

## Three new species of cavernicolous goblin spiders (Araneae, Oonopidae) from Australia

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**Abstract** – The first cavernicolous members of the goblin spider family Oonopidae from Australia are described, all from Western Australia: *Opopaea ectognophus* sp. nov. from the Pilbara region; *Opopaea phineus* sp. nov. from the Kimberly region; and *Camptoscapbiella infernalis* sp. nov. from Cape Range.

### INTRODUCTION

The Oonopidae are one of the more diverse spider families in the world with 472 species in 68 genera (Platnick, 2007). They can be found in most terrestrial environments but are particularly dominant in leaf litter and humus, especially in the tropics. The Australian fauna has been little studied and at present only nine species have been named: *Gamasomorpha clarki* Hickman, *G. loricata* (L. Koch), *G. servula* Simon, *Grymeus barbatus* Harvey, *G. robertsi* Harvey, *G. yanga* Harvey, *Oonops leai* Rainbow, *Opopaea banksi* (Hickman), *Orchestina launcestoniensis* Hickman, and the introduced *Oonops pulcher* Templeton (see Davies, 1985; Harvey, 1987). Six other species originally attributed to the Oonopidae by Hickman (1930, 1932, 1979) – *Cornifalx insignis* Hickman, *Oonopinus mollipes* Hickman, now *Hickmanolobus mollipes* (Hickman), *Tasmanoonops alipes* Hickman, *T. fulvus* Hickman, *T. inornatus* Hickman and *T. magnus* Hickman – were transferred to the Orsolobidae by Forster and Platnick (1985) as they share the putative synapomorphy of orsolobids (an elevated tarsal organ).

During surveys of several cave and karst systems in Western Australia, three anophthalmous, poorly pigmented species have been recently collected. Although each is represented by only a single specimen, the likelihood of obtaining additional material in the near future is very small, and descriptions of these peculiar species are warranted.

The material examined for this study is lodged in the Western Australian Museum, Perth (WAM). The specimens were examined with a Leica MZ16 microscope. Temporary slide mounts of dissected structures were prepared by immersion of specimens in concentrated lactic acid or glycerol at room temperature for several hours, and mounting

them on microscope slides with 10 or 12 mm coverslips supported by small sections of 0.25 mm diameter nylon fishing line. These slide-mounts were studied with an Olympus BH-2 compound microscope and illustrated with the aid of a drawing tube. Measurements were taken at the highest possible magnification using an ocular graticule. After study the specimens were rinsed in water and returned to 75% ethanol with the dissected portions placed in 12 x 3 mm glass genitalia microvials (BioQuip Products, Inc.). The terminology of the female genitalia follows Saaristo and Harten (2006).

### SYSTEMATICS

#### Family Oonopidae Simon

#### Genus *Opopaea* Simon

*Opopaea* Simon, 1891: 560.

#### Type species

*Opopaea deserticola* Simon, 1891, by monotypy.

#### Diagnosis

As defined by Saaristo (2001) males of *Opopaea* have a greatly enlarged and ovoid pedipalpal patella, and the cymbium is completely fused to the bulb with no trace of a suture line. Females have a depression on the scute behind the epigastric furrow and a small rounded protuberance (the parmula) situated anterior to the furrow.

#### Remarks

The oonopid genus *Opopaea* has a world-wide distribution and 43 species are currently recognised (Platnick, 2007). Species of *Opopaea* have long been

confused with other oonopid genera such as *Gamasomorpha*, but the work of Brignoli (1975, 1976, 1978) has helped to reduce the confusion by providing a redefinition of these genera, with the subsequent transfer of some species to other genera. The main criterion that distinguishes *Opopaea* from most other genera of Oonopidae is the unusual shape of the male pedipalp in which the patella is greatly enlarged (Figure 4) (Brignoli, 1975; Saaristo, 2001). This character state is also shared with *Marsupopaea* Cooke and *Camptoscaphiella* Caporiacco (Cooke, 1972; Brignoli, 1976, 1978). Males of *Marsupopaea* can be recognised by the deep "pouch" under the mouthparts which receives the pedipalps (Cooke, 1972). *Camptoscaphiella* can be distinguished from both of these genera by the lack of fusion of the cymbium to the bulb (Brignoli, 1976, 1978). Several species currently listed within *Opopaea* do not exhibit the diagnostic morphology of the male pedipalp with the enlarged patella, combined with the completely fused cymbium and bulb, including *O. foveolata* Roewer from Micronesia, *O. calona* Chickering from Florida, U.S.A., *O. fosuma* Burger from central Sumatra and *O. viamao* Ott from Rio Grande do Sol, Brazil (see Burger *et al.*, 2002; Chickering, 1969; Ott, 2003; Roewer, 1963). The relationships of these unusual species must be tested via comprehensive phylogenetic analyses on a wide range of taxa.

The Australian members of *Opopaea* have been little studied and the sole described species until now is *O. banksi* (Hickman) from Reevesby Island, South Australia. The various Australian museum collections contain vast numbers of new species (Harvey, unpublished data). The two new species are the first fully blind species to be recorded from Australia. *Opopaea ectognophus* differs from most species of *Opopaea* by lacking sternal apodemes leading away from coxae II–IV (Figure 2), but the morphology of the male pedipalp conforms closely to the generic diagnosis presented by Saaristo (2001) and we therefore attribute this species to *Opopaea*. *Opopaea ectognophus* and *O. phineus* also resemble other members of the genus by the presence of paired apodemes leading posteriorly from the genitalic region. These apodemes have been illustrated for the males and females of numerous species of *Opopaea* and other some oonopid genera (Saaristo, 2001) and will prove to be an important feature in assessment of the phylogenetic studies of the family.

*Opopaea ectognophus* sp. nov.

Figures 1–5

**Material examined**

*Holotype*

Australia: *Western Australia*: ♂, Mesa G, 24.8 km

SW of Pannawonica (Borehole MEGRC0130, trap 2), 21°44'10"S, 116°06'28"E, depth 20 m, March–May 2005, M. Greenham, D. Kamien and L. Mould (WAM T65789).

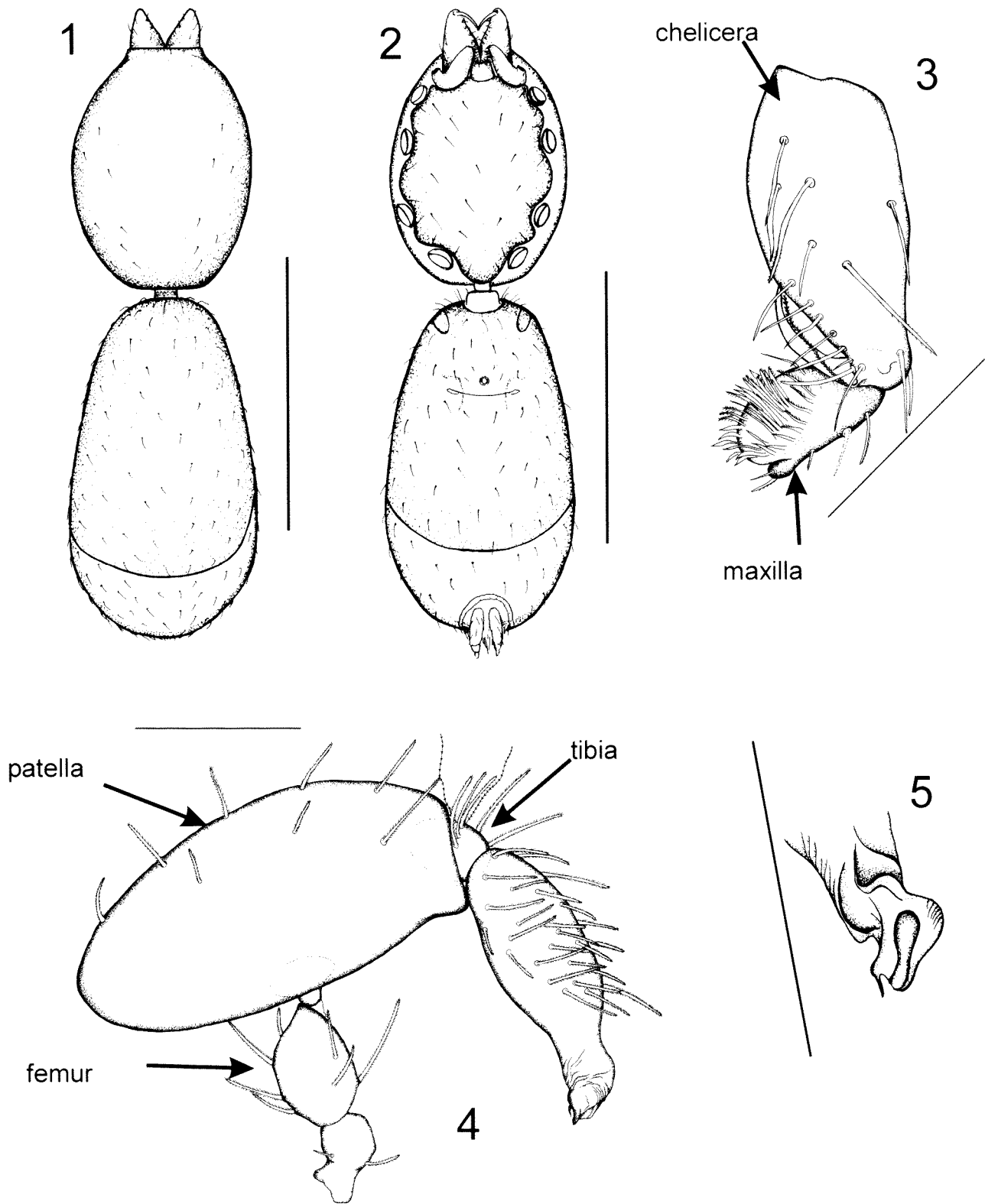
**Diagnosis**

*Opopaea ectognophus* and *O. phineus* are the only fully blind species of the genus currently known. *Opopaea ectognophus* differs from *O. phineus* as follows: it is significantly smaller than *O. phineus* (total length 1.12 versus 1.50 mm); the dorsal abdominal scute only partially covers the opisthosoma (it covers all of the opisthosoma in *O. phineus*); the postero-lateral margins of the carapace rounded and less angulate in *O. ectognophus* (they are angulate in *O. phineus*); and the sternum of *O. ectognophus* lacks apodemes leading away from coxae II–IV (apodemes are present in *O. phineus*).

**Description**

*Adult male* (WAM T65789)

*Colour*: pedipalp deep orange-red; prosoma, chelicera, legs and opisthosoma pale yellow; soft areas white. *Carapace* (Figure 1): ovoid; 1.38 times longer than broad; setae sparse. *Eyes*: absent. *Clypeus*: clypeus and posterior ridge of pars cephalica with only a few fine setae. *Sternum* (Figure 2): smooth; fused with carapace; longer than wide; sparsely covered with short, thin setae; without apodemes leading away from trochanters II–IV. *Labium*: fused with sternum; anteriorly indented; 12 setae on anterior margin and 2 medial setae. *Chelicera* (Figure 3): 2.14 times longer than wide; without teeth; with median lamella; fang without proximal lobe; anterior inner margin with distal setae. *Opisthosoma* (Figures 1, 2): ovoid; 1.97 times longer than broad; dorsal scute partially covering opisthosoma; ventral scute partially covering opisthosoma and is divided by epigastric furrow; book-lung covers without setae, colour similar to surrounding cuticle. *Colulus*: long and slender with 2 setae; sclerotised ring incompletely surrounding spinnerets and colulus. *Male pedipalp* (Figures 4, 5): trochanter and femur minute; patella ovoid, greatly enlarged and swollen, attached to femur medially; ovoid tibia minute with 2 trichobothria; cymbium completely fused to bulb without suture line; cymbium covered with plumose setae; tip of bulb stout and complex, containing distinctive concavities. *Genital region* (Figure 2): operculum slightly ovoid and relatively large; posteriorly directed apodemes present. *Legs*: without spines; inferior tarsal claw absent; leg I tarsal claws with 6 ventral clawlets in a single row, 1 distal trichobothrium on metatarsus and 3 equally spaced trichobothria on tibia; leg II tarsal claws with 6 large ventral clawlets and an internal row of



Figures 1-5 *Opopaea ectognophus* sp. nov., holotype male: 1, dorsal aspect; 2, ventral aspect; 3, left chelicera and maxilla, anterior aspect; 4, left pedipalp, prolateral aspect; 5, tip of embolus, detail. Scale lines = 0.5 mm (Figures 1-2), 0.1 mm (Figures 3-5).

5 ventral clawlets, 1 distal trichobothrium on metatarsus and 3 equally spaced trichobothria on tibia; leg III tarsal claws with 4 ventral clawlets, internal row not visible, 1 subdistal trichobothrium on metatarsus and 3 equally spaced trichobothria

on tibia, teeth on superior tarsal claws shaped differently to other legs.

Dimensions (mm), holotype ♂: total length (excluding chelicerae) 1.12. Carapace length 0.47, width 0.34, height 0.10. Sternum length 0.37, width

0.28. Opisthosoma length 0.65, width 0.33. Chelicera length 0.15, width 0.07. Pedipalp: femur 0.08, patella 0.25, tibia 0.05, tarsus 0.17, total 0.55. Leg I: femur 0.32, patella 0.19, tibia 0.24, metatarsus 0.18, tarsus 0.11, total 1.04. Leg II: femur 0.30, patella 0.19, tibia 0.22, metatarsus 0.17, tarsus 0.11, total 0.99. Leg III: femur 0.23, patella 0.13, tibia 0.19, metatarsus 0.13, tarsus 0.11, total 0.79. Leg IV missing.

### Remarks

This species is only known from a single adult male specimen collected from a leaf litter-baited trap placed at 20 m depth within a borehole drilled within an iron-bearing pisolite mesa in the Pannawonica region of Western Australia (Figure 14). Pisolitic mesa deposits within this region have been found to support a number of other troglobitic organisms such as schizomids and pseudoscorpions (unpublished data).

### Etymology

The specific epithet is a noun in apposition and refers to the subterranean habitat of this species (*ekto*, Greek, out of; and *gnophos*, Greek, darkness).

### *Opopaea phineus* sp. nov.

Figures 6–8

### Material examined

#### Holotype

**Australia: Western Australia:** ♀, cave KNI-27, Ningbing Range, Western Australia, Australia, 15°17'S, 128°41'E, 16 May 1994, R.D. Brooks, BES 2881 (WAM T65943).

### Diagnosis

*Opopaea phineus* and *O. ectognophus* are the only fully blind species of the genus currently known. *Opopaea phineus* differs from *O. ectognophus* by being significantly larger (total length 1.50 mm versus 1.12 mm), the dorsal abdominal scute covers all of the opisthosoma (only partially covers the opisthosoma in *O. ectognophus*), the shape of the carapace in which the postero-lateral margins of *O. phineus* are more angulate than in *O. ectognophus*, and the sternum of *O. phineus* bears apodemes leading away from coxae II–IV which are absent in *O. ectognophus*.

### Description

#### Adult female (WAM T65943)

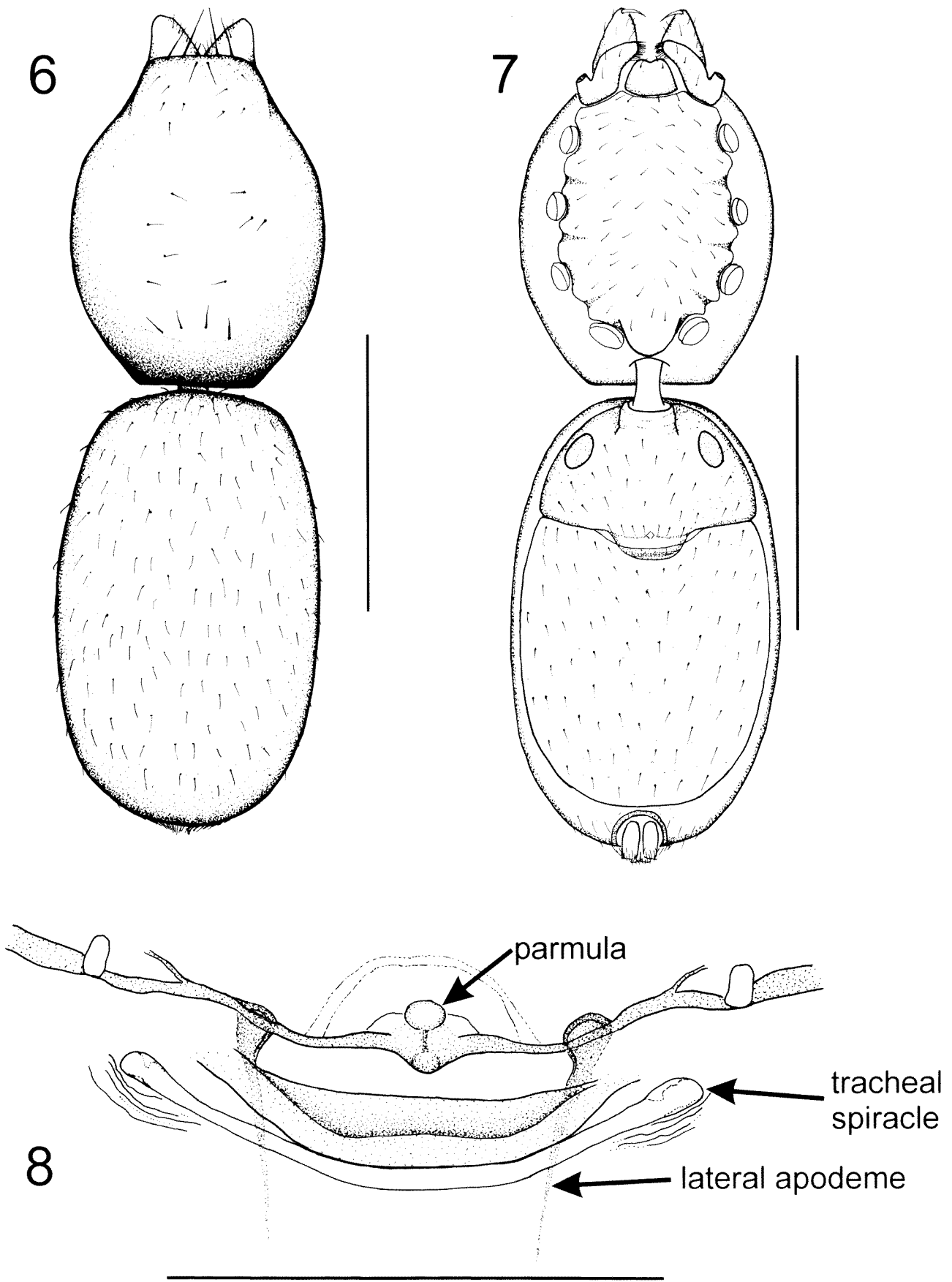
**Colour:** pale orange; soft parts white. **Carapace** (Figure 6): ovoid; 1.33 times longer than broad; narrowing anteriorly; postero-lateral corners angular, not evenly rounded; setae distributed over

surface, predominately anteriorly and medially. **Eyes:** absent. **Clypeus:** clypeus and posterior ridge of pars cephalica with several long forwardly projecting setae. **Sternum** (Figure 7): longer than wide; fused with carapace; posteriorly rounded; covered with thin setae; with apodemes leading away from trochanters II–IV. **Labium:** fused with sternum; anteriorly indented; 2 setae on anterior margin and 2 situated subdistally. **Chelicera:** without teeth; with median lamella; fang without proximal lobe; anterior inner margin with distal hairs. **Opisthosoma** (Figures 6, 7): ovoid; 1.7 times longer than broad; extensive non-overlapping dorsal and ventral plates; ventral plate divided into 2 by epigastric furrow which extends to lateral margins of ventral plate. **Colulus:** small with 2 setae; sclerotised ring only surrounding spinnerets and colulus ventrally. **Female genitalia** (Figure 8): with thick transverse muscle plate from which arises a small anterior spherical lobe (the parmula), and a large thin-walled anterior receptaculum; posterior receptaculum apparently absent; posteriorly directed apodemes present. **Pedipalp:** tibia with three serrate trichobothria dorsally; claws absent. **Legs:** without spines; inferior tarsal claw absent; leg I tarsal claws with 8 ventral clawlets and an internal row of 6 lateral clawlets, 1 distal trichobothrium on metatarsus and 3 trichobothria on tibia; leg II tarsal claws with 8 large ventral clawlets and an internal row of 6 ventral clawlets, 1 distal trichobothrium on metatarsus and 3 trichobothria on tibia; leg III tarsal claws with 5 ventral clawlets, internal row of 4 lateral clawlets, 1 subdistal trichobothrium on metatarsus and 3 trichobothria on tibia; leg IV tarsal claws with 4 ventral clawlets, and an internal row of 4 lateral clawlets; 1 subdistal trichobothrium on metatarsus and 3 trichobothria on tibia.

**Dimensions** (mm), holotype ♀: total length (excluding chelicerae) 1.50. Carapace length 0.64, width 0.48, height 0.16. Sternum length 0.46, width 0.35. Opisthosoma length 0.85, width 0.50. Pedipalp: femur 0.14, patella 0.10, tibia 0.08, tarsus 0.15, total 0.47. Leg I: femur 0.45, patella 0.25, tibia 0.31, metatarsus 0.25, tarsus 0.18, total 1.44. Leg II: femur 0.41, patella 0.23, tibia 0.30, metatarsus 0.27, tarsus 0.18, total 1.39. Leg III: femur 0.31, patella 0.17, tibia 0.22, metatarsus 0.24, tarsus 0.17, total 1.11. Leg IV: femur 0.44 (0.14), patella 0.26, tibia 0.35, metatarsus 0.29, tarsus 0.19, total 1.53.

### Remarks

*Opopaea phineus* occurs in cave KNI-27 which is situated in the Ningbing Range of northern Western Australia (Figure 14). The cave is found within limestone karst and forms part of the Devonian Reef system of Upper Devonian (probably Famennian) age (Humphreys, 1995). Like *O. ectognophus*, this species is remarkably modified for a troglobitic



Figures 6–8 *Opopaea phineus* sp. nov., holotype female: 6, dorsal aspect; 7, ventral aspect; 8, genital region, ventral. Scale lines = 0.5 mm (Figures 6–7), 0.2 mm (Figure 8).

existence as it completely lacks eyes. Although we have had access to only a single female specimen, this species is clearly distinct from all others of the genus.

### Etymology

The specific epithet is a latinised noun in apposition and refers to the mythical prophet Phineus, struck blind by Zeus and referring to a blind person.

### Genus *Camptoscaphiella* Caporiacco

*Camptoscaphiella* Caporiacco, 1935: 118; Brignoli, 1976: 230–232; Brignoli, 1978: 33.

### Type species

*Camptoscaphiella fulva* Caporiacco, 1935, by monotypy.

### Diagnosis

As defined by Brignoli (1976, 1978), males of *Camptoscaphiella* have an enlarged and ovoid pedipalpal patella and the cymbium is not fused to the bulb.

### Remarks

Only five species are currently attributed to *Camptoscaphiella* Caporiacco: *C. fulva* Caporiacco from Karakorum (Caporiacco, 1935; Brignoli, 1976), *C. strepens* Brignoli and *C. silens* Brignoli from Nepal (Brignoli, 1976), *C. hilaris* Brignoli from Bhutan (Brignoli, 1978) and *C. sinensis* Deeleman-Reinhold from south-western China (Deeleman-Reinhold, 1995). *Ischnothyreus shillongensis* Tikader from Bhutan and possibly India (Tikader, 1968) was transferred to *Camptoscaphiella* by Brignoli (1976), but was later reinstated to *Ischnothyreus* by Brignoli (1978). The type species of *Camptoscaphiella*, *C. fulva*, is regrettably known only from a juvenile, thus compromising any attempts to adequately define the genus. Brignoli (1976, 1978) based his diagnosis of the genus upon *C. strepens*, *C. silens* and *C. hilaris*, for which he had adult specimens but a proper definition of the genus will only be possible when adults of *C. fulva* are described.

### *Camptoscaphiella infernalis* sp. nov.

Figures 9–13

### Material examined

#### Holotype

**Australia: Western Australia:** ♂, Cape Range region, Learmonth Limestone bore #LL11, [22°13'27"S, 114°01'52"E], depth 31 m, 6 April 2001, R.D. Brooks (WAM T54533).

### Diagnosis

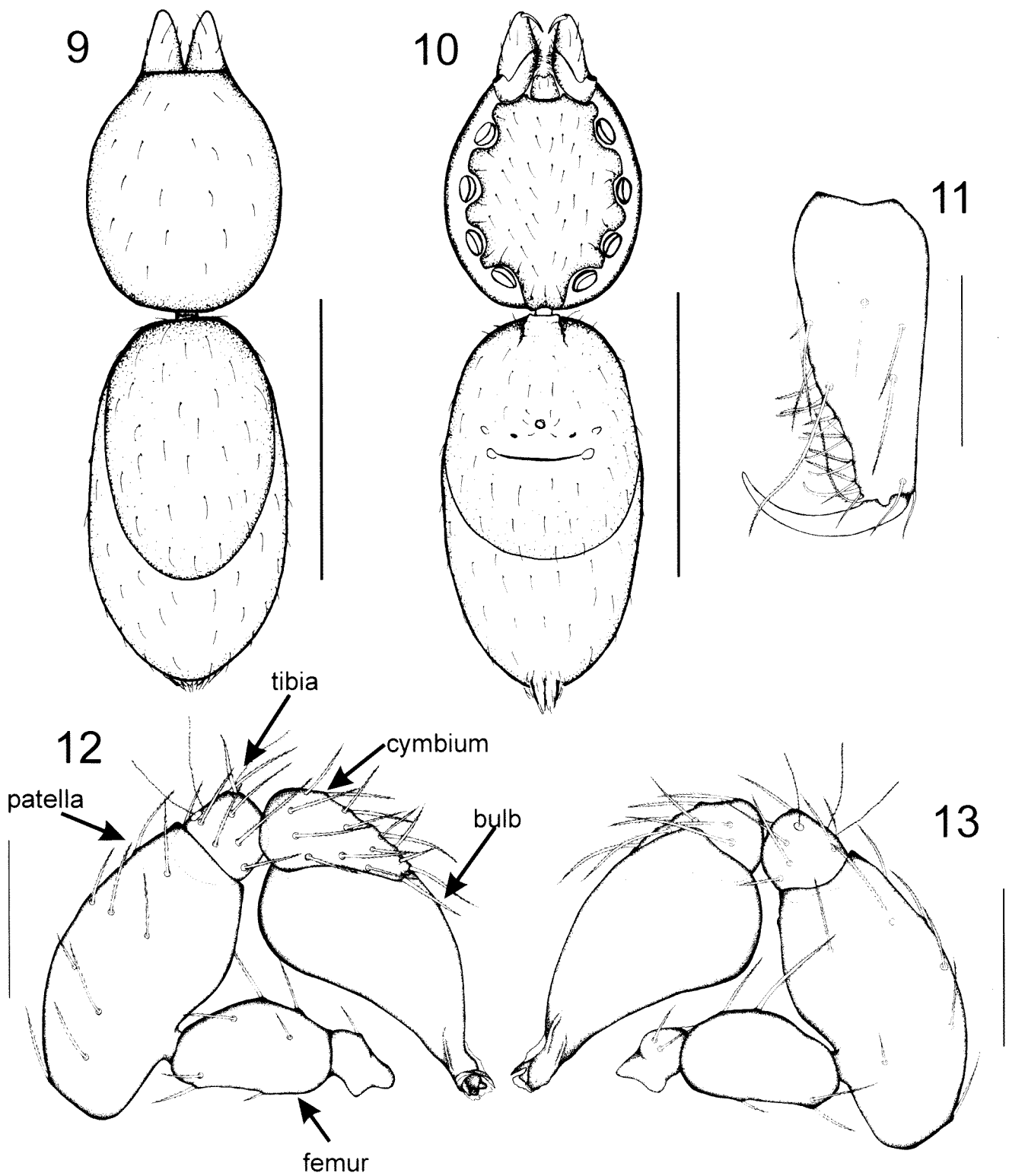
*Camptoscaphiella infernalis* differs from all other described species of *Camptoscaphiella*, except *C. sinensis* Deeleman-Reinhold from south-west China, by the complete lack of eyes. This species differs from *C. sinensis* as it is much smaller in size, 1.19 mm compared with 1.48 mm, has dorsal and ventral scutes, which are lacking in *C. sinensis*, and the male pedipalp differs in shape and relative proportions of the segments (Deeleman-Reinhold, 1995).

### Description

#### Adult male (WAM T54533)

**Colour:** Prosoma, legs, and chelicera yellow-orange; opisthosoma pale yellow; pedipalp orange; soft parts white. **Carapace** (Figure 9): ovoid; 1.35 times longer than broad; setae sparse. **Eyes:** absent. **Clypeus:** clypeus and posterior ridge of pars cephalica with a few small setae. **Sternum** (Figure 10): longer than wide; fused with carapace; sparsely covered with short, thin setae; without apodemes leading away from trochanters II–IV. **Labium:** fused with sternum; anteriorly indented; 11 setae on anterior margin, 2 situated subdistally, and 2 setae situated medially. **Chelicera** (Figure 11): 2.38 times longer than wide; without teeth; with median lamella; fang without proximal lobe; anterior inner margin with distal setae. **Opisthosoma** (Figures 9, 10): opisthosoma ovoid; 2.06 times longer than broad; small dorsal and ventral scutes partially covering opisthosoma; book-lung covers not apparent. **Colulus:** weakly sclerotised; colulus and ring not evident. **Male pedipalp** (Figures 12, 13): trochanter minute; patella enlarged and swollen, attached to femur subbasally; tibia small, with 3 dorsal serrate trichobothria; cymbium relatively short, covered with plumose setae, and separate from bulb; pedipalpal bulb, enlarged and swollen posteriorly, tapering to a stout embolus with complex tip. **Genital region** (Figure 10): operculum slightly ovoid; posteriorly directed apodemes apparently absent. **Legs:** without spines; inferior tarsal claw absent; leg I tarsal claws with 7 ventral clawlets with ca. 10 lateral clawlets on internal row, 1 distal trichobothrium on metatarsus and 3 trichobothria on tibia; leg II tarsal claws with 5 large ventral clawlets and an internal row of ca. 8 lateral clawlets, 1 distal trichobothrium on metatarsus and 3 trichobothria on tibia; leg III tarsal claws with 5 ventral clawlets and an internal row of ca. 6 lateral clawlets, 1 subdistal trichobothrium on metatarsus and 3 trichobothria on tibia, teeth on superior tarsal claws shaped differently to other legs; leg IV tarsal claws with 4 large ventral clawlets, internal row of 4 lateral clawlets, 1 subdistal trichobothrium on metatarsus and 3 trichobothria on tibia.

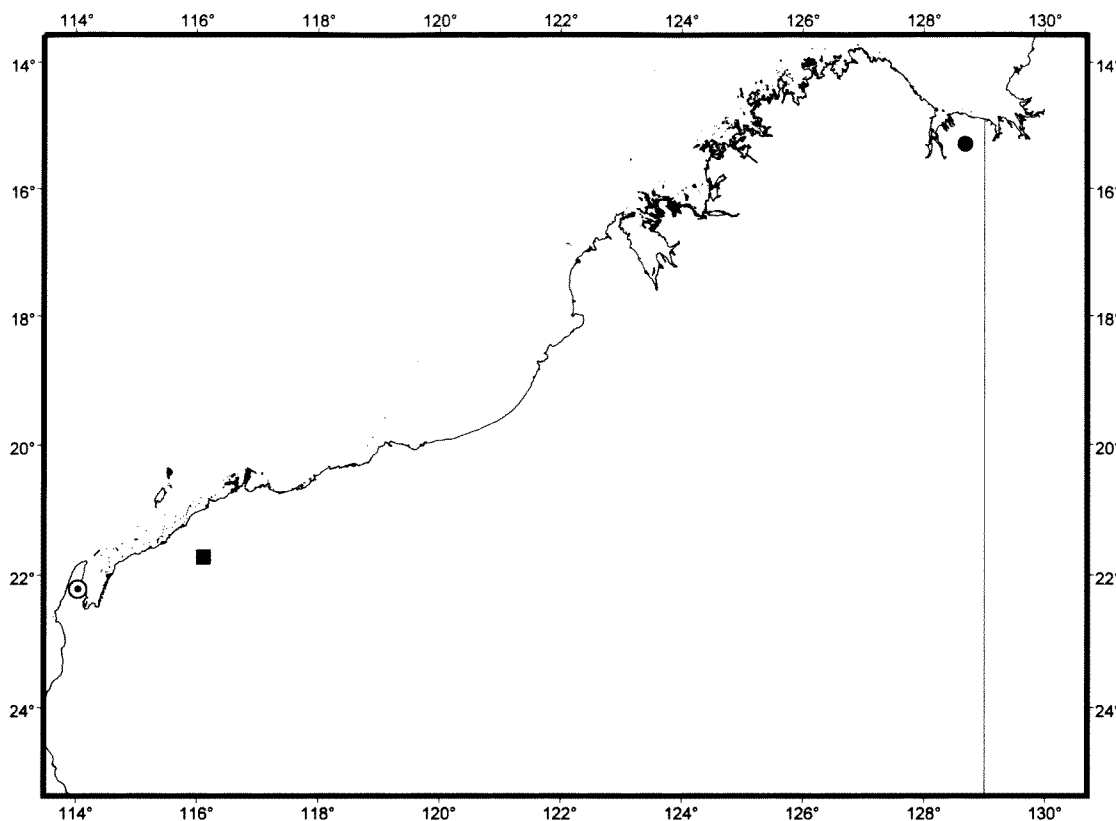
Dimensions (mm), holotype ♂: total length (excluding chelicerae) 1.19. Carapace length 0.50,



Figures 9–13 *Camptoscapbiella infernalis* sp. nov., holotype male: 9, dorsal aspect; 10, ventral aspect; 11, left chelicera, anterior aspect; 12, left pedipalp, prolateral aspect; 13, left pedipalp, retrolateral aspect. Scale lines = 0.5 mm (Figures 9–10), 0.1 mm (Figures 11–13).

width 0.37, height 0.19. Sternum length 0.36, width 0.29. Opisthosoma length 0.68, width 0.33. Chelicera length 0.19, width 0.08. Pedipalp: femur 0.11, patella 0.19, tibia 0.06, cymbium 0.10, bulb 0.22, total (excluding pedipalpal bulb) 0.46. Leg I: femur 0.36, patella 0.19, tibia 0.27, metatarsus 0.22, tarsus

0.16, total 1.20. Leg II: femur 0.30, patella 0.18, tibia 0.22, metatarsus 0.20, tarsus 0.16, total 1.06. Leg III: femur 0.28, patella 0.12, tibia 0.18, metatarsus 0.19, tarsus 0.16, total 0.93. Leg IV: femur length 0.36 (0.08), patella 0.20, tibia 0.27, metatarsus 0.25, tarsus 0.21, total 1.29.



**Figure 14** Map showing known distributions of *Opopaea ectognophus* sp. nov. (■), *Opopaea phineus* sp. nov. (●) and *Camptoscaphiella infernalis* sp. nov. (⊙).

### Remarks

*Camptoscaphiella infernalis* is the only Australian species of the genus in which eyes are totally absent, which is consistent with its subterranean existence. It is only known from an individual specimen collected from a leaf litter-trap placed down a borehole at 31 m depth. The borehole was drilled into limestone karst present in the Cape Range region of Western Australia (Figure 14), a system that is known to contain many other troglobites and stygobites (e.g. Adams and Humphreys, 1993; Harvey *et al.*, 1993; Knott, 1993; Humphreys, 2000).

### Etymology

The specific epithet is an adjective referring to the subterranean habitat of this species (*infernalis*, Latin, belonging to the lower regions).

## DISCUSSION

The three species described in this paper represent the first cavernicolous Oonopidae to be named from Australia. Their pale colouration and total lack of eyes (Figures 1, 6, 9) suggests that they are permanent inhabitants of subterranean spaces in karst systems, with *Opopaea ectognophus* and *Camptoscaphiella infernalis* found in the Pilbara region, and *O. phineus* found in the Kimberley

district. *Opopaea phineus* and *Camptoscaphiella infernalis* were taken from limestone deposits whilst *O. ectognophus* was from a pisolite formation.

Most oonopids possess six relatively large eyes which represents the plesiomorphic feature in the Oonopidae and other dysderoid families (Platnick *et al.*, 1991). Species with various forms of eye reduction have also been recorded, including those that retain the six eyes but have one or more pairs reduced in size. Others retain at least one pair of eyes, but one or more of the other pairs have been lost. The most extreme form of eye reduction occurs when all eyes are absent. Such blind oonopids have been found in several regions of the world (Deeleman-Reinhold, 1995), including Africa (*Blanioonops patellaris* Simon and Fage, *Caecoonops apicotermitis* Benoit, *C. cubitermitis* Benoit, *Cousinea keeleyi* Saaristo, *Termitoonops apicarquieri* Benoit, *T. bouilloni* Benoit, *T. faini* Benoit, *T. furculitermitis* Benoit, *T. spinosissimus* Benoit), Asia (*Dysderoides typhlos* Fage and *Camptoscaphiella sinensis* Deeleman-Reinhold), and North America (*Wanops coecus* Chamberlin and Ivie). The three species described here represent the first recorded anophthalmous oonopids from the Australian region, and probably represent three separate incidents of eye loss.



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