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# The identity of *Cercophonius himalayensis* Lourenço, 1996, and the exclusion of the scorpion family Bothriuridae from the Indian fauna

**Andrés A. Ojanguren-Affilastro**[1], **Erich S. Volschenk**[2] and **Camilo I. Mattoni**[3]: [1]Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" (MACN, CONICET), Avenida Ángel Gallardo 470, CP: 1405DJR, CABA, Buenos Aires, Argentina. E-mail: andres.ojanguren@gmail.com; [2]Alacran Environmental Science, 32 Amalfi Way, Canning Vale, Western Australia 6155, Australia; Research Associate, Department of Terrestrial Zoology, Western Australian Museum, Locked Bag 49, Welshpool DC, Western Australia 6986, Australia; [3]Laboratorio de Biología Reproductiva y Evolución, Instituto de Diversidad y Ecología Animal (IDEA, CONICET–UNC), Facultad de Ciencias Exactas, Físicas y Naturales, Universidad Nacional de Córdoba, Av. Vélez Sársfield 299, 5000, Córdoba, Argentina.

**Abstract.** We studied the male holotype of *Cercophonius himalayensis* Lourenço, 1996, the sole member of the scorpion family Bothriuridae from India, and concluded that it belongs to a species of the genus *Phoniocercus* Pocock, 1893, which is endemic to the temperate forests of Patagonia. The presence of a Patagonian genus in India is extremely unlikely; therefore, we consider this to be a case of mislabeling of the specimen, and consequently exclude the scorpion family Bothriuridae from Indian fauna. *Cercophonius himalayensis* is transferred to the genus *Phoniocercus*, and formally synonymized with *Phoniocercus sanmartini* Cekalovic, 1968. A brief illustrated description of the type specimen is made, emphasizing important diagnostic characters and some body parts not previously described, such as the hemispermatophore. We also present a probable explanation for the origin of the material.

**Keywords:** *Phoniocercus*, Scorpiones, South America, Australia, Endemic, Gondwanaland

The scorpion family Bothriuridae comprises small to medium-sized fossorial species, mostly from temperate areas (Sissom 1990; Kovařík & Ojanguren-Affilastro 2013). This family is more diversified in southern and central South America with 14 genera and more than 140 species. It is also present in southern Africa with two basal genera and three species, as well as in Australia with one genus and six species (Acosta 1990; Prendini 2003a; Kovařík & Ojanguren-Affilastro 2013). The distribution of this family indicates a Gondwanic origin (Prendini 2003a). Maury (1975) suggested a paleo-Antarctic origin for Bothriuridae; however, at that time, he did not consider *Lisposoma* Lawrence, 1928 (the only African bothriurid genus known at the time) as a member of Bothriuridae.

Lourenço (1996) recorded the presence of a member of the family Bothriuridae in the Himalayas of India with the description of *Cercophonius himalayensis* Lourenço, 1996. Prior to that contribution, *Cercophonius* Peters, 1861 was only known from Australia (Koch 1977; Acosta 1990). The presence of a member of Bothriuridae in India is plausible, since this subcontinent was once part of Gondwana (Prendini 2003a); however, the absence of other bothriurid records from the Indian subcontinent, as well as the placement of the species in the genus *Cercophonius*, raised doubts about its identity. Although Bastawade et al. (2004) ignored this record in their identification key for the scorpions of India, Bastawade et al. (2012) later considered this species as part of the Indian fauna in their revision of the scorpion fauna of India. However, they followed the original description of Lourenço (1996) and did not contribute additional data about this species. In a taxonomic revision of family Bothiuridae, Kovařík & Ojanguren-Affilastro (2013) noticed that some of the characters in the original description of *C. himalayensis* (Lourenço 1996) did not fit with the diagnostic characteristics of the genus *Cercophonius*, and considered the species to be a *nomen dubium*. Kovařík & Ojanguren-Affilastro (2013) noted that a review of the holotype was fundamental to determine its identity. In a more recent revision of the scorpion fauna of India, Dupré (2017), also considered *C. himalayensis* as a *nomen dubium* and did not include it in his checklist of the Indian fauna. *Cercophonius himalayensis* is only known from the type specimen and to our knowledge, no members of the genus *Cercophonius* or family Bothriuridae have subsequently been reported from India or surrounding countries.

## METHODS

Digital habitus images were taken under visible light, and images of external morphology under UV and visible light, using a Leica DFC290 digital camera attached to a Leica M165C stereomicroscope; the focal planes were fused with Helicon Focus 3.10.3 (online at http://heliconsoft.com). Scanning electron micrographs (SEM) were taken with a Philips XL30 TMP SEM at the Museo Argentino de Ciencias Naturales "Bernardino Rivadavia" (MACN). Samples were dehydrated and coated with gold-palladium in a Thermo VG Scientific SC 7620 sputter coated prior to SEM.

Abbreviations for collections are as follows: MACN-Ar: Museo Argentino de Ciencias Naturales "Bernardino Rivadavia", (Buenos Aires, Argentina); MNHN: Muséum National d'Histoire Naturelle, (Paris, France); ZMH: Zoologisches Museum, Hamburg, (Hamburg, Germany).

Descriptive terminology follows Mattoni & Acosta (2005) for hemispermatophores; Vachon (1974) for trichobothria; Francke (1977) for metasomal carinae, abbreviated as follows: DL: dorsolateral; LIM: lateral inframedian; LSM: lateral supramedian; LM: lateral median; VSM: ventral submedian; VL: ventrolateral; VM: ventromedian; and Prendini (2000) for pedipalp carinae, abbreviated as follows: DI: dorsal internal; DE: dorsal external; VI: ventral internal; VE: ventral external;

D: digital; E: external; IM: internomedian; EM: externomedian; V: ventral; VM: ventral median; DM: dorsal marginal; DS: dorsal secondary.

## TAXONOMY

**Family Bothriuridae** Simon, 1880
***Phoniocercus sanmartini*** Cekalovic, 1968
Figs. 1a–g, 2a–d, 3e–h; Table 1

*Phoniocercus sanmartini* Cekalovic 1968:64–73; Fet et al. 2000:38 (complete synonymic list until 1998); Prendini 2000:4, 5, 12, 19; Prendini 2003a:154; Prendini 2003b:242; Soleglad & Fet 2003:6; Fet et al. 2004:203; Rein 2007: 8; Kovařík & Ojanguren-Affilastro 2013:101; Ojanguren-Affilastro et al. 2013:114.

*Cercophonius himalayensis* Lourenço 1996:87–89. Kovařík 1998:101; Fet et al. 2000:33; Prendini 2003a:151; Rein 2007:8; Bastawade et al. 2012:4; Kovařík & Ojanguren-Affilastro 2013:74, 75 (*nomen dubium*); Dupre 2017:2. **New synonymy**.

**Types examined.**—*Phoniocercus sanmartini:* Holotype male, Lago Calafquen, Valdivia Province, Chile, 16 October 1964, Grupo de Ecólogos de la Facultad de Medicina Veterinaria de la Universidad de Chile (MZUC 455).

*Cercophonius himalayensis*: Holotype male, label data: India, Himalaya, Ukal, Pauri Garhwal, U.P., 30°N-79°5′E, about 45 km from the town of Pauri (2250 m alt.), 16 May 1958. F. Schmid (ZMH, Eing. Nr. A40/96).

**Comparative diagnosis and taxonomic position of *Cercophonius himalayensis*.**—The type specimen of *C. himalayensis* does not bear retrolateral pedal spurs on its legs (Fig. 1e), like all species of *Phoniocercus* Pocock, 1893 (Fig. 3e); however, *Cercophonius* bears well developed prolateral and retrolateral spurs (Fig. 3c). The spinal formula of telotarsi is: 3/3; ?/?; 4/4; 4/4; and the ventrolateral spines have setiform apices (Fig. 1e); the spinal formula of *Phoniocercus* is 3/3; 3/3; 4/4; 4/4, and also bears ventrolateral spines with setiform apices (Fig. 3e). The ventrolateral spines of *Cercophonius* species have blunt apices (Fig. 3c), with only the first one setiform, and the spinal formula is: 1/1; 2/2; 3/3; 3/3. The median ocelli are located in the proximal half of the carapace (Fig. 1a), as in *Phoniocercus*; in contrast to all *Cercophonius* species which have the median ocelli in the middle of the carapace. The dentate margin of the fingers of its pedipalp chelae bears only a single median row of denticles, which becomes double (or disordered) only in its basal part (Fig. 1h), and 5 pairs of internal and external accessory denticles, as in *Phoniocercus* (Fig. 3g), whereas in *Cercophonius* the dentate margin of the fingers bears 3 to 5 median rows of denticles, and 5 or 6 pairs of internal and external accessory denticles (Fig. 3b). Metasomal segment V has two VSM carinae extending along the whole segment and placed very close to the VM margin of the segment (Fig. 1g), as in *Phoniocercus* (Fig. 3h), whereas in *Cercophonius* the VSM carinae of metasomal segment V are reduced to some granules in the posterior third of the segment, joining with the VM carina (Fig. 3d). The telson vesicle is globose (Fig. 1c), as in males of *Phoniocercus*; being conspicuously less globose in *Cercophonius*. The hemispermatophore has a frontal crest at the base of the lamina (Fig. 2d), as in *Phoniocercus* (Fig. 3f), but not a frontal fold, nor two denticles in the external side of internal lobe as in *Cercophonius* (Fig. 3a). On the basis of these characteristics, this specimen is clearly not a member of genus *Cercophonius* but a species of *Phoniocercus*.

The distal lamina of the hemispermatophore is relatively short and blunt, and its frontal crest and distal crest are poorly developed, therefore this specimen should be assigned to *P. sanmartini*.

The measurements of the holotype of *C. himalayensis*, a male specimen of *C. michaelseni* Kraepelin, 1908, and a male specimen of *P. sanmartini* are compared in Table 1.

**Redescription of *C. himalayensis* holotype.**—*Color:* Base color reddish brown, with a variegated pattern in carapace, legs, tergites, sternites, and metasoma; however, in most parts of the body, this pattern is faded (presumably owing to poor preservation). Tergites with 2 lateral spots, separated by a median, incomplete and unpigmented stripe in the anterior two thirds of the segment, both lateral spots connected by reticular pigment in the posterior third of the segment. Sternites, legs and carapace with reticulated pattern. Metasoma: Ventral surface, segments I–IV with 3 stripes, 2 VL which are narrow anteriorly and become wider posteriorly, and 1 VSM sub-triangular spot with its anterior angle in the anterior margin of the segment and the posterior angles connecting with the posterior third of the VL stripes; segment V ventrally with 2 VL wide stripes, and a thin VM stripe. Dorsal surface: Segments I–III each with a median triangular spot, and posterolateral reticulate pigment; segment IV with posterolateral reticulate pigment; segment V with faint pigment on the dorsolateral margins. Telson: Ventral surface of the vesicle with faint pigment pattern; dorsal surface whitish due to the presence of a glandular area; reddish aculeus.

*Carapace:* Anterior margin with a conspicuous median notch that divides the anterior margin into 2 lobes (Fig. 1a). Surface smooth. Anteromedian longitudinal sulcus, interocular sulcus; posteromedian longitudinal and posterolateral sulci present and conspicuous, but not very deep. Median ocular tubercle small, placed slightly proximal from the middle of the carapace; median ocelli well developed, 2 diameters apart. Three small lateral ocelli on each side of the anterior margin of the carapace, 2 larger anterior ocelli in the same horizontal axis, and 1 smaller posterior ocellus situated slightly dorsal to the others; lateral ocelli pattern type 3A (Loria & Prendini 2014).

*Chelicerae:* Movable finger, distal internal tooth well developed, strongly curved, forming an angle of almost 90° with the rest of the finger, and slightly displaced ventrally with respect to the line formed by the other teeth; with 2 well-developed subdistal teeth (Fig. 2c).

*Pedipalps:* Femur, surface smooth; VE carina absent; DE, DI and VI carinae granular and well-developed, extending the entire length of the segment. Patella DI, VI, and VE carinae, extending the entire length of the segment, DI represented by some scattered big granules, VI carina poorly developed. Chela manus slender; with barely discernible carinae, with a small conical apophysis near the base of the movable finger (Fig. 1f), that partially surrounds a small internal smooth depression; with a small group of granules near the base of fixed finger, but not joining the granules of the dentate margin;

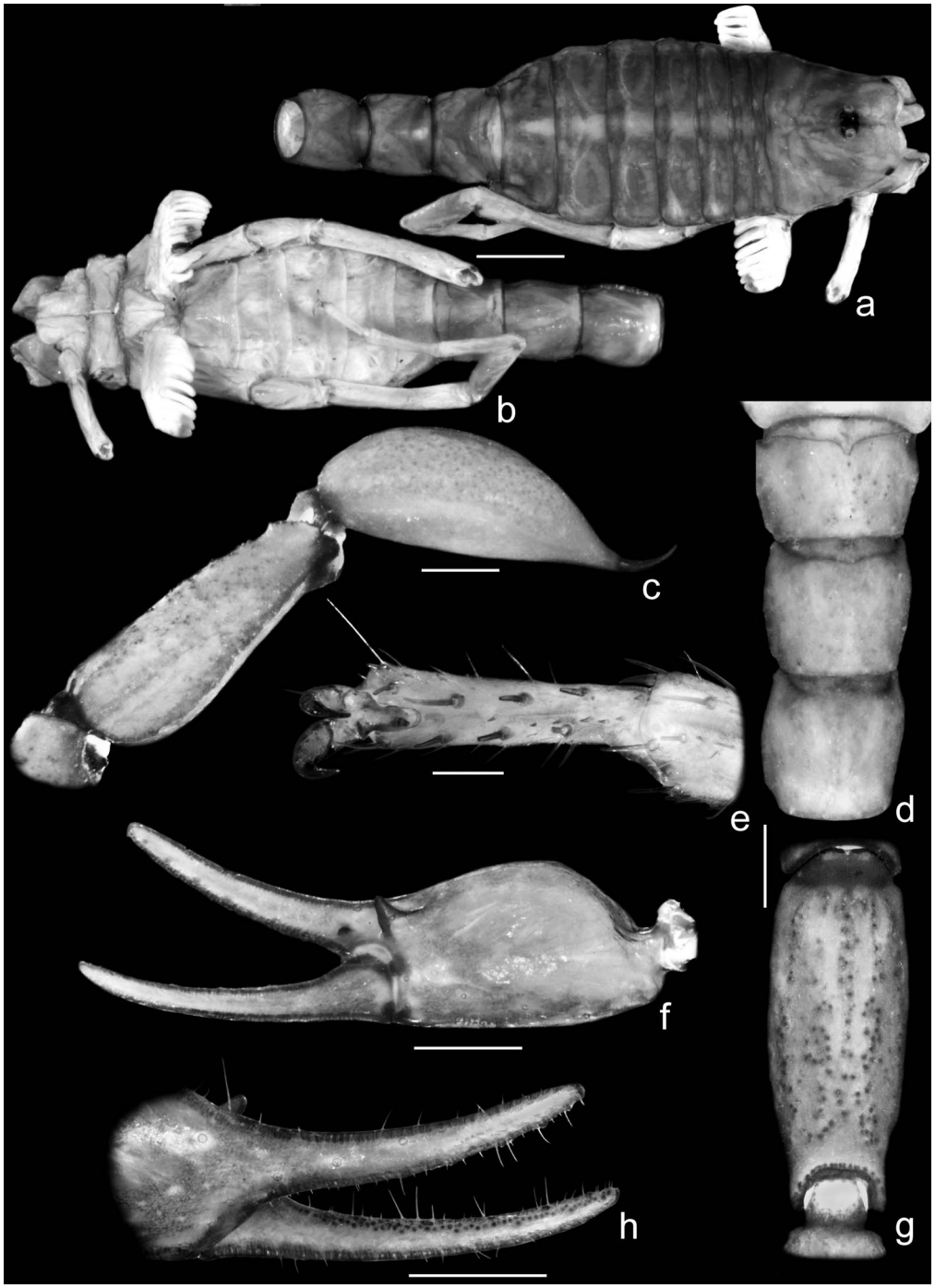


Figure 1.—*Cercophonius himalayensis*, holotype male: a. Habitus, dorsal aspect under visible light; b. Habitus, ventral aspect under visible light; c. Metasomal segment V and telson, lateral aspect under UV light; d. Metasomal segments I–III, ventral surface, under UV light; e. Telotarus III, ventral surface under visible light; f. Pedipalp chela, ventrointernal surface under visible light; g. Metasomal segment V, ventral surface under UV light; h. Pedipalp chela, detail of fingers from dorsal view under visible light. Scale bars: a, b: 0.2 mm; c–h: 1 mm.

fingers medium-sized and slightly curved, dentate margin of fingers with a single row of denticles, and 5 pairs of internal and external accessory denticles, the basal external accessory granule forming part of the median row, the median row is quite disordered basally, becoming double in some areas (Fig. 1h). Trichobothrial pattern neobothriotaxic major Type C, with one accessory trichobothrium in *V* series of chela; femur with 3 trichobothria (*d*, *i*, *e*), one macroseta (M1) associated with *d* and *i*, *e* situated slightly proximal to M1; patella, with 19 trichobothria (2 *d*, *i*, 3 *et*, *est*, 2 *em*, 2 *esb*, 5 *eb*, 3 *V*); chela with 27 trichobothria (*Dt*, *Db*, 5 *Et*, *Est*, *Esb*, 3 *Eb*, *dt*, *dst*, *dsb*, *db*, *et*, *est*, *esb*, *eb*, *ib*, *it*, 5 *V*), $V_2$ displaced externally with respect to the line of *V* trichobothria; *Esb* forming a triangle with $Eb_2$ and $Eb_3$.

Table 1.—Measurements in mm of the holotype male of *Cercophonius himalayensis*, a male specimen of *Phoniocercuis sanmartini* (Chiloe Island, Chile), and a male of *Cercophonius michaelseni* (taken from Acosta 1990).

| | *Cercophonius himalayensis,* holotype male | *Phoniocercus sanmartini,* male | *Cercophonius michaelseni,* male |
|---|---|---|---|
| Total length | 24.20 | 29.82 | 23.60 |
| Carapace, length | 2.93 | 3.53 | 2.99 |
| Carapace, anterior width | 2.00 | 2.26 | 1.83 |
| Carapace, posterior width | 3.46 | 3.80 | 3.23 |
| Mesosoma, total length | 5.66 | 8.11 | 5.11 |
| Metasoma, total length | 15.61 | 18.18 | 15.50 |
| Metasomal segment I, length | 1.33 | 1.66 | 1.39 |
| Metasomal segment I, width | 2.06 | 2.20 | 1.71 |
| Metasomal segment II, length | 1.73 | 2.00 | 1.71 |
| Metasomal segment II, width | 1.86 | 2.00 | 1.59 |
| Metasomal segment III, length | 1.93 | 2.33 | 1.83 |
| Metasomal segment III, width | 1.80 | 1.90 | 1.52 |
| Metasomal segment IV, length | 2.20 | 2.53 | 2.27 |
| Metasomal segment IV, width | 1.66 | 1.86 | 1.44 |
| Metasomal segment V, length | 3.66 | 4.06 | 3.71 |
| Metasomal segment V, width | 1.73 | 1.93 | 1.36 |
| Metasomal segment V, height | 1.46 | 1.60 | 1.24 |
| Telson, length | 4.76 | 5.60 | 4.59 |
| Vesicle, length | 3.93 | 4.60 | 3.39 |
| Vesicle, width | 1.86 | 2.10 | 1.39 |
| Vesicle, height | 1.60 | 1.66 | 1.12 |
| Aculeus, length | 0.83 | 1.00 | 1.20 |
| Femur, length | 2.86 | 3.33 | 2.87 |
| Femur, width | 0.93 | 1.00 | 0.84 |
| Patella, length | 3.20 | 3.66 | 2.91 |
| Patella, width | 1.06 | 1.13 | 0.99 |
| Chela, length | 5.35 | 6.26 | 5.19 |
| Chela, width | 1.60 | 1.66 | 1.39 |
| Chela, height | 1.60 | 1.86 | 1.24 |
| Movable finger, length | 3.20 | 3.40 | 3.07 |

*Legs:* Basitarsi with medium-sized prolateral spurs, but without retrolateral pedal spurs (Fig. 1e). Telotasi: ungues well developed and strongly curved, with ventrointernal and ventroexternal spines, each ending in a seta-shaped tip; since the material is poorly preserved most of the tips of these spines are broken, and spinal apices are generally blunt. Spinal formula leg I: 3/3, with the basal internal spine setiform; leg II: unknown (lost); legs III and IV: 4/4. Almost all legs are detached from the body, only right leg IV is still attached; both legs II, and left leg III are lost.

*Sternum:* Barely visible, strongly compressed longitudinally.

*Genital opercula:* Sclerites subtriangular, strongly enlarged posteriorly (Fig. 1b).

*Pectines:* With 1 row of median lamellae. Fulcra present, small. Pectinal teeth large; tooth count: 11–11, but one tooth is missing in each pecten.

*Tergites:* Tergites I–VI, surfaces smooth; VII with paired submedian carinae and lateral carinae; paired submedian carinae are restricted to posterior third of segment, and lateral carinae are restricted to posterior half; intercarinal surfaces smooth.

*Sternites:* Sternites III–VII, surfaces entirely smooth; III–VI each with small, elliptical spiracles.

*Metasoma:* Metasomal segments I–III: DL and LSM carinae well developed, LIM carina poorly developed becoming less developed in posterior segments; VL and VSM carinae poorly developed, only represented as a slight elevation of the tegument, becoming more developed in posterior segments (Fig. 1d). Metasomal segment IV: DL and LSM carinae well developed, LIM carina absent, VL and VSM carinae well developed. Metasomal segment V: DL carina well developed, LSM and LIM carinae absent, lateral margins granular, VL carinae poorly developed and displaced externally almost to the lateral margins; VSM carinae granular, subparallel, extending the entire length of the segment, placed very close to the VM carina (Fig. 1g); VM carina barely visible, represented by some granules in the median part of the segment.

*Telson:* Vesicle globose dorsal surface smooth, slightly concave, telson gland not very conspicuous; ventral surface slightly granular. Aculeus very short, moderately curved (Fig. 1c).

*Hemispermatophore:* Distal lamina well developed, slightly curved, and similar in length to the basal portion; distal crest almost straight, occupying the apical fourth of the distal lamina, without transversal keels. Frontal crest small, forming a sub-circular distal lobe in the basal portion of the distal lamina (Figs. 2b, d). Lobe region was not examined because we could not clean it from surrounding tissues due to the poor condition of the material (Fig. 2a).

**Remarks.**—The specimen is poorly preserved; several body parts are broken and separated from the body, and some of them even missing (Figs. 1a, b).

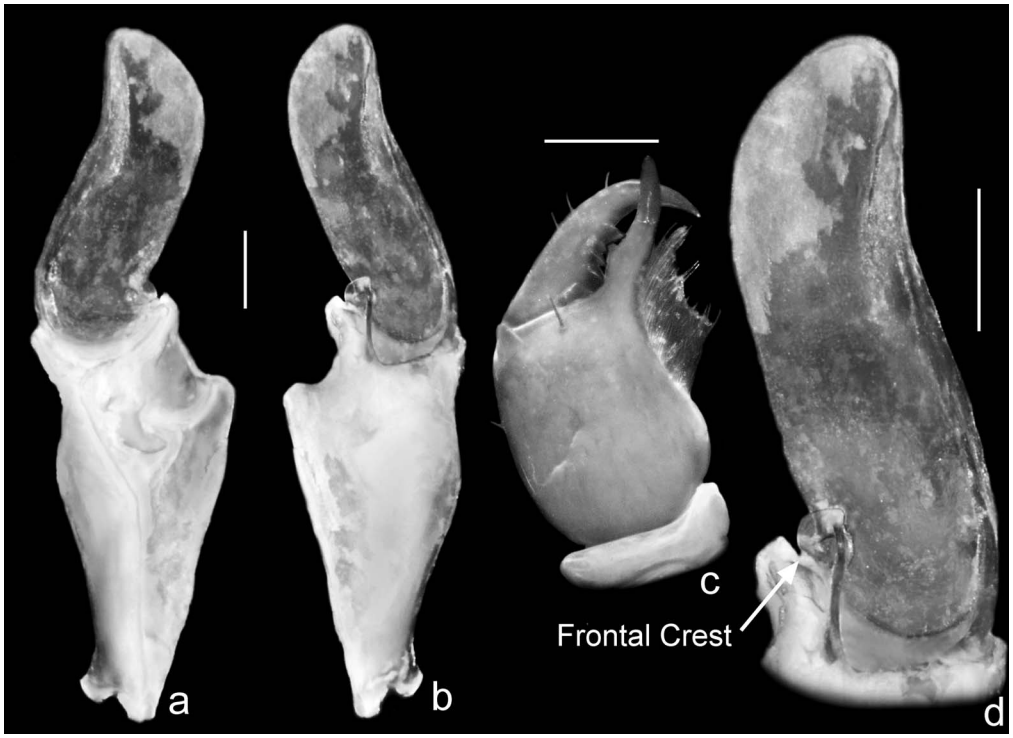


Figure 2.—*Cercophonius himalayensis*, holotype male: a. Left hemispermatophore, internal surface under visible light; b. Left hemispermatophore, external surface under visible light; c. Left chelicera, dorsal aspect under UV light; d. Detail of distal lamina of hemispermatophore, external aspect under UV light. Scale bars: 0.5 mm.

The genus *Phoniocercus* includes only two described species: *P. pictus* Pocock, 1893, the type species of the genus, and *P. sanmartini*. Both species share several characters; the females are extremely similar, but males can be separated by characteristics of the hemispermatophore: in *P. pictus* the distal lamina is more elongated and narrower than in *P. sanmartini*. In addition, the frontal crest and the distal crest are both more developed in *P. pictus* than in *P. sanmartini* (see Figs. 2b, 2d, 3f, and San Martín & Cekalovic (1968) for drawings of *P. pictus*, and Cekalovic (1968) for *P. sanmartini* description). Using these characters, we assigned the type specimen of *C. himalayensis* to *P. sanmartini* and here synonymize *C. himalayensis* with *P. sanmartini*. This species inhabits humid, evergreen forest in the Región de Los Ríos (XIV) and Región de Los Lagos (X), in the extreme south of Chile (Cekalovic 1968).

## DISCUSSION

**The labels, history and locality of *Cercophonius himalayensis*.**—At the time of our examination of the specimen, the holotype was accompanied by six different labels (Fig. 4). These labels were assigned to three different authors/origins on the basis of handwriting characteristics. Two of these labels belong to the Zoologisches Museum of Hamburg, and are printed with that inscription; one contains all the information of the locality, collectors and collection date of the specimen, whereas the other corresponds to the identification of the specimen as the type material of *C. himalayensis*, as well as the author of the species. A second group of three labels were probably written by the author of the species; one includes the identification of the specimen as the type material of *C. himalayensis*, another one includes the collector and year of collection, and the remaining refers to "other data in the paper." Finally, there is a single label corresponding to Lorenzo Prendini who revised the material in 2004 and determined it as the holotype of *C. himalayensis*. After considering the information already noted in this contribution, we conclude that none of these labels is the original label/s of this specimen.

According to Lourenço (1996) the specimen was loaned to Dr. Max Vachon at the MNHN of Paris in the 1970s. Vachon apparently recognized it as a member of Bothriuridae, and then returned it to the ZMH, never publishing his discovery. Many years later Lourenço was able to locate the specimen, confirmed the decision of Vachon, and published his description of the species (Lourenço 1996).

Scorpions of the genus *Phoniocercus* are climax species of wet Patagonian forests. The presence of an introduced (exotic) population of *Phoniocercus* in India is unlikely, and the possibility that a single specimen came into India with imported goods from Chile is remote. Bothriuridae cannot be considered part of the Indian fauna with the data currently available.

We consider that the most plausible explanation for the labels of this specimen is that the specimen was mislabeled at some point of its history, or the tubes containing the specimen inter-changed between some Indian and Chilean material. Supporting our hypothesis of a mislabeled specimen, the "collector", the entomologist Fernand Schmid (1924–1998),

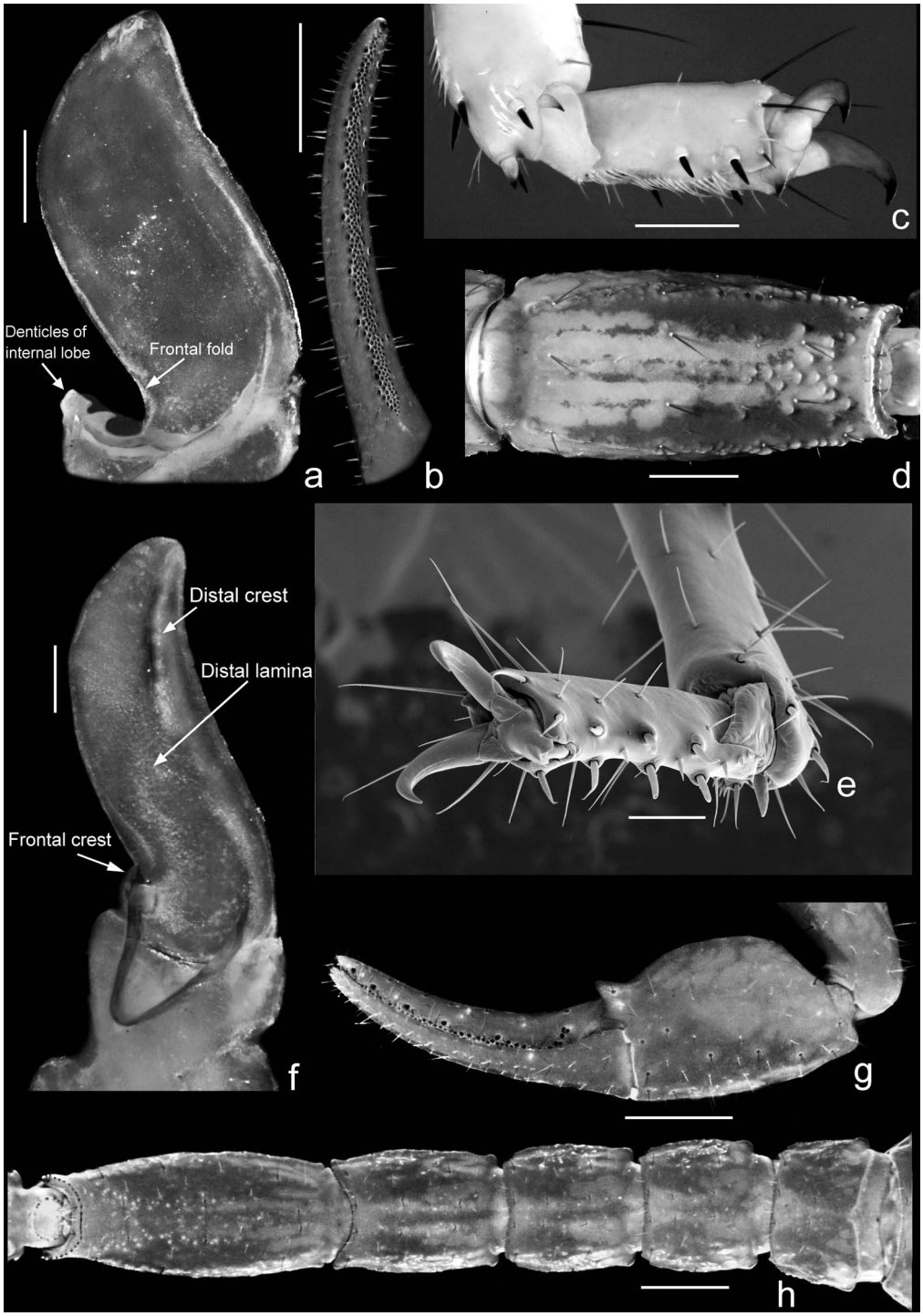


Figure 3.—*Cercophonius michaelseni*, male (from Tammin, Western Australia, MACN-Ar): a. Detail of distal lamina of hemispermatophore, external aspect under UV light; b. Detail of the internal surface of the movable finger of left pedipalp chela under UV light; c. Detail of the ventral surface of telotarsus III under UV light; d. Metasomal segment V, ventral surface, under UV light. e–h. *Phoniocercus sanmartini*, male (from Chacao, Chiloe Island, Chile, MACN-Ar): e. SEM image of ventral surface of telotarsus IV; f. Detail of distal lamina of hemispermatophore, external aspect under UV light; g. Ventrointernal surface of right pedipalp chela under UV light; h. Ventral surface of metasomal segments under UV light. Scale bars: a, c, e, f: 0.3 mm; b, d, g, h: 1 mm.

was actually collecting in Uttar Pradesh (India) in 1958 (Weaver & Nimmo 1999). At the same time, he was also working with material collected in Chile (Schmid 1958) by Luis Enrique Peña (1921–1995). Peña was a Chilean entomologist who regularly sent arachnid and insect specimens from Chile to researchers, museums and collections around the world (Barriga-Tuñón & Ugarte-Peña 1995). It is plausible that at some time, one of the labels of F. Schmid was placed

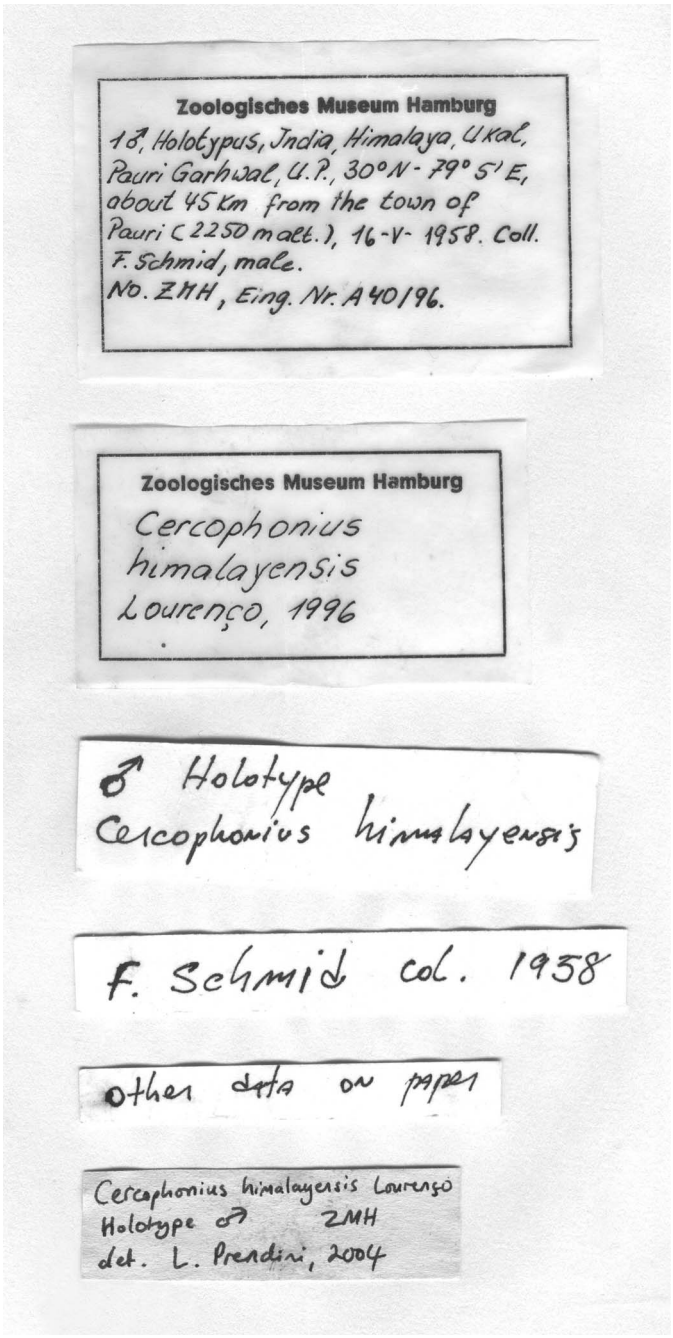


Figure 4.—Scanned image of all the labels currently accompanying the type material of *Cercophonius himalayensis*.

inside the vial of the scorpion collected by L.E. Peña, that ended in the Zoologisches Museum of Hamburg.

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