

## Oniscidea (Crustacea, Isopoda) from caves of Cape Range in Western Australia. I. The genus *Buddelundia*.

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### Abstract

Oniscidae, Philosciidae and Armadillidae have been collected in caves of Cape Range. Armadillidae of the genus *Buddelundia* are the most represented with five species and one subspecies. Four of them new to science are described. None is a true troglobite.

### Introduction

For some years explorations have been carried out in caves of the semi-arid Cape Range in Western Australia (Humphreys 1990, 1991; Humphreys, Adams & Vine 1989). The Oniscidea crustaceans collected during 1988 and 1989 belong to the three families Oniscidae, Philosciidae and Armadillidae. This first note deals with the genus *Buddelundia* (Armadillidae) which is, by the number of species, the best represented in caves. This genus is well distinguished by its pleopods which are coadapted and fit together except the fifth which is without pseudotracheae and hidden by the fourth. This form is unique among Oniscidea and a good account of it, at the same time as a guide of the described species, was given by Wahrberg (1922, p.198-200 & 203-204).

Numbers with a C- prefix denote caves in the Cape Range Karst region. Holotypes of new species and the greater number of paratypes are lodged in the Western Australian Museum, Perth (WAM); specimens prefixed by the letters DH are in the personal collection of the author.

### Systematics

#### *Buddelundia cinerascens* (Budde-Lund, 1912)

Figure 1

*Armadillo (Buddelundia) cinerascens* Budde-Lund, 1912, p.26, fig.IX.

*Buddelundia cinerascens* .-Wahrberg, 1922, p.204 & 229.

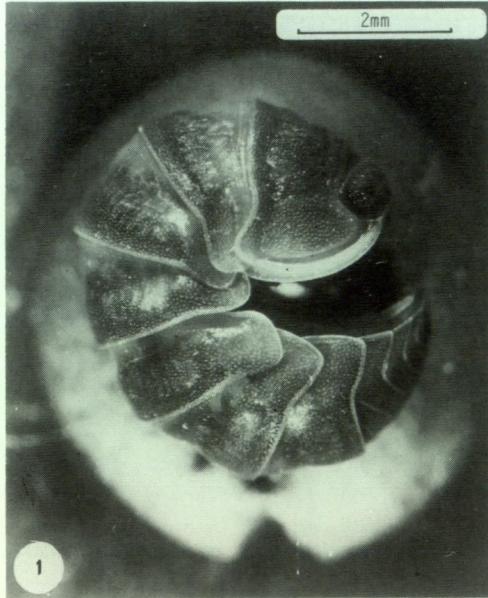
*Buddelundia cinerascens* .-Vandel, 1973, p.148.

*Buddelundia cinerascens* .-Bunn & Green, 1982, p.147 & 149.

**Syntypes:** Budde-Lund coll., British Museum (Natural History), 1921 10.18.2464-2465, 1 male & 1 female; Wahrberg coll., Swedish Museum of Natural History, n°6189, 1 male & 2 broken specimens.

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**Figure 1** *Buddelundia cinerascens* (Budde-Lund), whole animal in lateral view.

**Other material examined:** C-118, 12.VIII.1989, WAM 51-91 1 female.

This species was described from Rottnest Island (Budde-Lund, 1912) and later found on Carnac Island (Wahrberg, 1922) both in Western Australia. It is not necessary to redescribe this species, well described by Wahrberg and it is only illustrated here (fig.1). This species is not a troglobite and it was collected in a "pitfall trap placed around the outside of the doline containing the cave entrance" (Humphreys pers. comm.).

***Buddelundia grisea* sp.nov.**

Figures 2-9

**Holotype**

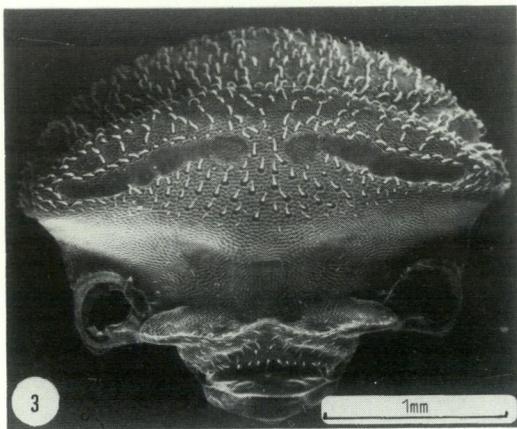
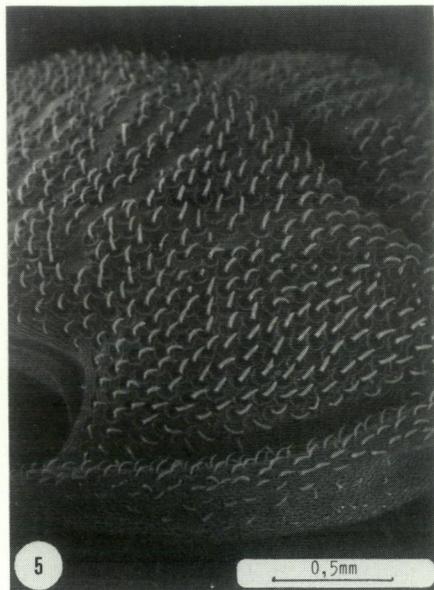
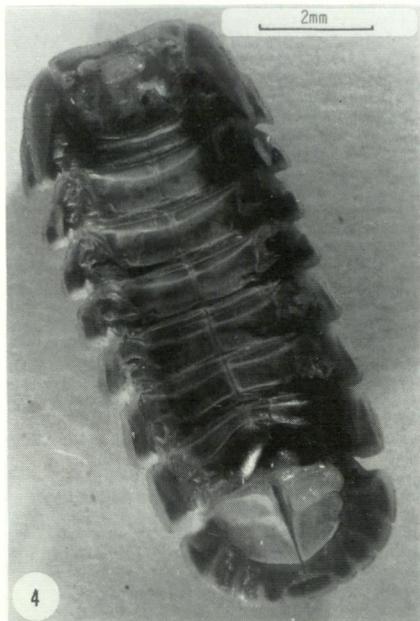
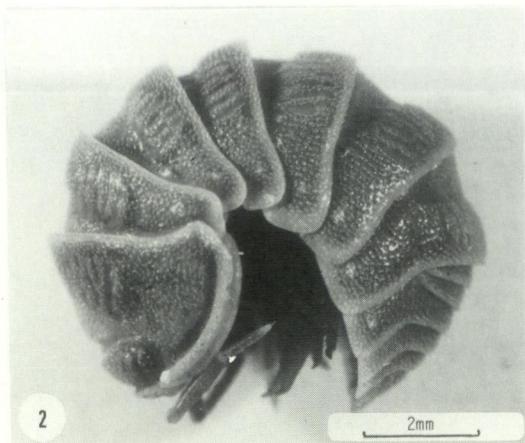
C-162 (= Rock Bench Cave), 12.IX.1988, WAM 972-88 1 male.

**Paratypes**

C-15, 25.VI.1989, WAM 52-91 1 juvenile; C-21, 10.VII.1989, WAM 53-91 1 female; C-60, 9.VII.1989, WAM 54-91 1 female; C-64 (= Shot-Hole Tunnel), 27.VI.1989 & 3.VII.1989, WAM 55-91, 56-91 & 57-91 1 male and 7 females, DH 1 male and 3 females; C-68, 26.VI.1989, WAM 58-91 2 males and 1 female, DH 1 male; C-96 (= Anomaly Cave), 30.VI.1989, WAM 59-91 1 female; C-118, 8.IX.1988, WAM 964-88 1 female; C-156, 23.VI.1989 & 16.VIII.1989, WAM 60-91, 61-91, 62-91 & 63-91 4 males; C-162 (= Rock Bench Cave), 6.IX.1988, WAM 469-92 1 male; 12.IX.1988, WAM 64-91 1 male, DH 1 male and 1 female; 20.VI.1989, 21.VI.1989, WAM 65-91 & 66-91 5 males & 5 females, DH 2 males & 2 females.

**Diagnosis**

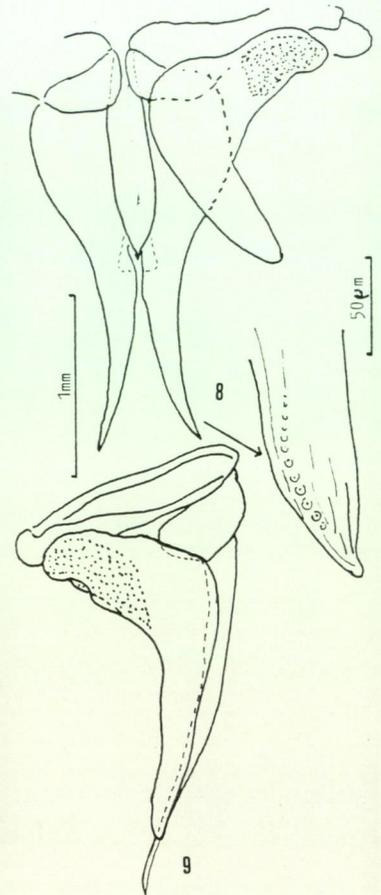
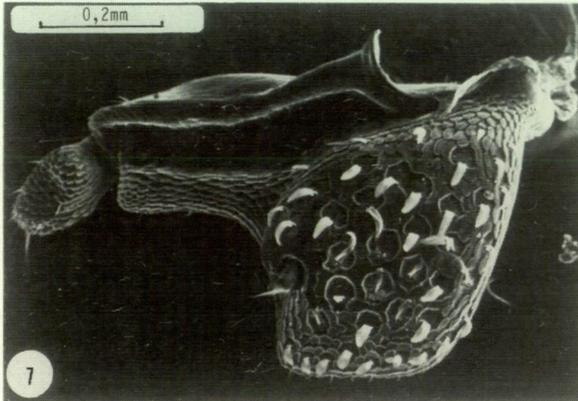
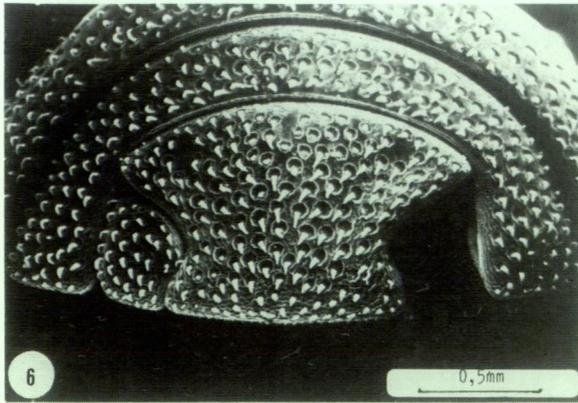
Conglobating species with lateral sides of the body vertical. A secondary frontal line well developed, while frontal line is discrete. Exterior lobe of the schisma larger than



Figures 2-5 *Buddelundia grisea* sp.nov. 2: whole animal in lateral view; 3: cephalon in frontal view (S.E.M.); 4: whole animal in ventral view; 5: surface of the first peraeonite (S.E.M.).

internal. *Sulcus arcuatus* on first peraeon segment and interlocking system present as far as the third pleon segment.

By its frontal line, the parallel pleura of the fifth pleonite and the relative size of external and internal lobes of the first peraeon segment, *B. grisea* is to be compared with *B. bulbosa* Wahrberg, 1922 and *B. frontosa* (B.-L., 1912). From the first, *B. grisea*



Figures 6-9 *Buddelundia grisea* sp.nov. 6: telson (S.E.M.); 7: right uropod (S.E.M.); 8: first male pleopod; 9: second male pleopod.

differs in many characters and in particular by the shape of both the secondary frontal line and frontal line, by the *sulcus arcuatus* being more developed in *B. grisea*, by the sinuosity of the posterior margin of the first peraeon segment being more marked in *B. bulbosa* and by the shape of the telson and uropods. From *B. frontosa*, the differences are related to the secondary frontal line and frontal line, the shape of the anterior parts of first peraeon epimeron which are slightly turned up in *B. grisea* and also the telson and uropods which are different between the two species.

### Description

Size of holotype 10.6x4.2mm. Lead grey colour with sites of muscle attachment paler. Black eyes with 15 ommatidia. Conglobating (fig.2) with lateral sides of the body

vertical. Cephalon (fig.3) with frontal line discrete and which disappears in the middle part, where it is just concave. Secondary frontal line well developed and overhanging vertex. Lateral ocular tubercles present. Clypeal line split and clypeal lobes rounded and horizontal.

First peraeon segment with posterior margin sharp sinuated. Lateral margins slightly thickened and turned up. *Sulcus arcuatus* present. Schisma with external lobe protruding backward compared to internal lobe. A discrete groove extends anterior to the schisma. Process well developed on ventral surface of second peraeonite epimeron; indications of folds on the ventral face of fourth to seventh peraeon segments (fig.4).

Well developed fold belonging to interlocking system, present on ventral face of pleura of third pleon. Pleura of fifth segment parallel. Telson hour-glass shaped with distal part short and with apex slightly rounded (fig.6).

Body smooth but covered by setae in close order. These setae curved backwards and, in the paramedian part of peraeon, arranged in rib-like parallel rows (fig.5). A1 (antennule) three-jointed, with about 10 aesthetascs on the apex of the distal article. A2 (antennae) with two jointed flagellum, ratio distal joint: proximal joint = 2.

Mx1 (first maxilla) with 10 teeth. Uropod with distal part of protopodite rectangular and minute exopodite (figs 6 & 7). No sexual dimorphism apparent in peraeopods. Pleopods 1 and 2 of male as in figs 8 & 9.

### Distribution

This species is known only from caves of Cape Range but it is not considered to be a troglobite as there is no depigmentation, nor anophthalmy or elongation of appendages. It will probably be found outside caves when investigated. It is a facultative troglobite like *B. albomarginata* Wahrberg, 1922 described from Broome in Western Australia but often found in caves on the Nullarbor Plain in South Australia.

### Derivation of name

From the old german language *gris*, in allusion to its coloration.

### *Buddelundia hirsuta* sp.nov.

Figures 10-16

#### Holotype

C-162 (= Rock Bench Cave), 10.IX.1988, WAM 967-88 1 male.

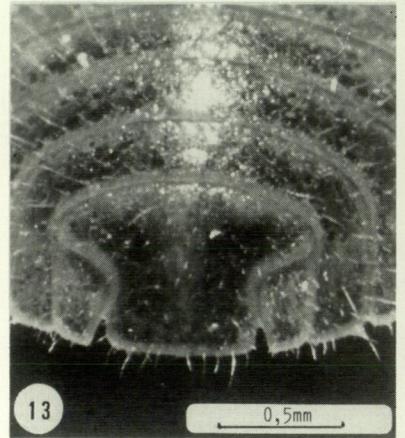
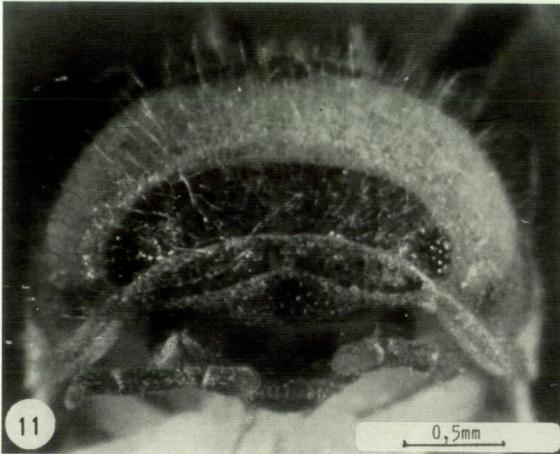
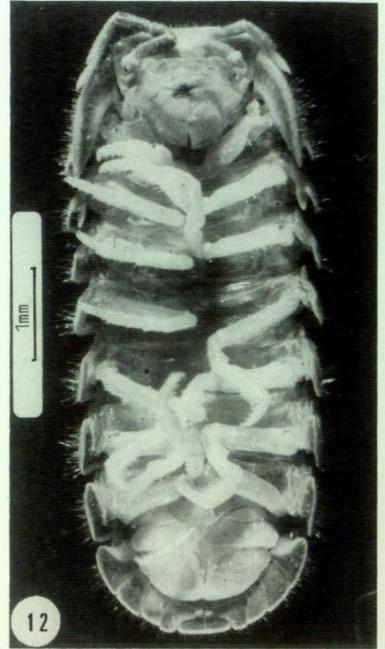
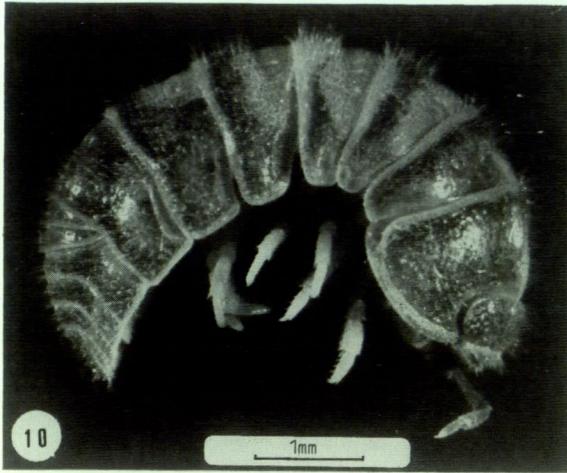
#### Paratype

C-118, 18.VIII.1989, pitfall trap near entrance, WAM 67-91 1 female.

### Diagnosis

Frontal line and secondary frontal line well developed. A slight groove in place of *sulcus arcuatus*. Internal lobe of the schisma greater than external. Interlocking system present on all the peraeon segments and on the third segment of pleon.

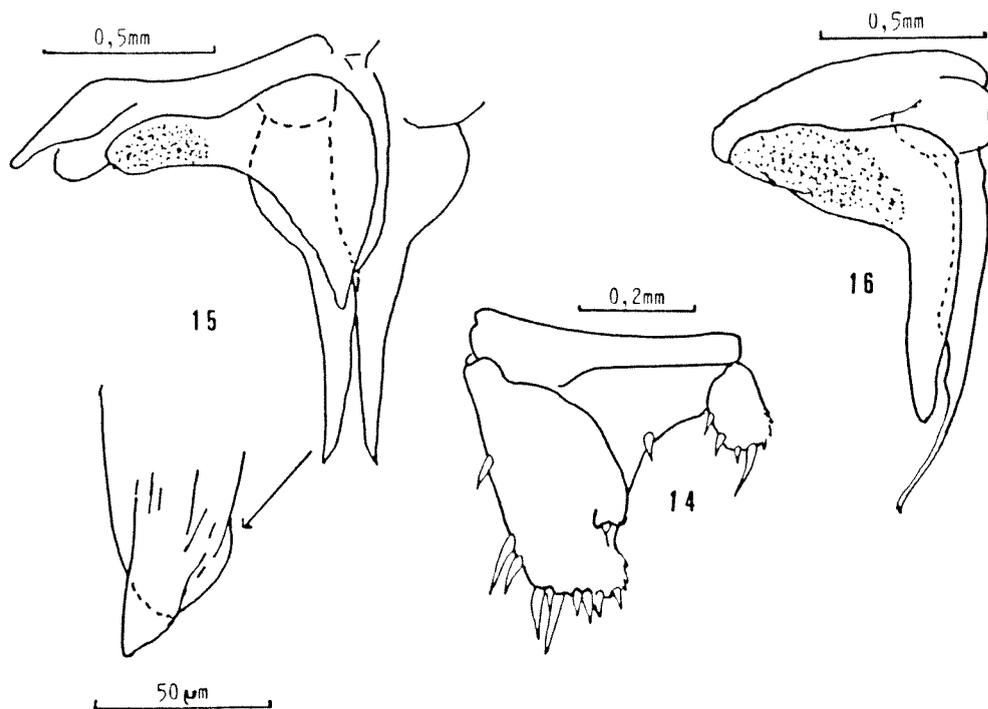
This species is near *B. monticola* (B.-L., 1912) and closest to *B. grisea*.



Figures 10-13 *Buddelundia hirsuta* sp. nov. 10: whole animal in lateral view; 11: cephalon in frontal view; 12: whole animal in ventral view; 13: telson and uropods.

From *B. monticola* it differs in the shape of the secondary frontal line, of the lateral margin of the first pereon segment, of the protopodite of uropod, by the hairy appearance and by the pigmentary patterns.

From *B. grisea*, it differs in the hairy appearance, in the sinuosity of the posterior



Figures 14-16 *Buddelundia hirsuta* sp.nov. 14: left uropod; 15: first male pleopod; 16: second male pleopod.

margin of the first peraeon segment, and in the shape and respective size of external and internal lobes of the schisma of the first peraeon segment.

### Description

If the specimens are adult, this species is small for the genus *Buddelundia*. Size 6.9x2.9mm. Lead grey colour with places of muscular attachment paler. Clear spot on each epimeron of peraeon. Black eyes with 13-14 ommatidia.

Congobulating species with lateral sides of body vertical (fig.10). Cephalon with secondary frontal line well developed, in arc of a circle (fig.11). Frontal line distinct and uninterrupted. Lateral ocular tubercles absent. Clypeal line uninterrupted and clypeal lobes rounded and horizontal.

First peraeon segment with posterior margin not sinuate and with lateral margins slightly thickened and revolute. *Sulcus arcuatus* not well differentiated but a slight groove present. Schisma with internal lobe greater than external. Internal process of second peraeon segment well developed. Internal face of epimera with processes progressively more developed from third to seventh peraeon segment (fig.12).

Pleuron of third pleon segment with distinct process in relation to interlocking

system. Pleuron of fifth segment parallel. Telson with apex subrectangular (fig.13).

Body smooth with long, upright setae making animal seem hairy. A1 with 7 to 8 aesthetascs at tip. A2 with two jointed flagellum; ratio distal joint/proximal joint = 2.9. Mx1 with 10 teeth. Uropod with distal part of protopodite rounded and very minute exopodite (fig.14).

Male pleopods 1 and 2 (figs 15&16) without distinctive features.

### **Distribution**

This species is not a troglobite as it was collected also in pitfall trap on the surface near C-118.

### **Derivation of name**

From the latin *hirsutus* in allusion to the upright setae which made the animal hirsute.

## ***Buddelundia humphreysi* sp.nov.**

Figures 17-23

### **Holotype**

Learmonth near Cape Range, outside of cave, 1.VII.1989, WAM 68-91 1 male.

### **Paratypes**

Learmonth, outside of caves, 5.IX.1988, WAM 984-88 1 female; 9.IX.1988, WAM 985-88 3 males and 10 females, DH 3 males and 5 females; 1.X.1988, WAM 986-88 1 male, WAM 987-88 1 male and 2 females, DH 1 female; C-162 (= Rock Bench Cave), 6.IX.1988, WAM 963-88 1 female; C-203, 19.VII.1989, WAM 69-91, 70-91 & 71-91 4 females, DH 1 female; C-328, 28.VIII.1989, WAM 72-91, 73-91, 74-91 & 75-91 5 males and 3 females, DH 2 males and 1 female.

### **Diagnosis**

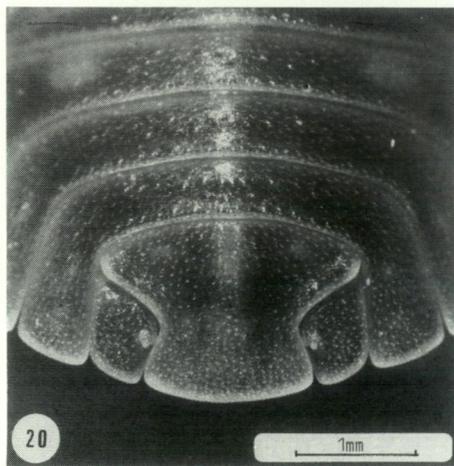
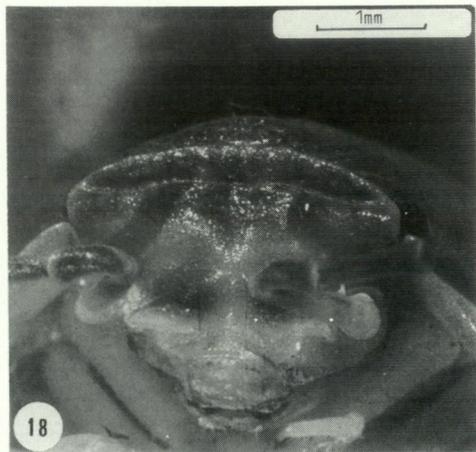
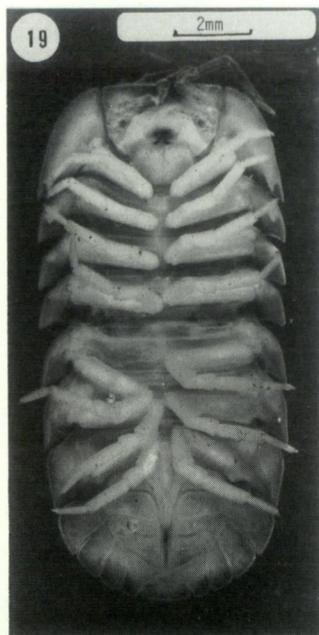
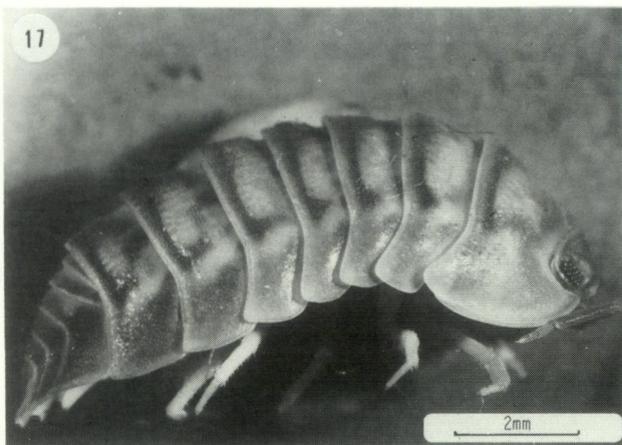
Light brown-coloured body with two clear spots on every peraeonite. Lateral sides of the body oblique. Frontal line and secondary frontal line uninterrupted. *Sulcus arcuatus* absent and external lobe of the schisma greater than internal. Interlocking system restricted to I and II peraeonites.

This species differs from *B. binotata* (B.-L., 1912), *B. laevigata* (B.-L., 1912) and *B. sulcata* (B.-L., 1912) in many characters, particularly in that the *sulcus arcuatus* is absent in *B. humphreysi* and present in the three other species.

### **Description**

Size of 13.4x6.5mm. for the holotype and 15.7x6.5mm. for the biggest female. Colour light brown, with two clear spots on every peraeon segment on both sides of uniformly coloured central part of body. Dark spot between uniformly coloured light grey brown (fig.17) tergite and epimeron. Pleon and telson uniformly coloured. Black eyespots with 18-19 ommatidia.

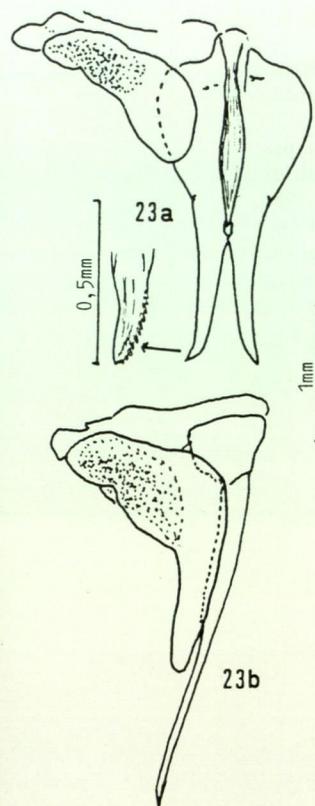
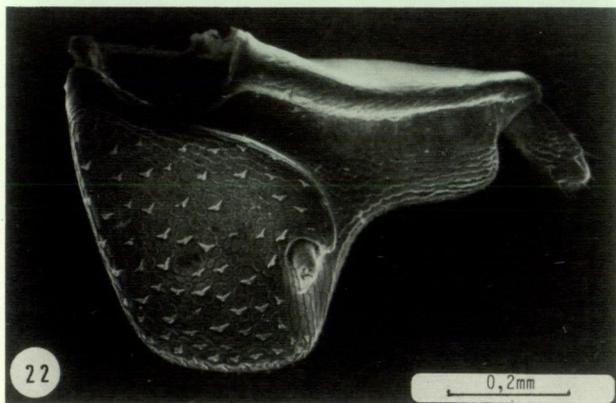
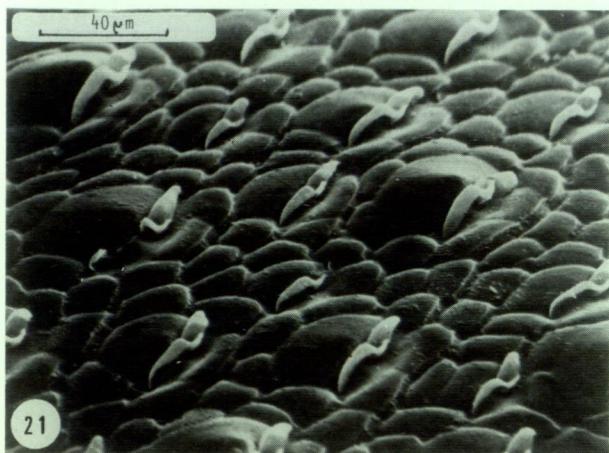
Conglobating species with lateral sides of body oblique. Cephalon (fig.18) with uninterrupted secondary frontal line not raised above level of vertex. Frontal line



Figures 17-20 *Buddelundia humphreysi* sp. nov. 17: whole animal in lateral view; 18: cephalon in frontal view; 19: whole animal in ventral view; 20: telson and uropods.

distinct and uninterrupted. Very small latero-ocular tubercles. Clypeal line divided and depressed medially; clypeal lobes subrectangular and horizontal.

First pereaeon segment with posterior margin progressively sinuate. Lateral margins thin. No *sulcus arcuatus*. Schisma with external lobe greater than internal. Internal



Figures 21-23: *Buddelundia humphreysi* sp.nov. 21: surface of the first peraeonite (S.E.M.); 22: left uropod; 23: first (23a) and second (23b) male pleopods.

process of the second peraeon segment moderately developed. Interlocking system restricted to first two peraeon segments (fig.19).

Pleura of fifth pleon segment parallel; telson hour-glass shaped with apex margin convex (fig.20).

Body smooth, without setae (fig.21). A1 with about 7 aesthetascs apically. A2 with two jointed flagellum; ratio distal joint/proximal joint = 1.2. Uropod with distal part of the protopodite slightly rounded, exopodite reduced (fig.22).

#### Distribution

This species is not troglobitic and is common outside caves.

#### Derivation of name

After Dr W.F. Humphreys who collected many of these new species.

***Buddelundia zebricolor* sp.nov.**

Figures 24-32

**Holotype**

Outside of C-167, 16.IX.1988, WAM 977-88 1 female

**Paratypes**

Outside of cave C-18 (= Dry Swallet Cave), 21.IX.1988, WAM 983-88 1 female; outside of cave C-118, 14.X.1988, WAM 973-88 1 female; C-15, 25.VI.1989, WAM 76-91 1 female; C-102, 9.VII.1989, WAM 77-91 1 male; C-106 (= Shot Pot Cave), 21.VI.1989, WAM 78-91 2 males, DH 1 male; C-163 (= Wanderer's Delight Cave), 29.VI.1989, WAM 79-91 1 male; C-177, 7.VII.1989, WAM 80-91 1 male; C-207 (= Two Hundred Cave), 16.VII.1989, WAM 81-91 1 female; C-219, 30.VI.1989, WAM 82-91 1 male; C-222, 30.VI.1989, WAM 83-91 1 female; C-224, 30.VI.1989, WAM 84-91 1 female; C-252, 22.VII.1989, WAM 85-91 1 female; C-254, 7.VIII.1989, WAM 86-91 1 female, DH 1 female.

**Diagnosis**

Lateral sides of the body oblique. Only the frontal line is present and uninterrupted. No *sulcus arcuatus* and external lobe of the schisma greater than internal. Interlocking system includes all the peraeon segments.

*Buddelundia zebricolor* belongs to the primitive group of *Buddelundia* which lack a secondary frontal line. Within this group it is closest to *B. albomarginata* Wahrberg, 1922 and *B. tomentosa* (B.-L., 1912).

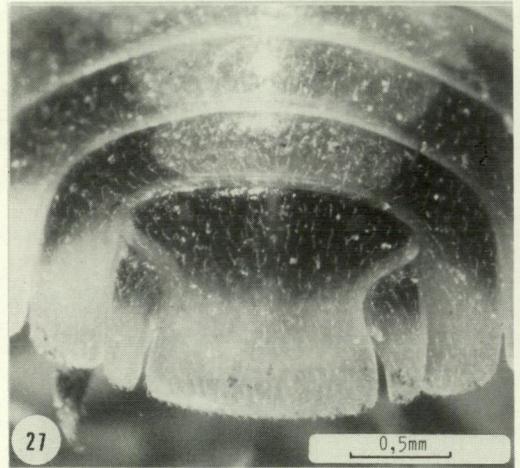
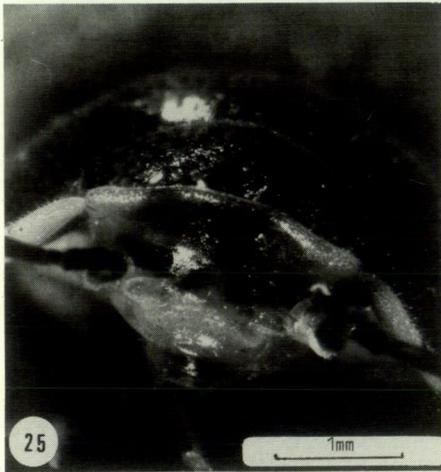
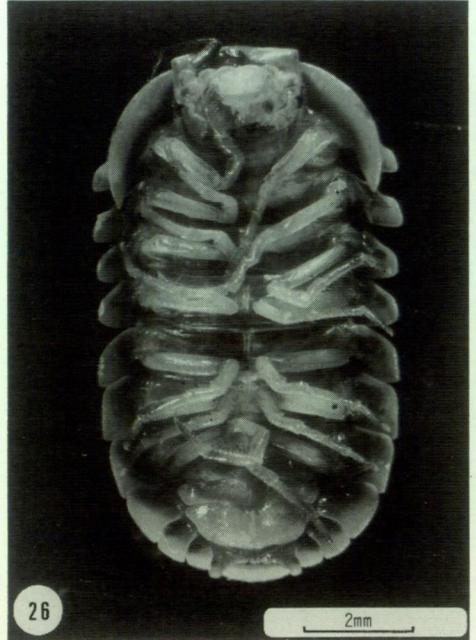
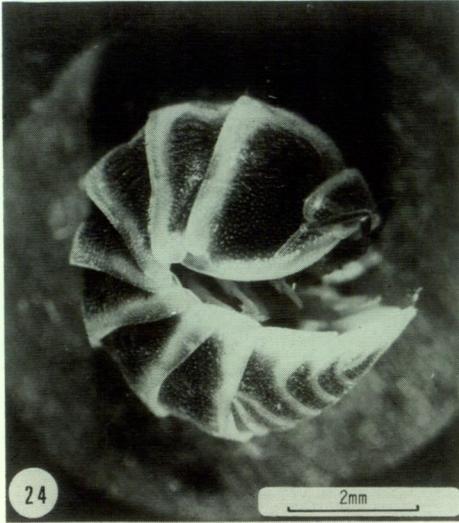
It differs from *B. albomarginata* by the tegumentary surface having setae which are absent in *B. albomarginata*. The shape of the schisma is also different and the external lobe, is greater in *B. albomarginata*, and smaller in *B. zebricolor*. The shape of the telson shows an apex wider in *B. zebricolor* than in *B. albomarginata*; while the protopodite of uropod is triangular in *B. zebricolor*, subquadrangular in *B. albomarginata*. The posterior margin of the first peraeon segment is barely or not sinuate in *B. zebricolor* and angularly sinuate in *B. albomarginata*.

It differs from *B. tomentosa* by the shape of the frontal line which is straight in *B. zebricolor* and curved backwards on the vertex in *B. tomentosa*. Moreover this line is higher on the vertex in *B. zebricolor* than in *B. tomentosa*. The tegumentary surface has erect setae in *B. tomentosa*; curved setae in *B. zebricolor*. The lateral margins of the first peraeon segment are thicker in *B. tomentosa*; the lateral sides of the peraeon segments are more vertical in that species and oblique in *B. zebricolor*.

**Description**

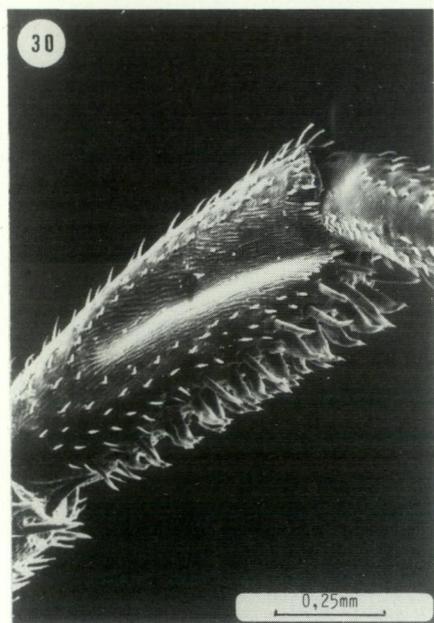
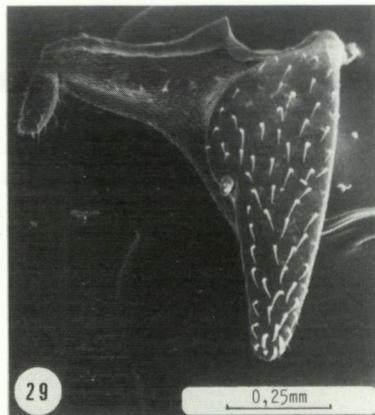
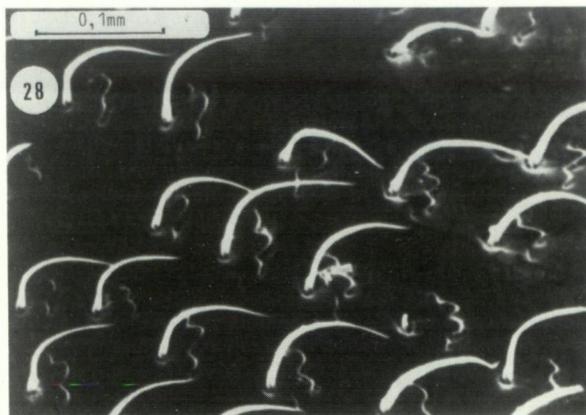
Size of holotype 10.2x5.3mm. Generally deep grey colour, posterior and lateral margins of peraeon segments, pleura of pleon segments and apex of uropod protopodite and of telson white, giving animal pale transverse stripes and white border (fig.24). Black eyes with 14-15 ommatidia.

Conglobating with lateral sides of body oblique, splayed out at anterior part of first epimera of peraeon. Cephalon (fig.25) with frontal line clear and uninterrupted. Secondary frontal line absent, as is lateral-ocular tubercle. Clypeal line uninterrupted and clypeal lobes horizontal and rounded.



**Figures 24-27** *Buddelundia zebricolor* sp. nov. **24:** whole animal in lateral view; **25:** cephalon in frontal view; **26:** whole animal in vertical view; **27:** telson and uropods.

First peraeon segment with posterior margin not sinuate, lateral margins thin; no *sulcus arcuatus*. External schisma with external lobe protruding backwards compared to internal lobe (fig.26). Second peraeon segment with triangular process on ventral

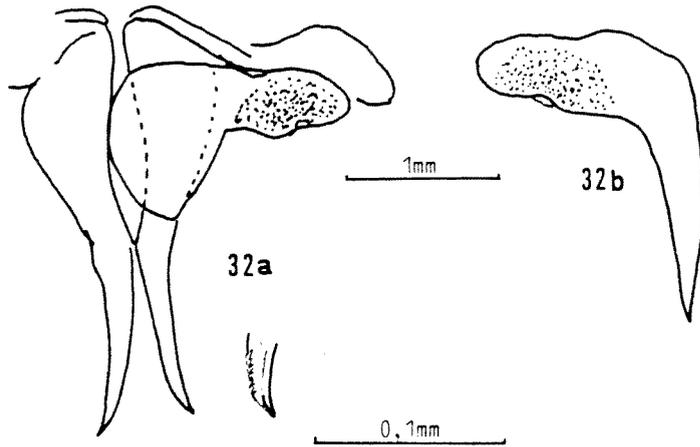


**Figures 28-31** *Buddelundia zebricolor* sp. nov. **28:** surface of the first pereon (S.E.M.); **29:** right uropod (S.E.M.); **30:** carpus of first male pereopod (S.E.M.); **31:** ventral setae of carpus of the first male pereopod.

surface of epimera; fold on ventral face of third to seventh pereon segment, progressively more prominent posteriorly.

Pleon with pleura of fifth segment parallel. Telson hour-glass shaped with apex slightly rounded (fig.27).

Body smooth, tergites covered with small setae curved backwards (fig.28). A1 with



**Figure 32** *Buddelundia zebricolor* sp. nov.; first (32a) and second (32b) male pleopods.

7-8 aesthetascs on apex of distal article. A2 two-jointed flagellum; ratio distal joint/proximal joint = 1.32. Uropod (fig. 29) with distal part of protopodite convergent and with apex rounded; largest specimens and males with protopodite triangular with apex acute; exopodite and endopodite reduced.

Sexual dimorphism is obvious on peraeopods where some carapian brush setae are broad and short in males (figs 30 & 31).

### **Distribution**

This species is not troglobitic and is common outside caves.

### **Derivation of name**

In allusion to the regular succession of clear and dark stripes which make the animal stripy.

### ***Buddelundia zebricolor fulva* subsp. nov.**

Figures 33-34

#### **Holotype**

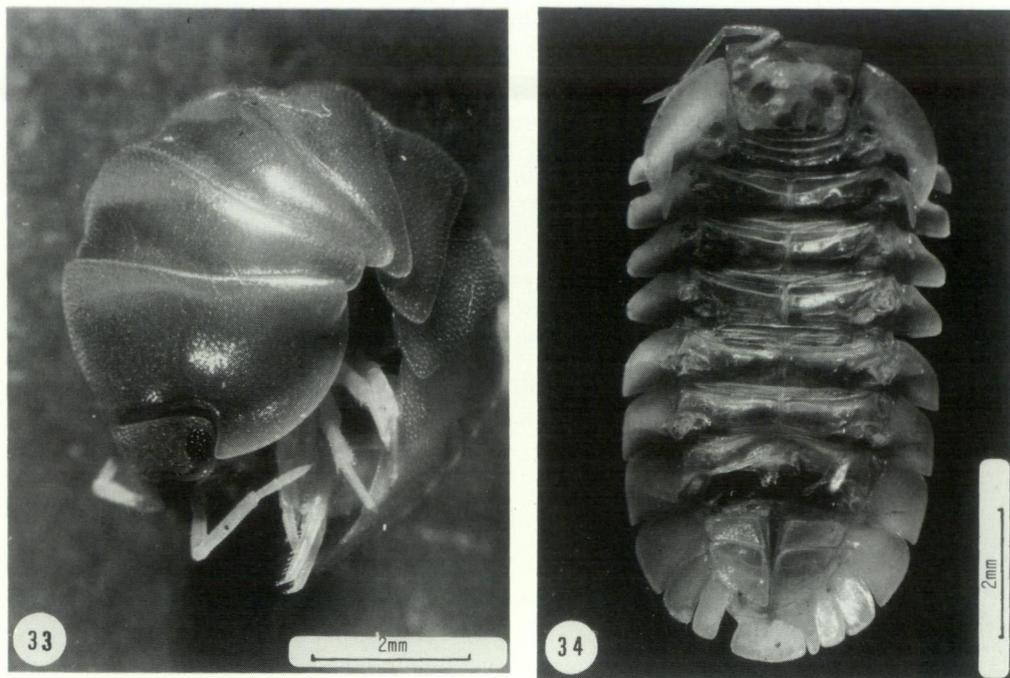
C- 94, 20.IX.1988, WAM 981-88 1 male.

#### **Paratypes**

C- 94, 20.IX.1988, WAM 87-91 2 males, DH 1 male.

### **Diagnosis**

Similar to *B. z. zebricolor* except frontal line which is slightly more raised above vertex and colour which is uniformly fawn-coloured. For the moment, it seems advisable to consider *fulva* as a subspecies of *zebricolor* rather than a distinct species.



Figures 33-34 *Buddelundia zebricolor fulva* subsp. nov. 33: whole animal in lateral view; 34: whole animal in ventral view.

### Description

Size 11.7x5.7mm. for holotype. Fawn colour in animals freshly preserved, changing to pale grey with time in alcohol. Black eyes with 14 ommatidia, the external row colourless, so animal appears microphthalmic.

The overall morphology is similar to *B. z. zebricolor* (fig.33-34). Differences concern the frontal line which is slightly more raised above the level of the vertex in *B. z. fulva* than in *B. z. zebricolor zebricolor*. The lateral margins of the first pereopod segment are more splayed in *B. z. fulva* than in *B. z. zebricolor* but they are not structurally different and the two subspecies are closely related.

### Distribution

This subspecies has been collected only in a cave and seems the single *Buddelundia* found in Cape Range caves which shows inclinations to troglomorphic features.

### Derivation of name

From the latin *fulvus* in allusion to its fawn colour.

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