

## Review of the Neotropical fauna of the millipede family Fuhrmannodesmidae, with the description of four new species from near Manaus, Central Amazonia, Brazil (Diplopoda, Polydesmida)

by

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### Abstract

The Neotropical fauna of the chiefly tropical/subtropical millipede family Fuhrmannodesmidae has been reviewed, four new species have been described, and one more redescribed, from near Manaus, Brazil. As few as six genera are regarded valid: *Phaneromerium* VERHOEFF, 1941, solely with the generotype *P. obtusangulus* (CARL, 1914); *Olmodesmus* KRAUS, 1954, with *O. laticeps* KRAUS, 1954 (the type-species), *O. minimus* KRAUS, 1954, *O. taulisensis* KRAUS, 1954, *O. longipes* KRAUS, 1954, and *O. robustus* KRAUS, 1955; *Fuhrmannodesmus* CARL, 1914 (= *Gyrophallus* CARL, 1914, = *Phylacomerium* VERHOEFF, 1941a, = *Schizotelopus* VERHOEFF, 1941b, all syn.n.!), with *F. lividus* CARL, 1914 (the type-species), *F. imitans* (CARL, 1914), *F. simillimus* (CARL, 1914), *F. funiculus* (PETERS, 1864) sensu CARL 1914, the three latter as comb.n. ex *Gyrophallus*, *F. album* (VERHOEFF, 1941), *F. esperanza* (KRAUS, 1960), both comb.n. ex *Phylacomerium*, and *F. brevicornis* (CARL, 1914), comb.n. ex *Schizotelopus*; *Cutervodesmus* KRAUS, 1957, with *C. niger* KRAUS, 1957 (the type-species), *C. similis* KRAUS, 1959, and *C. adisi* n.sp.; *Cryptogonodesmus* SILVESTRI, 1898 (= *Brachycerodesmus* CARL, 1914, syn.n.!), with *C. clavidives* SILVESTRI, 1898 (the type-species). *C. angulifer* (PETERS, 1864) sensu CARL 1914, *C. fuhrmanni* CARL, 1914, *C. peruvianus* KRAUS, 1954, *C. petersi* (CARL, 1914), *C. oxapampaensis* (KRAUS, 1960), *C. tarmaensis* (KRAUS, 1959), the three latter as comb.n. ex *Brachycerodesmus*, and *C. carli* (KRAUS, 1955), comb.n. ex *Fuhrmannodesmus*; and finally *Moojenodesmus* SCHUBART, 1945 (= *Pichitaria* KRAUS, 1959, = *Esperanzella* KRAUS, 1960, = *Giustoella* KRAUS, 1960, all syn.n.!), with *M. pygmaeus* SCHUBART, 1945 (the type-species), *M. pumilus* SCHUBART, 1944 (the first description of the male sex), *M. armatus* (KRAUS, 1959), comb.n. ex *Pichitaria*, *M. polydesmoides* (KRAUS, 1960), comb.n. ex *Esperanzella*, *M. cryptus* (KRAUS, 1960), *M. minutissimus* (KRAUS, 1960), both latter as comb.n. ex *Giustoella*, as well as *M. irmgardae* n.sp., *M. bethaniae* n.sp., and *M. susannae* n.sp.

Keywords: Diplopoda, Fuhrmannodesmidae, Amazon, Neotropics, inundation forest.

## Introduction

Among the few dozen millipede species mostly taken in great numbers and by means of various collecting techniques by PD Dr. Joachim ADIS, of the Max-Planck-Institut für Limnologie in Plön (MPI), Germany, during his investigations of the fauna of inundation forests at Manaus, Brazil, several deserve special attention for being among the dominants. However, only some seven of them have hitherto been named and, what seems particularly important, more or less adequately studied from a viewpoint of survival strategies in the extreme conditions of an Amazonian inundation forest (see reviews by ADIS 1992b, c).

Thus, *Gonographis adisi* HOFFMAN 1985 (Pyrgodesmidae, Polydesmida), appears to be unique in being perhaps the only hitherto known millipede capable to survive submersion up to 11 months due to the conspicuous structure of its plastron (HOFFMAN 1985, ADIS 1986, MESSNER & ADIS 1988). For comparison, it would be interesting to investigate the behaviour of *G. hastata* SCHUBART, 1945, the only other congener, and generotype, quite widespread in Brazil and Argentina and probably associated with human activities and/or ant nests (see SCHUBART 1954, HOFFMAN 1985).

Contrary to that and like most of the other diplopods, the even more widespread synanthropic (?) *Muyudesmus obliteratus* KRAUS, 1960 (Pyrgodesmidae), another forest floor-dweller, escapes inundations through moving to the non-inundated tree trunks and canopy areas; it possesses an incomplete plastron ensuring a fatal long-term submersion (ADIS 1986, MESSNER & ADIS 1988). *Mestosoma hylaeicum* JEEKEL, 1963 (Paradoxosomatidae, Polydesmida) generally displays the same pattern of behaviour, with all the phases of its life-history neatly corresponding to local seasonality (ADIS 1992a). Probably the same holds true for *Prostemmiulus adisi* MAURIES, 1984 (Stemmiulidae, Stemmiulida), perhaps the only one of three congeners (plus *P. amazonicus* MAURIES, 1984, and *P. wellingtoni* MAURIES, 1984) encountered at Manaus that shows similar seasonal vertical migrations from the forest floor to the canopy areas and back (MAURIES 1984).

Still a different survival strategy is demonstrated by *Epinannolene arborea* HOFFMAN, 1984 (Pseudonannolenidae, Spirostreptida), an obviously strict arboricole (HOFFMAN 1984, ADIS 1984) which remains in the canopy region unless forced down the trunk by insolation/drought to retreat under the bark and there aestivates.

The present paper, accomplished by the author at the MPI, continues Dr. J. ADIS' efforts in revealing the rest of the Manaus faunal list and puts on record further five millipede species, all belonging in the family Fuhrmannodesmidae. In this connection, a review of the Neotropical Fuhrmannodesmidae is attempted. This contribution copes only with taxonomic problems, whereas ecological issues will be discussed elsewhere.

## Review of the Neotropical Fuhrmannodesmidae

The Fuhrmannodesmidae definitely represent one of the quite numerous families of the millipede order Polydesmida famous for being entirely confused taxonomically (HOFFMAN 1979). For one thing, most of the known fuhrmannodesmids are small to tiny creatures, i.e. the so-called micropolydesmidans usually ranging between 0.5 and

1.3 cm in length. To exacerbate the situation, the gonopod structure in the majority of the constituent species is relatively to dramatically complex, i.e. often very difficult to trace/interpret. Secondly, the family is distributed worldwide, showing clear preponderance to tropical and subtropical parts of Asia, Africa, and the Americas (including the Caribbean), but no obvious coherent patterns. As a result, we face now about 100 described species and no fewer than 60 nominal genera! In other words, most of those genera are monobasic, this alone being sufficient as evidence of the poor state of the art. SCHUBART's (1945b) attempt to review and key worldwide everything known at that time (under his commodious Vanhoeffeniidae) is to be discarded as being both outdated and extremely eclectic. Indeed, the genera he dealt with are at the present scattered among several (!) families such as the Fuhrmannodesmidae, Opisetretidae, Haplodesmidae, Pyrgodesmidae (cf. HOFFMAN 1979). To sum, a critical review/revision is badly necessary even at a regional, let alone global, level. In order to properly allocate the few new taxa below, a brief outline of the Neotropical fuhrmannodesmid fauna is given, followed by certain taxonomic comments in relation to the four newly described species from the Manaus region.

The fauna of the Neotropical realm (excluding both Central America and the Caribbean) encompasses at the moment at least 29 nominate species from as many as 13 nominate genera: *Brachycerodesmus* CARL, 1914 (not *Brachycercodesmus*, as misspelt by KRAUS 1959a), with *B. petersi* CARL, 1914 (the type-species), from Colombia, *B. oxapampaensis* KRAUS, 1960, and *B. tarmaensis* KRAUS, 1959a (both latter species from Peru); *Cryptogonodesmus* SILVESTRI, 1898, with *C. clavidives* SILVESTRI, 1898 (the type-species), from Venezuela, *C. angulifer* (PETERS, 1864), *C. fuhrmanni* CARL, 1914 (all from Colombia), and *C. peruvianus* KRAUS, 1954, from Peru; *Cuterodesmus* KRAUS, 1957, with *C. niger* KRAUS, 1957 (the type-species), and *C. similis* KRAUS, 1959b (both species from Peru); *Esperanzella* KRAUS, 1960, monobasic, with *E. polydesmoides* KRAUS, 1960, from Peru; *Fuhrmannodesmus* CARL, 1914, with *F. lividus* CARL, 1914 (the type-species of both genus and family), from Colombia, and *F. carli* KRAUS, 1955, from Peru; *Giustoella* KRAUS, 1960, with *G. crypta* KRAUS, 1960 (the type-species), and *G. minutissima* KRAUS, 1960 (both species from Peru); *Gyrophallus* CARL, 1914, with *G. imitans* CARL, 1914 (the type-species), *G. funiculus* (PETERS, 1864), and *G. simillimus* CARL, 1914 (all from Colombia); *Moojenodesmus* SCHUBART, 1945, with *M. pygmaeus* SCHUBART, 1945b (the type-species), and *M. pumilus* SCHUBART, 1944 (both from Brazil); *Olnodesmus* KRAUS, 1954, with *O. laticeps* KRAUS, 1954 (the type-species), *O. longipes* KRAUS, 1954, *O. minimus* KRAUS, 1954, *O. robustus* KRAUS, 1955, and *O. taulisensis* KRAUS, 1954 (all from Peru); *Phaneromerium* VERHOEFF, 1941a, monobasic, with *P. obtusangulus* (CARL, 1914), from Colombia; *Phylacomerium* VERHOEFF, 1941a, with *P. album* VERHOEFF, 1941a (the type-species), and *P. esperanza* KRAUS, 1960 (both from Peru); and *Pichitaria* KRAUS, 1959, monobasic, with *P. armata* KRAUS, 1959a, from Peru; and *Schizotelopus* VERHOEFF, 1941b, monobasic, with *S. brevicornis* (CARL, 1914), from Colombia. Perhaps also "*Paraphilus*" SCHUBART, 1947, monobasic, with *biporus* SCHUBART, 1947, belongs in this family, although this is not too evident from the singular ozopore formula and thus has to be both confirmed upon the discovery of a male and renamed as being preoccupied (HOFFMAN 1979). Judged from the structure of the metaterga and gonopods, *Arndtodesmus* SCHUBART, 1945, with *A. coendu* SCHUBART, 1945b (the type-species), *A. carvalhoi* SCHUBART, 1947, *A. ourisso*

SCHUBART, 1944, and *A. ourisso montanus* SCHUBART, 1945a (all from Brazil), appears to be close to, although definitely different from, the above set; so, following HOFFMAN (1979), it seems best to eliminate that genus from consideration.

Despite this quite impressive taxonomic diversity, only a few patterns of gonopod morphology can actually be perceived. If one gives emphasis to that of *Fuhrmannodesmus lividus* CARL, the type of both genus and entire family, one will face a relatively simple gonopod, with the coxa not particularly enlarged, bearing a prominent apophysis laterally, and the telopodite subtransverse, relatively short, with a frontal apical process and a quite short, hairy solenomerite branch. Generally speaking, this pattern is just intermediate between the extremes represented by *Phaneromerium* and *Moojenodesmus*. The former, erected by VERHOEFF (1941a) for *Cryptogonodesmus obtusangulus* CARL, 1914, displays a gonopod with a relatively small, non-globose coxite devoid of apophyses, whereas the telopodite is suberect, quite simple, with a relatively long solenomerite branch and a long frontal process. On the other hand, *Moojenodesmus* is distinguished by a greatly enlarged coxite prominently excavated (ventro-) caudally and subtending a highly transverse, massive, generally evidently sunken and complex telopodite, with the solenomerite branch from moderately developed to virtually missing. Practically all the other forms definitely fall within the above spectrum, probably representing an evolutionary trend of gonopod complication.

Viewing the problem of generic classification this way, one must neglect most of the other characters often chosen by the predecessors for the definition of genera, for they seem to display no correlations with gonopod structure. Being perhaps the least adaptive, this is the latter that has to be, and at the present is, given top priority in most of the Polydesmida (and even Diplopoda) in general (HOFFMAN 1979), whereas such features in the Fuhrmannodesmidae as segment number, shape of the antennae, male head and walking leg modifications, etc., appear to be only species-characteristic.

In other words, judged from gonopod conformation alone, with the only exception of that of "*Paraphilus*" which remains unknown from the male sex, we have the following natural groupings, or sets, of genera arranged according to the degree of complexity. The species with simplest gonopods obviously especially closely related to *Phaneromerium*, are all the known *Olmodesmus*, with the main difference between the two genera lying in the latter's less developed solenomerite branch (KRAUS 1954, 1955).

This pattern could have given rise to two different, apparently divergent, lineages. One implies the development by a still moderately incrassate gonocoxa of a ?protecting lateral apophysis, with the telopodite being basically of the same, primitive, conformation. Such are *Fuhrmannodesmus lividus* CARL and all the hitherto described *Gyrophalus*, *Phylacomerium* and perhaps even *Schizotelopus*, but not *F. carli* KRAUS (see below). The other trend could have lain in the evolvement by the coxa of a great cavity for the telopodite to hinge into, with the same result of protecting the solenomerite and adjacent accessory structures. The gonocoxae of such species would need no additional apophyses, but instead grow enormously in size to subtend an increasingly transverse and complex telopodite. A stage somewhat intermediate or transitional between, e.g., *Phaneromerium* and, e.g., *Cryptogonodesmus* sensu stricto appears to be demonstrated by *Cutervodesmus*. In such taxa, the gonocoxae tend to grow increasingly enlarged against the background of a still moderately incrassate telopodite. Finally, both gonocoxae and telopodites could have become particularly swollen, as is the case in *Cryptogo-*

*nodesmus* sensu stricto, *Brachycerodesmus*, *Moojenodesmus*, *Esperanzella*, *Pichitaria*, and *Giustoella*.

When the species assemblages are split as above, it seems to be far easier to assess the taxonomic structure of each grouping and (re)assign the constituents. In view of the evidently too overloaded generic composition of almost all the above, supposedly natural, groupings, certain taxonomic changes are inevitable. The degree of development of the solenomerite branch known to be rather modestly developed to (almost) missing combined with the entirely mesial course of the seminal groove throughout the Fuhrmannodesmidae being another important character, the following genera are now regarded valid within each lineage:

1. *Phaneromerium* VERHOEFF, differs from the closest *Olmodesmus* KRAUS by the relatively well-developed solenomerite branch. At least for the time being, apparently both can be maintained as separate genera in their original scope.

2. *Fuhrmannodesmus* CARL. Since no significant variation is displayed in the degree of development of the solenomerite branch within this lineage, only this single genus is believed justified, whereas *Gyrophallus* CARL, *Phylacomerium* VERHOEFF, and *Schizotolopus* VERHOEFF are considered here as its strict subjective synonyms, syn.n.! Most of their erstwhile constituent species must be reassigned into *Fuhrmannodesmus* sensu strictiorum, with the following formal result: *Fuhrmannodesmus lividus* CARL, 1914 (the type-species), *F. funiculus* (PETERS, 1864) sensu CARL 1914, comb.n., *F. imitans* (CARL, 1914), comb.n., *F. simillimus* (CARL, 1914), comb.n., *F. album* (VERHOEFF, 1941a), comb.n., *F. esperanza* (KRAUS, 1960), comb.n., and *F. brevicornis* (CARL, 1914), comb.n. Contrary to them, *F. carli* KRAUS must be ejected from the genus concerned (see below).

3. As few as three genera are recognized here as valid: *Cutervodesmus* KRAUS, apparently closer to the lineage's stem, at least with the generotype distinguishable by the relatively little swollen gonocoxae as well as the usually more simple and exposed telopodites lacking a free solenomerite branch. As an example, a new species will be described below.

*Cryptogonodesmus* SILVESTRI differs in having a moderately long to relatively short, but never missing, solenomerite branch usually lying more laterally due to the considerably less swollen/elaborate mesial parts of the telopodite; the latter is very evidently sunken into the (syn)coxal cavity. This entity also includes *Fuhrmannodesmus carli* KRAUS and *Brachycerodesmus* CARL, the latter genus treated here as a strict subjective synonym of *Cryptogonodesmus*, syn.n.! As a result, the formal outcome is that *Cryptogonodesmus* comprises at the present the following nominal species: *C. clavidives* SILVESTRI, 1898 (the type-species), *C. angulifer* (PETERS, 1864) sensu CARL 1914, *C. fuhrmanni* CARL, 1914, *C. peruvianus* KRAUS, 1954, and *C. carli* (KRAUS, 1955), comb.n. However, both *C. obtusangulus* CARL, 1914, and *C. brevicornis* CARL, 1914 must be ejected from that genus (see above), i.e. quite in accordance with CARL's (1914) own inclination and VERHOEFF's (1941a, b) formal erection of a new genus for each of them.

*Moojenodesmus* SCHUBART is particular in having the solenomerite branch from relatively well-developed to practically missing, the seminal groove usually terminates considerably more mesally where the telopodite is especially elaborate and/or swollen, i.e. highly transverse; the telopodite is deeply to very deeply sunken into the (syn)coxal cavity. This pattern also occurs in *Pichitaria* KRAUS, *Esperanzella* KRAUS, and

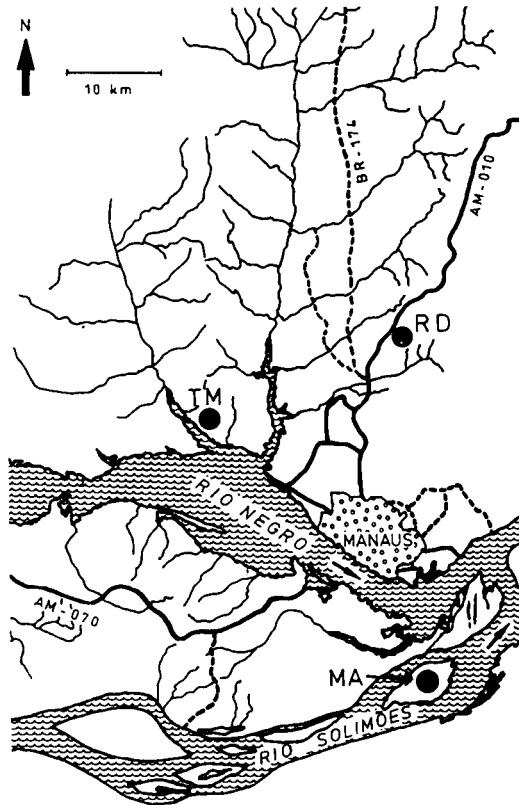
*Giustoella* KRAUS, the trio being considered here as strict subjective synonyms of *Moojenodesmus*, syn.n.! The formal outcome of such a procedure means that *Moojenodesmus* comprises at the present the following nominal species: *M. pygmaeus* SCHUBART, 1945 (the type-species), *M. pumilus* SCHUBART, 1944, *M. armatus* (KRAUS, 1959a), comb.n., *M. polydesmoides* (KRAUS, 1960), comb.n., *M. cryptus* (KRAUS, 1960), comb.n., and *M. minutissimus* (KRAUS, 1960), comb.n., as well as three new species described herein.

Such drastic nomenclatorial changes do not necessarily mean that no separate homogeneous species groups/swarms are delimitable inside some of the above six genera recongized as valid. Nor do they imply that the Neotropical fuhrmannodesmid fauna is fully assessed. On the contrary, besides alpha-taxonomy, some synopsis has long been warranted on a far larger, even global, scale, one requiring a revision of several older types. For instance, the types of PETERS (1864) as revised by CARL (1914) actually demand re-examination, this being reflected by the qualifications above. In addition, based on a restudy of type material of the generotype *Cryptogonodesmus clavidives* SILVESTRI, which regrettably remains unpublished, HOFFMAN (1979) perceives very close affinities existing between *Cryptogonodesmus* SILVESTRI, *Giustoella* KRAUS and several of the West African genera such as *Hemisphaeroparia* SCHUBART. The above nicely confirms this statement at least within the Neotropical realm and suggests further explorations.

Such a highly stringent approach effectuated at a relatively local, Neotropical, level might seem rather discouraging on a broader, even worldwide, scale. However, the idea is to delimit the various evolutionary trends/lineages in the complication of gonopod structure, roughly outlined and surely not exhausted here, within all the major zoogeographical regions to finally produce a synthesis. Otherwise we shall for ever remain at a stage when the species only slightly outnumber the genera.

The purpose of the descriptions below is not only to enrich our knowledge of a very poorly known Central Amazonian faunule, but also to substantiate and illustrate some of the above ideas.

The materials treated here have been collected in three localities (Map), with TM standing for Rio Tarumã Mirim, MA for Ilha de Marchantaria, and RD for Reserva Florestal A. Ducke. Holotypes and the bulk of paratypes of the new species, as well as most of non-types, have been deposited in the collection of the Instituto Nacional de Pesquisas da Amazônia, Manaus (INPA), while some paratypes and duplicates have been housed in the collections of the Zoological Museum of the State University of Moscow (ZMUM), Senckenberg Museum, Frankfurt/M. (SMF), Zoologisk Museum, University of Copenhagen (ZMUC), Muséum d'Histoire Naturelle, Geneva (MHNG), and Dr. J. ADIS (CA), as indicated hereinafter.



Map:

Study area near Manaus (from ADIS, 1992c): MA - Ilha de Marchantaria (3°15'S, 58°58'W), RD - Reserva Florestal A. Ducke (2°55'S, 59°59'W), TM - Rio Tarumã Mirim (3°2'S, 60°17'W). Other explanations in the text.

## Systematics

### *Cutervodesmus adisi* n.sp. (Figs. 1-8)

Holotype: ♂ (INPA), Brazil, Edo. Amazonas, Igapó of Rio Tarumã Mirim (=blackwater inundation forest), ca. 20 km NW of Manaus, affluent of Rio Negro, soil extraction: 17.XII.1981; leg. J. ADIS. -

Paratypes: 1 ♀ (ZMUC), same data, 30.IX.1981. - 4 ♂♂ (INPA), 1 ♂ (MHNG), 1 ♂ (ZMUM), 1 ♂ (SMF), same data, 30.XI.1981. - 3 ♂♂, 3 ♀♀ (INPA), 4 ♂♂, 3 ♀♀ (CA), 1 ♂, 1 ♀ (ZMUM), 1 ♀ (SMF), same data, 17.XII.1981. - 1 ♀ (INPA), 1 ♀ (MHNG), same data, 1.II.1982. - 1 ♂ (ZMUC), same data, 2.III.1982; all leg. J. ADIS.

Other material: Several incomplete adults and a huge number of juveniles of various instars from the same locality, mostly taken by means of soil extraction, but also on tree trunks, from September 1981 to March 1982. All leg. J. ADIS.

Etymology: Honours the collector of this fascinating species, my colleague Dr. Joachim ADIS.

Diagnosis: Differs from congeners by certain external features such as the incrassate male collum and metasomite 2 as well as reduced telopodite 2 and enlarged coxae 2 of males, combined with the peculiar gonopod structure.

Description: Length 4.5-5.3 (♂) to 5.0-6.0 mm (♀), width of midbody somites 0.45-0.55 (♂) and 0.50-0.60 mm (♀). Colour entirely pallid, whitish to pale yellowish, often with translucent patches (alcohol material).

Body with 20 segments (♂, ♀). Head normal, frons densely and rather delicately setose (Fig. 1). Antennae relatively long, clavate, in situ reaching to about midlength of somite 2 (in ♂ being somewhat longer in absolute values due to the somewhat longer ♂ collum - see below); antennomere 5 relatively slender, distodorsally distinctly sloping to support a prominent group of bacilliform sensillae; antennomere 6 larger, distodorsal group of sensillae somewhat smaller. Collum and metasomite 2 distinctly enlarged and about twice as long in ♂ (Fig. 1) as compared to ♀, with three usual rows of long, bacilliform setae. Head subequal in width to somites 2-3 and 5-16, somite 4 narrowest and shortest (♂), or head considerably broader than collum, a little less so than somite 2, subequal to somites 3-16 (♀). Body very gently and gradually tapering toward somite 19, rapidly so on telson. Surface dull, shagreened. Disregarding collum, metaterga with rather well-developed (a bit less so in ♀ - Fig. 2) lateral paranota absent only from ♂ metatergum 2 (rather swellings - Fig. 1), set quite high (at about 1/4 of midbody height, with dorsum a bit more convex in ♀), laterally modestly incised at insertion points of tergal setae, anteriorly more broadly, posteriorly rather narrowly rounded. Tergal setae in normal three transverse rows (Fig. 2), usually slightly subclavate and medium-sized, evidently longer and bacilliform only on collum, in fore row of somite 2 and rear row on somites 18-19 (Fig. 1), generally a bit shorter and more subclavate in ♀ as compared to ♂. Metatergal sculpture/bosses practically wanting. Ozopores dorsolateral. Pleurosternal keels missing. Epiproct short, straight, digitiform.

Sterna rather sparsely setose, about as broad (♂) or twice as broad (♀) as coxal length. Epigynal ridge behind ♀ leg-pair 2 not very high, blade-like, with even ventral margin due to elevated corners. Legs a little more incrassate in ♂ as compared to ♀, only tarsi invariably slender and long, with neither tarsal papillae nor other evident modifications but for ♂ tarsus 1 being as long as that of a midbody leg, and ♂ leg-pair 2 (Fig. 3) with a rather strongly reduced telopodite, enormous coxal processes directed caudad and conspicuously setose, and an enlarged claw. No particularly long, dorsal, tactile setae on tibiae.

Gonopods (Figs. 4-8) with very voluminous, ventrally deeply concave coxites each bearing a couple of particularly long setae frontally. Telopodites relatively high, subfalcate, in situ crossing each other, transverse. Inner femoral piece relatively small, distolaterally at base of distofemoral process (J) carrying a hairy pulvillus marking a relatively short course and orifice of seminal groove; no trace of a free solenomerite branch. Process J strong, simple, at about midway with an additional, somewhat glandular, frontal finger.

Remarks: Judged from gonopod structure, the above new species is quite close to both hitherto known congeners, *C. niger* and *C. similis* (s. KRAUS 1957, 1959b), although appearing to be disjunct in having several striking modifications such as the peculiar enlargement of both ♂ collum and metasomite 2, huge coxae and reduced telopodites of the ♂ leg-pair 2, etc., which, to the best of my knowledge, remain unique in the entire family Fuhrmannodesmidae. Earlier, this alone could have justified the erection of another new genus, but I refrain from doing so in view of the common and quite clear-cut pattern of gonopod conformation.

#### *Moojenodesmus pumilus* SCHUBART, 1944. (Figs. 9-11)

Material: 2 ♂♂, 3 ♀♀ (INPA), 1 ♂, 7 ♀♀ (SMF), Brazil, Edo. Amazonas, Ilha de Marchantaria (Rio Solimões) ca. 12 air-km S of Manaus, Várzea (= whitewater inundation forest), soil extraction, 3.III.1982. - 1 ♂, 7 ♀♀, 1 juv. (17 segm.)(CA), same data, 6.II.1981. - 10 ♀♀, 5 juv. (17 segm.)(INPA), 1 ♂, 16 ♀♀, 19 juv. (17 segm.)(ZMUM), 2 ♀♀ (ZMUC), 2 ♀♀ (MHNG), same data, 26.II.1981; all leg. J. ADIS.

Other material: Hundreds of adult ♀♀ and juveniles of various instars, taken by means of soil extraction and, to a lesser extent, with pitfall trapping and on tree trunks in the very same locality from February 1981 to April 1982. All leg. J. ADIS.



Structural notes: Length of adults 2.0-2.2 (♂) to 2.1-3.2 mm (♀), width 0.3-0.35 mm (♂, ♀). Coloration pallid, whitish to yellowish, often with translucent patches (alcohol material).

Body with 18 segments (♂, ♀). Head without particulars, antennae very short and clavate. Collum usual, small, discoid in shape, with somewhat longer, bacilliform setae in usual three rows. Paranota rather well-developed, somewhat better so in ♂, with two (somites of anterior body half) to three (mainly posterior somites) transverse rows of short, increasingly claviform bacilli. Surface finely reticulate-alveolate, very delicately shagreened, metaternal sculpture wanting.

Sterna somewhat narrower in ♂, usual. Legs without modifications, only long tactile tibial setae present.

Gonopods (Figs. 9-11) practically the same as in the genotype *M. pygmaeus* SCHUBART, 1945. Telopodite highly transverse, enlarged mesially. Solenomerite quite distinct, at base with a subtriangular frontal lobe (B) and a bigger unciform apophysis (C).

Remarks: This tiny enigmatic species was originally described from near São Paulo, southern Brazil, but from a few dozen females and juveniles. SCHUBART (1944) was certainly right allocating it within his *Moojenodesmus*. His description is good enough to be sure about conspecificity of the above samples with *M. pumilus*. Moreover, the males at hand allow both completion of the original description (above) and confirmation of the species' identity.

Surprisingly, the habitus and gonopods of both *M. pygmaeus* and *M. pumilus* are practically identical! The only true difference between both species lies in the number of segments: 19 (♂) and 20 (♀) in the former and 18 in both sexes of the latter. So if it were not for the different number of somites, both could be easily mistaken/merged.

It is important to note that *M. pygmaeus* was described from two series, one comprising 1 ♂ (holotype), 1 ♀ and 1 juv. ♀, and the other only 2 juv. ♀♀, both taken perhaps from near Rio de Janeiro, southern Brazil, for provenance of that material was questioned by SCHUBART (1945). One male out of five specimens is rather evidence of *M. pygmaeus* being a bisexual species. However, this remains guesswork, as no material of *M. pygmaeus* has since been reported.

As regards *M. pumilus*, it has since been rediscovered only once, again only by several females deriving from another locality near São Paulo (SCHUBART 1952). Hence, with the present record some 4.000 km north of its locus typicus in gigantic quantities, but with only a few males in between, we are likely to face a widespread parthenogenetic ?species or race possibly restricted, at least in the environs of Manaus, to whitewater inundation forests, or Várzea. It would be interesting to learn more about the distribution of *M. pumilus*, because at the moment all the options are equally plausible: (1) two separate species, (2) two subspecies, or (3) one single species. For the time being, however, it seems best to stick to the first alternative. Biology of this Manaus population will be dealt with elsewhere (ADIS & GOLOVATCH, in preparation).

#### *Moojenodesmus irmgardae* n.sp. (Figs. 12-15)

Holotype: ♂ (INPA), Brazil, Edo. Amazônia, Terra firme (=nonflooded upland forest), Reserva Florestal A. Ducke ca. 25 km N of Manaus, soil extraction, 11.VII.1983; leg. J. ADIS. - Paratypes: 1 ♀ (ZMUM), same data, 10.XI.1982. - 1 ♀ (INPA), same data, 12.I.1983. - 1 ♀ (INPA), same data, 12.II.1983. - 1 ♂ (INPA), same data, 12.V.1983. - 1 ♂ (ZMUM), 1 ♀ (CA), same data, 12.VI.1983. - 1 ♂ (CA), same data, 6.IX.1983; all leg. J. ADIS.

Other material: 1 ♀ (INPA), same data, 10.XI.1982. - A few dozen juveniles of various instars only, taken by means of soil extraction from October 1982 to September 1983. All leg. J. ADIS.

Etymology: Honours Mrs. Irmgard ADIS, the devoted wife of Dr. J. ADIS who shares her husband's research activities as a laboratory assistant.

Diagnosis: Differs from congeners by the relatively large size, longer antennae, and gonopod structure.

Description: Length 5.0-6.2 (♂) and 7.0-9.0 mm (♀), width 0.5-0.6 (♂) and 0.65-0.85 mm (♀). Colour entirely pallid, whitish to pale yellow, often with translucent patches.

Body with 20 segments (♂, ♀). Head very finely pilose on vertex, rather sparsely setose on frons, without particulars (Fig. 12). Antennae very long, slightly clavate, in situ reaching beyond somite 4 (♂) or 3 (♀); antennomere 5 with a less compact, antennomere 6 with a bigger and more compact group of distodorsal sensillae (Fig. 12). Collum with usual three rows of transverse, relatively long and filiform setae. Seldom (non-type ♀) collar setae distinctly bacilliform. Head very considerably broader than discoid collum and less so than subsequent somites 2-4(5), subequal in width to somite 6. Postcollar constriction very faint, somite 3 being narrowest, somites 2 and 4 subequal in width, either a bit narrower than 5th. Body parallel-sided until somite 16, onward very gently and gradually tapering. Surface dull, finely alveolate-reticulate, shagreened. Metaterga (Fig. 13) with very distinct paranota (a bit better developed in ♂) set rather high (a bit more so in ♂) at about 1/4-1/5 of midbody height, laterally poorly incised at insertions points of setae, caudally more or less pointed, a little produced behind, but remain within rear contour until somite 15, from 16th increasingly beak-shaped till 18th, as very small spinules and less-expressed on 19th. Metatergal setae usually rather short, bacilli- to subclaviform, a little longer and more slender only on collum, in fore rows of subsequent terga and, to a lesser degree, on paranota. Seldom (non-type ♀) quite long throughout, especially so in fore rows on somite 2 and, to a bit lesser degree, on somite 3. Metatergal sculpture as bosses hardly traceable (Fig. 13). Ozopores dorsolateral, normal. Pleurosternal carinae absent. Epiproct quite short, straight, digitiform.

Sterna evidently wider in ♀ as compared to ♂, usual, rather sparsely setose. Epigynal ridge in ♀ distinct, blade-like due to elevated corners, ventral edge straight. Legs a little thicker in ♂, primarily due to pretarsal podomeres, unmodified, without tarsal brushes, only coxae mesially somewhat more densely setose than usual. No particularly long tactile tibial setae dorsally.

Gonopods (Figs. 14-15) rather complex, with telopodital mesial swelling extremely pronounced. Solenomerite branch evident, subspiniform, somewhat hidden by a little larger tooth (C) from behind and a rounded lobe (B) in front. A pair of conspicuous, somewhat glandular and not too regularly shaped distolateral apophyses (A) fusing at base.

Remarks: This appears to be a rare species on the forest floor in the type locality, for also the numbers of juveniles taken is quite limited in spite of a year-long sampling.

*Moojenodesmus bethaniae* n.sp. (Figs. 16-21)

Holotype: ♂ (INPA), Brazil, Edo. Amazónas, Terra firme (=nonflooded upland forest), Reserva Florestal A. Ducke ca. 25 km N of Manaus, soil extraction, 9.VIII.1983; leg. J. ADIS. - Paratypes: 2 ♂♂, 1 ♀ (INPA), 1 ♂, 1 ♀ (CA), same data, 8.IX.1982. - 1 ♂, 1 ♀ (INPA), 1 ♂ (MHNG), same data, 13.X.1982. - 1 ♂, 5 ♀♀. 1 juv. (INPA), same data, 10.XI.1982. - 1 ♂ (ZMUM), 1 ♀ (INPA), same data, 8.XII.1982. - 2 ♂♂ (INPA), same data, 12.I.1983. - 1 ♂, 1 ♀ (SMF), 1 ♂ (INPA), same data, 12.II.1983. - 1 ♀ (INPA), 1 ♂, 1 ♀ (CA), 1 ♂, 1 ♀ (ZMUC), 1 ♂ (ZMUM), same data, 12.IV.1983. - 1 ♂, 1 ♀ (INPA), same data, 10.V.1983. - 1 ♂, 1 ♀ (SMF), 1 ♂ (CA), 1 ♂ (ZMUC), 1 ♀ (ZMUM), same data, 9.VI.1983. - 1 ♀ (MHNG), same data, 11.VII.1983. - 1 ♀ (INPA), 2 ♀ (CA), same data, 9.VIII.1983. - 2 ♂♂, 3 ♀♀ (INPA), 1 ♂ (MHNG), same data, 6.IX.1983. - 1 ♀ (CA), same data but on tree trunk, 5.IV.1982; all leg. J. ADIS.

Other material: 1 ♀ (INPA), same data, soil extraction, 10.XI.1982. - 1 ♂, 1 ♀ (INPA), same data, 8.XII.1982. - 4 ♂♂, 2 ♀♀, 1 juv. (INPA), 12.I.1983. - 1 ♂, 2 ♀♀, 2 juv. (INPA), same data, 13.III.1983. - 2 ♀♀ (ZMUM), same data, 11.VII.1983. - A few badly damaged adults and hundreds of instars of various ages, taken by means of soil extraction and on tree trunks from April 1982 to September 1983. All leg. J. ADIS.

Etymology: Honours Miss Bethania ADIS, the daughter of Dr. J. ADIS.

Diagnosis: Differs from congeners by the peculiar vertigial hump in the ♂ combined with the relatively simple gonopod structure.

Description: Length 2.5-4.5 (♂) and 4.2-6.0 mm (♀), width 0.25-0.40 (♂) and 0.30-0.45 mm (♀). Colour entirely pallid, whitish to pale yellow, often with translucent patches.

Body with 20 segments (♂, ♀). Head rather sparsely setose on frons, very delicately pubescent on vertex, in ♀ usual, in ♂ frons very distinctly flattened, vertex bearing a more or less prominent, median, bare hump (**H**) just behind antennae (Fig. 20). Latter very short, highly clavate, in situ hardly reaching beyond somite 2 (♂); antennomere 5 with a less compact, antennomere 6 with a bigger and more compact group of distodorsal sensillae, antennomere 7 with a tiny dorsal midway knob supporting a few sensillae (Fig. 21). Collum with usual three rows of transverse, relatively long and bacilli- to filiform setae. Head more or less considerably broader than discoid collum and a bit broader than or subequal to subequal somites 2 and 4, somite 3 narrowest. Body parallel-sided on somites 5-16, onward very gently and gradually tapering. Surface dull, finely alveolate-reticulate, shagreened. Metaterga with quite distinct paranota (a bit better developed in ♂) set rather high (a bit more so in ♂) at about 1/4-1/5 of midbody height, laterally poorly incised at insertion points of setae, caudally more or less narrowly rounded, never beak-shaped, a little produced behind but remain within rear contour until somite 16, slightly surpassing rear contour on 17th and, even less so, on 18th, as very small spinicles on 19th. Metatergal setae usually rather short, bacilli- to (sub)claviform, a little longer and more slender only on collum, in fore rows of subsequent terga and, to a lesser degree, anteriorly on lateral edges of paranota. More usually, most of setae are (sub)clavate, seldom (non-type ♀) somewhat longer throughout, especially so in fore rows on somite 2 and, to a bit lesser degree, on somite 3(4). Metatergal sculpture wanting. Ozopores dorsolateral, normal. Pleurosternal carinae absent. Epiproct quite short, straight, digitiform.

Sterna subequally wide in ♂ and ♀, usual, rather sparsely setose. Epigynal ridge in ♀ rather indistinct, low, blade-like due to elevated corners, ventral edge straight. Legs a little thickened (♂, ♀) primarily due to pretarsal podomeres, unmodified, without tarsal brushes, but with extremely long, tactile setae distodorsally on each tibia.

Gonopods (Figs. 16-19) rather simple, massive, with coxite bearing an apical setose lobe (**Z**). Telopodite well enlarged mesially, latero-apically with a short setose bouge opposing Z, mesio-apically with a very short dentiform solenomerite branch and a similar frontal tooth at base.

Remarks: This species is abundant in the locus typicus and displays quite a degree of variability. The hump **H** on the male head can be even lower than depicted, particularly in the smallest males, but sometimes a little bigger than shown in Fig. 20. The antenna is always short, only sometimes a bit longer than depicted in Fig. 20. The generally quite short tergal setae range from bacilli- to claviform, but change always proportionally, i.e. the shorter the collar setae, the shorter and more strongly clavate most of the others.

#### *Moojenodesmus susannae* n.sp. (Figs. 22-25)

Holotype: ♂ (INPA), Brazil, Edo. Amazonas, Igapó of Rio Tarumã Mirim (=blackwater inundation forest), ca. 20 km NW of Manaus, affluent of Rio Negro, pitfall traps, 6.I.1977; leg. J. ADIS. - Paratypes: 1 ♂ (INPA), same data but soil extraction, 30.IX.1981. - 1 ♀ (INPA), 1 ♂ (ZMUM), same data, 17.XII.1981; all leg. J. ADIS.

Etymology: Honours Miss Susanne HAMANN, the devoted laboratory assistant of Dr. ADIS.

Diagnosis: Differs from congeners by the particularly developed hump on the male head, especially short and clavate setae, as well as by the simplest gonopod conformation.

Description: Length 4.3-4.6 (♂) and 5.7 mm (♀), width 0.5-0.6 (♂) and 0.7 mm (♀). Coloration entirely pallid, whitish to yellowish, sometimes translucent (alcohol material).

Characters like in *M. bethaniae* n.sp., but head subequal in width to somites 2 and 4, either a little broader than collum and a bit broader than narrowest somite 3, but narrower than somite 5. Head of ♂ with vertical hump (**H**) particularly pronounced (Fig. 22). Tergal setae extremely short, mainly highly clavate, only collum with somewhat longer, bacilliform setae either in all three rows or only in fore one (Fig. 22); sometimes a bit longer, subbacilliform setae in fore row on somite 2 and in rear row on somite 19. Caudal

corners of paraterga mostly rounded, from hind body half increasingly narrowly rounded, never beak-shaped, produced somewhat behind only on somites 17 and, especially, 18.

Legs without particulars, a little enlarged primarily due to pretarsal podomeres (♂, ♀), also with long tactile setae on tibiae. Epyginal ridge rather poorly developed, also low and blade-shaped.

Gonopods (Figs. 22-25) highly simplified, globose. Telopodite hardly visible, being greatly sunken into coxite. Latter with a marked distolateral field of setae opposing a smaller field of setae on lateral portion of telopodite (L). Solenomerite branch practically missing, with an inconspicuous denticle near hairy orifice of seminal groove.

Remarks: If it were not for *M. bethaniae* n.sp., the above *M. susannae* n.sp. could have easily been mistaken as warranting the rank of a separate genus for itself, even following the highly stringent approach adopted here. However, the similarities between both forms concerned are so great that there can be no doubt whatever, we face congeners. *M. susannae* seems to be especially disjunct in having the ?secondarily highly simplified gonopods rather easily derivable from those of *M. pygmaeus/pumilus* or *M. irmgardae* via *M. bethaniae*, the latter already demonstrating a good deal of simplicity in gonopod structure.

Amongst the Neotropical Fuhrmannodesmidae, a tubercle on the male vertex similar/identical to that present in both *M. bethaniae* and *M. susannae* seems to have heretofore been reported solely in *Cryptogonodesmus angulifer* (PETERS) sensu CARL 1914, another reinforcing evidence for keeping both genera concerned within a single lineage.

*M. susannae* appears to be a rare species in the locus typicus.

☞ To conclude, in the environs of Manaus we face two coexisting species of Fuhrmannodesmidae each in a blackwater inundation forest at R̄io Tarumã Mirim (TM) and a primary dryland forest of Reserva Florestal A. Ducke (RD), whereas only a single, probably extremely widespread (due to thelytoky?) species seems to populate a white-water inundation forest of the Ilha de Marchantaria (Map). In case of syntopy (TM, RD), only one of the two species revealed by sampling in/on the soil and on tree trunks appears to be dominant. Further observations on their biology and ecology will be published elsewhere (ADIS & GOLOVATCH, in preparation).

## Resumo

A fauna neotropical dos principais diplópodos família Fuhrmannodesmidae foi revisada, quatro espécies novas foram descritas e mais uma redescrita, nas proximidades de Manaus, Brasil. Apenas seis gêneros são reconhecidamente válidos: *Phaneromerium* VERHOEFF, 1941, somente com o generotipo *P. obtusangulus* (CARL, 1914); *Olmodesmus* KRAUS, 1954, com *O. laticeps* KRAUS, 1954 (o espécie tipo), *O. minimus* KRAUS, 1954, *O. taulisensis* KRAUS, 1954, *O. longipes* KRAUS, 1954, e *O. robustus* KRAUS, 1955; *Fuhrmannodesmus* CARL, 1914 (= *Gyrophallus* CARL, 1914, = *Phylacomerium* VERHOEFF, 1941a, (= *Schizotelopus* VERHOEFF, 1941b, todos syn.n.!), com *F. lividus* CARL, 1914 (o espécie tipo), *F. imitans* (CARL, 1914), *F. similimus* (CARL, 1914), *F. funiculus* (PETERS, 1864) sensu CARL 1914, as três últimas espécies como comb.n. ex. *Gyrophallus*, *F. album* (VERHOEFF, 1941), *F. esperanza* (KRAUS, 1960), ambas comb.n. ex. *Phylacomerium*, e *F. brevicornis* CARL, 1914), comb.n. ex. *Schizotelopus*; *Cutervodesmus* KRAUS, 1957, com *C. niger* KRAUS, 1957 (o espécie tipo), *C. similis* KRAUS, 1959, e *C. adisi* n. sp.; *Cryptogonodesmus* SILVESTRI, 1898 (= *Brachycerodesmus* CARL, 1914, syn.n.!), com *C. clavivides* SILVESTRI, 1898 (o espécie tipo). *C. angulifer* (PETERS, 1864) sensu CARL 1914, *C. fuhrmanni* CARL 1914, *C. peruvianus* KRAUS, 1954, *C. petersi* (CARL, 1914), *C. oxapampaensis* (KRAUS, 1960), *C. tarmaensis* (KRAUS, 1959), as três últimas como comb.n. ex. *Brachycerodesmus*, e *C. carli* (KRAUS, 1955), comb.n. ex. *Fuhrmannodesmus*; e finalmente *Moojenodesmus* SCHUBART, 1945 (= *Pichitaria* KRAUS, 1959, = *Esperanzella* KRAUS, 1960, = *Giustoella* KRAUS, 1960, todos syn.n.!) com *M. pigmaeus* SCHUBART, 1945 (o espécie tipo), *M. pumilus* SCHUBART, 1944 (a primeira descrição do sexo masculino), *M. armatus* KRAUS, 1959), comb.n. ex. *Pichitaria*, *M. polydesmoides*

(KRAUS, 1960), comb.n. ex. *Esperanzella*, *M. cryptus* (KRAUS, 1960), *M. minutissimus* (KRAUS, 1960), ambas as últimas como comb.n. ex. *Giustoeilla*, bem como *M. irmgardae* n. sp., *M. bethaniae* n. sp., e *M. suzanna* n. sp.

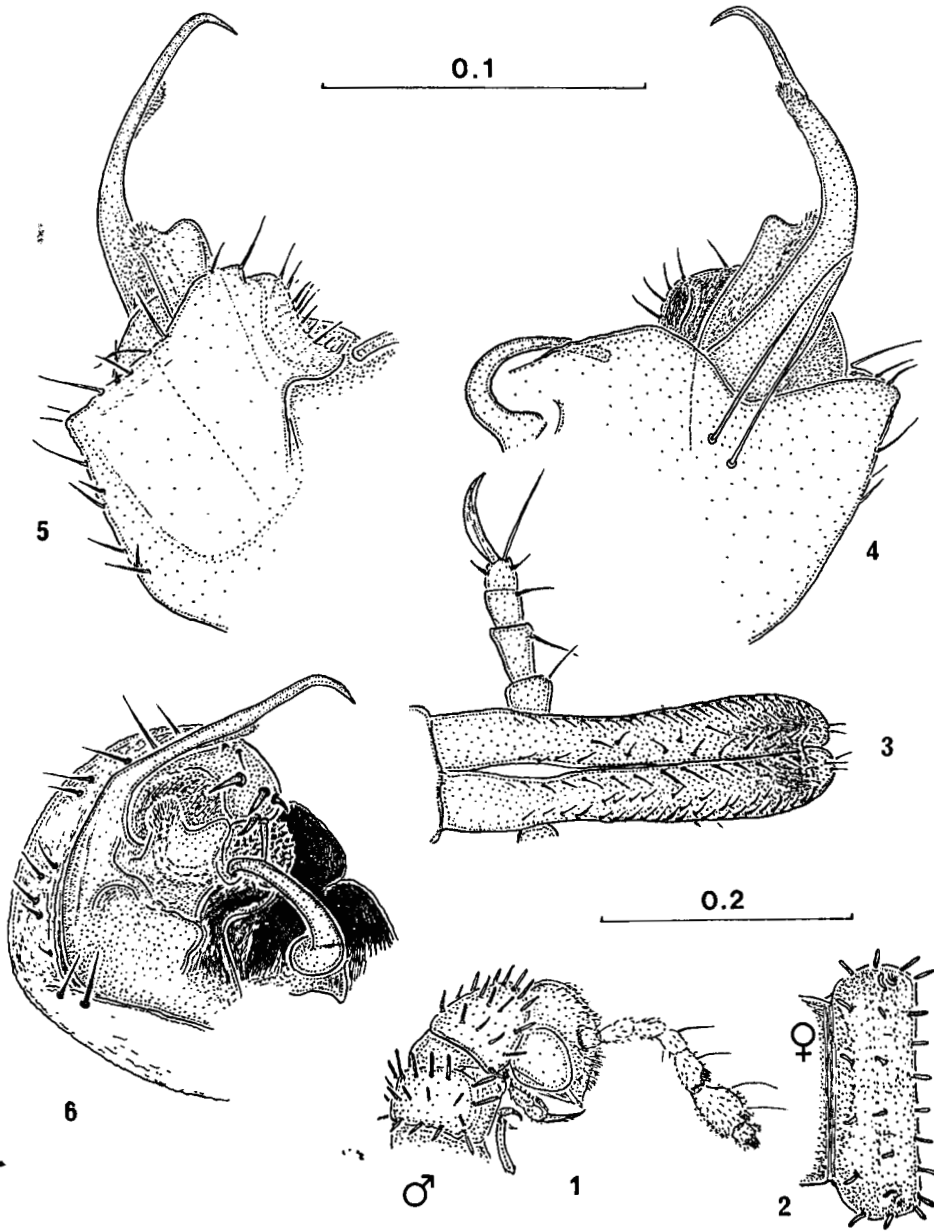
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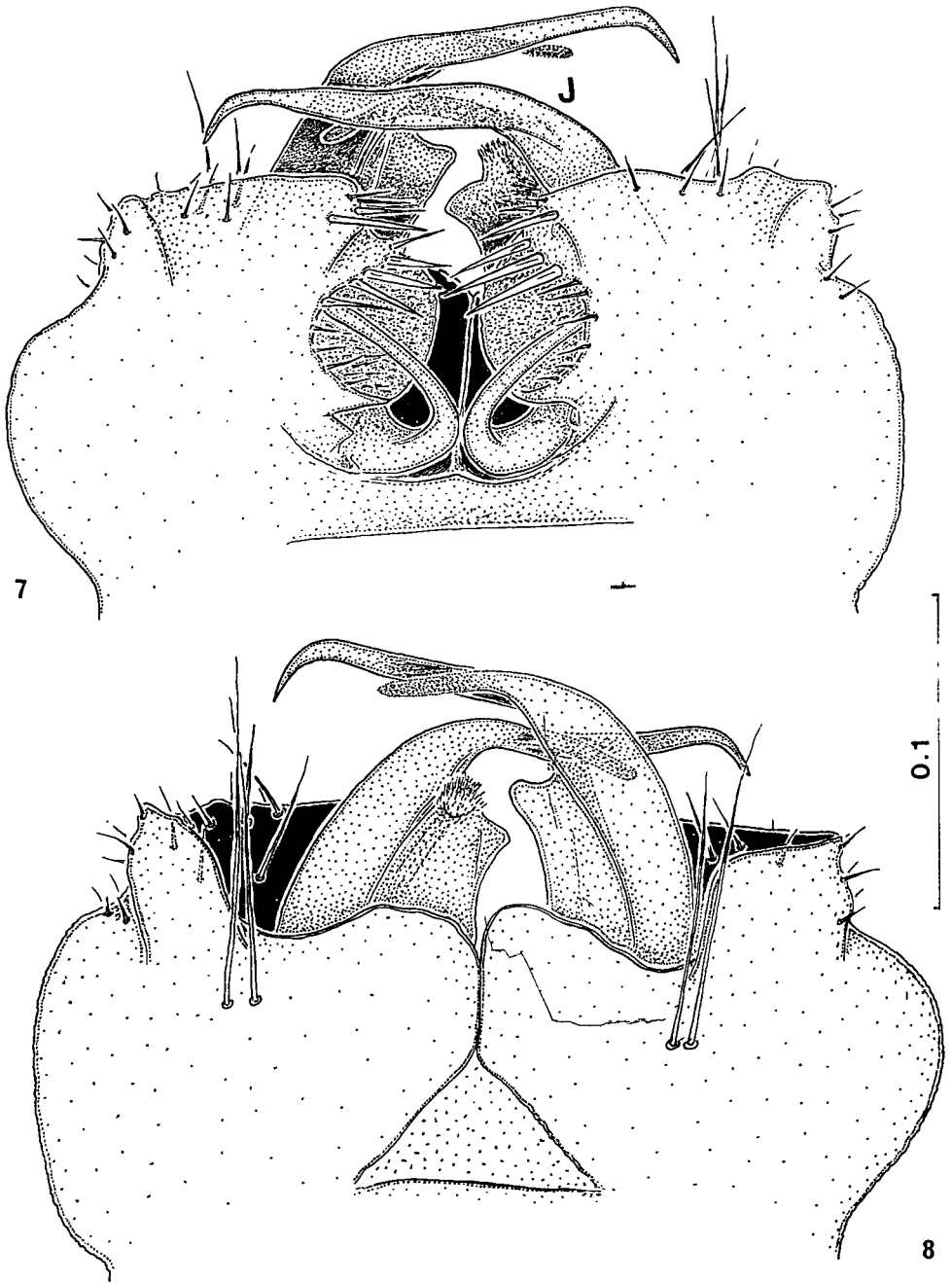
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Figs. 1-6:

*Cutervodesmus adisi* n.sp., ♂ paratype (1, 3), ♀ paratype (2) and ♂ non-type (4-6).

1: anterior body end, lateral (drawn not to scale); 2: midbody metatergum, dorsal (drawn not to scale); 3: leg-pair 2, ventral; 4-6: gonopod, subfrontal, subcaudal, and ventrocaudal respectively. - Scales in mm.

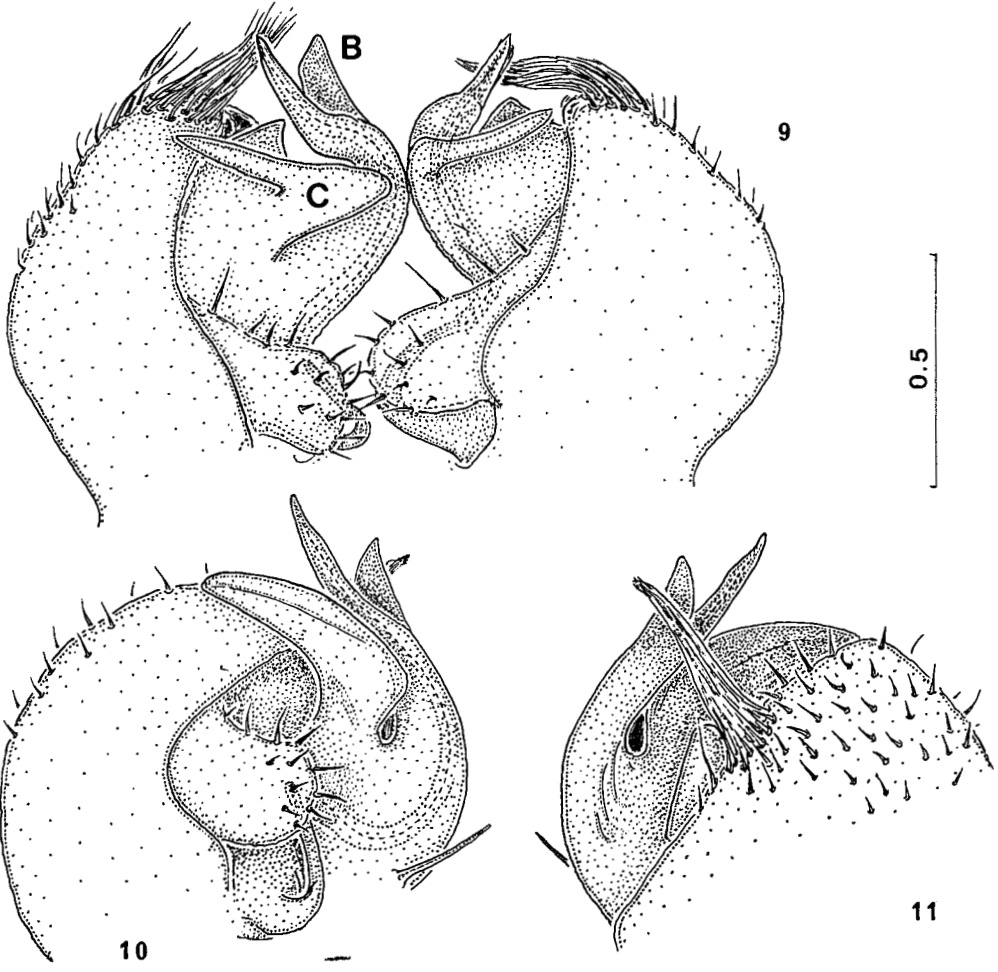


Figs. 7-8:

*Cutervodesmus adisi* n.sp., ♂ paratype.

7-8: both gonopods, caudal and frontal respectively. - Scale in mm.

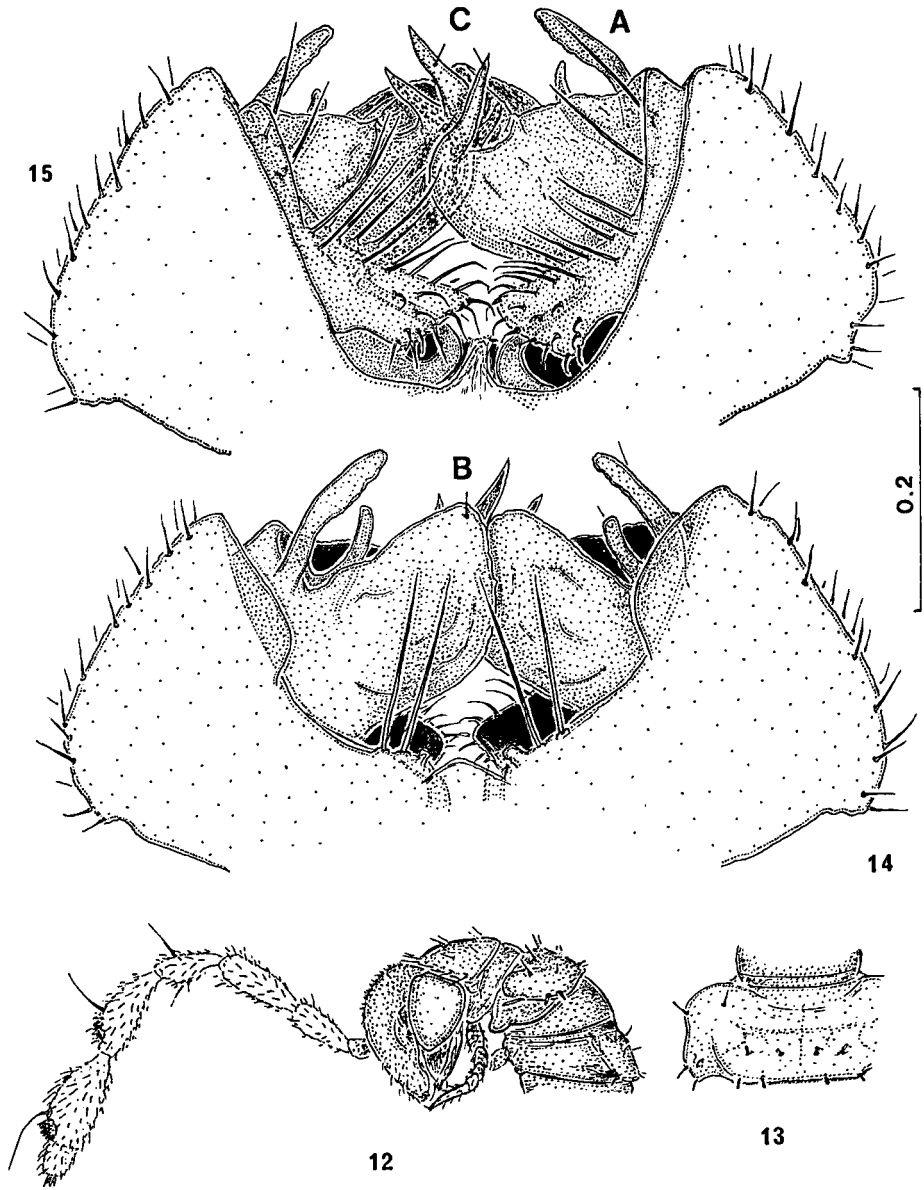




Figs. 9-11:

*Moojenodesmus pumilus* SCHUBART, 1944.

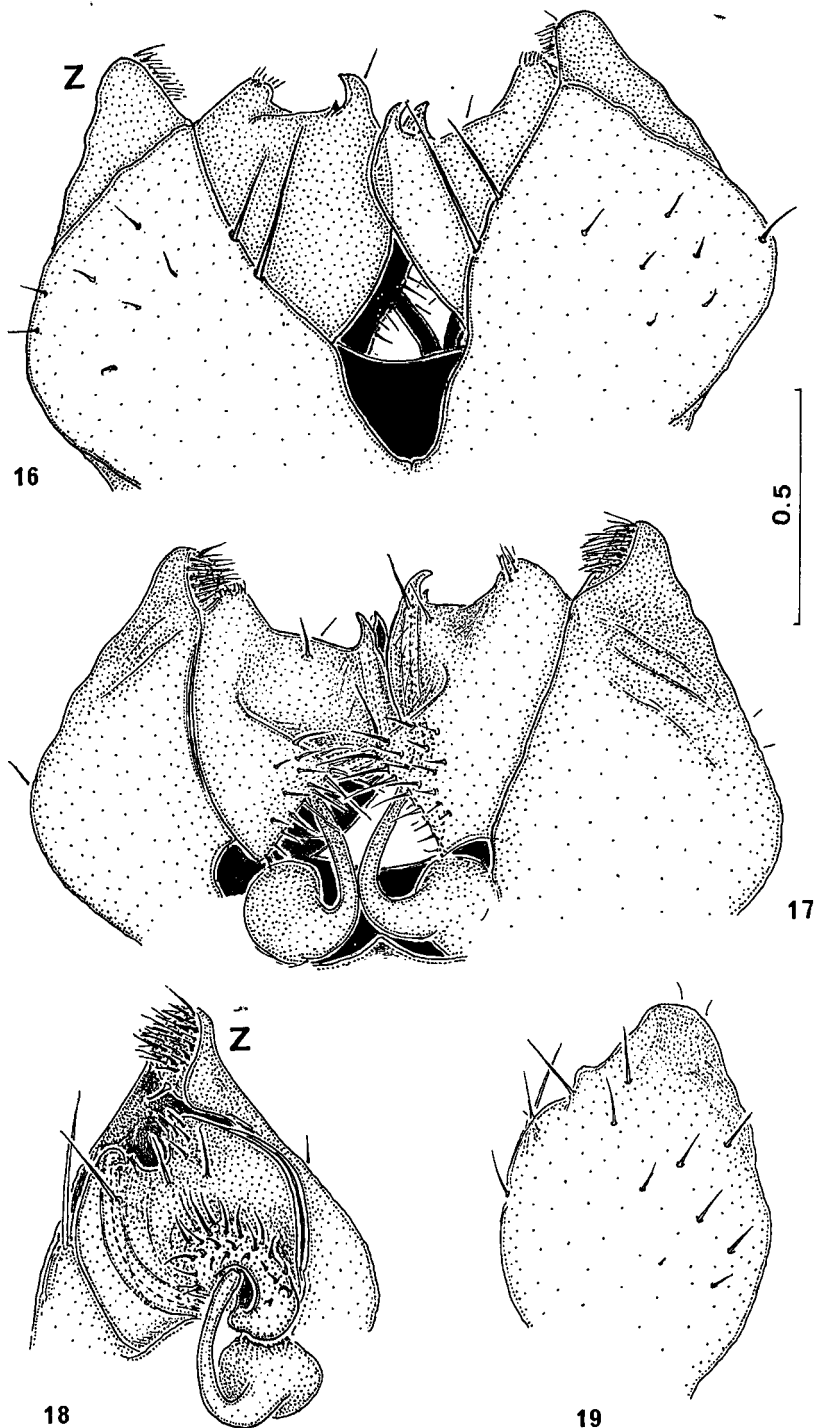
9: both gonopods, caudal; 10-11: right gonopod, caudal and frontal respectively. - Scale in mm.



Figs. 12-15:

*Moojenodesmus irmgardae* n.sp., ♂ paratype.

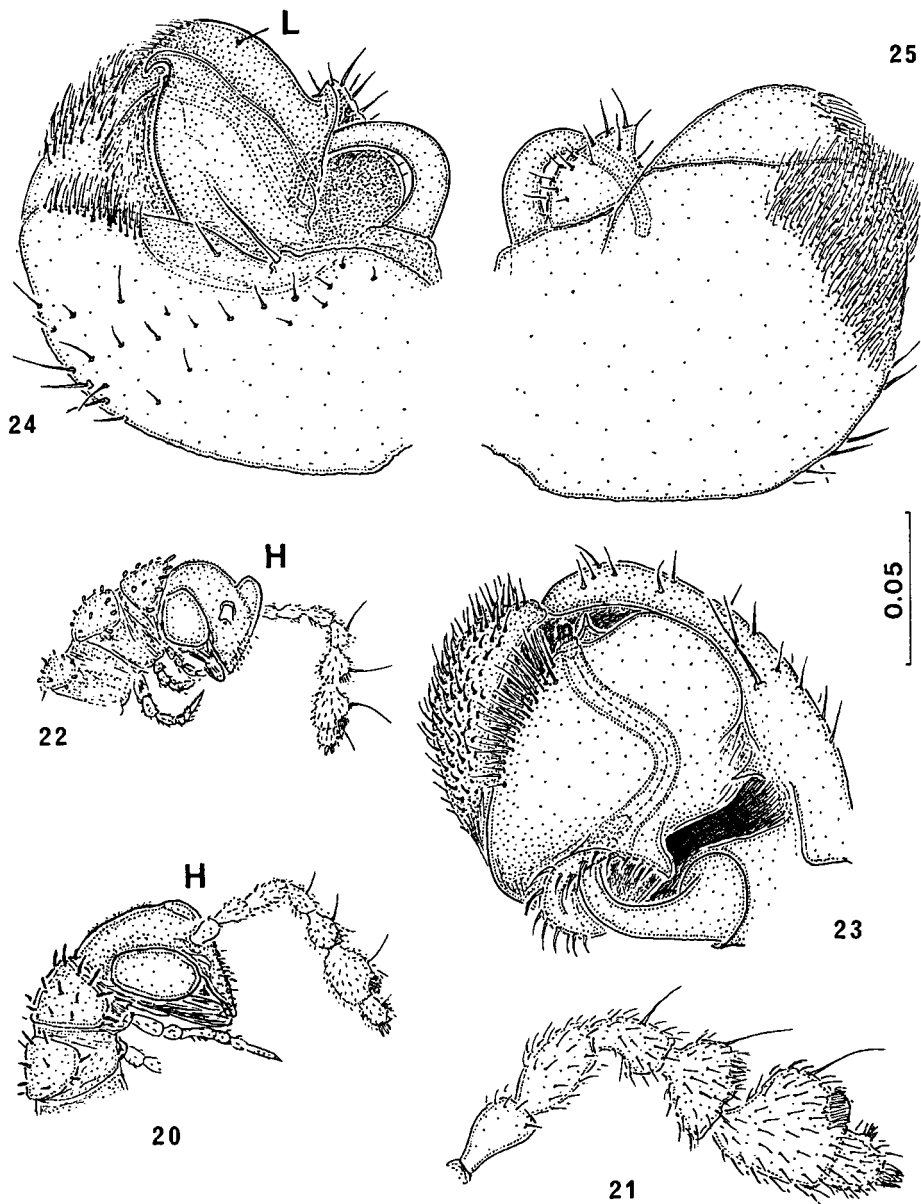
12: anterior body end, lateral, left antenna removed (drawn not to scale); 13: midbody metazonite, dorsal (drawn not to scale); 14-15: both gonopods, frontal and caudal respectively. - Scale in mm.



Figs. 16-19:

*Moojenodesmus bethaniae* n.sp., ♂ paratypes.

16-17: both gonopods, frontal and caudal respectively; 18-19: left gonopod, submesial and sublateral respectively. - Scale in mm.



Figs. 20-25:

*Moojenodesmus bethaniae* n.sp., ♂ paratypes (20-21), and *Moojenodesmus susanna* n.sp., ♂ paratype (22-25).

20&22: anterior body end, lateral (drawn not to scale); 21: antenna (drawn not to scale); 23: left gonopod, mesial; 24-25: right gonopod, ventrocaudal and ventrofrontal respectively. - Scale in mm.