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A new species of *Masteria* (Araneae: Dipluridae: Masteriinae) from southeastern Brazil

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ABSTRACT. A new species of *Masteria* L. Koch, 1873 from iron ore caves at Caeté and Santa Bárbara, state of Minas Gerais, Brazil, *Masteria emboaba* **sp. nov.**, is described. It was collected inside caves and in the litter of nearby dry forests. It is the first masteriine species described from southeastern Brazil and the second masteriine species for the country. The new species is the only known *Masteria* with only two eyes. Additionally, the male of *M. emboaba* **sp. nov.** has only two regular, thin spines at the apex of tibia I, lacking the tibial apophysis found in most other *Masteria* species. The only other described *Masteria* species that has spines in the place of tibial apophysis is *M. aimeae* (Alayón, 1995) from Cuba; however, the last species has a longer and sinuous embolus, contrasting the embolus of *M. emboaba* **sp. nov.**, which is much smaller, less sinuous and transversally placed. The only other described Brazilian species, *M. manauara* Bertani, Cruz & Oliveira, 2013, has a double tibial apophysis, with both ends tipped by a strong, short spine, and a very long embolus, parallel to the bulb.

KEYWORDS. Iron ore; lateritic cave; Minas Gerais; Mygalomorphae; Serra da Gandarela.

Masteria L. Koch, 1873 belongs to Dipluridae, Masteriinae (Raven 1985), which contains many of the smallest mygalomorph species known (Raven 1979, 1981, Raven & Platnick 1981, Platnick & Foster 1982). The 23 described species are widely distributed in the Australasian Region and in the New World (Platnick 2014). The Australasian region has eight species, including the type species, *M.hirsuta* L. Koch, 1873, from the Fiji Islands and Micronesia. In the New World, there are 15 described species: *M. aimeae* (Alayón, 1995) and *M. golovatchi* Alayón, 1995 – Cuba; *M. lewisi* (Chickering, 1964) and *M. pecki* Gertsch, 1982 – Jamaica; *M. petrunkevitchi* (Chickering, 1964) – Puerto Rico; *M. modesta* (Simon, 1891) – Saint Vincent; *M. barona* (Chickering, 1966) and *M. simla* (Chickering, 1966) – Trinidad; *M. downeyi* (Chickering, 1966) and *M. spinosa* (Petrunkevitch, 1925) – Costa Rica and Panama; *M. colombiensis* Raven, 1981 – Colombia; *M. cyclops* (Simon, 1889), *M. lucifuga* (Simon, 1889) and *M. tovarensis* (Simon, 1889) – Venezuela. Finally, a single species is known from Brazil (state of Amazonas), *M. manauara* Bertani, Cruz & Oliveira, 2013. It inhabits the ground litter (Bertani et al. 2013), particularly amongst the leaves of small palm trees.

Besides *M. manaura*, there are records of an unidentified *Masteria* species from the state of Piauí (L.S. Carvalho unpubl. data) and several areas of the state of Minas Gerais: Nova Lima (AngloGold Ashanti 2009), Conceição de Mato Dentro (Leão & Auler 2012), Caeté and Santa Bárbara (Coelho et al. 2010). The records from Minas Gerais are based on material collected in and around caves in iron ore deposits.

There are more than 3,000 caves in iron ore deposits in Brazil (Auler et al. 2014). Most of these caves are located at the two major iron ore provinces: Carajás ridge, in the Amazon, and Iron Quadrangle, in Minas Gerais, southeastern Brazil. The Iron Quadrangle caves are found on iron-rich deposits topped by "canga", an iron-rich breccia surface cemented by ferruginous matrix (Auler et al. 2014). The vegetation of the "canga" areas is open grassland with scattered trees and is dominated by herbs and bushes. The alfa and beta diversity of plant species is high, including dozens of rare and endemic species (Carmo & Jacobi 2013). The plant species are a mix of elements from the Atlantic Forest, Cerrado and Serra do Espinhaço (Carmo & Jacobi 2013).

Despite the small average size of iron ore caves, they have "a high potential as habitat of troglobitic invertebrates in Brazil" (Trajano & Bichuette 2010). Several troglobitic species have been found in Brazilian iron ore caves, both in the Carajás area (Pellegrini & Ferreira 2011, Pedroso & Baptista 2014) and the Iron Quadrangle (Souza & Ferreira 2005, Coelho et al. 2010). Caves from iron ore areas are usually near the surface and have an extensive array of microchannels that house a highly diverse associated fauna (Ferreira 2005). The fauna of the "canga"

areas of Minas Gerais also include many endemic taxa (e.g., Bernardi et al. 2013, Ázara & Ferreira 2013).

Herein we describe the second masteriine species from Brazil and the first from Southeast Brazil. In addition, it is the first Masteriinae from iron ore caves collected at Caeté and Santa Barbára, Minas Gerais.

MATERIAL AND METHODS

Specimens were collected inside and near iron ore caves located at the hilltops of "Serra da Gandarela" (Gandarela range), at Caeté and Santa Bárbara, in the Iron Quadrangle area, state of Minas Gerais, southeastern Brazil. The caves are located on "canga" plates; however, the collecting area also included dry patches of Atlantic forest, especially on the small river valleys near the tips of the hill range. Most specimens were collected during a trip of the "Projeto Mina Apolo", a project to study the environmental impact from the installation of a large iron ore mine. The first author participated in the project as a member of the environmental consulting "Amplo Consultoria" team. Additional specimens from the caves in the collecting area had been mentioned by Coelho et al. (2010).

The general description format follows Raven (1981) with some modifications; e.g., eye diameters are given in their real measurements, not in ratios. All measurements are in millimeters and were obtained with a Leica LAS Interactive Measurements module. Leg and palp measurements were taken from the dorsal aspect of the left side (unless appendages were lost or obviously regenerated). A Leica LAS Montage and LAS 3D module, mounted on a Leica M205C dissecting microscope, were used to capture images of the structures of spiders. Illustrations of spermathecae were drawn over images obtained with a Leica DM 2500 compound microscope. The spermathecae soft tissues were digested with trypsin for several days and subsequently cleared with clove oil before they were photographed.

Abbreviations. (ITC) inferior tarsal claw, (PLS) posterior lateral spinnerets, (PME) posterior median eyes, (PMS) posterior median spinnerets, and (STC) superior tarsal claws.

Specimens are deposited in the arachnological collection of the Museu Nacional, Universidade Federal do Rio de Janeiro (MNRJ).

TAXONOMY

Masteria emboaba **sp. nov.**

Figs. 1-16

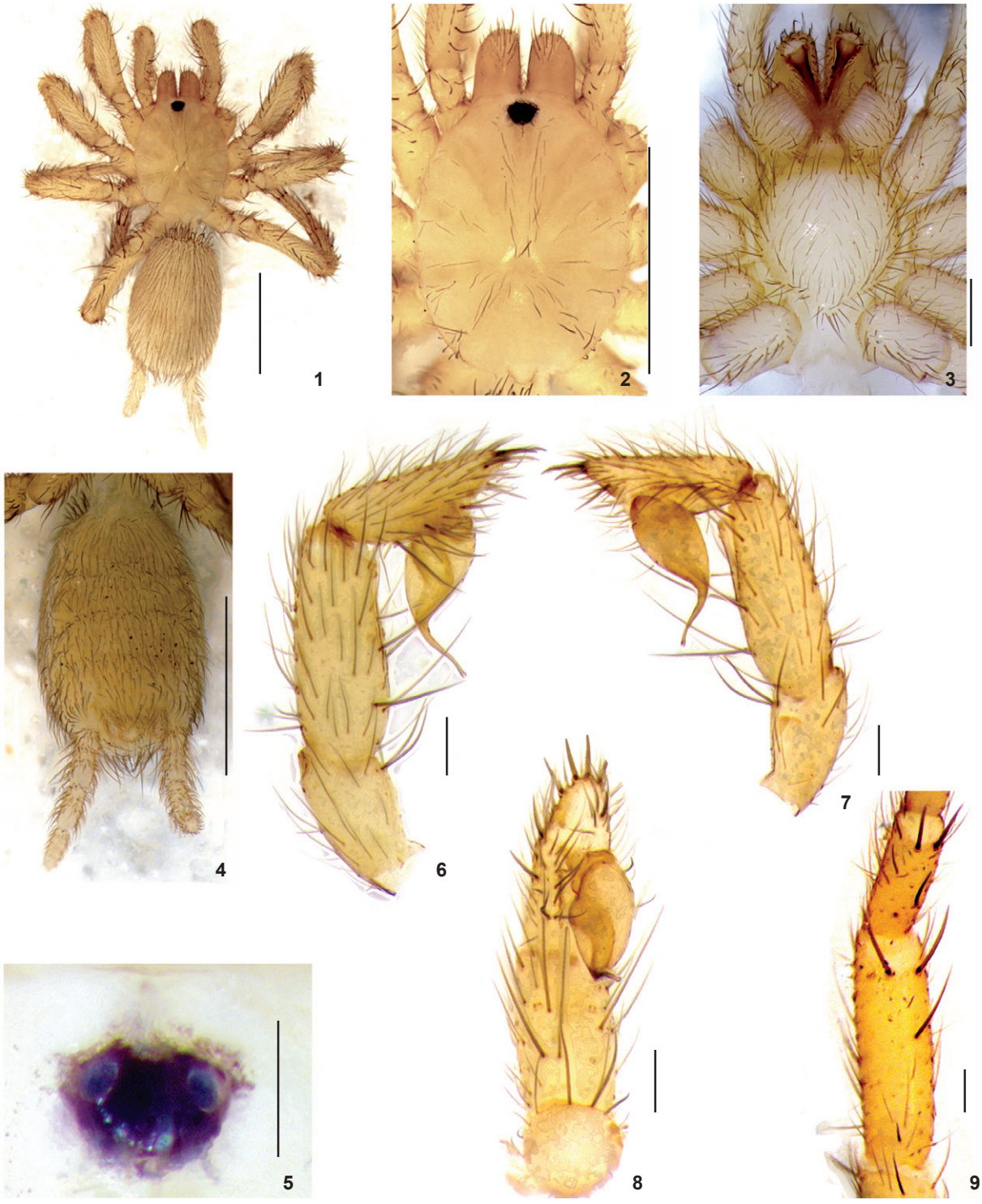
Diagnosis. Males and females of *Masteria emboaba* **sp. nov.** have only two eyes (Figs. 5 and 14). Most other species have six to eight eyes and two, *M. pecki* and *M. caeca* (Simon, 1892), have no eyes at all. This new species is much smaller than the other known South American species, except for *M. manauara*, a tiny species from the state of Amazonas and the only other species described from Brazil. The male of *M. emboaba* **sp. nov.** has only two regular, thin spines at the apex of tibia I, lacking the tibial apophysis found in most other *Masteria* species. The only other described *Masteria* species with spines in the place of tibial apophysis is *M. aimeae*, from Cuba; however, the last species has a longer and sinuous embolus (Alayón 1995: figs. 1c-d), contrasting with the embolus of *M. emboaba* **sp. nov.**, which is much smaller, less sinuous and transversally placed (Figs. 6-8). The only other described Brazilian species, *M. manauara*, has a double tibial apophysis, with both ends tipped by a strong, short spine, and a very long embolus, parallel to the bulb (Bertani et al. 2013: figs. 6-9). Table I summarizes the available information on the geographical range and characters of all species of *Masteria*.

Description. Male holotype (MNRJ 4540) (Fig. 1). Entirely pale yellow. Carapace 1.22 long, 0.96 wide, clothed with long (ca. 0.15) prostate gray bristles on interstrial ridges (Figs. 1 and 2). Two eyes on tubercle occupying 0.28 of head width (Fig. 5). Eye group 0.12 wide. Sizes and interdistances: PME 0.04, PME-PME 0.04. Chelicerae 0.29 long, 0.21 wide, with nine spaced teeth on promarginal furrow and six spinules mesobasally. Labium 0.10 long, 0.20 wide. Maxillae 0.31 long, 0.26 wide. Sternum 0.66 long, 0.63 wide; sigilla not evident (Fig. 3).

Palp with elongated cymbium, bearing seven spines on apical edge; bulb pear-shaped, tegulum 0.22 long, 0.12 wide, tapering and giving origin to a short (0.13) and relatively thin (0.012) embolus, almost transversally placed, due to a strong basal curve to retrolateral side, keeping its diameter and with a gentle curvature on apical half, not tapering to apex (Figs. 6-8). Leg lengths and midwidths in Table II.

Leg formula 4123. Tibia I lacking spur, with two large, thin spines ventrally on distal edge. Metatarsus I lacking spur (Fig. 9). Spines elongate: leg I tibia v3, metatarsus v2; leg 2, patella d1, tibia p1, v4, metatarsus v4; leg 3, patella d3, tibia d3, p2, r1, v5, metatarsus d6, p1, v3; leg 4, patella d2, tibia d4, p3, r1, v4, metatarsus d7, p2, r1, v3; palp, tarsus 7. Five to seven teeth on STC; zero to three teeth on ITC. Abdomen 1.42 long, 0.98 wide. Spinnerets (Fig. 4): PMS 0.20 long, 0.81 wide, 0.24 apart; basal, middle, and apical segments of PLS 0.34 long, 0.14 wide; 0.29 long, 0.13 wide; 0.29 long, 0.11 wide, respectively.

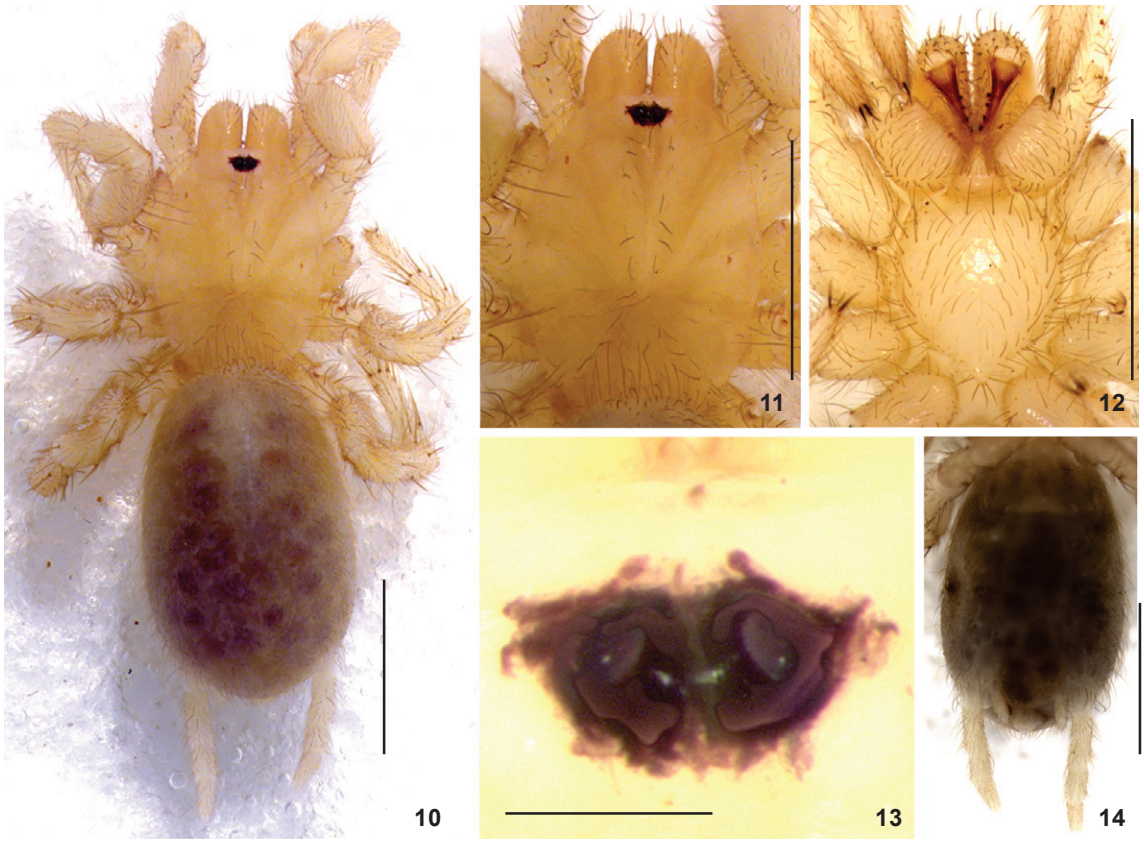
Female paratype (MNRJ 4540). As in male, except as noted. Abdominal tegument translucent, allowing recognition of internal structures (Figs. 10 and 13). Carapace 1.20 long, 0.97 wide, clothed with long (ca. 0.11) prostate gray bristles on interstrial ridges (Fig. 11). Two eyes on tubercle occupying 0.36 of head width (Fig. 14). Eye group 0.07 wide. Sizes and interdistances: PME 0.05, PME-PME 0.05. Chelicerae 0.31 long, 0.26 wide, with eleven widely spaced teeth on promarginal furrow and six spinules mesobasally. Labium 0.10 long, 0.22 wide. Maxillae 0.32 long, 0.28 wide. Sternum 0.72 long, 0.65 wide; sigilla not evident (Fig. 12). Leg lengths and midwidths in Table II. Leg formula 4123. Spines elongate: leg 1,metatarsus v2; leg 2, metatarsus v3; leg 3, tibia d4, v2, metatarsus d5, v4; leg 4, tibia d4, v4, metatarsus d6,v3; palpus, tarsus v4. Four



Figures 1-9. *Masteria emboaba* **sp. nov.** Holotype male (MNRJ 4540) (1) habitus; (2) carapace and chelicerae; (3) sternum, maxillae, chelicerae, coxae and labium; (4) abdomen, ventral; (5) eye tubercle; (6-8) left male palp, (6) retrolateral, (7) prolateral, (8) ventral; (9) left leg I, ventral. Scale bars: 1-2, 4 = 1 mm, 5-9 = 0.1 mm, 3 = 0.5 mm.

Table I. Comparison of geographical distribution and main characters of species of *Masteria*. (M) Male, (F) female, (I) immature, "(–)" non-applicable, "(?)" data not available.

Species	Sex	Type-Locality	Eyes	Carapace length	Spermathecae	Apex of male tibia I	Metatarsal apophysis	Paraembolic apophysis	Embolus
M. aimeae (Alayón, 1995)	M	Cuba: Holguín	6	1.3	–	four spines	no	no	long, curved
M. barona (Chickering, 1966)	MF	Trinidad: Arima Valley, Simla	6	M 1.69 F 1.63	?	holotype legs I missing	holotype legs I missing I	no	long, thickened, sinuous
M. caeca (Simon, 1892)	F	Philippines: Morong, d'Antipolo Cave	0	?	?	–	–	–	–
M. cavicola (Simon, 1892)	F	Philippines: Manila, Montalvan, San-Mateo Cave	6	?	?	–	–	–	–
M. colombiensis Raven, 1981	MF	Colombia: Magdalena	8	M 1.8 F 2.1	two spermathecae, basally divided, wide stalk, rounded tip	three distal processes on tibia articulation.	yes	no	short, slightly curved
M. cyclops (Simon, 1889)	I	Venezuela: Caracas, Catuche Forest	6	?	?	–	–	–	–
M. downeyi (Chickering, 1966)	MF	Costa Rica: Turrialba	6	M 1.67 F 2.05	?	three distal processes on tibia articulation	no	no	very short, straight
M. emboaba **sp. nov.**	MF	Brazil: Minas Gerais	2	M 1.2 F 1.2	Two spermathecae, double thin stalk, wide flattened tip	two unmodified spines	no	no	short, slightly curved
M. franzi Raven, 1991	M	New Caledonia: Hienghène, Tiouandé	6	1.25	–	three distal processes on tibia articulation	?	yes	long, filiforme, almost straight
M. golovatchi Alayón, 1995	M	Cuba: Guantánamo, Paso Cuba	6	1.5	–	six spines	no	no	very short, curved
M. hirsuta L. Koch, 1873	F	Fiji, Micronesia: Ovalau	6	F 2.75	four spermathecae, the outer ones large and rounded, the inner short and coniform; all lobes lack circular ribbing (Raven, 1991)	–	–	–	–
M. kaltenbachi Raven, 1991	F	New Caledonia: Nékliai	6	1.0	four spermathecae, the outer ones with a spiral ribbing	–	–	–	–
M. lewsi (Chickering, 1964)	MF	Jamaica: St. Catherine Parish	6	1.34	?	three distal processes on tibia articulation	no	no	short, thickened, tapering strongly on its distal portion
M. lucifuga (Simon, 1889)	I	Venezuela: Aragua, Colonia Tovar	6	?	?	–	–	–	–
M. macgregori (Rainbow, 1898)	F	New Guinea: Neneba	6	1.7	four spermathecae	–	–	–	–
M. manauara Bertani, Cruz & Oliveria, 2013	MF	Brasil: Amazonas	6	M 0.7 F 0.8	two spermathecae, convoluted stalk, large rounded tip	one upper and one lower spur, both with an enlarged spine at tip	yes	no	long, very thin
M. modesta (Simon, 1891)	F	St. Vincent	6	?	?	–	–	–	–
M. pallida (Kulczyn'ski, 1908)	F	New Guinea	6	?	?	–	–	–	–
M. pecki Gertsch, 1982	F	Jamaica: Falling Cave	0	2.75	two low suboval spermathecae	–	–	–	–
M. petrunkevitchi (Chickering, 1964)	MF	Puerto Rico: Mayaguez	8	1.69	?	three distal processes on tibia articulation	no	no	short, thickened, tapering to its tip
M. simla (Chickering, 1966)	MF	Trinidad: Arima Valley, Simla	8	M 1.52 F 1.78	?	three distal processes on tibia articulation	no	yes	short, curved
M. spinosa (Petrunkevitch, 1925)	MF	Panama: San Lorenzo River	8	M 1.86 F 2.05	?	three distal processes on tibia articulation	no	yes	short, thin, curved
M. toddae Raven, 1979	MF	Australia: Queensland, Home Rule	6	M 1.56 F 2.26	four spermathecae	three distal processes on tibia articulation	no	yes	short, thin, straigh
M. tovarensis (Simon, 1889)	F	Venezuela: Aragua, Colonia Tovar	6	?	?	–	–	–	–



Figures 10-14. *Masteria emboaba* **sp. nov.** Paratype female (MNRJ 4540): (10) habitus; (11) carapace and chelicerae; (12) sternum, maxillae, chelicerae, coxae and labium; (13) eye tubercle; (14) abdomen and spinnerets, ventral. Scale bars: 10-12, 14 = 1 mm, 13 = 0.1 mm.

to eleven teeth on STC; two to four on ITC. Abdomen 1.86 long, 1.22 wide. Spinnerets (Fig. 13): PMS 0.23 long, 0.09 wide, 0.34 apart; basal, middle, and apical segments of PLS 0.33 long, 0.14 wide; 0.19 long, 0.14 wide; 0.22 long, 0.11 wide, respectively. Epigastric plate not posteriorly produced; two spermathecae, each one with one pair of long, thin stalks bearing a distal rounded and somewhat flattened receptacle. The outer stalk-receptacle set is smaller than the inner one (Fig. 15).

Type material. Male Holotype: Brazil, *Minas Gerais*: Caeté (inside a natural cavity, 20°01'40"S, 43°40'52"W, 1,484 m a.s.l., highlands of Serra da Gandarela), May 2011, Bichuettte, M.E. *leg*. (MNRJ 4540). Paratypes: Brazil, *Minas Gerais*: Caeté, same data as holotype (2 females, 1 immature, MNRJ 4540); near cave AP. 09 (20°01'33"S, 43°40'54"W), 1,439 m a.s.l., Projeto Mina Apolo, sifting forest litter, July 09 2011, Equipe Aracno *leg*. (2 females, 10 immatures, MNRJ 4388); Santa Bárbara: near cave AP. 31 (20°02'14"S, 43°40'38"W), 1,443 m a.s.l., Projeto Mina Apolo, sifting forest litter, July 08 2011, Equipe Aracno *leg*. (1 immature, MNRJ 4380).

Additional material. Brazil, *Minas Gerais*: Caeté: (near cave AP. 54, 20°01'40"S, 43°40'52"W, 1,484 m a.s.l.), Projeto Mina Apolo, sifting forest litter, July 06 2011, Equipe Aracno *leg*. (1 immature, MNRJ 4378); same locality, under stones and rotten wood, forest, September 24 2011, Equipe Aracno *leg*. (1 female, 1 immature, MNRJ 4436; 1 immature, MNRJ 4437).

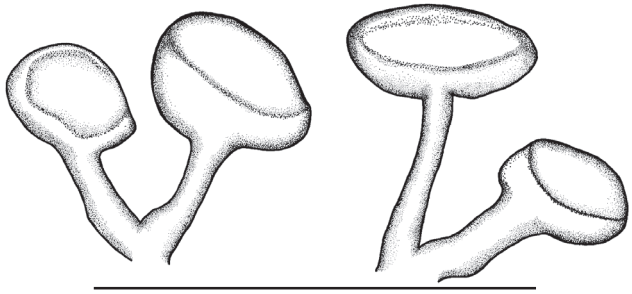


Figure 15. *Masteria emboaba* **sp. nov.** paratype (MNRJ 4540), spermathecae dorsal view. Scale bar: 100 µm.

Distribution. Only known from small tracts of Atlantic Forest and caves on "canga" areas, on the hilltops of the Gandarela range, Caeté and Santa Bárbara, state of Minas Gerais, Brazil.

Table II. *Masteria emboaba* **sp. nov.** Male holotype and femlale paratype (MNRJ 4540). Length and midwidths of right legs and palpal segments.

Length/Midwidths	Male holotype						Female paratype					
	Femur	Patella	Tibia	Metatarsus	Tarsus	Total (length)	Femur	Patella	Tibia	Metatarsus	Tarsus	Total (length)
Pp	0.54/0.19	0.31/0.16	0.41/0.16	–	0.33/0.14	1.59	0.53/0.17	0.38/0.18	0.40/0.17	–	0.46/0.14	1.77
I	0.84/0.26	0.46/0.18	0.54/0.17	0.49/0.13	0.30/0.11	2.63	0.85/0.29	0.45/0.26	0.59/0.23	0.46/0.15	0.39/0.12	2.74
II	0.77/0.25	0.47/0.19	0.47/0.17	0.43/0.14	0.38/0.11	2.52	0.72/0.23	0.48/0.20	0.44/0.20	0.44/0.15	0.36/0.12	2.44
III	0.70/0.23	0.42/0.19	0.45/0.17	0.50/0.12	0.43/0.09	2.50	0.66/0.23	0.38/0.21	0.44/0.18	0.48/0.13	0.41/0.11	2.37
IV	0.85/0.23	0.50/0.21	0.64/0.18	0.70/0.11	0.48/0.08	3.17	0.88/0.21	0.55/0.23	0.65/0.17	0.64/0.14	0.52/0.10	3.24

Etymology. The specific name, "emboaba" is a noun in apposition and refers to the historical episode "Guerra dos Emboabas" (loosely translated as "War of the Emboabas"). This episode was a series of fights between gold miners from different regions of Brazil in the early 18th century throughout Minas Gerais, especially at the Caeté region (Mello 1979).

Remarks. The spiders were whitish and almost translucent when alive (Fig. 16), but became yellowish and opaque in alcohol (Figs. 1 and 10). Additional specimens of *M. emboaba* **sp. nov.** were collected during the initial phase of the "Mina Apolo" project (Coelho et al. 2010), inside several of the "canga" caves, located between 20°01'33"S and 21°02'31"S to 43°40'25"W and 43°41'18"W. The *Masteria* specimens from a locality near Caeté, in Nova Lima, Minas Gerais, mentioned by AngloGold Ashanti (2009), may also belong to *M. emboaba* **sp. nov.**

Natural history. *Masteria emboaba* **sp. nov.** was collected both inside "canga" caves and in the dry forested tracts near the "canga" area. However, they were not found in open grassland areas covering the "canga" around the caves (Fig. 17). In the dry forest (Fig. 18), they were found sieving through the litter, or were spotted under rotten wood and stones. Therefore, we may assume that this species is associated with forest litter, eventually invading nearby caves. Cave colonization would be an easy step for an animal that is already adapted to small cavities in litter. The small patches of dry forests covering the slopes of drainage valleys do not present a continuous and deep litter layer, but there are litter pockets amassed in suitable areas. The "canga" caves are placed just below the surface and are penetrated by many plant roots. They seem to offer a suitable environment for the species, with high humidity and plenty of spider food. In addition, there are many access points to the cave through the microchannels in the porous iron matrix (Ferreira 2005). These access points may serve as a refuge for animals during dry periods, allowing the species to survive the long, dry winter of the area.

The *Masteria* species for which habitat information is available live in underground habitats, for instance in the depths of litter or in caves. Their pale color and some degree of eye reduction seem to be correlated with life in dark habitats. Most species of *Masteria* have only six eyes (e.g., Simon 1889, 1892, Raven 1991), and those that have eight eyes have a pronounced reduction of the anterior median pair, e.g. *M. petrunkevitchi* and *M. simla* (Chickering 1964, 1966). The complete loss of eyes is found in two troglobite species: *M. caeca*, from Phillipines (Simon 1892), and *M. pecki*, from Jamaica (Gertsch 1982). The reduction to only two eyes in *Masteria emboaba* **sp. nov.** may point to a high degree of specialization to underground habitats.

Figures 16-18. (16) *Masteria emboaba* **sp. nov.**, living female, near AP-54; (17) view of typical open grassland vegetation found in "canga" areas; (18) view of dry forest patches covering drainage valleys near "canga" areas. Photos: D. Pedroso.

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