

RECORDS OF MILLIPEDES FROM KEW GARDENS AND THE EDEN PROJECT, INCLUDING DESCRIPTIONS OF THREE SPECIES

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INTRODUCTION

The millipedes of glasshouses and formal gardens have been relatively well studied in Britain and new and interesting species regularly reported. Kew Gardens is perhaps the most well known botanic garden and glass house complex and many species have been reported here first and subsequently found elsewhere (for example *Poratia digitata* and *Haplopodoiulus spathifer*), Kew is also the type locality for *Prosopodesmus panporus*, the native country of which is still unknown. A new extensive glasshouse complex, the Eden Project, has also been established in Cornwall in recent years. This has already been the source of new species to Britain, for example the centipede *Cryptops doriae* (Lewis 2007).

In October 2002 the BMIG held a field meeting at Kew Gardens to establish the current status of some of the unusual species previously recorded following complete refurbishment of the Palm House. Several other visits have also been made in recent years. Collecting visits to the Eden Project were carried out by the Entomology Department of the Natural History Museum (London) in 2003 and University of Plymouth in 2005. This report lists the millipedes found and gives descriptions of three species not previously described in British literature. A notable find at the Eden Project is *Paraspirobolus lucifugus* (Gervais) the first example of a millipede of the order Spirobolida, in the British Isles, this order has no indigenous species in the Western Palaearctic.

KEW GARDENS

The millipedes recorded are shown in Table 1. Of the Kew 'specialists' *Haplopodoiulus spathifer* was found in both the palm house and outside close to a lake; this species is clearly well established. *Prosopodesmus panporus* still occurs in the Palm House and was found on two separate occasions. An apparent notable addition is *Cylindrodesmus hirsutus*, also from the Palm House and found on three separate times between 2002 and 2005. The very widespread hot house millipede *Oxidus gracilis* was still very common and *Cylindroiulus truncorum*, a species largely known from botanic gardens in the UK, was refound. Several British native species were also recorded from the outside areas as well as the glass houses.

THE EDEN PROJECT

The millipedes found are given in Table 2. The frequently found hot house millipede *Oxidus gracilis* appears to be common in the litter samples. The warm temperate biome seems to be inhabited by common British species but there are two species found that are apparently new to Britain, the spirobolidan *Paraspirobolus lucifugus* and the small relative of *Polyzonium*, *Rhinotus purpureus*. The tiny polydesmidan *Cylindrodesmus hirsutus* previously only known in the British Isles from Kew Gardens was also found.

Table 1: Millipedes collected from Kew Gardens

Key: P.O.W. - Princess of Wales Conservatory. Recorders: ADB - Tony Barber, SG - Steve Gregory, ZK - Zoltan Korsos, PL - Paul Lee, JPR - J. Paul Richards, HR - Helen Read.

Location	Species	Date	Recorders
Palm House	<i>Oxidus gracilis</i>	13/10/2002	JPR, SG, HR
Palm House	<i>Oxidus gracilis</i>	21/12/2002	Mann & Hogan
Palm House	<i>Oxidus gracilis</i>	06/2005	PL
Palm House	<i>Cylindrodesmus hirsutus</i>	13/10/2002	HR
Palm House	<i>Cylindrodesmus hirsutus</i>	26/09/04	PL
Palm House	<i>Cylindrodesmus hirsutus</i>	06/2005	PL
Palm House	<i>Prosopodesmus panporus</i>	06/2005	PL
Palm House	<i>Prosopodesmus panporus</i>	13/10/2002	HR
Palm House	<i>Choneiulus palmatus</i>	13/10/2002	SG, HR
Palm House	<i>Proteroiulus fuscus</i>	13/10/2002	SG, HR
Palm House	<i>Haplopodoiulus spathifer</i>	13/10/2002	JPR
Palm House	<i>Cylindroiulus parisiorum</i>	13/10/2002	SG, HR
Palm House	<i>Cylindroiulus truncorum</i>	13/10/2002	JPR
Palm House	<i>Cylindroiulus truncorum</i>	22/12/2002	Mann & Hogan
Evolution House. Under stones	<i>Nopoiulus kochii</i>	13/10/2002	JPR
P.O.W. 1: wet tropics	<i>Prosopodesmus panporus</i>	13/10/2002	SG
P.O.W. 1: wet tropics	<i>Choneiulus palmatus</i>	13/10/2002	SG, HR
P.O.W. 1: wet tropics	<i>Cylindroiulus parisiorum</i>	13/10/2002	JPR
P.O.W. 3: dry tropics	<i>Choneiulus palmatus</i>	13/10/2002	SG, HR
P.O.W. 3: dry tropics	<i>Cylindroiulus caeruleocinctus</i>	13/10/2002	SG
P.O.W. 3: dry tropics	<i>Cylindroiulus truncorum</i>	13/10/2002	HR
P.O.W. 4: tropical ferns	<i>Oxidus gracilis</i>	13/10/2002	SG, HR
P.O.W. 4: tropical ferns	<i>Choneiulus palmatus</i>	13/10/2002	SG, HR
P.O.W. 4: tropical ferns	<i>Cylindroiulus parisiorum</i>	13/10/2002	SG
P.O.W. 4: tropical ferns	<i>Cylindroiulus truncorum</i>	13/10/2002	HR
P.O.W.	<i>Choneiulus palmatus</i>	13/10/2002	ADB
P.O.W.	<i>Oxidus gracilis</i>	13/10/2002	ADB
Temperate House	<i>Choneiulus palmatus</i>	13/10/2002	ADB
Temperate House	<i>Choneiulus palmatus</i>	06/2005	PL
Temperate House	<i>Blaniulus guttulatus</i>	13/10/2002	ADB
Temperate House	<i>Blaniulus guttulatus</i>	06/2005	PL
Temperate House	<i>Cylindroiulus britannicus</i>	06/2005	PL
Temperate House	<i>Cylindroiulus truncorum</i>	13/10/2002	ADB
Temperate House	<i>Cylindroiulus vulnerarius</i>	13/10/2002	ADB
Temperate House	<i>Cylindroiulus vulnerarius</i>	06/2005	PL
Lakeside towards POW	<i>Blaniulus guttulatus</i>	13/10/2002	HR
Under conifers	<i>Haplopodoiulus spathifer</i>	13/10/2002	ADB
Lakeside towards POW	<i>Haplopodoiulus spathifer</i>	13/10/2002	SG, HR
Lakeside towards POW	<i>Cylindroiulus britannicus</i>	13/10/2002	SG, HR
Lakeside towards POW	<i>Cylindroiulus vulnerarius</i>	13/10/2002	SG
Palm House	<i>Cylindroiulus truncorum</i>	12/1991	ZK, HR
Palm House	<i>Proteroiulus fuscus</i>	12/1991	ZK, HR
Palm House	<i>Oxidus gracilis</i>	12/1991	ZK, HR
Palm House	<i>Prosopodesmus panporus</i>	12/1991	ZK, HR

Table 2: Millipedes collected from the Eden Project

Key: x – present and abundant

to recorders: ADB - Tony Barber, BM – British Museum (Natural History)

Location	Species	Male	Fe- male	Imma- ture	Date	Recorder
Litter 1	<i>Oxidus gracilis</i>	1			28/4-2/5/2003	BM
Litter 8	<i>Oxidus gracilis</i>	2	1		28/4-2/5/2003	BM
Litter 9	<i>Oxidus gracilis</i>			1	28/4-2/5/2003	BM
Litter 5	<i>Oxidus gracilis</i>		1		28/4-2/5/2003	BM
Litter 14	<i>Oxidus gracilis</i>	1			22/10/2003	BM
Litter 1	<i>Tachypodoiulus niger</i>	2	1		28/4-2/5/2003	BM
Warm Temperate biome	<i>Oxidus gracilis</i>	x	x		11/5/2005	ADB
Warm Temperate biome	<i>Cylindroiulus punctatus</i>	x			11/5/2005	ADB
Warm Temperate biome	<i>Polydesmus angustus</i>	1			11/5/2005	ADB
Warm Temperate biome	<i>Cylindroiulus britannicus</i>	1	1		11/5/2005	ADB
Warm Temperate biome	<i>Oxidus gracilis</i>	x			2005	ADB
Humid tropics biome	<i>Paraspirobolus dictyonotus</i>	x	x		2005	ADB
Humid tropics biome, site 8	<i>Cylindrodesmus hirsutus</i>				11/5/2005	ADB
Humid tropics biome, site 5	<i>Cylindrodesmus hirsutus</i>				11/5/2005	ADB
Litter 9	<i>Cylindrodesmus hirsutus</i>				22/10/2003	BM
Litter 15	<i>Cylindrodesmus hirsutus</i>				22/10/2003	BM
Litter 7	<i>Cylindrodesmus hirsutus</i>				28/4-2/5/2003	BM
Litter 9	<i>Cylindrodesmus hirsutus</i>				28/4-2/5/2003	BM
Litter 17	<i>Poratia digitata</i>				28/4-2/5/2003	BM
Litter 4	<i>Rhinotus purpureus</i>	1	2		28/4-2/5/2003	BM
Litter 8	<i>Rhinotus purpureus</i>		1	3	28/4-2/5/2003	BM
Litter 15	<i>Rhinotus purpureus</i>	1	2	(1jM)	28/4-2/5/2003	BM

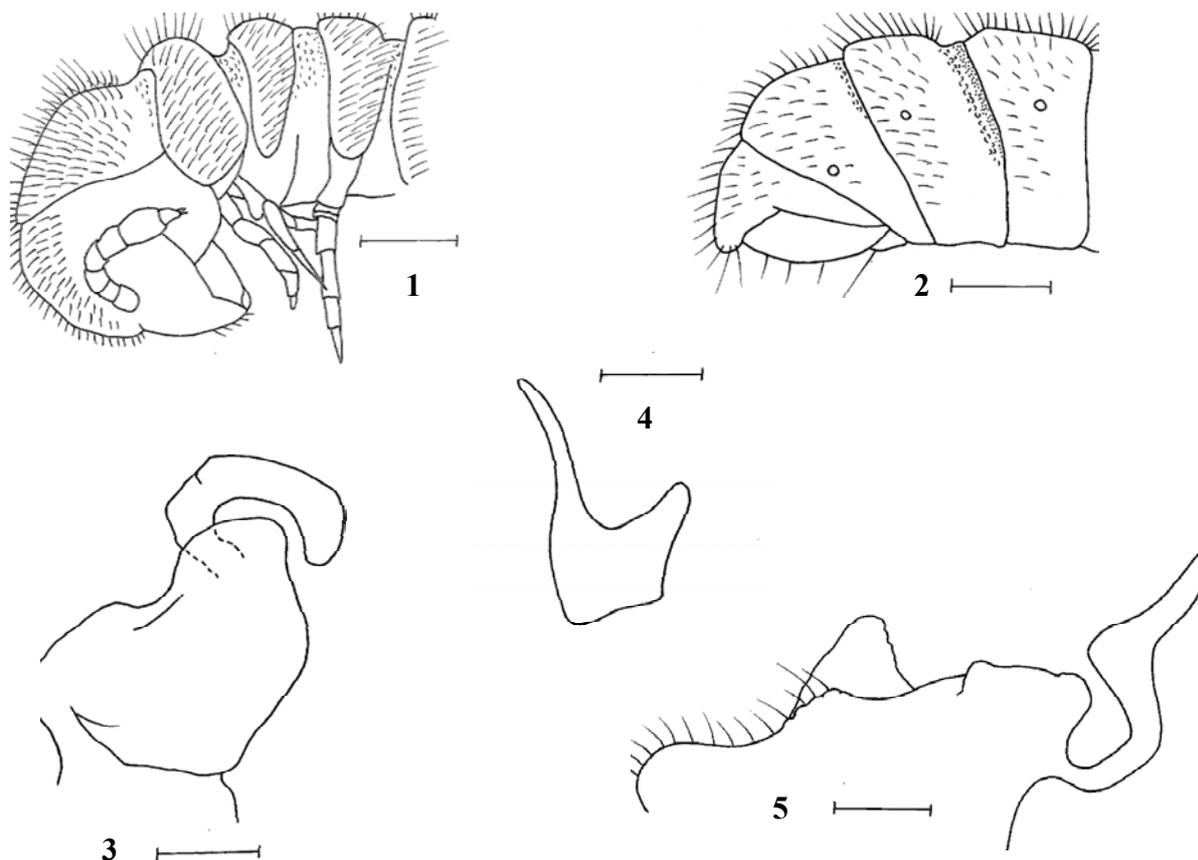
DESCRIPTIONS OF NEW SPECIES***CYLINDRODESMUS HIRSUTUS* POCOCK, 1889****Appearance**

A small white polydesmoid with most paranota totally reduced. British female specimens up to 6.5mm in length and 0.6mm wide. The only entire male 3.8mm long and 0.5mm wide.

Body shape quite cylindrical in appearance. Collum and metaterga clothed with dense, in part 2-segmented setae (Figure 1). Antennae relatively short, in one specimen with chestnut coloured apical segments. Only body ring 2 with clear paranota, following segments only with small swellings laterally. 19 (male) or 20 (female) body rings (including collum and telson) in adults. Telson with short but clearly defined projection bearing four setae (Figure 2).

Of the five specimens collected at Kew Gardens there are no males. From the Eden Project 26 specimens were collected of which two were mature males. The majority of the others had 18-19 body rings and thus were immature but none showed any reduction in legs normally expected of polydesmid males in the moult before maturity.

Male gonopods (Figures 3-5) with clear anterior and posterior parts. Anteriorly with long (but rather sigmoid shaped) projection. Laterally with more gentle expansion. See Golovatch *et al.* 2000 for SEM micrographs of the gonopods which show the structure more clearly. Males from the Eden Project seem to have rather more bent gonopods than some of those described previously, a feature described by Golovatch *et al.* (2001) as something that might be expected in residual males in a population which is largely parthenogenetic.



Figures 1-5: *Cylindrodesmus hirsutus*

1. Head and first few segments. 2. Telson. Scale bars = 0.21mm
 3. Male gonopods posterior view. 4. Male gonopods anterior view. Scale bars = 0.025mm
 5. Male gonopods lateral view. Scale bar = 0.04mm

Distribution

This species is first mentioned for Britain by Lee (2006), based on specimens from Kew in 2002. As mentioned in Lee (2006) however, correspondence between Adrian Rundle and Henrik Enghoff in spring 1986 confirms the identification of some specimens Adrian had found at Kew as *Cylindrodesmus laniger* Schubart, 1944 (a junior synonym of *C. hirsutus* see below). Golovatch *et al.* 2000 also mentions 'strong evidence of its presence in the British Isles'. In 2005 it was also found in a tropical butterfly house in South Yorkshire (Lee 2005). This species has also been found in hothouses in Paris, Vienna and Berlin (Golovatch *et al.* 2000). It has also been found in a wide range of tropical countries and islands including the Galapagos, Ecuador, the Seychelles, Brazil, Indonesia etc.

Taxonomy

Until recently (Golovatch *et al.* 2001) two separate species of *Cylindrodesmus* were considered to inhabit European hothouses, *C. hirsutus* and *C. laniger*. These are now considered to be synonymous, with variations described by Golovatch *et al.* (2000). Populations of larger individuals (7-8mm), previously identified as *C. hirsutus*, are (nearly) always bisexual; those of smaller individuals (up to 5.5mm), previously identified as *C. laniger*, include some parthenogenetic populations.

It is interesting to note that males appear to be more abundant in the samples from the Eden Project than most other collections.

***PARASPIROBOLUS LUCIFUGUS* (GERVAIS, 1836)**

The order Spirobolida can be distinguished from the Julida (i.e. the families Julidae and Blaniulidae of the British Isles) by the form of the gnathochilarium (seen by examining the underneath of the head capsule, Figure 6), the presence of a suture on the front of head (Figure 7) and details of the male gonopod structure.

Appearance

P. lucifugus resembles a shorter, fatter julid. Males from the Eden Project are 10-16mm in length, 1.2-1.45mm in body height with 25-33 podous rings and 2-4 apodous. Females are up to 19mm in length, up to 1.7mm in body height with up to 35 podous rings and usually 2 apodous rings.

The body shape is cylindrical with very blunt anterior and posterior ends. The background colour of the animals is yellow/green gold with darker red brown stripes at ozopore level and a thin dark dorsal stripe (Figure 8). The repugnatorial glands are dark brown and prominent (in preserved specimens at least).

The head (Figures 7 & 9) has the anterior suture, diagnostic of Spirobolida, clearly visible as a dark line on a paler background (in the Juliformia this is a more or less distinct vertigial furrow). There are 21-25 obvious black ocelli on mature specimens but the rows not easily readable. The antennae are very short and the legs also relatively short.

The telson lacks any anal projection (Figure 10) and is barely distinguishable from the trunk in outline. A notable difference from British Julida is the lack of any setae on the body, head or telson area. British *Cylindroiulus* species may lack setae on the body and head but always have a few on the telson and anal valves.

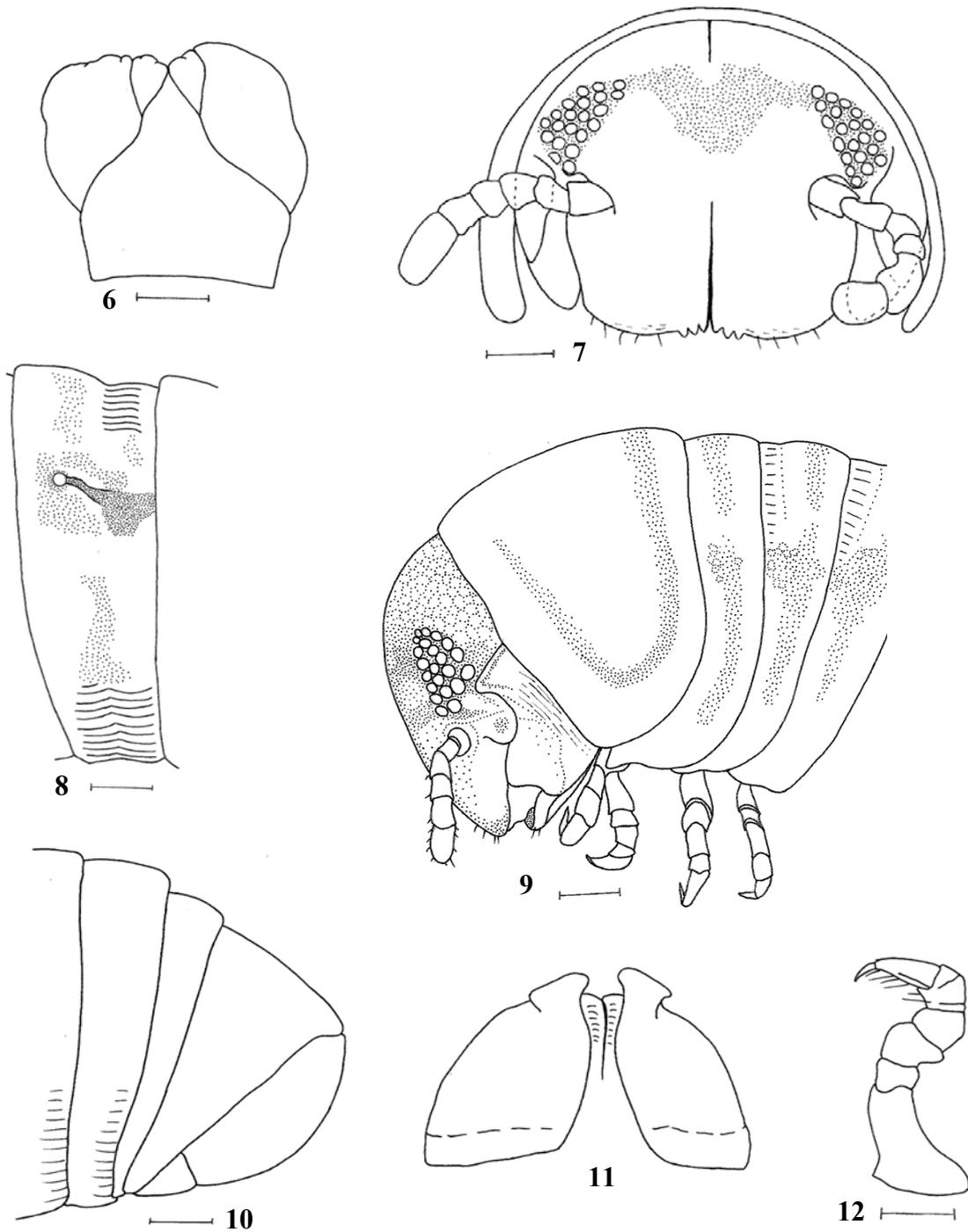
The mature males have gonopods enclosed in the trunk and not projecting at all but the body is slightly swollen where legs 8 & 9 should be. The gonopods are very simple in structure with two main structures closely pressed together (Figure 11). The first pair of legs of mature males looks like slightly shorter, thicker walking legs (Figure 12).

Distribution

No species of this order are represented 'naturally' in Europe and are more typical of tropical regions. The family Spirobolellidae, to which *P. lucifugus* belongs, is found in northern South America, Mexico, the Seychelles, Mauritius, Indonesia and eastern Australian region. *P. lucifugus*

is the only species to have become established in Europe and has been recorded from hothouses in Hamburg (Latzel, 1895) and Denmark (Enghoff, 1975) but its native country and habitat are unknown.

The finding of this species in 2005 by Tony Barber was first reported in the BMIG Newsletter 11. It has subsequently been referred to in Lee (2006) where it is listed as an alien species. It is reported to be well established in the tropical biome.



Figures 6-12 *Paraspirobolus lucifugus*

6. Gnathochilarium. 7. Head anterior view. 8. Mid body segment. 9. Head and first few segments. 10. Telson. 11. Gonopods anterior view. 12. Male first pair of legs.

Scale bars 0.21mm

Taxonomy

Until recently this species has been known as a variety of different names but a recent paper by Jeekel (2001) demonstrated various synonymies and clarified the name. In European literature referring to hot house finds it has largely been referred to as *P. dictyonotus* (Latzel).

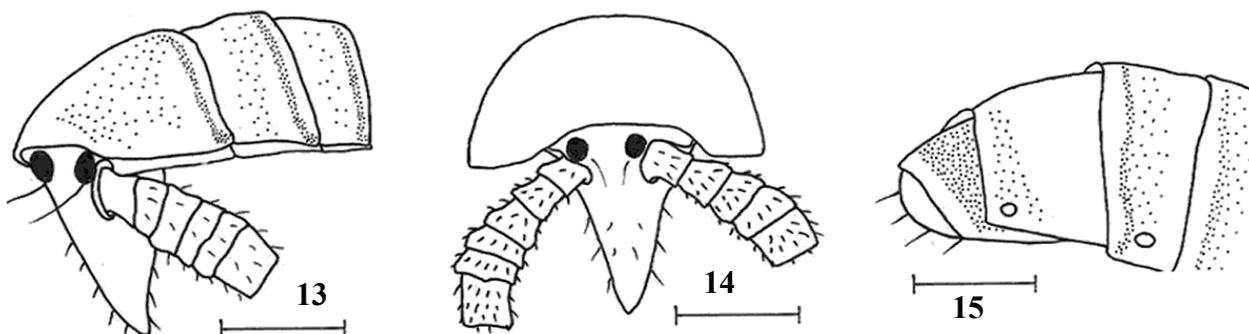
***RHINOTUS PURPUREUS* (POCOCK 1894)**

This is the second genus and species of the order Polyzoniida to be found in Britain, the other being *Polyzonium germanicum* from Kent.

Appearance (based on specimens collected in the Eden Project)

Small in size, males 5-8mm in length, 0.6-0.7mm wide, females up to 6mm long and 0.7mm wide. Males with 31-44 body rings plus telson, females with up to 36.

Head tiny and triangular (Figures 13 & 14), with two large black ocelli and some setae, a very long seta associated with each ocellus. Antennae straight, more or less parallel-sided but slightly broader at the tip. Some of the antennal segments are hard to see and condensed into previous segments. Larger animals purple brown all over, with slightly darker bands on the metazonites, the anterior edge of which is pale. Ozopores clearly visible. Smaller animals paler but at least the anterior parts suffused with purple. Several individuals are darker anteriorly than posteriorly with a very definite demarcation of colour change. Ventrally pale. Tergites smooth, shiny and lacking setae. Legs pale. Telson much smaller than the pre anal ring, which has a slight point dorsally but barely projecting (Figure 15). Setae on telson and approximately three pairs on the anal valves.



Figures 13–15 *Rhinotus purpureus*

13. Head lateral view. 14. Head anterior view. 15. Telson. Scale bars 0.21mm

Leg pairs 9 and 10 are modified in the males into gonopods. These are external and appear from the side as thickened white appendages. The gonopods are illustrated in Golovatch & Korsós (1992)

These specimens agree with the original description (of *Siphonotus purpureus*) by Pocock except that he listed the maximum size as 7mm and considered the antennae to be considerably longer than the head (shown clearly in his diagram). Experience of other colobognathan millipedes suggests that the length of the antennae can be very variable depending on the state of preservation (Read in prep.). The colour was described as light purple in the field, dark purple in alcohol.

Distribution

This species was originally described from under bark in mountain forest 2500ft on St Vincent in the West Indies. J-P Mauriès reports it to be a very widespread species well known in neotropical sites (pers. comm.). It has been formally reported from central America and southern USA (Mauriès, 1980) and the Comoro Islands, Madagascar and Mauritius in the Indian Ocean VandenSpiegel & Golovatch (2007) however it is not clear if it has been recorded from glasshouses.

Finds of *Rhinotus purpureus* in Britain have not previously been referred to in any literature but correspondence between Adrian Rundle and Henrik Enghoff in spring 1986 mentions that specimens had been sent to J-P Mauriès who confirmed them as this species. The correspondence does not state that they were found at Kew Gardens but this is the most likely locality since Adrian Rundle was a frequent collector there and the rest of the correspondence is mostly about species found there, however there is a possibility it was from Edinburgh Botanic gardens (Enghoff pers comm.).

Taxonomy

Originally described as a species of *Siphonotus* Brandt, it was made type species of the genus *Rhinotus* by Cook (1895).

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