keels of 2nd segment directed somewhat upwards, their level scarcely below that of the keels of the 3rd segment. Marginal rim well developed along the anterior and latero-anterior borders; a very fine rim along the posterior border. 3rd and 4th segments of subequal width, somewhat narrower than the 2nd. The keels anteriorly very weakly shouldered at the base, rather
widely rounded. The posterior edges projecting rather strongly behind the margins of the segments. Keels directed upwards a little, those of the 4th segment less than those of the 3rd. Premarginal furrow not reaching the posterior margin. Posterior margin with a fine rim. Marginal rim ventrally not marked off by a furrow. 5th segment distinctly wider than the 4th. Keels from the 5th segment onwards anteriorly and laterally widely rounded, scarcely or not shouldered at the base. Posterior edges acutely angular, especially in the posterior segments projecting well behind the margins of the segments. In the segments of the middle part of the body, however, they hardly project behind the posterior margins. Keels horizontal in most of the segments, only in the 17th or 18th to 19th segments they are raised a little above the middorsal surface of the metasomites. Poriferous keels extending very slightly more laterad than the poreless. Dorsal premarginal furrow reaching from the waist to near the posterior border; a fine marginal rim along the posterior border. Marginal rim ventrally generally demarcated only in the posterior half of the poriferous keels. The rim generally not ventrally demarcated in the poreless keels. Pores dorso-lateral in a slight excavation of the marginal rim. In most segments the pores are visible from the dorsal side.

Sternites and legs. — Sternites about as long as wide in middle segments. Cross impressions represented by a rather sharp transverse furrow and a very weak and wide longitudinal impression. Sternal process of 5th segment somewhat broader than long, the sides almost parallel, the end truncate and scarcely incised in the middle. In lateral view the process is thick, a little acuminate towards the rounded end. Process directed ventrad, not projecting before the anterior border of the sternite. Anterior side of process near the end densely set with short setae. Sternite of 5th segment with a normal transverse furrow behind the process and a normal longitudinal impression between the posterior legs; sternal cones at the bases of the posterior legs vestigial. Sternite of 6th segment somewhat longitudinal-ly convex and transversely concave between the anterior legs, without transverse furrow and sternal cones. Granular protuberances of the sternite of the 7th segment well developed. Sternites from the 8th to the 17th segments with rather well developed pointed cones near the bases of the legs. The cones are pointing ventrad and a little caudad. Legs (fig. 42) moderately setiferous, the ventral side of the joints distad of the coxa with dense brushes up to the legs of the 17th segment. The last two pairs without brushes, more normally setiferous. Legs rather strongly incrassate, in particular the three proximal joints. From the 3rd or 4th pair onwards the legs have the femora rather strongly arched. Legs of moderate length. Length of joints: 3>6>5>4 = 2>1.

Anal segment. — (fig. 43). Tail of moderate length, rather broad and thick at the base. Sides rather strongly converging. Basal lateral setiferous tubercles rather weakly developed, distal lateral setiferous tubercles and terminal tubercles moderately developed. Near the base of the tail a more or less developed dorsal transverse depression. Ventral side of tail somewhat concave. Valves with rather narrow rims, the setiferous tubercles weakly developed. Scale parabolically rounded, the sides a little concave, the setiferous tubercles rather weakly developed and not projecting behind the margin.

Gonopods. — (fig. 44—45). Coxal setiferous area extending from the lateral, over the anterior towards the medial side. Anterior crest of the femur gradually
Fig. 44—45. Gigantomorpha immanis spec. nov. — 44: right gonopod of the holotype ♂, medial view; l: lamina lateralis; m: lamina medialis. 45: distal portion of the tibiotarsus of the same; p: laminate process of the lamina medialis

fading away towards the distal end. Femur not constricted halfway. End of tibiotarsus with a small simply rounded lobe. Lamina medialis with a well developed laminate process (p), which is T-shaped in cross section.

Female. — Aside from the usual secondary sexual characters the females differ from males by the somewhat more robust build, caused by the weaker constriction of the somites. Collum with a rectangular latero-posterior edge; the posterior margins of the lateral keels of the collum scarcely emarginate. Dorsal surface of metasomites a little more convex transversely, so that in none of the segments the lateral keels project dorsad of the middle of the tergites. Lateral keels comparatively a little less prominent, the posterior angles of the corresponding keels less acute than in the males. Sternites somewhat longer than broad; sternal cones present
from the 5th to the 17th segments, somewhat more weakly developed than in the males. Legs not notably shorter, but distinctly more slender, in particular in the three proximal joints. Pubescence moderate, the ventral side of the joints without dense brushes, but only slightly more densely setiferous than the dorsal side. Femora straight. Length of joints: 3 > 6 > 5 > 2 > 4 > 1. The 6th joint somewhat more distinctly longer than the 5th than in the males.

Juvenile. — The juvenile ♀ with 19 segments is essentially similar to the adult females, although most of the characters are less pronounced. In particular the lateral keels are distinctly less prominent and generally do not project behind the margins of the somites.

Remarks. — The specimens of *immanis* collected in the Mahakkam river area differ in some minor details from the typical form from Mt. Tibang and Pajan River. At least the males appear to have a slightly smaller size: 6.0 to 6.6 mm as against 7.0 to 7.2 mm. Moreover the keels are very slightly less prominent because their lateral margins are a little more parallel to the longitudinal axis of the body. In the tail the basal lateral setiferous tubercles are decidedly more strongly developed. The setiferous tubercles of the anal scale are somewhat more strongly developed too, so that they are projecting very slightly behind the posterior margin. However, a much more abundant material is needed to decide whether these characters are of really subspecific value or just represent population varieties.

A form not directly referable to *immanis* although very closely related to that species was represented by a male and a female specimen from East Borneo, without nearer location (Coll. Dr. E. Mjöberg, Mus. Stockholm). Width of ♂ 7.3 mm, of ♀ 7.6 mm. The male differs from that of *immanis* in the pubescence of the legs. The dense brushes on the ventral side of the joints distad of the coxa are thinning out in the legs of the second half of the body and disappear in those of the 15th to the 18th segments. As regards the characters of the anal segment both specimens agree with the *immanis* specimens from the Mahakkam area. Without more material and an exact locality it seems best not to name this particular form which may represent a subspecies of *immanis*.

**Gigantomorpha cornalata** spec. nov.


Differing from *immanis* in the following characters.

Colour. — Entirely similar to that of *immanis*.

Width. — 5.8 mm in both ♂.

Head and antennae. — The 6th antennal joint scarcely shorter than the 2nd.

Collum. — (fig. 46—47). Width in relation to the head larger than in *immanis*. Latero-posterior edge of keels somewhat more acute than in *immanis*, the posterior border of the keels almost straight. Surface more finely rugulose to subgranulose. Along the posterior border of the collum a few flat, rather indistinct tubercles resembling coarse wrinkles. The keels slightly turned upwards.

Body segments. — Surface of metatergites more finely rugulose to subgranulose. The tubercles along the posterior margin a little smaller than in *immanis*, but slightly more prominent. Sides somewhat more densely and more coarsely granulate.
Fig. 46—51. *Gigantomorpha cornalata* spec. nov. — 46: left side of the head and the four anterior segments of the holotype ♂, lateral view. 47: left side of the head and the three anterior segments of the holotype ♂, dorsal view. 48: left side of the 10th and 11th segments of the holotype ♂, dorsal view. 49: left side of the 17th, 18th and 19th segments of the holotype ♂, dorsal view. 50: leg of the 7th segment of the holotype ♂. 51: anal segment of the holotype ♂, ventral view.
Pleural keels somewhat more strongly developed than in *immanis*. The anterior swellings more coarsely granular, disappearing earlier than the posterior cones which remain visible up to the 14th or 15th segment.

Lateral keels. — (fig. 47—49). More strongly developed than in *immanis*. The lateral margins more straight, diverging a little more strongly in caudal direction. Posterior edges more acute, curving somewhat inwards in the posterior segments, and projecting distinctly behind the posterior margin of the metasomites in all segments. Keels of all segments slightly turned upwards, projecting dorsad of the middle of the tergites from the 3rd to the 19th segments. Pores situated a little more laterally, the excavation of the marginal rim around the pores more distinct.

Sternites and legs. — Sternal process of 5th segment slightly constricted at the base. The distal end somewhat more rounded, though still weakly incised in the middle. From a lateral view the process is more attenuate and the end more narrowly rounded than in *immanis*. Legs (fig. 50) distinctly longer than in *immanis*, the proximal joints not particularly incassate. Ventral brushes considerably less dense, the hairs longer. The brushes are gradually thinning out in the postgonopodial legs, but still remain rather dense even in the legs of the 17th segment. Length of joints: $3 > 5 > 6 > 2 = 4 > 1$.

Anal segment. — (fig. 51). The tubercles of the tail are more or less equally developed. Anal scale subtriangular, the posterior end more narrowly rounded.

Gonopods. — Similar to those of *immanis*. The anterior femoral crest more abruptly ending distally.

Female. — Unknown.

**Gigantomorpha aterrima** spec. nov.


Differing from *immanis* in the following characters.

Colour. — Entirely black, with the clypeal area of the head, the posterior part of the lateral margin of the keels, the venter and the end of the tail dark brown. Antennae, legs and sternite pale yellowish to brownish yellow. The 6th antennal joint infuscate towards the end, the 7th joint dark brown, but its distal part and the 8th joint whitish.

Width. — Holotype $\delta$ 7.3 mm, other $\delta$ 7.5 and 7.8 mm; $\varphi$ 7.8 mm.

Head and antennae. — 6th antennal joint of about the same length as the 2nd, the 4th and the 5th; the 3rd somewhat longer.

Collum. — (fig. 52—53). Width in relation to the head larger than in *immanis*. Lateral sides of the keels very weakly emarginate in front of the latero-posterior edge. Latero-posterior angle somewhat more acute than in *immanis*. Posterior border of keels straight. Surface somewhat dull, much more finely rugulose than in *immanis*. Tubercles at the posterior margin weakly indicated.

Body segments. — Metatergites somewhat dull, very finely rugulose. The tubercles at the posterior margin distinct but rather small in most of the segments. Pleural keels as in *immanis*, disappearing in the 10th or 11th segment, those of the 4th segment not projecting behind the margin.

Lateral keels. — (fig. 52—55). Somewhat more strongly developed than in
*immanis*. The posterior edges often sharply pointed and bent somewhat inwards, the points especially distinct in the keels of the posterior segments. Posterior edges in all segments projecting more or less behind the margin of the metasomites. Keels either horizontal or turned a little upwards, in the latter case they project dorsad of the middle of the metatergites either in a few anterior and posterior segments or in nearly all segments. Marginal rim of the keels in all segments distinctly narrower dorso-ventrally than in *immanis*, the dilatation around the pores.

Fig. 52—56. *Gigantomorpha aterrima* spec. nov. — 52: left side of the head and the four anterior segments of the holotype $\delta$, lateral view. 53: left side of the head and the three anterior segments of the holotype $\delta$, dorsal view. 54: left side of the 10th and 11th segments of the holotype $\delta$, dorsal view. 55: left side of the 17th, 18th and 19th segments of the holotype $\delta$, dorsal view. 56: leg of the 7th segment of the holotype $\delta$. 
smaller. Pores somewhat more lateral than in *immanis*, the excavation of the marginal rim in the pore area more distinct.

Sternites and legs. — Sternal process of 5th segment similar to that of *immanis*, but slightly narrower in lateral view. In posterior view the end is very weakly incised, appearing like a wide V. Legs (fig. 56) similar to those of *immanis*, very slightly less incrassate, the femora somewhat less strongly arched, the ventral pubescence of the distal joints less dense. Ventral pubescence of the proximal joints rather dense, at least in the legs of the anterior half of the body; the setae are very short and typically curved distad. In the legs of the second half of the body the pubescence is moderate, but the setae of the proximal joints remain short. Length of joints: \(3 \geq 6 \geq 5 \geq 4 \geq 2 \geq 1\).

Anal segment. — Tail almost as in *cornalata*. Anal scale as in *immanis*, the setiferous tubercles a little more distinct.

Gonopods. — Similar to those of *cornalata*.

Female. — Aside from the usual secondary sexual characters the \(\varphi\) differs from the males in having a somewhat more robust appearance. Latero-posterior edge of collum somewhat less acute than in the males. Dorsum of metatergites only very little more convex. Lateral keels on a high level and in some anterior and posterior segments almost projecting dorsad of the middle of the tergites. Keels a little less prominent than in the males, the posterior edges scarcely less acute. Sternites somewhat broader than long, the cones similarly well developed. Legs slightly shorter but much more slender than in the males, moderately setiferous and without a more dense ventral pubescence, the hairs normal. Femora straight. Length of joints: \(3 \geq 6 \geq 5 \geq 2 = 4 \geq 1\).

**Gigantomorpha pallida** spec. nov.


Differing from *immanis* in the following characters.

Colour. — Head rather dark brown, paler in the clypeal area. Antennae also rather dark brown, the 6th joint infuscate towards the end, the 7th joint also dark, but the distal end and the 8th joint whitish. Collum and the dorsal part of the pro- and metasomites of the subsequent body segments pale brownish gray. In the middle of the collum on each side straight behind the antennal sockets a rather small rounded brown spot. In the body segments the lateral part of the prosomites near the waist, the lateral part of the waist itself, the area of the metasomites before, immediately below and behind the lateral keels and the lateral part of the posterior border of the metasomites dark brown. The middle portion of the sides pale brownish gray. Venter, sternites and legs very pale brownish gray or pale brownish. Anal segment pale brownish gray, the sides of the anal ring and the valves dark brown.

Width. — Holotype 6.4 mm; other \(\varphi\) 6.4 mm and 6.8 mm.

Head and antennae. — Length of antennal joints as in *aterrina*.

Collum. — (fig. 57). Width in relation to the head somewhat larger than in *immanis*. Latero-posterior edges more acute, the posterior border of the keels somewhat more distinctly emarginate. Surface somewhat dull, finely rugulose to
sub-granulose, a few hairs may be present along the anterior border. Tubercles weakly indicated.

Body segments. — Metatergites rugulose to sub-granulose. Tubercles along the posterior margin small, but rather distinct. Tubercles in front of the transverse furrow almost obsolete. Sides somewhat more coarsely and densely granulate. Pleural keels more strongly developed than in *immanis*, the swellings more coarsely granulate, posterior cones well developed, disappearing on the 16th or 17th segment.

Lateral keels. — (fig. 57—58). Somewhat more strongly developed than in *immanis*. The posterior edges often with a small sharp point curving a little inwards, in particular in the posterior segments. The edges slightly more acute, scarcely or not projecting behind the margin of the segments in the middle part of the body, but more strongly than in *immanis* in the posterior segments. Pores more lateral than in *immanis*, the lateral emargination of the rim in the pore area somewhat more distinct.

Sternites and legs. — Sternal process of 5th segment distally acuminate from a lateral view, the distal end sub-laminate. From a posterior view the base is very slightly constricted, and the end is medially incised as in *aterrima*. Legs as in *immanis*.

Anal segment. — (fig. 59). The basal and distal lateral setiferous tubercles of...
the tail are distinctly more strongly developed. Setiferous tubercles of scale slightly projecting.

Gonopods. — (fig. 60). The anterior femoral crest ends abruptly; the end being even very slightly produced.

Female. — Unknown.

Gigantomorpha fasciata (Att.)

1898 Prionopeltis fasciatus Attems, Denks. Ak. Wien, vol. 67, p. 353, pl. 5, fig. 120—121 (1).
1937 Pratinus fasciatus, Attems, Tierreich, vol. 68, p. 115, fig. 150 (2).

Previous records. — Borneo (1); South Borneo: Bandjermasin (1), Pagat, Barabei (2).


Differing from immanis in the following characters.

Colour. — Head black, brown in the clypeal area. Antennae very dark brown, particularly in the distal joints. The tip of the 7th and the 8th joint whitish. Collum and subsequent body segments black, with a rather narrow continuous pale brown mid-dorsal band running from the anterior border of the collum to the end of the tail. Lateral keels of collum and other segments with pale brown latero-posterior edges. Venter brown. Sternites pale brown to brownish yellow. Legs pale yellow. Anal segment. Sternites pale brown to brownish yellow. Legs pale yellow. Anal segment laterally and dorsally black, aside from the mid-dorsal band. The ventral side and the scale brown, the valves a little darker brown.

Width. — 5.5 mm, 5.5 mm, 5.6 mm and 5.6 mm.

Head and antennae. — Length of antennal joints as in aterrima.

Collum. — (fig. 61—62). Width in relation to the head only a little larger than in immanis. Latero-posterior edges about rectangular, the posterior border of the keels nearly straight. Surface somewhat dull, sub-granulose, a few hairs along the anterior border. Tubercles obsolete. Lateral keels slightly raised above the horizontal level.

Body segments. — Metatergites somewhat dull, sub-granulose. Tubercles along the posterior margin small but distinct. Sides rather densely and somewhat more coarsely granulate. Pleural keels more strongly developed, similar to those of corydala, disappearing in the 14th or the 15th segment.

Lateral keels. — (fig. 61—64). Very similar to those of immanis, but the posterior edges somewhat more acute in the posterior segments. 2nd segment wider than the collum, more distinctly than in immanis. All of the keels more or less raised above the horizontal level, projecting above the middle of the metatergites either in all segments from the 4th to the 19th or only in a few anterior and posterior segments. Pores distinctly more lateral, the marginal rim more distinctly emarginate than in immanis.

Sternites and legs. — Sternites scarcely longer than wide. Process of the sternite of the 5th segment distally acuminate from a lateral view, though not laminate. From a posterior view the process is slightly constricted at the base, the end
scarce emarginate. Legs (fig. 65) rather long and not particularly incrassate. Ventral pubescence of the joints rather dense in the anterior legs, but gradually thinning out, becoming moderately dense in the legs of the posterior half of the body and normal in the last two pairs. Length of joints: $3 > 6 > 5 > 4 = 2 > 1$.

Anal segment. — (fig. 66). Almost similar to that of immanis, but especially the distal lateral setiferous tubercles of the tail somewhat more strongly developed.

Gonopods. — (fig. 67—68). The anterior femoral crest rather thick, less laminate than in immanis, ending more abruptly distally. Femur distinctly constricted about halfway. Terminal lappet of tibiotarsus small. The end of the tibiotarsus curving laterad. The process of the lamina medialis rather weakly developed, subspiniform.

Remarks. — It is not without some doubt that the presently described material has been referred to fasciata, because the characters which actually have proved to be of diagnostic value, such as the shape of the lateral keels, the rate of development of the pleural keels, the shape and pubescence of the legs, etc., have scarcely been mentioned by Attems. Of the lateral keels of the type material of fasciata only characters of generic value have been given, of the pleural keels we only know that they are disappearing in the second half of the body, and of the legs it has been said (vide Carl, 1912) that tarsal brushes are found only in the eight anterior pairs of legs.

In the present material typical tarsal brushes are absent, although the tarsi of the anterior legs are more densely setiferous, as usual indeed, than those of the middle and posterior legs.

Still, there appears to be no evidence justifying a specific separation of the present material. Obviously there is no important difference in coloration, the type specimens apparently having been slightly paler. In outline, the gonopods of the present specimens agree largely with the drawings published by Attems, although, there remain some minor discrepancies as a comparison of the figures will show.

Although conforming essentially with the group of very closely related species embracing immanis, cornalata, aterrima and pallida, fasciata is decidedly more disjunct, in particular in the characters of its gonopods such as the femoral constriction, the weaker development of the process of the lamina medialis of the tibiotarsus, etc.

Gigantomorpha trichopleura spec. nov.


Differing from immanis in the following characters.

Fig. 61—68. Gigantomorpha fasciata (Att.). — 61: left side of the head and the four anterior segments of a ♂, lateral view. 62: left side of the head and three anterior segments of the same ♂, dorsal view. 63: left side of the 10th and 11th segments of the same ♂, dorsal view. 64: left side of the 17th, 18th and 19th segments of the same ♂, dorsal view. 65: leg of the 7th segment of the same ♂. 66: anal segment of the same ♂, ventral view. 67: telopodite of the right gonopod of the same ♂, medial view. (The solenomerite has moved out of its natural position). 68: distal portion of the tibiotarsus of the same
Colour. — Head more or less dark castaneous, paler in the clypeal area. Antennae brownish yellow, the end of the 6th and particularly the 7th joint dark brown. Tip of 7th and the 8th joint whitish. Collum and body segments more or less dark castaneous, the lateral keels entirely yellow or brownish yellow. Venter pale brown, the sternites and legs brownish yellow. Anal segment dark castaneous, the tail yellowish, the valves and the scales paler castaneous.

Width. — Holotype ♂ 5.0 mm; other ♂ 5.0 mm; ♀ 5.4 mm each juvenile ♂ with 19 segments 3.1 mm, 3.1 mm and 3.2 mm; juvenile ♀ with 19 segments 3.3 mm; juvenile ♀ with 18 segments 2.5 mm.

Head and antennae. — Headplate rather weakly to sparsely setiferous in the clypeal and frontal parts. Length of antennal joints as in *aeterrina*.

Collum. — (fig. 69—70). Subsemicircular in dorsal outline. Sides rather widely rounded, without a latero-posterior edge. Latero-anterior border almost straight above the lateral rounding, posterior border with a weak notch above the lateral rounding. Surface shining and rugulose as in *immanis*, a few bristles along the anterior margin, tubercles obsolete. The lateral margins slightly raised, the dorsal surface moderately convex. Marginal rim rather weakly developed but extending to the latero-posterior border.

Body segments. — Metatergites shining, rugulose, tubercles small but distinct, generally 8 to 10 in front of the posterior border and 4 in front of the transverse furrow. Tubercles sometimes setiferous. Transverse furrow indicated in the 3rd segment, generally well developed from the 4th to the 18th segments. Sides rather weakly rugulose but rather coarsely granulate, in particular up to the 4th segment. Along the posterior margin of the metasomites below the level of the keels an irregular row of setae present up to about the 17th or 18th segment. Pleural keels present up to the 17th segment, obsolete from the 18th onwards. They are well developed and represented by complete, granulate to subtuberculate ridges up to the 6th segment. From about the 7th segment the pleural keels consist of a well developed longitudinal swelling which is densely granulate above the anterior legs and granulate to subtuberculate above the posterior legs of each segment. A posterior cone, directed laterad and somewhat caudad is well developed, but it does not project behind the margin of the segments in the posterior half of the body.

Lateral keels. — (fig. 69—72). Anterior border of keels of 2nd segment weakly rounded, latero-anterior edge with a small tooth. Lateral border widely rounded, the margin somewhat irregular. Latero-posterior edge obtusely angular. Marginal rim rather weakly developed, the pre-marginal furrow complete. Keels of 2nd segment directed somewhat ventrad, their level distinctly below that of the keels of the 3rd segment. Keels of the 3rd segment almost horizontal. From the 4th segment onwards the keels are horizontal and do not project dorsad of the metatergites. Pre-marginal furrow of the keels of the 3rd and 4th segments com-

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Fig. 69—76. *Gigantomorpha trichopleura* spec. nov. — 69: left side of the head and the four anterior segments of the holotype ♂, lateral view. 70: left side of the head and the three anterior segments of the holotype ♂, dorsal view. 71: left side of the 10th and 11th segments of the holotype ♂, dorsal view. 72: the same, lateral view. 73: leg of the 7th segment of the holotype ♂. 74: anal segment of the holotype ♂, ventral view. 75: right gonopod of the holotype ♂, medial view. 76: distal portion of the tibiotarsus of the same
plete. In all segments the lateral keels project behind the posterior margins of the segments, especially in the posterior segments where the posterior edges of the keels are more acute than in *immanis* and have a sharply pointed end curving inwards a little. Marginal rim of keels from the 5th segment onwards with a slight lateral prominence about halfway followed up by an emargination. Pores lateral, in most of the segments not visible from the dorsal side. Pore area rather weakly emarginate.

Sternites and legs. — Sternites of middle segments about one and a quarter longer than wide. Sternal process of the 5th segment distally acuminate when seen from the lateral side, the end even sublaminate. From a posterior view the process is not constricted at the base and the sides are parallel. The end has a very wide V-shaped incision. Legs (fig. 73) moderately setiferous, more densely only in the tarsi. Ventral side of the joints a little more densely setiferous than the dorsal side but without brushes. Legs of moderate length, rather thick, the femora straight.

Length of joints: $3 > 6 = 2 > 4 > 5 > 1$.

Anal segment. — (fig. 74). Tail very broad at the base, the sides strongly converging, a little concave. Basal and distal lateral setiferous tubercles very small, terminal tubercles moderately developed. Dorsal transverse depression weak or obsolete. Scale with well developed setiferous tubercles, projecting behind the margin and equalling the middle of the posterior border.

Gonopods. — (fig. 75—76). The coxal setiferous area does not extend to the medial side. Tibiotarsus comparatively smaller than in *immanis*, the terminal end distinctly bifid. Process of lamina medialis less strongly developed, sub-spiniform.

Female. — Aside from the usual secondary sexual characters the ♀ differs from the ♂ in having a distinctly more robust appearance. The segments are somewhat less constricted in the waist area and the lateral keels are distinctly less prominent, their posterior edges somewhat less acute. Keels from the 3rd segment to the segments of the middle of the body not projecting behind the posterior margins of the segments. Sternites as long as wide. Legs a little more slender than in the ♂. Pubescence rather weak, that of the ventral side of the joints not different from that of the dorsal side. Length of joints: $6 > 3 > 2 > 4 = 5 > 1$.

Juvenile. — The juvenile specimens agree essentially with the ♀. The sculpture of the collum and the metatergites is rather weakly rugulose, tubercles are missing, but a few more hairs are present. The hairs along the lateral and ventral margins of the somites are absent. The lateral keels are relatively much less developed than in the adults.

Remarks. — Although *trichopleura* and the closely related *spinescens* are rather disjunct from the other species of *Gigantomorpha*, there can be no doubt as to the correctness of the present reference, since the gonopod structure in the two species is basically the same as in *immanis*. In this respect, the genus *Gigantomorpha* is a perfect example to show the dubious value of the level of the lateral keels of the 2nd segment as a taxonomic character. Doubtless previous authors merely on account of this sole character would have referred *immanis* to the genus *Pratinus* and *trichopleura* to *Orthomorpha*. 
Gigantomorpha spinescens spec. nov.

Material. — East Borneo: without nearer location (Coll. Dr. E. Mjöberg, Mus. Stockholm), 2 ♂, 1 ♀.

Differing from immanis in the following characters.

Colour. — Exactly similar to that of trichopleura.

Width. — Holotype ♂ 6.8 mm; other ♂ 6.3 mm; ♀ 8.0 mm.

Head and antennae. — Pubescence of head as in trichopleura. Length of antennal joints as in aterrima.

Collum. — (fig. 77—78). Relative width of collum in comparison to the head somewhat larger than in immanis. Dorsal outline subtrapezoidal to subsemicircular.

Fig. 77—81. Gigantomorpha spinescens spec. nov. — 77: left side of the head and the four anterior segments of the holotype ♂, lateral view. 78: left side of the head and the three anterior segments of the holotype ♂, dorsal view. 79: left side of the 10th and 11th segments of the holotype ♂, dorsal view. 80: left side of the 17th, 18th and 19th segments of the holotype ♂, dorsal view. 81: anal segment of the holotype ♂, ventral view.
Anterior border evenly rounded. Sides rather widely rounded, without a distinct latero-posterior edge, although the lateral rounding is somewhat narrower at the posterior side. Posterior border of the lateral sides straight, with a weak notch above the lateral rounding. Surface somewhat dull, rather coarsely rugulose to subgranulose. A few tubercles along the posterior border are either weakly indicated or rather distinct. Lateral keels somewhat raised but not attaining a horizontal level. Marginal rim laterally weakly developed, the furrow almost obsolete laterally.

Body segments. — Metatergites somewhat dull, rather coarsely rugulose to subgranulose. Along the posterior margin six to, sometimes, eight rather large, distinct tubercles. In the anterior segments there are also four large flat tubercles behind the waist, which, however, rapidly grow less distinct on the subsequent segments to become faintly indicated or obsolete in the segments of the middle and posterior parts of the body. Transverse furrow of metatergites present, though weakly developed, also in the 4th and the 18th segments. Sides rather coarsely granular, in particular up to the 4th segment. Pleural keels more or less similarly developed as in immans but the anterior swelling somewhat more densely granulate; the posterior cones disappear in the 14th or 15th segment, the swellings remain up to about the 17th segment.

Lateral keels. — (fig. 77—80). Keels of 2nd segment largely similar to those of trichopleura. The latero-anterior edge without a tooth, but obtusely angular. Latero-posterior edge about rectangular. Lateral keels of the other segments also largely similar to those of trichopleura, the posterior edges more acute, becoming more or less spiniform in the posterior segments. Keels mostly horizontal, only those of the posterior segments raised slightly above the horizontal level but just not projecting dorsad of the middle of the metatergites. Marginal rim of keels with a similar lateral prominence, though much less distinct, than in trichopleura.

Sternites and legs. — Sternal process of the 5th segment differing from that of trichopleura only in being somewhat constricted at the base. Legs as in trichopleura, the ventral pubescence of the joints somewhat more dense.

Anal segment. — (fig. 81). Tail similar to that of trichopleura, the sides, however, converging somewhat less strongly and not concave. Scale with setiferous tubercles strongly developed, projecting well caudad of the middle of the posterior margin.

Gonopods. — Similar to those of trichopleura.

Female. — Differing from the ♂ in the same characters as does the ♀ of trichopleura from the ♂ of that species. Sternites somewhat broader than long.

Remarks. — A species very closely related to spinescens was represented by a single female specimen from West Borneo: Sambas, October, 1893 (Borneo Exped., Coll. Dr. Hallier, Mus. Leiden). It has a width of 7.2 mm and agrees with spinescens in colour and general appearance. The main differences are found in the smaller tubercles of the metatergites, the acute posterior edge of the lateral keels of the 2nd segment, the much less elongate lateral keels of the posterior segments and the development of the tubercles of the tail, which resemble those of pallida.

In Celebes the genus Gigantomorpha is represented by a single species:
Gigantomorpha socialis (Carl)

1912 Prionopelis socialis Carl, Rev. Suisse Zool., vol. 20, p. 139, pl. 5, fig. 13—15.

Distribution. — South Celebes: Bontorio.

In colour this species apparently resembles immanis and coranalata. In the characters of the legs it seems to agree with immanis. The collum, however, has the lateral sides rounded, the pleural keels remain visible up to the 16th or 17th segment, so that socialis is clearly distinct from both immanis and coranalata. The gonopods of socialis apparently have the generic characters of Gigantomorpha, although the details of the acropodite have not been sufficiently illustrated.

Orthomorpha Bollm.


Type-species. — Polydesmus beauumontii Le Guillou, by subsequent designation: POCOCK, 1909. (Type-species of Asiomorpha: Polydesmus coarctatus De Saussure, by monotypy; of Brasilogonopus: B. attemsi Verhoeff, by monotypy; of Orthomorpha: Polydesmus coarctatus De Saussure, by original designation).

Range. — Burma, Indochina, Siam, Malayan Peninsula, Java, Borneo, Philippines; one species has a circumtropical distribution.

Number of species. — 33 and one variety.

Remarks. — A discussion of the taxonomy of the genus has to be preceded by some remarks relating the correctness of the application of the name Orthomorpha and the designation of the type-species.

Orthomorpha was introduced by BOLLMAN in 1893 as a substitute for Paradesmus Sauss., a name preoccupied by Paradesmus Corda. As such, Orthomorpha has been generally accepted and used by all subsequent authors.

It is, therefore, rather surprising to find that the name Paradesmus Corda is not included in the well-known Nomenclator Zoologicus by NEAVE. As a matter of fact, in this Nomenclator we find behind the name Orthomorpha the addition: "in err.?, suggesting the probability of Bollman’s name being superfluous.Apparently, this condition recently has led to some confusion as regards the correctness of the use of Orthomorpha and required some investigation.

Paradesmus has been used as a generic name first by A. J. C. CORDA in a paper: "Ueber die Infusorien der Carlsbader Quellen", published in: J. de Carro, Almanach de Carlsbad, 1835. Unfortunately, this paper was not available to me. An abstract, however, was given by A. F. A. Wiegmann in the "Bericht über die Leistungen im Felde der Zoologie während des Jahres 1835" which appeared in Arch. Naturg., vol. 2, fasc. 2, p. 184 (1836).
Besides a discussion of Corda's paper by Wiegmann, this article contains also a synonymic list by C. G. Ehrenberg of the genera and species described by Corda. In this list, Parademas Folium Corda is referred with some doubt to the genus Fragilaria which belongs to the botanical Class Diatomaeae. There seems to be little doubt therefore that Parademas Corda was based on a vegetable organism.

Contrary to this present day opinion, authors around 1835, or at least a number of them, apparently were of the opinion that the Diatomaeae (or Bacillaria, as they were called at that time) were part of the animal kingdom. This is proved, for instance, by the admission of Parademas Corda and other botanical genera, united as a group Polygastrica, in the Nomenclator Zoologicus by Agassiz (1842—1846).

Whether or not Corda actually described Parademas as a zoological genus I am unable to ascertain since I did not have access to his paper, but from Wiegmann's discussion it may be inferred that Corda regarded the organisms described by him as animals. This question, however, becomes irrelevant, since Ehrenberg ended his synonymic list, which included Parademas, with the significant words: "Alle übrigen Formen kann ich nicht für Thiere anerkennen".

From the available evidence I have concluded that Parademas Corda at least for some time has figured as a generic name in zoology, so that according to article 2 of the International Code the substitution of Parademas Sauss. by Orthomorpha Bollm. was quite correct.

There has been a considerable diversity of opinion as to the question which species should be regarded as the type of the genus Orthomorpha.

In Bollman's paper of 1893 the name has been mentioned two times. The author introduced it first on page 159, where in a footnote is stated: "Orthomorpha Bollman for Parademas Saussure, which is preoccupied". On page 196 of the same paper the name is used again with the addition: "Orthomorpha, nom. gen. nov. for Parademas Saussure, which is preoccupied by Parademas Corda, Polyg.". From this evidence one can only conclude that the name was proposed as a direct substitute for Parademas Sauss. The type-species of Orthomorpha consequently must be one of the species included in the original concept of Parademas.

As far as I am aware a type-species of Parademas has not been designated previous to 1893. Afterwards three opinions on this matter have been brought forward.

The first of these has been the one of Cook and Silvestri, who in 1895 and 1896, respectively, without any comment, designated O. coarctata (Sauss.) as the type of Orthomorpha, in which they were followed subsequently by Attems, for instance in the "Tierreich" in 1937.

The action by Silvestri was criticized by Pocock in 1909, with the following cogent arguments:

"The name Parademas, Saussure, was originally applied to the following species: — Section I. P. carolinensis; Section II. P. klugi, P. erchsoni, P. picteti; Section III. P. beannonti (Linn. Ent., xiii, pp. 325, 326, 1859). One of these must be its type, the addition of P. coarctatus to the list in 1860 (Mem. Soc. Phys. Genève, xv, p. 297) not in any way affecting the question. As a matter
of fact this question was settled by Humbert and Saussure in 1869 (Verh. z.-b. Ges. Wien, xix, p. 670), who eliminated the members of Sections I. and II., respectively under the names Euryurus and Pachyurus, and restricted Paradesmus to Section III., making P. beamontii its type species*). But since Paradesmus was preoccupied, Bollman proposed Orthomorpha to replace it. Therefore P. beamontii is the type of Orthomorpha and not P. coarctatus as Silvestri asserts (Ann. Mus. Genova (2) xvi, p. 198, 1896)."

Nothing needs to be added to Pocock’s words, which quite satisfactorily settle the point.

In 1911, however, Cook rejected Pocock’s type designation, maintaining that the Sections I and III of Paradesmus were considered by De Saussure as forming transitions to other genera. According to Cook the name Orthomorpha could therefore be applied only to the species of Section II. Fortunately Cook’s designation of P. klugii Brandt as the type of Paradesmus was antedated by that of Pocock, for the acceptance of his proposal would have caused a lamentable amount of confusion in nomenclature since the species of Section II belong to the family Euryuridae. As a matter of fact his opinion scarcely found any notice in literature.

In the previous pages of this paper I have already emphasized the heterogeneity which exists in the genera Orthomorpha and Pratinus as conceived by Attems in the Tierreich in 1937. From Orthomorpha two species, namely O. rotundata Att. and O. borneona Att. have already been separated and brought to the new genera Dajakina and Arthrogonopus, respectively. The genus Pratinus was brought back to its original concept, and it was pointed out that most of the species which had been referred to this genus by Attems are true species of Orthomorpha. For "Pratinus" fasciatus (Att.) and "P." socialis (Carl) and a number of newly described species the genus Gigantomorpha has been erected.

The re-examination of the type-species of Orthomorpha gives a good opportunity for a discussion of the taxonomic status of the remaining species of Orthomorpha and Pratinus.

In 1937, Attems recognized two subgenera of Orthomorpha: Orthomorpha s. str. and Kalorthomorpha Att., 1914. Of course the latter name by isotypy is an objective junior synonym of Oxidus Cook, 1911. In 1945, Chamberlin has already proposed to treat Oxidus as a separate genus, and in 1953, Attems too, although persistently rejecting Cook’s name, appears to have held the same opinion as regards Kalorthomorpha. Although this proposal is quite correct inasmuch as the type-species of Oxidus, O. gracilis (C. Koch) seems to have no obvious relationship with the type-species of Orthomorpha, it does not bring us a step nearer to the solution of the main problem, the unraveling of the systematic confusion existing in both genera.

As I have already stated in connection with the genus Gigantomorpha, many of the species previously referred to the genus Pratinus are to be reallocated in

*) Here Pocock has been obviously mistaken, as Humbert and De Saussure did not actually indicate a type-species; they merely referred beaumontii, together with coarctatus, to Paradesmus in the restricted sense. Of course this does not affect the intention of his argument.
the genus Orthomorpha. Up to now the sole character used for the distinction of Pratinus and Orthomorpha has been the position of the lateral keels of the second segment. Species in which these keels are situated on about the same level as those of the third segment have been referred to Pratinus, species in which these keels are situated below the level of those of the third segment have been brought to Orthomorpha. That this character is of comparatively little importance was shown already in Gigantomorpha. Still, previous authors, namely Attems and Verhoeff, have attributed to the character a primary systematic value even against the evidence of the gonopods. The latter author even went so far as to base a family, Prionopeltidae (＝ Pratinidae Schubart), on this single character. This family quite correctly was discarded by Attems as an artificial group in 1938 and 1953, but curiously enough the latter author apparently would not risk uniting the generic categories involved.

In 1953, Attems erected the subgenus Paternostrana for the species of Orthomorpha in which the posterior edges of the lateral keels are rounded instead of angular. The species referred to him to this subgenus were the following: O. rotundata Att., constricita (Carl), biritipes (Carl), borneona Att., sumbawana Att., javanica (Att.), thienemanni Att., and a new species minuscula Att. Although Attems was quite correct in separating these species from Orthomorpha, the choice of the character upon which he based his subgenus was most unlucky, since by evidence of the gonopod structure of the pertaining species it brings together a number of quite unrelated forms.

As yet a type-species of Paternostrana has not been designated. To validate the name, Orthomorpha sumbawana Att. is herewith selected as the type-species of Paternostrana. Further reference to this genus will be found under category XI of the discussion of the species of Orthomorpha.

I arranged the species of Orthomorpha s.str., Pratinus and Paternostrana sensu Attems, as far as they are not referred in the previous pages to other genera, in a number of groups which are based in the first instance on the structure of the gonopods.

Some of these groups may well prove to represent generic categories. For some of them generic names are already available, and these have been used here, although provisionally. For others generic names will have to be proposed; the introduction of new names, however, is deliberately deferred to a later period, pending actual study of the species involved.

The present arrangement is based largely upon literature data. It has been, however, greatly facilitated by an inspection of the Pocock types in the British Museum during a short visit there.

(I) — In this group are brought the species most closely associated with the type-species of Orthomorpha, O. beaumontii (Le Guillou). A comparatively large number of these hitherto have been referred to Pratinus, although others already belonged to the genus according to the concept of previous authors. Some species, previously considered of doubtful generic status, also are included, partly as a result of the examination of the type material and partly on the evidence of identified material.

In the species of this group the gonopods are of an extremely uniform type, apparently changing very little during the course of speciation and failing to give
us reliable characters for specific distinction generally. The gonopods are characterized by the laterally sharply demarcated postfemur and by a tibiotarsus in which the lamina medialis and the lamina lateralis both are well developed, sheathing the solenomerite for its greater part. The tibiotarsus lacks larger accessory processes and terminates in a number of minute lappets, usually three. The spermal channel runs along the medial side of the femur. However, characteristic for the species of this group seems to be that in the prefemur and at the base of the femur it follows a course along a typical fold in a more or less posterior direction to bend abruptly distad when reaching the posterior side of the femur. All the species of this group seem to have strongly developed lateral keels, with the pores located laterally in a rather strongly thickened marginal rim.

The following species belong here.

**Orthomorpha acutangulus** (Newport, 1844) Philippinnes

- *arboricola* (Att., 1937) Indochina
- *beaumontii* (Le Guillou, 1841) Borneo
- *bipunctata* (Sinclair, 1901) Malacca
- *cambodjana* (Att., 1953) Indochina
- *clivicola* Poc., 1895 Burma
- *coarctata* (Sauss., 1860) Circumtropical
- *coarctata var. gigas* Att., 1927 Teun Id., Banda Sea
- *consocius* Chamb., 1945 Java
- *conspicua* (Poc., 1894) Java
- *flaviventer* (Att., 1898) Java
- *francisca* Att., 1930 Lombok
- *fuscocollaris* Poc., 1895 Tenasserim
- *gestri* Poc., 1895 Tenasserim
- *glandulosa* (Att., 1937) Indochina
- *granosa* (Att., 1953) Indochina
- *hydrobiologica* Att., 1930 Java, Indochina
- *insularis* Poc., 1895 Tenasserim
- *intercedens* Att., 1937 Burma, Tenasserim
- *karschia* (Poc., 1889) Mergui, Tenasserim
- *montana* (Chamb., 1921) Philippines
- *monticola* Poc., 1895 Burma
- *oatesii* Poc., 1895 Tenasserim
- *palonensis* Poc., 1895 Burma
- *paviei* Brol., 1896 Siam
- *rotundicollis* (Att., 1937) Indochina
- *spinala* Att., 1932 Karimon Djawa
- *tenuipes* (Att., 1898) Java
- *tuberculata* (Att., 1937) Indochina
- *unicolor* (Att., 1930) Java
- *weberi* (Poc., 1894) Java
- *zehntneri* Carl, 1902 Java

The type specimens of *O. acutangulus* (Newp.) in the British Museum, a male and a fragment of a female specimen in the dry collection, have been examined. The species clearly belongs to the present group, although the tibiotarsus in both
gonopods is broken off. It is one of the species which previously would have been referred to the genus *Pratimus*, the keels of the 2nd segment being on a high level.

For the reasons why *O. beamontii* belongs here, the reader is referred to the remarks on page 272 relating to that species.

In the following two categories some species are brought together which although probably rather closely related to those of the first group seem to be somewhat disjunct by evidence of the gonopod structure. Their taxonomic position remains somewhat uncertain.

(II) — The single species of this category differs from the species of group (I) by having a comparatively shorter gonopod femur and by the apparent lack of a sharply demarcated postfemur. The distal end of the tibiotarsus, however, seems to be similar to that in the more typical species of *Orthomorpha*, and the species may prove after re-examination to be only a somewhat aberrant form of the first group.

*Orthomorpha butelii* (Carl, 1922)  
Java

(III) — This group also consists of a single species which, if we may trust Carl's drawing of the gonopod, lacks a sharply defined postfemur. Moreover, the distal end of the tibiotarsus of the gonopods differs from that of the species of the first group by being more deeply split.

*Orthomorpha bipulvillata* Carl, 1902  
Java

The following groups consist of species considered to be either subgenerically or generically distinct from the species of group (I). For some of these categories generic names are already available, for others new names will have to be proposed, an action, however, which better be deferred until actual study of the species involved.

(IV) — The single species of this group was referred to the genus *Pagioprium* by Attems in 1937. In the meantime, however, it was shown (Jekel, 1951) that it is not congeneric with the type-species of that genus, a species now belonging to the genus *Tectoporus* Carl. In the gonopods "*O.* cornuta" differs from the species of group (I) by the characteristically notched lamina medialis of the tibiotarsus, and apparently also by the absence of a sharply demarcated postfemur. The smooth waist of the body segments, the absence of pleural keels and the typical structure of the margins of the lateral keels also may prove to be characters of subgeneric or generic value.

"*Orthomorpha" cornuta* Att., 1930  
Sumbawa (and Sabang?)

(V) — This category also consists of one species which apparently has no distinct demarcation between the femur and the postfemur of the gonopods, and has a characteristically reduced tibiotarsus. The lateral keels seem to resemble those of the species in the first group, but the waist of the body segments has no sculpture and pleural keels are missing.

"*Orthomorpha" anastasia* Att., 1930  
Lombok

(VI) — The two forms referred to this group present another instance of the taxonomic confusion which has resulted from using the position of the lateral keels of the 2nd segment as a discriminating character. The first form was described as a *Pratimus*, the second as an *Orthomorpha*, but if it were not for some
small discrepancies in the descriptions, one would be inclined to unite both on account of the practically complete identity of the gonopods.

Both species lack a demarcation between femur and postfemur in the gonopods, and furthermore differ from the species of the first category in the structure of the marginal rim of the lateral keels. The tibiotarsus has not been described clearly, but seems to have a typical structure and way of sheathing the solenomerite.

"Orthomorpha" exarata (Att., 1953) Indochina
— setosa Att., 1937 Indochina

(VII) — Referable to this category is a single species, which seems to have sufficient characteristic features to justify a generic separation from Orthomorpha. As a matter of fact, it was made the type-species of a genus Leiozonius by AttEms in 1953, after having been referred to Pratinus originally. Leiozonius, which, as far as I am aware, was in fact a nomen nudum, is characterized in the gonopods by the structure of the tibiotarsus in which the lamina medialis seems to be unusually strongly developed as against the somewhat reduced lamina lateralis, so that the solenomerite appears to be applied to the lateral side of the tibiotarsus, a condition somewhat reminiscent of what is found in the genus Tectoporus. Generic characters also may be the absence of a distinct postfemur in the gonopods, the smooth waist of the body segments and the absence of a transverse furrow on the metatergites.

Leiozonius levigatus (Att., 1937) Indochina

(VIII) — In 1953 AttEms described a genus Piccola which was based on a single species, P. odontopyga. Apparently on account of the position of the lateral keels of the 2nd segment, the genus was compared with Pratinus and separated from it by the absence of well developed lateral keels, the absence of a sternal process in the 5th segment of the male, the irregularly wrinkled waist and the long terminal tubercles of the tail. However, a comparison of the gonopod structure of P. odontopyga with that of certain species referred to the genus Orthomorpha shows once again that too much value has been given to the characters of the lateral keels of the 2nd segment. Indeed, P. odontopyga is closely associated with five species previously referred to Orthomorpha. The whole group is characterized by the absence of a sharp demarcation between femur and postfemur of the gonopods, by the weak development of the lamina medialis of the tibiotarsus, and, apparently by the presence of a typical laminate crest on the medial side of the basal half of the gonopod femur.

Piccola banana (Att., 1937) Indochina
— corrugata (Att., 1953) Indochina
— debilis (Att., 1953) Indochina
— minuscula (Att., 1953) Indochina
— odontopyga Att., 1953 Indochina
— spadix (Att., 1937) Indochina

(IX) — The three species of this category agree in having the lamina medialis of the tibiotarsus very weakly developed to almost obsolete, whereas the lamina lateralis is well developed. Consequently the solenomerite is more or less freely applied to the medial side of the tibiotarsus, a condition strongly suggesting that of the species of Arthrogonoporus or the Sumatran species of Sundanina. The solenomerite in its natural position has its end near a small more or less triangular
lobe of the tibiotarsus, just as for instance in *Arthrogenopus edentulus* or *A. denticulatus*. A postfemur is not indicated. The known species have the lateral keels rather weakly developed.

Verhoeff proposed in 1941 the genus *Opisthodolichopus* for one of the species of this group, viz., *ibienemanni*, a generic name which now is adopted for the following species.

*Opisthodolichopus javanicus* (Att., 1903) Java
— *migricornis* (Poc., 1894) Sumatra
— *ibienemanni* (Att., 1930) Sumatra

(X) — A species, possibly related to the previous group but yet insufficiently known, may be provisionally located here. The tibiotarsus of the gonopods appears to have a somewhat different structure.

"*Orthomorpha" semicarnea* (Poc., 1894) Sumatra

(XI) — This category contains only two species, which are closely related if not identical. The tibiotarsus of the gonopods has a strongly developed lamina medialis, whereas the lamina lateralis appears to be almost completely absent. The distal part of the solenomerite consequently is almost freely applied to the lateral side of the tibiotarsus as in *Leiozonius*. There appears to be, however, no close relationship between this group and *Leiozonius* judging from the differences in the general outline of the gonopods. A postfemur is not demarcated, the lateral keels are rather weakly developed and both forms reportedly lack pleural keels.

To this group the genus *Paternostrana* Att., 1953, has been restricted. Possibly it is related to *Tectoporusb* Carl.

*Paternostrana sambawana* (Att., 1930) Sumbawa
— *vinosa* (Poc., 1894) Flores

(XII) — The gonopod structure of the two species enumerated here is not sufficiently known and a positive statement on their status is therefore premature. However, the outline of the tibiotarsus seems to be quite distinct from that met with in any of the other categories.

"*Orthomorpha" constricta* (Carl, 1912) Celebes
— *hirtipes* (Carl, 1912) Celebes

(XIII) — The species of this group certainly deserves a generic separation from *Orthomorpha*. Actual study of specimens of the original series has shown that it is probably related to species like *Sandamina sigma* Att., 1953, on the one hand and *Anoplodesmus mutilatus* Att., 1953, on the other, although it lacks the processes in the postfemoral region of the gonopods. The postfemur is demarcated from the femur, but not as distinctly as in the more typical species of *Orthomorpha*. The tibiotarsus is more elongate than in any of the species of the previous groups, and has a normally developed lamina medialis and lamina lateralis.

"*Orthomorpha" doriae* (Poc., 1895) Burma

(XIV) — A number of species referred to *Orthomorpha* by previous authors are characterized by the presence of a rather large lanceolate or spine-like process arising from the lamina medialis of the tibiotarsus of the gonopods, more or less similar to what is found in the genus *Gigantomorpha*. These species, enumerated under the present category, may not form an entirely homogeneous group, although at least there appears to be some geographical coherence. Generally a postfemur is rather weakly demarcated. Only in "*O." harpaga" the demarcation appears to
be quite distinct, and also by other characters this species may be somewhat disjunct from the others, having some affinities to the species of category (I).

A brief examination of specimens of the typical series of *melanopleuris, minlana* and *miranda* has shown a close relationship of these three forms with *festiva, orophila* and *uncinata*. However, a thorough study of the species of this group is needed to establish its characters. They certainly seem to be generically distinct from the species of group (1).

For one of the species, *miranda*, a generic name was proposed by Silvestri as far back as 1896. This name, *Brachytropis*, is preoccupied.

"Orthomorpha" festiva Brol., 1896  
— barpaga Att., 1937  
— mediovirgata Carl, 1941  
— melanopleuris Poe., 1895  
— minlana Poe., 1895  
— miranda Poe., 1895  
— orophila Carl, 1941  
— uncinata Att., 1931

There seems to be good reason to believe that the following species, not represented in the collection of the British Museum, also belong to this group.

"Orthomorpha" bistriata Poe, 1895  
— bivittata Poe., 1895  
— comotti Poe., 1895  
— pardalis Poe., 1895

(XV) — Aside from the process of the lamina medialis also present in the previous group, the three following species have in addition a more basal spinoform process on the medial side of the tibiotarsus. The postfemur appears to be clearly demarcated. Of these species, *coriacea* has been referred to the subgenus *Kalorthomorpha* by Attems.

"Orthomorpha" armata Carl, 1902  
— atrorosea (Poe., 1894)  
— coriacea Carl, 1902

Orthomorpha beaumontii (Le Guillou)


Probably misapplied:


Colour. — The colour has been described originally as being blackish brown,
with the lateral keels paler. The specimens now has a dark chocolate brown colour, the prosomites being a little paler. Lateral keels entirely pale dirty brown, tail also pale. Ventral side pale brownish, sternites and legs dirty pale brownish.

Width. — 5.0 mm, the prosomites 3.6 mm.

Body segments. — Rather weakly constricted by a narrow waist, which is distinctly longitudinally ribbed or "beaded" in the dorsal part down to the level of the lateral keels, and smooth below that level. Prosomites somewhat dulled by a fine cellular structure. Metatergites more shining, smooth or with some irregular wrinkles in particular near the bases of the keels, hairless. Transverse furrow well impressed, finely longitudinally striate, extending laterad to the bases of the lateral keels. Transverse furrow present from the 5th segment to the 18th. Sides up to the 4th segment rather densely but minutely granulate; from the 5th

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Fig. 82—87. Orthomorpha beaumontii (Le Guillou) — 82: left side of the 2nd to the 5th segments of the holotype ♂, lateral view. 83: the same, dorsal view. 84: left side of the 10th and 11th segments of the holotype ♂, dorsal view. 85: the same, lateral view. 86: left side of the 16th to the 20th segments of the holotype ♂, dorsal view. 87: anal segment of the holotype ♂, ventral view.
segment onwards the granulation is weak to almost obsolete. Pleural keels well developed, present from the 2nd to about the 15th segments. Up to the 4th segment they are represented by a continuous ridge which is caudally produced into a triangular lappet projecting behind the margin of the segment. From the 5th segment onwards there is in each segment a rather weak swelling above the anterior legs and a triangular lappet near the posterior border of the mesonotum. Both, swellings and lappets are diminishing gradually in the subsequent segments and disappear in about the 16th segment. The triangular lappets are projecting very little behind the posterior margin of the segments up to about the middle of the body.

Lateral keels. — (fig. 82—86). Strongly developed. Keels of 2nd segment anteriorly rounded, somewhat shouldered at the base. Lateral border very weakly rounded to almost straight. No tooth at the latero-anterior edge. Posterior edge acutely angular and projecting rather strongly behind the margin of the segment. Keels of 2nd segment scarcely below the level of those of the 3rd, turned slightly ventrad. Marginal rim well developed, demarcated by a sharp premarginal furrow. No ventral premarginal furrow. 3rd and 4th segments of subequal width, somewhat wider than the 2nd. Keels of these segments very similar to those of the 2nd segment, but those of the 3rd somewhat less turned ventrad and those of the 4th almost horizontal. 5th segment somewhat wider than the 4th. Keels from the 5th segment onwards anteriorly distinctly shouldered at the base, anterior and lateral borders widely rounded. Posterior edges acutely angular, projecting rather strongly behind the posterior margin of the segments. Keels on a high level, horizontal. Only in the 18th and 19th segments the keels are raised a little above the horizontal level, but do not project above the mid-dorsal surface of the metasternites. Poriferous keels slightly more prominent than the poreless. Marginal rim rather thick dorso-ventrally, in poriferous keels scarcely thicker than in the poreless, not abruptly widening near the pores. Dorsal premarginal furrow almost reaching the waist. Posterior margin with a very fine rim. Lateral marginal rims ventrally demarcated by a well developed furrow, present in poriferous and poreless keels. Pores lateral in a slight excavation of the rim, the excavation scarcely visible from the dorsal side.

Sternite and legs. — Sternites in middle segments $1^{1/4}-1^{1/3}$ as broad as long, moderately densely set with rather short setae. Cross-impressions moderately developed, the transverse furrow rather deeply and sharply impressed, the longitudinal furrow less deep and rather wide. Legs of moderate length, rather slender, moderately setiferous. Length of joints: $3>6>5>2>4>1$. The 6th joint about two thirds of the length of the 3rd. The 5th joint about three fifths of the 6th. Tarsal claw of moderate length.

Anal segment. — (fig. 87). Tail rather broad and thick at the base, of moderate length. Sides moderately converging, scarcely concave. Basal lateral setiferous tubercles moderately developed. Distal lateral tubercles and terminal tubercles almost obsolete. Dorsally near the base of the tail a shallow transverse depression, ventral side of tail weakly concave. Valves with rather narrow rims, the setae on weak tubercles. Scale triangular, the sides almost straight, the setiferous tubercles well developed, projecting behind the posterior margin but not surpassing the posterior edge of the scale.
Male. — Unknown.

Remarks. — That the type of *O. beaumontii* has turned out to be a female specimen is certainly a rather unfortunate condition, since as a rule the specific and generic identification of a Paradoxosomatid species is difficult if not impossible with female characters.

Fortunately, however, *O. beaumontii* proves to belong to a group of species in which the structure of the male gonopods is quite uniform and in which specific characters lay mainly in the external structure.

Actual comparison of the type specimen with female co-types of *O. weberi* (Poc.) has convinced me that *weberi* must be regarded as one of the closest relatives of *beaumontii*. The entire morphology of the two species is quite similar, in fact, they seem to differ only in the development of the lateral keels which in *weberi* have the posterior edges a little less acute and distinctly less produced caudal.

We may, therefore, safely assume that the gonopods of *beaumontii* ultimately will prove to be of the type of those of *weberi* and related species like *O. hydrobiologica* Att., *O. francisca* Att., *O. karschii* (Poc.), etc. (see group (I), p. 264).

**Orthomorpha coarctata** (Sauss.)


Previous records. — Borneo (1). Wide-spread in the tropical parts of all regions.


Remarks. — Not less than three generic names have been based on this species: *Asiomorpha* Verh., 1939, *Brasilogenopus* Verh., 1944, and *Orthomorphina* Kraus, 1958, but at present I am not able to detect any reason for separating *coarctata* either generically or subgenerically from *O. beaumontii*.

**Oxidus** Cook


Type-species. — *Fontaria gracilis* C. Koch, by original designation. (Type-species of *Kalorthomorpha*: *Fontaria gracilis* C. Koch, by original designation).

Range and number of species. — To be defined after a revision of the genus.

Remarks. — In its current concept, conforming with the subgenus *Kalorthomorpha* of ATTEMS in the Tierreich, this genus is at least as heterogeneous as the
previous one. The only species recorded from Borneo is certainly not congeneric with Oxidus gracilis (Koch), but in the absence of material the definition of its true taxonomic position is deferred to a later period.

"Oxidus" kuekenthali (Att.)

1937 Orthomorpha (Kalorhomorpha) kükenthali, Attems, Tierreich, vol. 68, p. 86, fig. 107.

Remarks. — The occurrence of this species in Borneo as well as in Celebes seems quite dubious. One of the records may be erroneous, and the species, therefore, may not pertain to the fauna of Borneo at all.

Euphyodesmus Att.


Segments rather strongly constricted. Prosomites with very fine cellular structure, somewhat dull. Waist broad, distinctly and sometimes somewhat irregularly longitudinally ribbed in the dorsal and lateral parts down to the level of the stigmata. Metatergites shining, smooth or with some setiferous tubercles. Transverse furrow well developed, rather deeply impressed, without longitudinal striation, present from the collum onwards. Pleural keels present only in the 2nd, or in the 2nd and 3rd segments.

Lateral keels rather strongly developed, on all segments from the 2nd to the 19th provided with an acutely angular to subspiniform posterior edge surpassing the posterior margin of the metasomites in most segments. Keels on a rather high level, the posterior edges of those of the 5th and the 7th segments are turned slightly upwards and project above the level of the metatergites. Keels of 2nd segment only a little below the level of those of the 3rd segment. Marginal rim of keels narrow, in poriferous segments widening only in the area of the pores.

Sternites much longer than wide, weakly setiferous, with well developed cross impressions. Sternite of 5th segment of ♂ with a strongly developed, distally laminate process between the anterior legs. Sternites of the 6th, 7th and 8th segments of the ♂ without modifications. Legs long to very long. Those of the first pair short and somewhat incrassate. Brushes of tibiae and tarsi present only in a few anterior legs of the ♂, rapidly thinning out and disappearing.

Gonopod coxa of moderate length and rather thick, tapering a little towards the distal end. Latero-distal surface with a setiferous area. Prefemur strongly elongate, in one line with the femur, laterally and in part also medially well demarcated from that joint, the demarcation almost in one line with the longitudinal axis of the femur. Femur rather weakly developed, straight, much shorter than the coxa. Postfemur medially weakly to very sharply demarcated. Spermal channel first running along the medial side of the femur, then curving towards the anterior, lateral and finally posterior sides. Solenomerite of moderate length,
rather thick at the base, gradually tapering towards the distal end; the end either simply acuminate or with an accessory lobe. Solenomerite arising from the posterior side of the distal end of the postfemur; it is not sheathed by the tibiotarsus. Tibiotarsus arising from the anterior side of the distal end of the postfemur, not distinctly demarcated from that joint, moderately developed or somewhat reduced, consisting of a more or less compound or of a simple lamella. Lamina medialis or lamina lateralis both not developed.

Type-species. — Euphyodesmus gracilis Att., by original designation.

Range. — Borneo.

Number of species. — Three.

Remarks. — After the reallocation in the genus Pratinus Att. of Euphyodesmus greeni Att. and E. vector Chamb. in the preceding pages of this paper, a single species was left in Euphyodesmus. From the present collection two new species are added.

The anomalous structure of the gonopods in Euphyodesmus makes a homologization of the distal parts of the acropodite rather difficult. Doubtless, the aberrant course of the spermal channel in the femoral division has been caused by a torsion of about 180° of the distal part of the acropodite as against its basal part. The true nature of the parts distal of the femur, however, is less easily determined and, in fact, could be ascertained only after the examination of the gonopods of the newly described E. postfemoralis.

As will be seen in the gonopod drawings for E. gracilis (fig. 94—95), the acropodite has a distinct constriction somewhat proximal of its branching into solenomerite and tibiotarsus, a constriction which laterally is accompanied by a very thin laminate transverse crest and which is the only indication of an articulation in the acropodite.

Comparison of this with the usual type of gonopods in the Oriental Paradoxosomatidae might lead to the conjecture that the constriction represents the boundaries between the tibiotarsus on the one hand and the femur and postfemur combined on the other. However, this would imply that the solenomerite in Euphyodesmus arises from the base of the tibiotarsus, a quite unusual condition since it is generally admitted that the solenomerite in the Paradoxosomatidae is a process arising from the postfemur, or, if this joint is not demarcated, from the distal end of the femur.

Indeed, a comparison of the gonopod drawings of E. postfemoralis with those of gracilis shows that the constriction in the acropodite of the latter species marks the end of the femur proper. The undivided part of the acropodite distal of the constriction therefore must be regarded as a postfemur. In postfemoralis there is a sharp demarcation between femur and postfemur on the medial side, homologous to a similar demarcation visible on the lateral side of the acropodite of the gonopods of, e.g., Arthrogonopus and Gigantomorpha. In postfemoralis the postfemur is furthermore also more clearly demarcated from the tibiotarsus, at least laterally, and, mediially from the solenomerite.

Thus, it is interesting to note that in Euphyodesmus, where the demarcation between postfemur and tibiotarsus tends to disappear, the demarcation between
femur and postfemur, which otherwise has disappeared in so many of the Paradoxosomatidae, remains distinct.

It is necessary to emphasize here, that I have considered the possibility that what is regarded here as a solenomerite could have been a solenomerite concealed in a closely applied solenophorous part of the tibiotarsus. Such a condition, of course, would involve a quite different homologization of the distal part of the acropodite. However, by studying a preparation of a gonopod crushed somewhat by the cover glass I could ascertain that the solenomerite is a simple, undivided process.

The fact that both Attems and Chamberlin have referred species of the genus Pratinus to Euphyodesmus might suggest a close relationship between the two genera. In reality, however, there exists only a superficial resemblance. In particular the gonopods of Pratinus are fundamentally different from those of Euphyodesmus. In Pratinus the spermal channel follows a straight course along the medio-anterior side of the femur, the solenomerite arising, consequently, from the anterior side of the distal end of the femur. Moreover, the tibiotarsus in Pratinus seems to be distinctly demarcated from the femur, and a postfemur is apparently not marked.

In the morphology of the body segments, in particular in the shape of the lateral keels Euphyodesmus is also quite distinct from Pratinus. The subdorsal location of the pores and the more or less rhomboid dilatation of the marginal rim of the poriferous keels are strongly reminiscent of similar structures found in some species of Tectoporus, e.g., T. hispidus Jeek., 1951.

Key to the species. — The species of Euphyodesmus are very similar in their external morphology. Important specific differences are to be found mainly in the male gonopods.

1. Metatergites with two transverse rows of four granules each; in the anterior rows the granules are setiferous. Tibiotarsus of the gonopods simply laminate. End of solenomerite bifurcate .................... E. granulifer spec. nov.
2. Metatergites without granules, hairless. Tibiotarsus of the gonopods more complicated. End of solenomerite not bifurcate .................... 2

2. Postfemur of gonopods medially sharply demarcated from the femur by a furrow. Solenomerite distinctly longer than tibiotarsus, the end with a triangular lamellar lobe. Head much wider than collum .... E. postfemoralis spec. nov.
3. Postfemur of gonopods medially not sharply demarcated from the femur. Solenomerite about as long as tibiotarsus, simply acuminate at the end. Head not much wider than collum .................. E. gracilis Att.

Euphyodesmus gracilis Att.

1931 Euphyodesmus gracilis Attems, Zoologica, Stuttg., vol. 30, fasc. 3/4, p. 126, fig. 195—199.

Previous record. — West Borneo: Sungei Malang.
Material studied. — West Borneo: Bungan River, July, 1894 (Borneo Exped., Coll. Dr. A. W. Nieuwenhuis, Mus. Leiden), 1 ♂, 1 ♀.

Colour. — Head brownish yellow to yellowish brown. Antennae pale brown,
darker in the distal half of the 6th joint and in the 7th joint. Distal end of the 7th and the 8th joint whitish. Collum and subsequent segments castaneous, the latero-posterior edges of the collum and of the lateral keels of the body segments paler, yellowish. Venter pale brownish, the sternites yellowish. Legs proximally and distally yellowish, the middle part from the distal end of the femur to about the middle of the tarsi dark castaneous. In the two last pairs the dark colour extends to the base of the femur. Anal segment castaneous, its ventral side paler.

**Width. — **♂ 1.6 mm; ♀ 1.9 mm.

**Head and antennae. —** Labrum rather widely but weakly emarginate. Clypeus weakly convex, weakly impressed towards the labrum; the lateral margins widely and rather weakly emarginate. Surface of head smooth and shining, densely to rather densely setiferous in the clypeal and frontal parts. Vertex with four setae. Antennal sockets separated by little more than the diameter of a socket or by about one third of the length of the 2nd antennal joint. Postantennal groove well developed, the wall in front of it rather prominent. Vertex strongly convex, not demarcated from the frontal area. Sulcus weakly impressed, not reaching the upper level of the antennal sockets. Antennae (fig. 88) slender. Length of joints: $3 > 4 > 5 = 2 > 6$. The 6th joint about half as long as the 3rd. Joints of subequal width, only the 6th somewhat thicker than the others. Pubescence of antennae moderate to, distally, rather dense.

**Collum. — (fig. 89—90).** Distinctly narrower than the head, subsemicircular in dorsal outline. Anterior border evenly rounded. Posterior border widely and weakly emarginate in the middle, almost straight laterally. Latero-posterior edge narrowly rounded, obtusely angular. Surface rather shining, somewhat irregularly uneven, apparently hairless. At about one third from the posterior margin a well developed transverse furrow. Surface of collum transversely almost flat in the middle, much more convex towards the lateral sides; the lateral sides slightly raised but not attaining a horizontal level. Marginal rim narrow and rather weakly demarcated, present only along the latero-anterior border.

**Body segments. —** Metatergites somewhat uneven in a few anterior segments, but in most segments smooth with a few weak wrinkles. Transverse furrow present up to the 18th segment, from the 5th to the 17th segments running laterad to the base of the keels and curving caudad there to end at the posterior margin of the keels. Metatergites hairless, only the 19th segment with a transverse row of four hairs. Sides up to the 4th segment rather densely granulate, smooth or weakly granulose from the 5th segment onwards. Pleural keels very weakly present in the 2nd segment only.

**Lateral keels. — (fig. 89—92).** 2nd segment a little wider than the collum. The border of the keels anteriorly rounded, laterally straight with two very weak
notches. Posterior edge acutely angular, but not sharply pointed; not projecting behind the margin of the segment. Posterior border emarginate. Marginal rim weakly developed, obsolete in the posterior half of the keels. 3rd and 4th segments of subequal width, scarcely narrower than the 2nd. Keels subsimilar to those of the 2nd segment; the notches of the lateral border vestigial or absent. The posterior edges are more acute, and project a little behind the margin of the metasomite in the 4th segment. Up to the 4th segment the lateral keels are horizontal. 5th segment a little wider than the 4th. Lateral border of the keels from the 5th segment onwards with widely to very widely rounded latero-anterior borders which laterally are straight or even a little concave in poriferous segments. Latero-posterior edges very acute and sharply pointed, in all segments projecting behind the posterior margin of the metasomites. Posterior borders of keels emarginate. Lateral margins often with a weak notch. Keels raised a little above the horizontal level. The posterior edges of those of the 5th and 7th segments bent upwards and projecting dorsad of the level of the metatergites. Posterior edges of the keels of the 13th, 15th, and 17th segments curving a little ventrad. Poriferous keels extending slightly more laterad than the poreless. Marginal rim of poreless keels narrow but distinct. The premarginal furrow running from near the waist to near the posterior margin. In poriferous keels the premarginal furrow reaches the posterior border, and the rim widens considerably in the area of the pores. Pores latero-dorsad, situated in a wide and shallow excavation of the rim. Posterior margin of all keels with a fine marginal rim. On the ventral side of the keels from the 5th segment onwards the marginal rim is demarcated by a pre-marginal furrow in the middle part of each keel.

Sternites and legs. — Sternites of middle segments somewhat more than two times longer than broad, sparsely setiferous. Cross impressions represented by a deep transverse depression and a moderately deep longitudinal impression. Sternal process of the 5th segment narrow, subrectangular, about two times longer than broad; the distal end widely and weakly rounded. The process is directed ventrad and does not project before the anterior margin of the sternite. Anterior side distally with a small brush of moderately short setae, normally setiferous. Posterior portion of the sternite of the 5th segment normal. Legs (fig. 93) long; the last two pairs distinctly longer than the preceding pairs. First pair of legs rather short, distinctly incrassate; the joints of subequal length, but the tarsus much longer. The first pair has well developed tibial and tarsal brushes, which in a few of the following pairs are rapidly thinning out and disappear. Legs of middle segments rather weakly to, distally, moderately setiferous, especially on the ventral side of the joints. Length of joints: $3 = 6 > 5 > 4 > 2 > 1$. The 5th joint about two thirds of the 6th.

Anal segment. — Tail of moderate length. Sides rather strongly converging, straight. The end narrowly truncate, rounded, with weak lateral and terminal tubercles. Valves with rather narrow and rather low marginal rims. Scale triangular; the sides rounded. Setiferous tubercles small, not projecting.

Gonopods. — (fig. 94—95). Postfemur indicated by a constriction and by a thin transverse lateral crest. Solenomerite simply acuminated, without secondary processes. Tibiotarsus moderately developed, rather complicated by several lobes, apparently supporting though not actually sheathing the solenomerite.
Female. — Distinctly more robust than the male. Aside from the usual secondary sexual characters also differing in that the somites are somewhat less strongly constricted in the waist area. The waist a little narrower. Sternites of middle segments about 1 3/4 \times longer than broad. First pair of legs incrassate as in the male, but without dense brushes. The other legs comparatively a little shorter than in the male.

Remarks. — Although there can be little doubt as to the correctness of the identification of the present material with gracilis Att., there are some minor differences between the gonopods of the male at hand and the type specimen described by Attems. The various lamellae of the tibiotarsus differ slightly in their outline, whereas the solenomerite is curved a little in the end instead of being almost straight. No doubt these variations are at most of a subspecific nature, but of not sufficient significance to justify a denomination.

Euphyodesmus postfemoralis spec. nov.

Material. — East Borneo: Mt. Tibang, 1700 m (Coll. Dr. E. Mjöberg, Mus. Stockholm), 5 ♂ (one of which the holotype), 4 ♀, 2 juv. ♀. East Borneo: Mt. Tibang, 1400 m (Coll. Dr. E. Mjöberg, Mus. Stockholm), 6 ♂, 3 ♀, 2 juv. ♂, 6 juv. ♀. East Borneo: Mt. Tibang, 1300 m (Coll. E. Mjöberg, Mus. Stock-
holm), 2 ♂, 3 juv. ♂, 2 juv. ♀. East Borneo: without nearer location (Coll. Dr. E. Mjöberg, Mus. Stockholm), 2 ♂, 1 ♀.

Differing from *gracilis* in the following characters.

Colour. — Most of the material of this species apparently was not in full colour when it was collected. The colour of the darkest specimens, however, agrees with that of *gracilis*, but the legs almost wholly lack the dark colouring.

Width. — Holotype ♂ 1.6 mm. The other ♂ in the order of the above enumeration: 1.6 mm, 1.5 mm, 1.5 mm, 1.4 mm; 1.5 mm, 1.5 mm, 1.5 mm, 1.4 mm, 1.4 mm, 1.3 mm; 1.5 mm, 1.5 mm; ♀: 2.2 mm, 2.2 mm, 2.1 mm, 2.0 mm; 2.0 mm, 2.0 mm, 1.8 mm; 2.0 mm, 2.0 mm; 2.1 mm. Juvenile ♂ with 19 segments: 1.0 to 1.1 mm. Juvenile ♀ with 19 segments: 1.0 to 1.4 mm.

Collum. — Much narrower than the head, as a consequence of the strongly inflated lateral sides of the latter (fig. 96).

Gonopods. — (Fig. 97–98). Femur sharply demarcated from the postfemur by a furrow on the median side. Solenomerite more strongly developed, the end with a triangular lamellate lappet. Tibiotarsus shorter than the solenomerite, apparently free from the solenomerite.

Female. — Differing from the ♂ in the same way as in *gracilis*.

Juvenile. — Although in general features agreeing with the adult ♀ specimens, the juvenile specimens have much more "normal" aspect because of the weaker constriction of the waist area of the body segments. The antennae and legs are comparatively much shorter than in the adults. The posterior edges of the lateral keels are less produced caudal.

Euphyodesmus granulifer spec. nov.


Differing from *gracilis* in the following characters.

Colour. — The best preserved specimens of this species are darker than *gracilis*. Head dark castaneous, the clypeal area lighter, yellowish towards the labrum. Antennae also dark castaneous, only the tip of the 7th and the 8th joints whitish. Collum and subsequent body segments dark castaneous, but the collum with a dirty whitish zone along the anterior margin and similarly coloured lateral edges. Lateral keels of the 2nd to the 4th segments entirely, of subsequent segments only in the latero-posterior portion pale yellowish. Dark portion of the legs also deeper brown than in *gracilis*, the brown colour extending to the end of the tarsi.

Width. — Holotype ♂ 1.6 mm. The other ♂ in the order of the above enumeration: 1.6 mm, 1.5 mm, 1.5 mm; 1.4 mm. ♂: 2.0 mm, 1.9 mm; 1.9 mm. Juvenile ♂ with 19 segments: 1.4 mm, 1.3 mm, 1.2 mm. Juvenile ♀ with 19 segments: 1.3 mm.

Head and antennae. — Antennal sockets separated by about 4/5 of the diameter of a socket, or by a quarter of the length of the 2nd antennal joint.
Vertigial sulcus running downward to just below the upper level of the antennal sockets.

Collum. — 4 + 4 minute but distinct setiferous granules along the anterior margin. The hairs of moderate length, rather stiff.

Body segments. — Metatergites with a row of 4 setiferous granules behind the waist, and 4 somewhat less distinct hairless granules behind the transverse sulcus. Waist with weakly developed, somewhat irregular ridges. Pleural keels on the 2nd segment represented by a triangular lappet projecting downward. In the 3rd segment weakly developed, in subsequent segments absent.

Lateral keels. — 2nd segment slightly narrower than the collum, the keels pointed. In general the lateral keels are slightly more strongly developed than in the two preceding species, the posterior points being a little longer.

Gonopods. — (fig. 99—100). Postfemur demarcated from the femur by a thin transverse crest on the medial side. Solenomerite bifurcate in the end. Tibiotarsus a simple subrectangular lamina, entirely free from the solenomerite.

Female. — Differing from the ♂ in the same way as in gracilis.

Juvenile. — See the remarks made for the juvenile of postfemoralis.

“Strongylosoma” nodulosum Att.


Distribution. — Borneo.

Remarks. — The male characters of this species are unknown, reason why its
generic position has remained a mystery. Even in the light of the present additions to the Borneo Paradoxosomatid fauna little can be said of its relationship. The weak development of the lateral keels at least seems to exclude the possibility that it might belong to Gigantomorpha, Orthomorpha or Euphydesmus. The colour pattern as described by Attems suggests a similarity with the colour of Borneonina retrorsa. To say more would be mere speculation, so nodulosum is condemned to remain an enigma probably for a long time to come.

References

