

**Parthenogenetic populations of the millipede *Cylindrodesmus laniger* Schubart, 1945 to be recorded in Europe for the first time
(Diplopoda: Polydesmida: Haplodesmidae)**

**Партеногенетические популяции диплоподы *Cylindrodesmus laniger* Schubart, 1945 впервые отмечаются в Европе
(Diplopoda: Polydesmida: Haplodesmidae)**

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КЛЮЧЕВЫЕ СЛОВА: Diplopoda, партеногенез, оранжерея, интродукция, Европа.

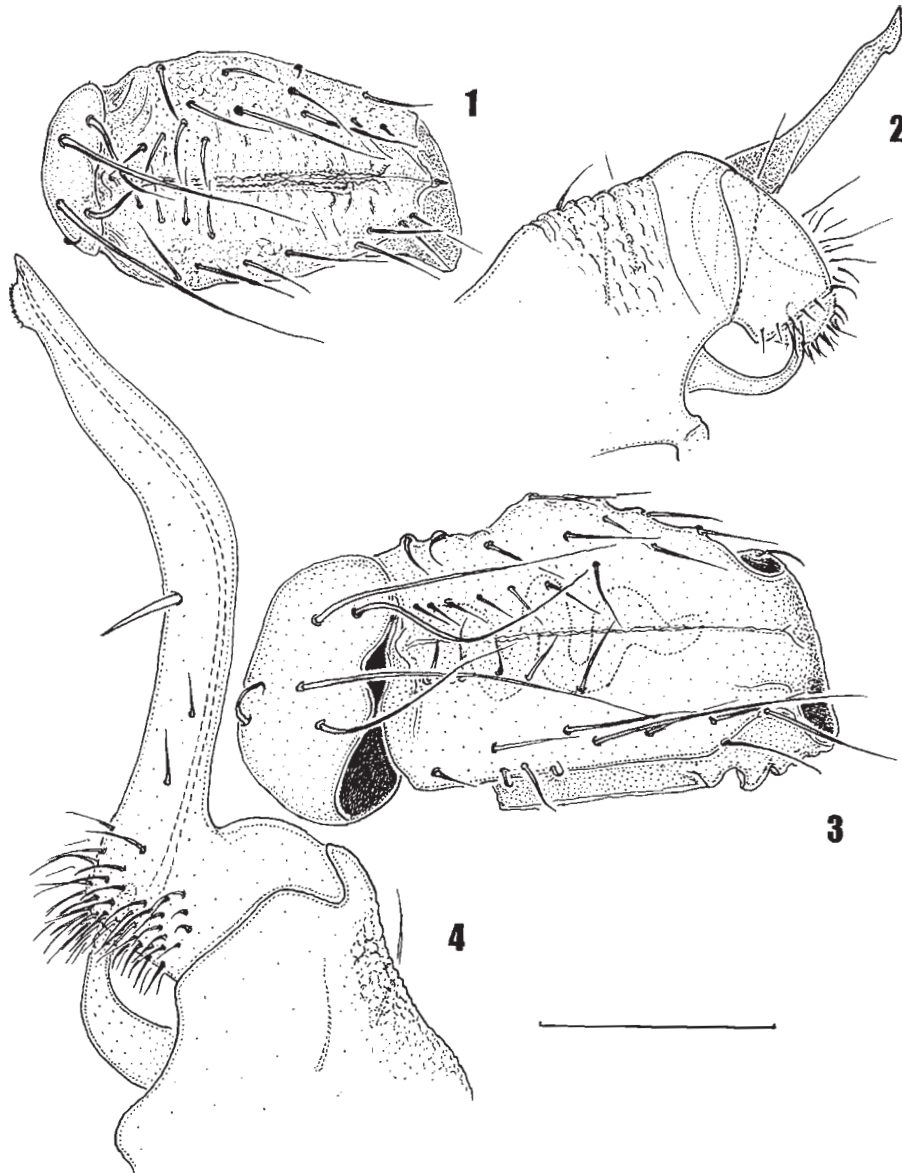
ABSTRACT: The pantropical millipede species *Cylindrodesmus laniger* Schubart, 1945 has been found introduced to hothouses in three European capitals, i.e. Paris, Vienna, and Berlin. In addition, there is strong evidence of its presence in the British Isles. These records appear to represent a species new to the European fauna. Furthermore, based on a strongly reduced receptaculum seminis in the vulva of *C. laniger* in European populations, the species can be reconfirmed as largely, if not always, parthenogenetic.

РЕЗЮМЕ: Пантропический вид диплопод *Cylindrodesmus laniger* Schubart, 1945 оказался интродуцированным в оранжереях трех европейских столиц, т.е. Парижа, Вены и Берлина. Кроме того, есть убедительные свидетельства о его присутствии на Британских островах. Эти находки отмечают этот вид как новый для фауны Европы. Более того, исходя из очень сильной редукции семяприемника в вульвах у европейских популяций *C. laniger*, подтверждается, что этот вид в основном, если не всегда, партеногенетический.

The oligotypic genus *Cylindrodesmus* Pocock, 1894 has only been reviewed by Schubart [1945], including a key to all four nominal species. At present, Hoffman [1980, 1999] lists the names *Haplosoma* Verhoeff, 1894, *Haplosomum* Brölemann, 1895, *Haplodesmus* Cook, 1895, *Lasiodesmus* Silvestri, 1908, *Inodesmus* sensu Loomis, 1934, *Elatosus* Chamberlin, 1945, and *Hypsoporus* Loomis, 1969 as established or likely synonyms of *Cylindrodesmus*.

Two of its species, *C. hirsutus* Pocock, 1894 (the type-species) and *C. laniger* Schubart, 1945, seem particularly widespread. As regards *C. hirsutus*, this species occurs in the Galapagos Islands, Ecuador, the Seychelle Islands, Christmas Island in the Indian Ocean, Indonesia, the Philippines, New Caledonia, and French Polynesia. *C. laniger* has been recorded in Brazil (terra typica: Distrito Federal, Pernambuco, and a suburb of São Paulo, stated by Schubart [1945] to be typically synanthropic), Panama, Guadeloupe, the Cape Verde Islands, Tanzania, Palmyra Island in the Pacific, and the Hawaii Islands [cf. Shelley & Golovatch, 2000]. *C. hirsutus* seems (nearly) always bisexual, i.e. usually with a sex ratio close to 1:1, whereas at least some of the *C. laniger* populations seem parthenogenetic [Enghoff, 1978]. The main difference between these two species seems to be only in the somewhat larger body size in *C. hirsutus* as compared to *C. laniger* (7–8 mm vs. up to 5.5 mm), Mauriès [1980a, b] suggesting that both taxa may prove to actually represent one and the same species, *hirsutus* by priority. Hoffman [1999] not only questions the species status of *C. laniger* but also casts serious doubts as regards the identity of *C. hirsutus* proper, because the present-day concept of the latter species relies on samples from the Seychelles [cf. Attems, 1940] rather than from Christmas Island in the Indian Ocean (NB: not Christmas Island in the Pacific Ocean, cf. Mauriès [1980b]), the terra typica.

No *Cylindrodesmus* species has hitherto been formally reported from Europe. Only Enghoff (in litt.) claims that, about 15 years ago, he saw hothouse material of *C. laniger* from Great Britain, but that record



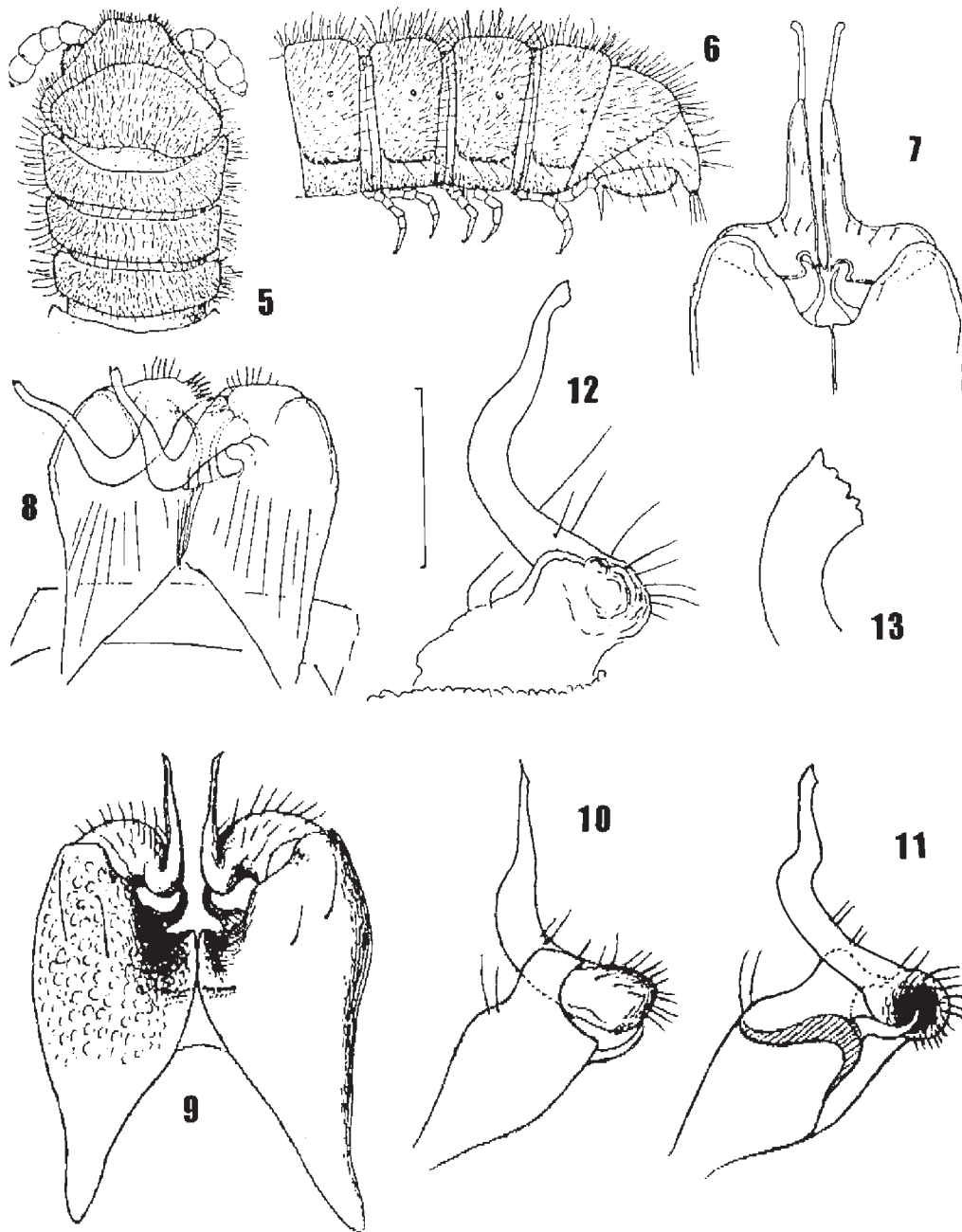
Figs 1–4. Male and female genitalia of *Cylindrodesmus laniger* Schubart, 1945 (1–2) and *C. hirsutus* (Pocock, 1894) (3–4): 1 — vulva (Paris, subcaudal view), 2 — right gonopod (Vienna, subcaudal view), 3 — vulva (Silhouette Island, subcaudal view), 4 — right gonopod (Silhouette Island, lateral view). Scale bar: 0.1 mm (all del. S. Golovatch).

Рис. 1–4. Мужские и женские гениталии *Cylindrodesmus laniger* Schubart, 1945 (1–2) и *C. hirsutus* (Pocock, 1894) (3–4): 1 — вульва (Париж, вид почти сзади), 2 — правый гоноподий (Вена, вид почти сзади), 3 — вульва (о-в Силуэт, вид почти сзади), 4 — правый гоноподий (о-в Силуэт, вид сбоку). Масштаб: 0,1 мм (все рисовал С. Головач).

seems to have never been published. We have provisionally identified all samples from European hothouses as belonging to *C. laniger*. At the moment, we have *C. laniger* cultures maintained at MPIL in Plön, to experimentally study and try to break parthenogenesis [cf. Adis et al., 2000]. These come from three European capitals, i.e. the Serre, Jardin des Plantes, Muséum National d’Histoire Naturelle in Paris (November 1999, leg. S. Golovatch & J.-P. Mauriès; May & June 2000, leg. M. Judson & S. Dashdamirov), the Vogelhaus (= Bird House, tropical rainforest part) in Schönbrunn Zoo and

the Palmenhaus, Tropenabteilung (= Palm House, tropical section) in Schloßpark Schönbrunn, both in Vienna (August 2000, leg. J. Gruber), as well as the Tropenhaus, Botanischer Garten in Berlin (May & August 2000, leg. M. Zerm). That all these samples are indeed conspecific and parthenogenetic has been proved by the structure of the vulvae and, where possible (Vienna and Berlin material), gonopods.

Interestingly, no males have yet been found in the Paris samples maintained and cloned at Plön. The sex ratio in the Vienna population, which is the most abun-



Figs 5–13. Some structural details of *Cylindrodesmus laniger* Schubart, 1945 from Brazil (5–8) and Vienna (12, 13), and of ?*C. hirsutus* (Pocock, 1894) from New Caledonia (9–11): 5 — anterior body part, dorsal view; 6 — caudal body part, lateral view; 7–9 — gonopods, ventrolateral, caudal and front views, resp.; 10 — right gonopod, sublateral view; 11 — left gonopod, mesal view; 12 — right gonopod, lateral view; 13 — tip of right gonopod, lateral view. Scale bar: 0.1 mm (12), others drawn not to scale (5–8: after Schubart [1945]; 9–11: after Carl [1926], 12 & 13: del. J. Gruber).

Рис. 5–14. Некоторые детали строения *Cylindrodesmus laniger* Schubart, 1945 из Бразилии (5–8) и Вены (12, 13) и ?*C. hirsutus* (Pocock, 1894) из Новой Каледонии (9–11): 5 — передняя часть тела, вид сверху; 6 — задняя часть тела, вид сбоку; 7–9 — гоноподии, соответственно вентролатерально, сзади и спереди; 10 — правый гоноподий, вид почти сбоку; 11 — левый гоноподий, вид изнутри; 12 — правый гоноподий, вид сбоку; 13 — кончик правого гоноподия, вид сбоку. Масштаб: 0,1 мм (12), остальные без масштаба (5–8: по Schubart [1945]; 9–11: по Carl [1926], 12 & 13: рисовал Ю. Грубер).

dant and representative, is 1:202 after its rearing in Plön (September–November 2000), but variation may actually be observed, possibly dependent on sample size, collecting locality and season. Thus, three samplings

(J.G.) in the Vogelhaus gave the following results. On January 16th, 2000 (shaken from underside of a piece of bark lying on the ground): 44 females, 14 juveniles, no adult males. On February 13th, 2000, an incomplete

“manual extraction“ from a large “handful“ of detritus (rotten wood, bark, plant fibres) yielded about 480 specimens, among them 84 adults: 77 females, 7 males; thus a sex ratio of 1:11. On August 11th, 2000, animals crawling freely on moist wood and rocks, collected manually: 95 specimens, including only 3 males, 69 verified females, and 23 juveniles; a sex ratio of 1:23. In the Berlin population, the sex ratio is only 1:7.8 and maybe biased as only few specimens are available yet.

To find a morphological proof that European hothouse populations of *C. laniger* are indeed parthenogenetic, a female from Paris, a female and a male each from Berlin and Vienna were dissected. The results show very clearly that these clones (i.e. all progeny obtained from a single individual, cf. Nichols [1969]) are identical, i.e. belong to the same species, with the vulva definitely underdeveloped in having only a reduced, rod-shaped receptaculum seminis (Fig. 1), whereas the gonopod is extremely simple, lacking any midway spine on the telopodite (Figs 2, 12, 13). For comparative purposes, we studied a female and a male of the bisexual *C. hirsutus* from Silhouette Island, Seychelles (September 2000, leg. J. Gerlach). The vulva appears definitely functional, especially so due to a well-developed spiral receptaculum seminis (Fig. 3), while the gonopod shows a small but evident midway spine on the telopodite (Fig. 4). However, as this prong is known to be sometimes absent (cf. Attems [1940], see also Figs 9–11), it remains pure guesswork whether the loss might occur during copulation. Proportionately to body size, all genitalic structures are considerably larger in *C. hirsutus* compared to *C. laniger*.

To provide the reader with a better idea of how *C. laniger* and *C. hirsutus* look, we give here some additional illustrations. Those taken from the original description of *C. laniger* [Schubart, 1945] plus some new drawings (Figs 1, 2, 12, 13) and several SEM micrographs (Figs 15, 16, 21, 22), all taken from fresh European samples, show clearly that variation in *C. laniger* is very modest. However, study of this variation is somewhat hindered by the slightly different angles the respective structures have been depicted at. The new sample of *C. hirsutus* from the Seychelles (Figs 3, 4, 14, 17–20) coupled with drawings copied from a good redescription of (?) this species by Carl [1926] as based on material from New Caledonia (Figs 9–11) reveal very few characters to distinguish *C. hirsutus* from *C. laniger*. Yet it seems as though, in addition to the abovementioned differences in size, there are other differences. In *C. hirsutus*, the frons (Fig. 14) is relatively a little wider, the gonopods are a little less falcate/sigmoid (Figs 4 & 17), and the microlamellae

composing the limbus at the caudal end of metaterga (Figs 19 & 20) a little more slender and longer as compared to *C. laniger* (Figs 16, 21, 22). Whether these characters are sufficiently stable and species-specific is something that still needs to be proved in a future study.

The taxonomy of *Cylindrodesmus* and of all of its nominal species is a project lying beyond the scope of the present paper. To assess this genus taxonomically, one must be aware that all records of *C. hirsutus* published before 1945, the year when *C. laniger* was first described (though mentioned by Schubart as a nomen nudum in a couple of his previous papers), are to be revised as they could have easily been confused with *C. laniger*. Hence it may be necessary to qualify Carl's [1926] record. Even some post-1945 records appear questionable, e.g. that by Shear & Peck [1987] of *C. hirsutus* in the Galapagos Islands. By noting a clear-cut bias toward females in some of their samples, and a tendency to establish parthenogenetic populations, these authors might have easily mistaken *C. laniger* for *C. hirsutus*.

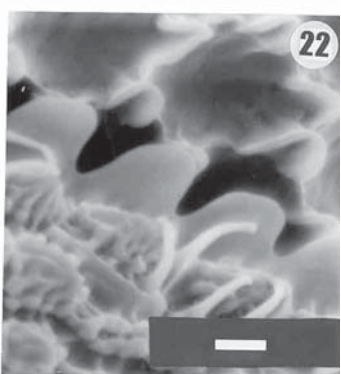
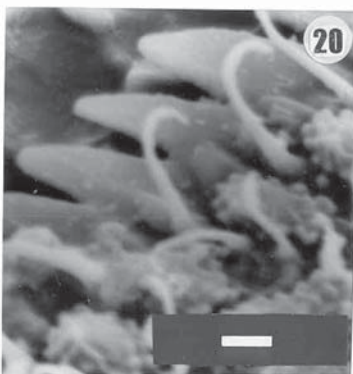
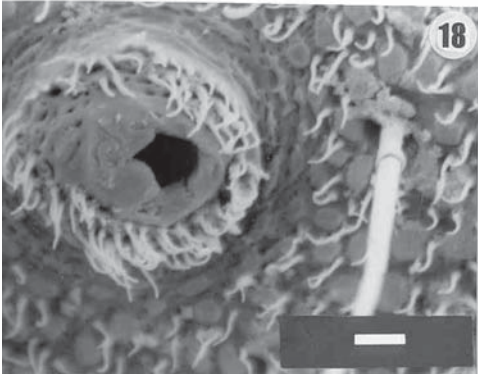
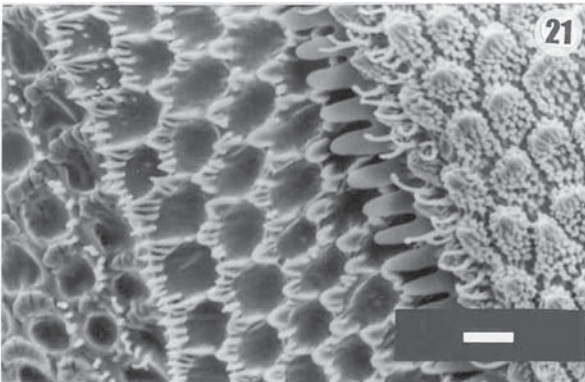
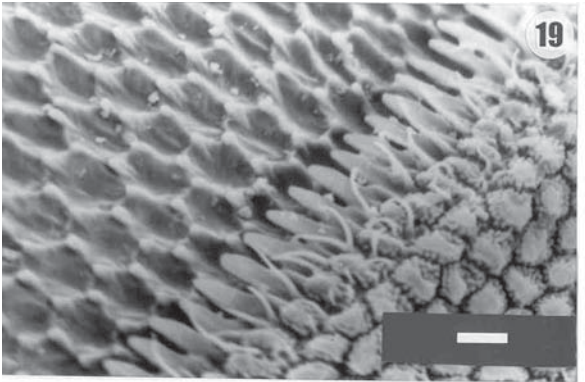
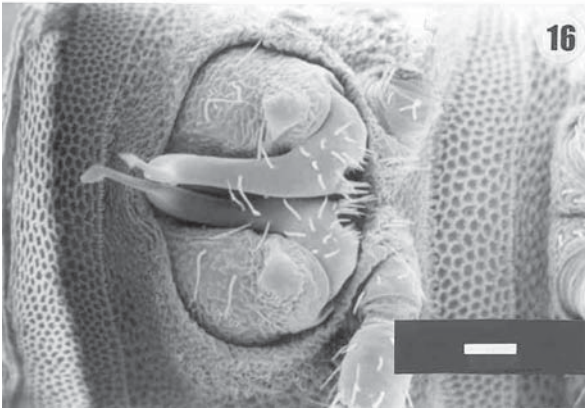
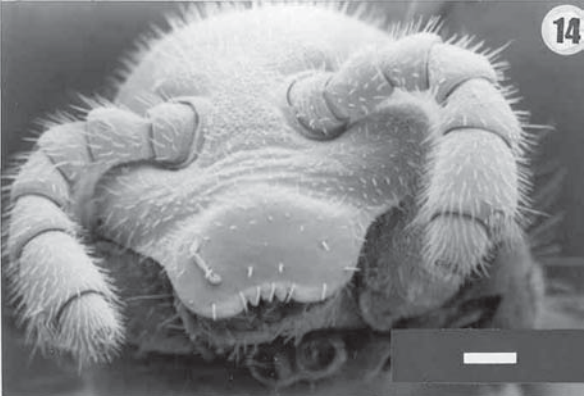
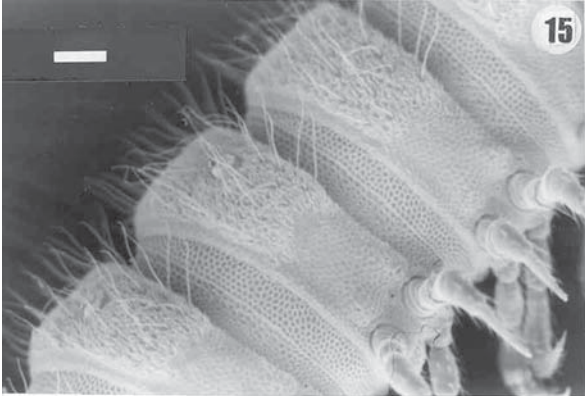
Similarly, some of the geographical reports appear dubious. In particular, Schubart's [1945] record of *C. hirsutus* in the Comoro Islands, repeated by Mauriès [1980b], seems to have never been substantiated by published material.

Our findings document *C. laniger* both as a species formally new to the European list and largely, if not always, parthenogenetic. So Enghoff's [1978] observations on possible parthenogenesis in *C. laniger* due to the mainly strongly female-biased samples of this species hitherto taken from various places in tropical countries are now confirmed based on morphological evidence derived from three European hothouse populations.

At least several decades ago, *C. laniger* must have been absent from Europe altogether, as this small but very conspicuously hirsute millipede (Figs 5, 6, 15) with parasally articulated macrochaetae and distinct ozopores opening on hirsute knobs on metaterga (as in Fig. 18) would have long been spotted, e.g., in a hothouse at Berlin [Schubart, 1934] and/or Paris [Schubart, 1947]. In Vienna at least, during some earlier short collecting trips in 1981 and 1982 in a smaller hothouse in the Schönbrunn Palace gardens (“Sonnenuhrhaus“; the larger Palmenhaus was closed to the public then), J.G. found no *Cylindrodesmus*. The first documented records by J.G. date from January 2000 (Palmenhaus and Vogelhaus). However, the species must have been present in Vienna somewhat earlier, as Mr. Gerhard Tichy, a gardener working in the Palmenhaus, remembered having seen such animals several years before.

Figs 14–22. SEM micrographs of several structures in *Cylindrodesmus laniger* Schubart, 1945 (Vienna material; 15, 16, 21, 22) and *C. hirsutus* (Pocock, 1894) (Silhouette Is.; 14, 17–20): 14 — head, front view; 15 — a few midbody segments, lateral view; 16 & 17 — gonopods, ventral and frontoventral views, resp.; 18 — ozopore of a midbody segment and base of a macrochaeta; 19–22 — limbus and adjacent parts at varying magnification. Scale bars: 100 µm (14, 15, 17), 40 µm (16), 10 µm (18, 19, 21), 4 µm (20, 22).

Рис. 14–22. Полученные с помощью сканирующей микроскопии фотографии некоторых структур у *Cylindrodesmus laniger* Schubart, 1945 (материал из Вены; 15, 16, 21, 22) и *C. hirsutus* (Pocock, 1894) (о-в Силуэт; 14, 17–20): 14 — голова, вид спереди; 15 — несколько среднетуловищных сегментов, вид сбоку; 16 и 17 — гоноподии, соответственно виды снизу и фронтотентрально; 18 — озопора среднетуловищного сегмента и основание макрохеты; 19–22 — лимбус и прилежащие части с разным увеличением. Масштаб: 100 мкм (14, 15, 17), 40 мкм (16), 10 мкм (18, 19, 21), 4 мкм (20, 22).



This seems to show that *C. laniger*, probably due to its parthenogenetic way of reproduction, being purely hothouse-dwelling of course, is tending to spreading over Europe.

Generally, among tropical introductions to Europe's hothouses, millipedes display a rather strong bias toward parthenogenesis. Thus, both *Poratia digitata* (Porat, 1889) and *Detodesmus* (= *Amphitomeus*) *attemsi* Schubart, 1934 have been described and still remain known as parthenogenetic solely from European hothouses (except for another, obviously introduced and similarly thelytokous population of the former species from a sugar cane plantation in Java, Indonesia). As mentioned above, *Cylindrodesmus laniger* might likewise prove to be parthenogenetic throughout, i.e. both in the tropics and in the hothouses in Europe. In contrast, *Poratia obliterata* (Kraus, 1960) is, as yet, the only millipede species in which the maternal, source populations in South and Central America are invariably bisexual, whereas parthenogenetic animals are only known in a few hothouses in Europe (Kiel and Paris). In addition, it is likely that *P. obliterata* is found both in the open and in hothouses in the United States [cf. Adis et al., 2000; Golovatch & Sierwald, 2001].

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