

## Revisionary Studies on the Enigmatic Neotropical Ant Genus *Stegomyrmex* Emery, 1912 (Hymenoptera: Formicidae: Myrmicinae), With the Description of Two New Species

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**Abstract.**—The recent increase in leaf litter ants sampling effort in Neotropical wet forests has revealed new and interesting records of the highly specialized myrmecine ant genus *Stegomyrmex* Emery, previously considered as extremely rare. We present a modified diagnosis for the genus and describe *Stegomyrmex bensoni* n. sp. and *S. olindae* n. sp., based on, respectively, workers, males, and gyne (central-north Brazil) and on a single worker (northern Brazil). *Stegomyrmex vizottoi* Diniz (southeastern Brazil) is redescribed and compared with *S. olindae* n. sp.; these species present significant differences in size, sculpturation, and sting apparatus morphology. The males of *S. vizottoi* are described for the first time. A key for workers and queens and a distribution map for the five known *Stegomyrmex* species are provided.

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*Stegomyrmex* is the sole representative of the peculiar and exclusively Neotropical myrmecine tribe Stegomyrmecini (Bolton 2003). These ants have been considered extremely rare by many authors, perhaps due to their cryptobiotic habits enhanced by peculiar soil-binding pilosity (Hölldobler and Wilson 1986), and by the foraging technique they employ (Diniz and Brandão 1993). However, recent collections employing large-scale sampling (e.g. Agosti et al. 2000) have revealed that they are relatively common inhabitants of the dense leaf litter of Neotropical forests.

Emery (1912) described *Stegomyrmex* with a single species, *S. connectens*, based on a gyne and a male from Peru and Bolivia respectively. Emery included *Stegomyrmex* in the Dacetini based on gyne characters. Wheeler (1922) established a new tribe, Stegomyrmicini (sic), with *Stegomyrmex* as its only member. He separated it from the Dacetini mainly by the shape of mandibles and wing venation. Smith (1946) described the second *Stegomyrmex*

species, *S. manni*, from Barro Colorado Island, Panama, and agreed with Wheeler's placement of the genus in an individual tribe.

Bernard (1951) and Lenko (1965) commented on the morphological resemblance of *Stegomyrmex* to some Attini. However, Brown (1949), Brown and Kempf (1960), and Hölldobler and Wilson (1986) considered stegomyrmecine ants more closely related to Basicerotini than to Attini or Dacetini, mainly by the presence of deep antennal scrobes and the soil-binding pilosity. Dlussky and Fedoseeva (1988) considered *Stegomyrmex* as *incertae sedis* in Myrmicinae, without further discussion. However, in the last proposals of Bolton (1994, 2003, 2006 et al.), *Stegomyrmex* is placed in its own tribe within the Myrmicinae. Bolton (2003) commented that the structure of the promesonotum may suggest a relationship between Stegomyrmecini and Pheidolini, but that there is no undisputed evidence for this yet.

Lenko (1965) found a worker of *S. vizottoi* (identified by him as *S. manni*) in the gizzard of a *Conopophaga lineata* Wied (Aves, Conopophagidae). Hölldobler & Wilson (1986) commented on the presumed role of the soil-binding hairs of basicerotine and stegomyrmecine ants in enhancing their camouflage to predators. Diniz (1990) was the first to revise the taxonomy of Stegomyrmecini, describing the third species of the genus, *Stegomyrmex vizottoi*, based on workers and a gyne from Brazil and Paraguay. In the same work, Diniz commented on the relatively slow movements of stegomyrmecine ants.

Diniz and Brandão (1993) were the first to describe the nesting habits of *Stegomyrmex*, based on observations on colonies of *S. vizottoi* from Mirassol, state of São Paulo, Brazil, describing nest architecture, population distribution among nest chambers, different worker behaviors at each part of the nest, and the foraging habits of the workers, which exploit the environment surrounding their nests singly, searching for myriapod eggs.

Recent surveys of leaf litter ants in the Brazilian Atlantic forest and in sparse localities of central and northern Brazil revealed several *Stegomyrmex* specimens, including a remarkable new species described here, and extending considerably the known distribution range of *S. vizottoi*. Our analysis of *S. vizottoi* along its distribution shows, however, that, as presently accepted, it includes two distinct species, recognizable by the surface sculpture, by morphometry, and by differences in the sting apparatus, as we fully describe and comment on below.

In this paper we offer taxonomic notes on the peculiar ant genus *Stegomyrmex*, based on the study of the specimens deposited in the Museu de Zoologia da Universidade de São Paulo ant collection, literature information, and enriched by unpublished observations. We also describe two new species and comment on new records and information regarding these seldom collected ants.

## METHODS

This study was based on the available specimens in the collection of the Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil, which is believed to hold most of the known *Stegomyrmex* specimens. Depository collections are referred to by the following acronyms:

**BMNH** – The Natural History Museum, London, UK.

**CASC** – California Academy of Sciences, San Francisco, California, USA.

**CPDC** – Centro de Pesquisas do Cacau, Itabuna, Bahia, Brazil.

**JLMD** – Laboratório de Zoologia, Campus Jataí, Universidade Federal de Goiás, Brazil.

**LACM** – Los Angeles County Museum of Natural History, Los Angeles, California, USA.

**MCSN** – Museo Civico di Storia Naturale “Giacomo Doria”, Genoa, Italy.

**MPEG** – Museu Paraense Emílio Goeldi, Belém, Pará, Brazil.

**MZSP** – Museu de Zoologia da Universidade de São Paulo, São Paulo, Brazil.

**USNM** – National Museum of Natural History – Smithsonian Institution, Washington, DC, USA.

The terms for external morphology and surface sculpturing follow, respectively, Bolton (1994, 2000) and Harris (1979). The terms for wing venation follow Brown and Nutting (1950). The reproductive females are here called “gynes”, as suggested by De Andrade and Baroni Urbani (1999).

Measurements were obtained with a micrometric reticule and using the scale of a scanning electron microscope (SEM). All measurements are given in mm, and the abbreviations used are:

**HW**: head width; the maximum width of the head capsule, measured in full face view, at a median transverse line that touches the superior margins of the compound eyes.

**HL**: head length; the maximum measurable length of head capsule excluding the

mandible, measured in full face view, in a straight line from the midpoint of the anterior clypeal margin to the midpoint of the vertexal margin.

**SL:** antennal scape length; the chord length of the antennal scape, excluding the basal condyle and its peduncle.

**WL:** mesosoma length (Weber's length); the diagonal length of mesosoma in profile, from the midpoint of the anterior pronotal declivity to the posterior basal angle of the metapleuron.

**PL:** petiole length; the longitudinal axis of petiole in lateral view.

**PPL:** postpetiole length; the longitudinal axis of postpetiole in lateral view.

**GL:** gaster length; the maximum length of gaster in lateral view, excluding sting.

**TL:** total length; the summed length of HL (plus the closed mandibles), WL, PL, PPL, and GL.

**CI:** cephalic index.  $HW \times 100 / HL$ .

**SI:** scape index.  $SL \times 100 / HW$ .

The SEM images of *Stegomyrmex* specimens were obtained from a single specimen of each species. The specimens were previously cleaned in acetone, critical-point dried in a Balzer (Bal-Tec® CPD 030), and sputtered over with gold (Bal-Tec® SCD 050). After that, the specimens were mounted on the tip of metallic triangles using silver glue and then affixed to stubs for the electron microscopy. The images were obtained under several magnifications (40 to 300x), according to the size of the specimen and/or structure observed. Finally, the images were edited (Adobe PhotoShop 7.0®) to enhance some brightness and contrast details.

We studied also the sting apparatus of the species from which we had enough individuals. The sting was obtained by rehydrating ants in 70% ethanol, extracting the terminal segments from the gaster, clearing them in 55–60°C lactophenol for five minutes (or longer if necessary), rinsing twice in 70% ethanol, and twice in 95% ethanol. After the clearing process, the sting apparatus was dismembered, soaked

in xylene, and then mounted in Canada balsam for observation and illustration under optical microscope. The terms for sting apparatus morphology follow Kugler (1978).

Coordinates of localities were obtained from the information on the specimens labels and after consulting the ENCARTA World Atlas® (Microsoft); they were plotted on the distribution map generated by the software ArcView 3.2 GIS®.

When citing label data, we present additional information between brackets, explanation of codes on the labels, eventual corrections to the misprints, and reference to the notebooks from which we took information regarding the localities and/or the biology of the species.

## RESULTS

### *Stegomyrmex* Emery, 1912

*Stegomyrmex* Emery, 1912: 99. Gyne. Type species: *Stegomyrmex connectens*, by monotypy. Emery, 1912: 101 (placement in Dacetini); Emery, 1914: 42 (placement in Dacetini); Forel, 1917: 246 (placement in Dacetini); Emery, 1924: 314 (placement in Dacetini, diagnosis, catalogue); Wheeler, 1922: 668 (establishment of Stegomyrmecini [as Stegomyrmicini]); Donisthorpe, 1943: 727 (placement in Dacetini, list of type specimens); Smith, 1946: 286 (revision); Brown and Kempf, 1960: 162 (systematic notes); Lenko, 1965: 201 (distribution and biology); Kempf, 1972: 242 (catalogue); Wheeler and Wheeler, 1985: 258 (tribal classification); Hölldobler and Wilson, 1986: 16 (pilosity); Dlussky & Fedoseeva, 1988: 81 (*incertae sedis* in Myrmicinae); Diniz, 1990: 277 (revision, species key); Hölldobler and Wilson, 1990: 15 (tribal classification); Brandão, 1991: 379 (catalogue); Diniz and Brandão, 1993: 301 (biology); Bolton, 1994: 106 (catalogue); Bolton, 1995a: 1052 (census); Bolton, 1995b: 392 (catalogue); Serna, 2002: 217 (first record for Colombia); Bolton, 2003: 255 (diagnosis, synoptic classification); Fernández and Ospina, 2003: 49 (census); Fernández, 2003: 325 (genera list for Neotropics); Bolton et al., 2006 (catalogue).

**Worker.** Monomorphic. 5 to 6.5 mm in length. Reddish brown to black. Integument thick, shining and in general densely areolate, except for *S. bensoni*. Pilosity conspicuous and bizarre; hairs varying from short, subdecumbent and filiform to long, suberect, and variably branched; mandibles sparsely covered by long filiform hairs; anterior margin of clypeus bearing one or two pairs of very long setae, reaching half the length of mandibles, but without an isolated median seta; appendages covered by short decumbent hairs and by a fine and dense appressed pubescence; inferior corners of pronotum with a dense row of plumose hairs.

Head subtrapezoidal with vertexal margin slightly depressed to slightly convex; occipital corners angulate; broader posteriorad. Palpal formula 2:2. Labrum bilobed. Mandible triangular, long, strongly curved down apically and with the blades crossing apically when mandibles are closed; masticatory border multidenticulate (total dental count 12–15), with the apical tooth longer than the preceding ones. Median portion of clypeus narrow, flat and vertical, not bicarinate, quite narrowly inserted between the frontal lobes. Frontal lobes enormously expanded anterolaterally and projected far out over the lateral portions of clypeus and mandibles. Each frontal lobe covering dorsally a very deep antennal scrobe; in full face view, space between frontal lobes narrowest near the middle of head, revealing the compound eyes; clypeus and basal portion of mandible entirely concealed by the frontal lobes. Frontal area impressed, glabrous and smooth, the anterior suture obsolete. A shallow groove, almost devoid of any sculpture, present on each side of the head dorsum, extending from the frontal area to the occipital corner of head, the two grooves meeting anteriorly, forming a noticeable V. Antenna with 12 segments, with a three-segmented club; antenal scape slender, curved basally and broader at apex. Compound eye exceedingly small, oval in shape, almost indistinct

from the integument sculpture; placed on the sides of head immediately beneath the antennal scrobe, but visible when head is in full face view.

Mesosoma, in dorsal view, slender, widest at the level of the anterior area of pronotum. Promesonotum evenly rounded in profile, dome-like; anterosuperior corner of anepisternum set much lower than the adjacent surface, forming a deep fovea; promesonotal suture almost obsolete in some individuals. Mesonotum elongate with posterior portion sloping down; metapropodeal impression relatively broad and usually shallow, except for *S. bensoni*. Propodeum, in side view, variably convex dorsally, and with the declivity sinuous; propodeal spiracles low on side and raised in prominent, subcylindrical protuberances; propodeal spines short and more or less acute; propodeal lobes large and usually projected over the petiolar peduncle. Legs relatively long; femora and tibiae moderately incrassated; tarsal claws simple; metatibial spurs absent.

Petiole long and pedunculate, with about twice the length of the postpetiole; petiolar node variably convex in profile; ventral carina present and bearing 0–2 blunt anterior projections. Postpetiole approximately as long as broad, globose, without ventral process. Gaster oval, without basal shoulder; tergite of abdominal segment IV (first gastral) not broadly overlapping sternite on gaster ventral surface.

Sting apparatus. Spiracular plate with spiracle placed ventrally; anal plate with several sensillae; lancet with a pair of functional valves; furcula with indistinct dorsal arms.

**Gyne.** Like conspecific worker, with the modifications expected for myrmicine gynes. Anterior ocellus slightly larger than posterior ones. Notauli and parapsidal lines usually indistinct from surrounding sculpture; prescutellum with central area indistinct, scutoscuteellar sulcus shallowly impressed, with transversal rugulae varying in number and forming distinct cells;

lateral wing of prescutellum not projecting laterally; scutellum semicircular, with its posterior half always sloping down and with posterior border concave; propodeal spines shorter than in conspecific workers.

Forewing with distinct and strongly colored stigma; longitudinal veins Sc+R, SR, M+Cu, and A present. Cells R, Cu and 1M closed. Hind wing with Sc+R extending shortly beyond point where they connect to M, which extends as a tubular vein up to the wing distal border; Cu cell closed and very short; six to eight submedian hamuli.

**Male.** Dark brown to black, with appendages and gaster usually lighter. Integument densely sculptured, opaque or nearly so, except for the postpetiole and gaster which are smooth and shining; appendages very finely punctate. Pilosity composed of fine hairs, whitish to golden, mostly curved or suberect on body, sparser on metasoma. Apressed pubescence on antennae and legs.

Head broadest across compound eyes, narrowed anteriorly; median portion of vertexal margin usually weakly convex; occipital corners rounded; ocelli prominent. Mandible relatively developed and subtriangular; masticatory border multi-denticulate, with the apical tooth much more developed than the others. Clypeus broad. Frontal lobes not so developed as in the conspecific gynes and workers, but concealing the antennal insertions, forming a short and shallow antennal scrobe. Antennae long and slender with 13 segments; scapes relatively short.

Mesosoma robust; prescutellum separated from scutellum by an impression with short longitudinal rugae. Scutellum narrow posterad. Metanotum narrow, with blunt median tumosity. Propodeum dorsal face flat, steeply sloping posterad, unarmed. Legs slender, middle and hind tibiae without apical spurs; tarsal claws slender and simple. Wing venation as in the gynes.

Petiole clavate, pedunculate, and with a long, low, rounded node. Postpetiole as broad as long, attached to the gaster by almost its full width. Gaster elongate, with first segment occupying most of its length; visible apical segments subequal in length.

*Comments.*—We revise the *Stegomyrmex* diagnosis presented by Diniz (1990) in order to include information on the shape of the head and on the structure of the alate’s mesosoma, besides features present in *S. bensoni* **n. sp** and *S. olindae* **n. sp**. Apomorphies for *Stegomyrmecini* defined by Bolton (2003) hold true for the new species.

Despite the recent information regarding these seldom collected ants, the phylogenetic position of *Stegomyrmex* remains truly enigmatic. The affinities with Dacetini and Attini, proposed in the past, seem improbable by the significant differences in habits and morphology. Despite the body sculpturation patterns and the presence of specialized pilosity approximating *Stegomyrmex* and Basicerotini (Hölldobler and Wilson 1986), the possibility of homoplasy can not be presently discarded.

REVISED KEY TO THE *STEGOMYRMEX* SPECIES (WORKERS AND GYNES)

- 1. Integument of mesosoma predominantly smooth and shining; body covered mainly by sparse aggregations of somewhat curved and multibranched hairs; metapropodeal groove deeply impressed; petiole without anteroventral spines (state of Pará, Brazil) ..... *S. bensoni* **sp. n.**
- Integument of mesosoma predominantly sculptured, areolate; body covered mainly by sparse and erect clavate setae; metapropodeal groove only moderately impressed; petiole with at least one anteroventral spine ..... 2



2. Petiole with two anteroventral spines; inferior margin of pronotum with a row of filiform hairs; known only from the gyne (Peru and Bolivia) . . . *S. connectens* Emery
- Petiole with a single anteroventral spine; inferior margin of pronotum with a row of plumose hairs . . . . . 3
3. Promesonotum much higher than propodeum, in lateral view; propodeal spines blunt and directed posteriorly; in dorsal view propodeal spiracles strongly projected laterally (Costa Rica, Panama and Colombia) . . . . . *S. manni* Smith
- Promesonotum slightly higher than propodeum, in lateral view; propodeal spines subtriangular, acute and directed upwards; in dorsal view propodeal spiracles not strongly projected laterally . . . . . 4
4. Mesosoma length  $\geq 1.59$  mm; mesosoma partially sculptured, with foveae sparsely set on the polished integument; metapropodeal impression without a projecting tubercle; nucal area predominantly smooth; in dorsal view basal face of propodeum relatively narrow (northern Argentina, Paraguay and southeastern Brazil) . . . . . *S. vizottoi* Diniz
- Mesosoma length  $< 1.59$  mm; mesosoma strongly sculptured, with the integument completely areolate; metapropodeal impression with a projecting tubercle; nucal area predominantly sculptured; in dorsal view basal face of propodeum relatively broad (central-north Brazil) . . . . . *S. olindae* sp. n.

*Stegomyrmex bensoni* n. sp.

(Figs 1, 7)

*Holotype worker*.—**BRAZIL**: Pará, Canaã dos Carajás (06°44'49"S, 50°21'05"W) (Gruta NV06) 22–28.ii.2005 (Andrade & Arnoni) [MZSP].

*Worker description*.—HW 1.26; HL 1.09; ML 0.61; SL 0.84; WL 1.77; PL 0.78; PPL 0.45; GL 1.70; TL 6.40; CI 115.56; SI 66.35. Color reddish brown. Basal portion of mandible finely and densely striate, with large and sparse piligerous punctures, apical portion and masticatory border mostly smooth and shining; inner surface of antennal scrobes with fine, dense, transversal and concentric striation; dorsal surface of head predominantly smooth and shining, with scattered punctures near the vertexal border; margin of frontal lobes finely areolate-rugose; central portion of each frontal lobe virtually translucent, so that is possible to observe the inner surface of the antennal scrobes near the insertions of antennae; antennae opaque and finely punctate; lateral and ventral surface of head deeply areolate; occipital face of head smooth and shining except for the nucal collar which is regularly and deeply scrobiculate; mesosoma almost entirely smooth

and shining, except for a few scattered punctures at the inferior portion of meso and metapleuron; legs smooth and rather opaque; petiole and postpetiole smooth and shining with some sparse piligerous punctures; dorsum of gaster feebly shining and with sparse and fine punctuation.

Pilosity golden and extremely diverse; sparse filiform hairs covering the dorsum of mandible, external borders of frontal carinae, antennal scapes, legs, dorsum of mesosoma and metasoma; long, slightly curved, moderately clavate hairs present on dorsum of head and promesonotum; short, curved, branched hairs present on head occipital corners, dorsal surface of legs and gaster; posteroventral corners of head, anterior and lateral portions of promesonotum, dorsum of metanotum and propodeum, ventral and lateral faces of waist and anterior portion of gaster (in special the sternite) with aggregations of long, multibranched (plumose), curved hairs, so that the integument is hardly visible in these areas.

Head vertexal margin convex in the middle. Compound eyes exceedingly small, with circa three almost indistinct facets at the maximum diameter.

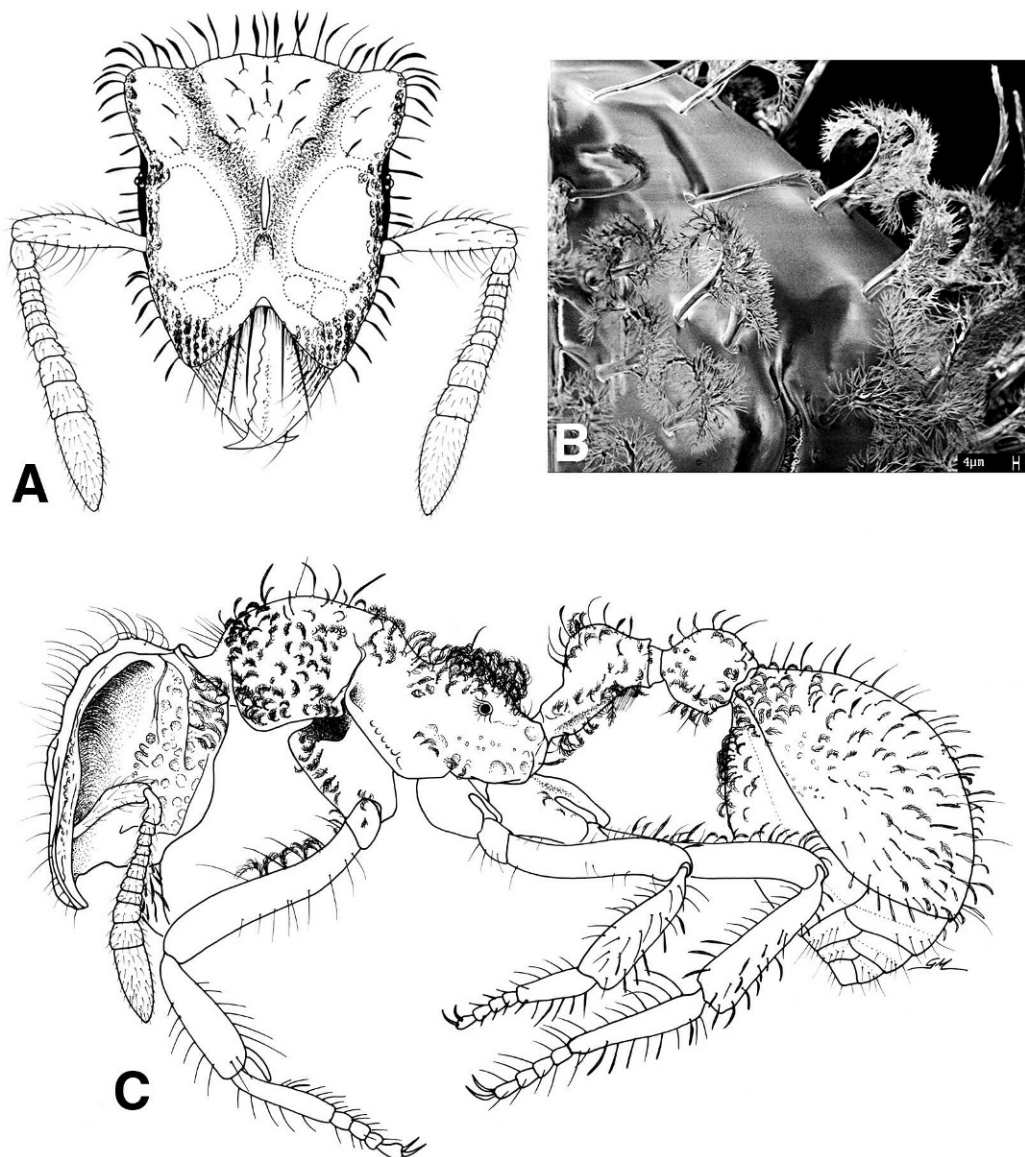


Fig. 1. *Stegomyrmex bensoni* n. sp., worker. A, head in full face view; B, SEM close-up view of promesonotal multibranch hairs; C, habitus.

Promesonotum strongly convex dorsally; metapropodeal groove deeply impressed; propodeal spines short and subtriangular, entirely covered by the propodeum pilosity; propodeal spiracle wide open, and moderately projected laterad; propodeal lobes subquadrate and weakly projected over the petiolar peduncle.

Petiole elongate, slightly arched, with a prominent rounded node; ventral carina of

petiolar peduncle without anterior projections. Postpetiole strongly convex dorsally and without ventral processes. Gaster oval and robust.

*Gyne*.—Unknown.

*Male*.—Unknown.

*Etymology*.—Species named after the prominent Brazilian-American ecologist, Woodruff Whitman Benson, well known for the study of ecological interactions in

Brazilian ecosystems. He organized for several years a field course on Ecology (graduate program of the Universidade Estadual de Campinas, São Paulo), given for several years in the Serra dos Carajás, Pará, where generations of Brazilian graduate students had their first field experience, and where the unique known specimen of *S. bensoni* was found.

*Comments.*—The peculiar multibranched pilosity, allied to the deep metapropodeal groove, and the absence of anteroventral petiolar projections, easily separate this species from all others in the genus.

The single worker known thus far was captured by our colleague arachnologist, Renata Andrade, while searching for cavernicolous pseudoscorpions in Serra dos Carajás, southeastern state of Pará (Amazon region), Brazil. The finding represents the first record of a stegomyrmecine ant in the Amazon Region.

Despite the fact that the only known specimen was collected inside a cave, near its mouth, there is no undisputed evidence that *Stegomyrmex bensoni* is restricted to this habitat.

***Stegomyrmex olindae* sp. n.**

(Figs 2, 3, 6, 7)

*Holotype worker.*—**BRAZIL:** Tocantins, Palmas do Tocantins (06°40'12"S, 47°31'48"W) (Winkler n.3) 14–19.i.2005 (Silva, R.R. and Silvestre, R.) [MZSP].

*Stegomyrmex vizottoi* Diniz, 1990: 290 (in part).

*Paratypes.*—**BRAZIL:** **Bahia:** Ilhéus, CEPEC-área Zoológ. (Km22 Ilhéus-Itabuna) x.1986 (J. Delabie) (1 worker) [MZSP]; Porto Seguro, E.E. Pau Brasil (16°23'33"S, 39°10'99"W) (Winkler n.1) 16.vi.2000 (Santos, J.R.M and Soares, J.C) (1 worker) [MZSP]; **Maranhão:** Açailândia, Horto Faz. Pompéia (04°52'30"S, 47°17'40"W) 13–22.ii.2006 (Silva, R.R. and Feitosa, R.M.) (1 worker) [MZSP]; Estreito, Fazenda Itaueiras (06°31'54"S, 47°72'16"W) 07–13.i.2005 (Silva, R.R. and Silvestre, R.) (2 workers and 1 gyne) [MZSP]; same data (1 worker) [BMNH]; same data (1 worker) [CDPC]; same data (1 worker

and 1 gyne) [LACM]; **Mato Grosso:** Sto. Antônio de Leverger, Águas Quentes (High Cerrado) (n. 0184) 26.x.1984 (J.C. Trager) (1 worker) [MZSP]; **Minas Gerais:** Timóteo, P.E. do Rio Doce (TM3–8) 07.v.2005 (Esteves, F.A.) (1 worker) [MZSP]; **Tocantins:** Palmeirante (Mata Ciliar/Cerradão) (07°52'25"S, 47°31'48"W) 10–15.xii.2001 (Albuquerque and Silva) (1 worker) [MZSP]; same data (1 worker) [CASC]; Araguaçema (08°59'20"S, 49°40'41"W) 16–30.xi.2005 (Silva, R.R. and Feitosa, R.M.) (1 worker) [MZSP]; same data (1 worker) [MPEG]; same data (1 worker) [USNM].

*Worker description.*—Holotype (workers N= 8); HW 1.09 (1.04–1.22); HL 0.97 (0.92–1.07); ML 0.49 (0.46–0.49); SL 0.74 (0.69–0.80); WL 1.43 (1.33–1.53); PL 0.68 (0.61–0.70); PPL 0.39 (0.33–0.44); GL 1.36 (1.24–1.50); TL 5.32 (5.01–5.70); CI 113.75 (104.88–114.63); SI 66.59 (63.83–67.44). Dark brown to ferruginous, with appendages somewhat lighter. Mandible finely and densely striate, with large and sparse piligerous punctures, except for the masticatory border and dorsum of apical portion which are smooth and shining; inner surface of antennal scrobes punctate and with fine transversal striation; central disc of head and external margin of frontal lobes densely areolate-rugose; oblique lateral grooves of head, frontal area and posterior portion of frontal lobes with smooth areas and sparse punctuation; anterior portion of frontal lobes shallowly areolate and with irregular longitudinal rugulae; antennae opaque and finely punctate; lateral, ventral and occipital surfaces of head deeply areolate; mesosoma (including the anterior coxae), petiole, and postpetiole entirely and deeply areolate; legs opaque and weakly sculptured; surface of gaster deeply and densely foveolate.

Pilosity cream-colored. Body covered by abundant, long, slightly stiffened, moderately clavate hairs, somewhat shorter in the external borders of frontal lobes, antennal scapes, and legs; mandible with long, sparse filiform setae; short, curved, plumose hairs present on the posteroventral corners of head, inferior and lateral por-



tions of pronotum, and more rarely on the lateral surfaces of waist; occipital face of head and lateral surface of mesonotum, metanotum, and propodeum virtually glabrous.

Vertexal border gently convex and with a discrete concavity medially. Compound eyes with circa six facets at maximum diameter.

Promesonotum strongly convex dorsally, in lateral view; promesonotal suture distinct only in the lateral faces of promesonotum; anepisternum set lower than the adjacent surface; metapropodeal groove relatively large, moderately impressed and with a median triangular projection; propodeal spines subtriangular, directed upwards and with the posterior faces enlarged medially; propodeal spiracles relatively wide, and considerably projected posterad; propodeal lobes rounded and moderately projected over the petiolar peduncle. In dorsal view, the propodeum is relatively broad, slightly narrower than the promesonotum.

Petiole elongate, gently arched, with a relatively long rounded node; ventral carina of peduncle with a well-developed anterior projection. Postpetiole with a long and moderately convex dorsal face, without ventral projections. Gaster oval and robust.

Sting apparatus (Fig. 3): Spiracular plate subquadrate, not extending towards the medial connection; margin of medial connection sclerotized; dorsal notch absent; spiracle relatively wide and set close to the posterior margin of plate; anterior apodema narrow with the medial region with a distinct angle; ventral edge vestigial, marked only by a weak projection. Quadrate plate with the dorsal region as broad as the ventral region, except for the apodema; apodema area smaller than the plate body; dorsal margin convex; apex of anterodorsal corner rounded; posterior margin complete. Anal plate with the arc rounded and strongly sclerotized; apical margin rounded and weakly definite; anal

sensilla sparsely distributed over the plate dorsum. Oblong plate with long posterior apodema; subterminal tubercle with rounded apex; postincision well developed. Gonostylus one-segmented and with six chaetae, five subequal in length and one extremely long; terminal sector short and membranous, with dorsoterminal and companion chaetae present. Triangular plate as long as broad, without tubercles or projections. Lancets with functional valves; sensorial barbles absent; dorsal and ventral margins converging towards the apex. Sting shaft weakly sclerotized, probably not perforating; dorsum of valve chamber indistinct in profile; internal apophysis absent; basal connection gently concave; anterolateral processes well developed, as broad as the furcula lateral arms; campaniform sensilla absent. Dorsal arm of furcula relatively reduced, indistinct; lateral arms well developed; fulcral articulation connected to the sting basis only by its lateral corners.

*Gyne*.—(N= 2); HW 1.24–1.26; HL 1.04; ML 0.52–0.53; SL 0.78; WL 1.82; PL 0.80–0.83; PPL 0.46–0.49; GL 1.82–1.84; TL 6.50–6.51; CI 118.60–120.93; SI 62.12–62.75. Like conspecific worker, with the modifications expected for myrmicine gynes. Plumose hairs restricted to the posteroventral corner of head and inferior corner of pronotum. Compound eyes with circa 11 facets at maximum diameter; propodeal spines drastically reduced; posterior face of propodeum vertical in side view, reaching the propodeal lobes in a rounded angle. Wings unknown.

*Male*.—Unknown.

*Etymology*.—This species is named after Florinda Gonzaga Teixeira, a long-term and always large-hearted steward of the MZSP ant lab, at the occasion of her retirement. She prefers to be called “Dona Olinda”, hence the specific name.

*Comments*.—While examining specimens of *Stegomyrmex vizottoi* from the MZSP collection, one of us (RMF) noticed that

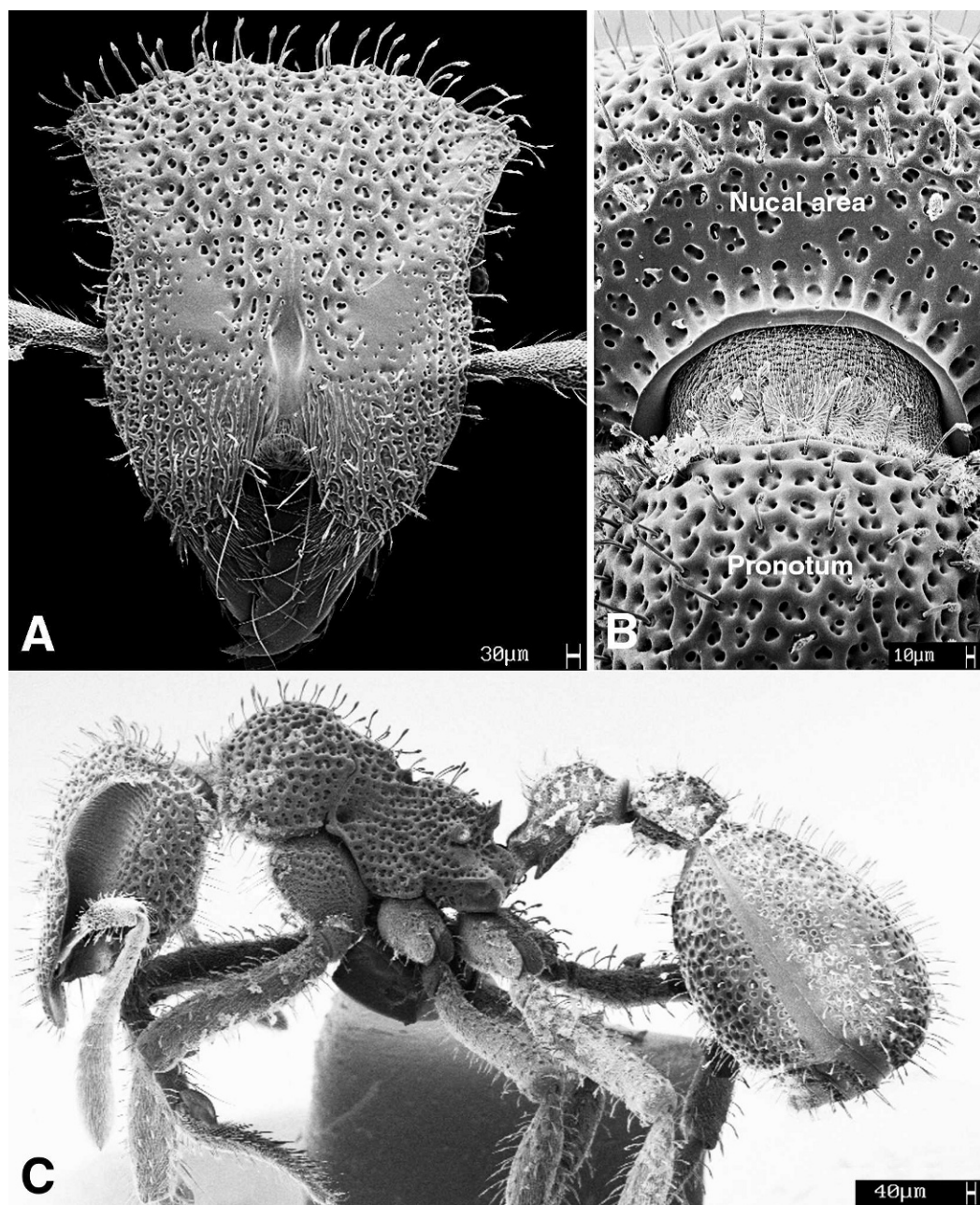


Fig. 2. *Stegomyrmex olindae* n. sp., worker (SEM). A, head in full face view; B, close-up view of nuchal area; C, habitus.

there was a morphologically distinct subgroup of individuals, all collected in the northern range of *S. vizottoi* distribution. Diniz (1990) already mentioned, while commenting on the original description of *S. vizottoi*, that a specimen from Ilhéus, state

of Bahia (northeastern Brazil) presented the lateral faces of the mesosoma more densely sculptured and the basal face of propodeum relatively enlarged in dorsal view in relation to other specimens, but he considered these characteristics as geographical variations

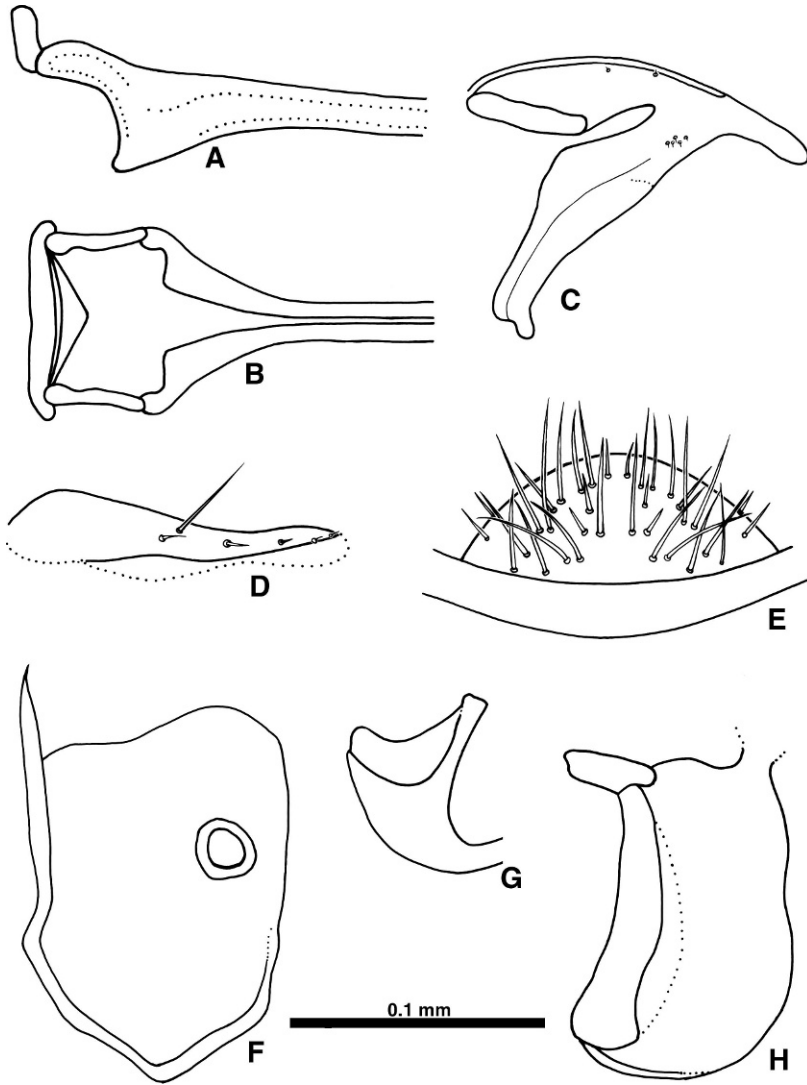


Fig. 3. *Stegomyrmex olindae* n. sp., worker sting apparatus. A, sting and furcula in profile; B, sting and furcula in dorsal view; C, oblong plate; D, gonostylus; E, anal plate; F, spiracular plate; G, triangular plate; H, quadrate plate.

and considered this specimen to belong to *S. vizottoi*. The study of the recently collected stegomyrmecine specimens deposited in the MZSP collection, led us to recognize this specimen and several others as a different and undescribed species.

This species can be separated from the related *S. vizottoi* by: the smaller size (Fig. 6), the nuchal area and the whole mesosoma densely areolate-rugose, the metapropodeal groove bearing a median

tumosity, and by the differences in the sting apparatus morphology.

*Stegomyrmex olindae* has been recorded in sparse localities in the Brazilian states of Bahia, Maranhão, Minas Gerais, Mato Grosso, and Tocantins (central-north Brazil). The specimens are usually collected in the leaf litter of mature wet forests. Nothing is known about its natural history.

The MZSP collection received recently two stegomyrmecine males from Itabirito,

state of Minas Gerais, Brazil. Despite the fact that these ants have been collected within the range of *S. olindae*, they are very similar to the males of *S. vizottoi*, differing only in discrete details of wing venation. So, we decided not to include these males in the present study until we have additional material from Minas Gerais.

***Stegomyrmex vizottoi* Diniz 1990**

(Figs 4, 5, 6, 7)

*Stegomyrmex vizottoi* Diniz, 1990: 290. **Holotype worker.** BRAZIL: São Paulo, Mirassol x.1971 (J.L.M. Diniz) (JLMD code 361) (MZSP code 11.029) [MZSP] (examined). Diniz and Brandão, 1993: 301 (biology).

*Stegomyrmex manni* Smith, 1946: 288 (in part). Lenko, 1965: 201 (distribution and biology); Kempf, 1972: 242 (catalogue).

*Worker description.*—Holotype (workers N= 7); HW 1.26 (1.17–1.33); HL 1.07 (1.00–1.14); ML 0.58 (0.51–0.61); SL 0.80 (0.76–0.85); WL 1.65 (1.59–1.77); PL 0.78 (0.70–0.80); PPL 0.46 (0.41–0.49); GL 1.60 (1.48–1.70); TL 6.14 (5.72–6.48); CI 118.18 (116.67–118.60); SI 63.46 (61.82–67.96). Dark brown to black, with ferruginous appendages. Mandible finely and densely striate, with large and sparse piligerous punctures, except for the masticatory border and dorsum of apical portion which are smooth and shining; inner surface of antennal scrobes feebly striate and with punctuation restricted to the region of antennal insertions; central disc of head and external margin of frontal lobes moderately areolate; oblique lateral grooves of head, frontal area and posterior portion of frontal lobes predominantly smooth and shining, with a few sparse punctures; anterior portion of frontal lobes weakly areolate and with irregular longitudinal rugulae; antennae opaque and finely punctate; lateral and ventral surfaces of head deeply areolate; occipital face of head mostly smooth and shining, except for the nuchal collar which is uniformly scrobiculate; mesosoma partially foveolate, with the dorsum densely

sculptured and the lateral surfaces mostly smooth and shining with a few sparse foveae; anterior coxae, petiole, and postpetiole entirely and deeply areolate-rugose; legs opaque and weakly sculptured; surface of gaster finely and deeply foveolate.

Pilosity cream-colored. Body covered by slightly stiffened, moderately clavate hairs, somewhat shorter in the external borders of frontal lobes, antennal scapes, and legs; mandibles with long, sparse filiform setae; posterior portion of ventral surface of head and anteroinferior portion of pronotum with short, curved, plumose hairs; occipital face of head and lateral surface of mesonotum, metanotum, and propodeum glabrous.

Head relatively broad in frontal view. Vertexal margin slightly convex and with a discrete concavity medially; eyes with circa six facets at maximum diameter.

Promesonotum relatively elongate in dorsal view, strongly convex dorsally in lateral view; promesonotal suture distinct only in the lateral faces of promesonotum; anepisternum set lower than the adjacent surface; metapropodeal groove large, shallowly impressed and without median projections; propodeal spines relatively short, subtriangular, with the apexes directed upwards and with the posterior faces straight; propodeal spiracles weakly projected posterad; propodeal lobes rounded and projected over the petiolar peduncle. In dorsal view, propodeum as narrow as the promesonotum.

Petiole elongate, slightly arched, with a long rounded node; ventral carina of peduncle with a well-developed anterior projection. Postpetiole globose, with the dorsal face gently convex, without ventral projections. Gaster oval and robust.

Sting apparatus (Fig. 5): Spiracular plate subquadrate, not extending towards the medial connection; margin of medial connection sclerotized; dorsal notch present; spiracle moderately wide and placed close to the posteroventral region of plate; anterior apodema enlarged medially and with an apical tubercle; ventral edge well



developed. Quadrate plate with the dorsal region broader than the ventral region, excluding the apodema; apodema area smaller than the plate body; dorsal margin flattened and sloped; anterodorsal corner of apex acute; posterior margin divided. Anal plate with the arc strongly sclerotized; apical margin triangular and well definite; anal sensillae equally developed and restricted to the posterior border of plate. Oblong plate with short posterior apodema; subterminal tubercle acute apically; postincision well developed. Gonostylus one-segmented and with five chaetae subequal in length; terminal sector short and membranous, with dorsoterminal and companion chaetae present. Triangular plate as long as broad; only the median tubercle is present. Lancets with functional valves; sensorial barbles absent; distal portion weakly sclerotized, probably not perforating; dorsal and ventral margins converging towards the apex; outer dorsal wall absent. Sting shaft weakly sclerotized, not perforating; dorsum of valve chamber indistinct in profile; internal apophysis long and well sclerotized, extending along the dorsum of valve chamber; basal connection strongly concave; anterolateral processes well developed, narrowed medially, and as broad as the furcula lateral arms; campaniform sensilla absent. Dorsal arm of furcula indistinct; lateral arms well developed; fulcral articulation connected to the sting basis only by its lateral corners.

*Gyne*.—(N= 1); HW 1.46; HL 1.19; ML 0.65; SL 0.95; WL 2.00; PL 0.92; PPL 0.56; GL 1.99; TL 7.31; CI 122.45; SI 65.00. Like conspecific worker, with the modifications expected for myrmicine gynes. Plumose hairs restricted to the posteroventral corner of head and inferior corner of pronotum. Compound eyes with circa 13 facets at maximum diameter; propodeal spines reduced; posterior face of propodeum slightly inclined in side view, reaching the propodeal lobes in rounded angles. Forewing with strongly colored stigma; longitudinal vein Sc+R nebulous when reaching the stigma;

SR extending distally beyond the stigma as a tubular vein for most of its length; M and Cu also extending distally, initially as tubular veins and then as spectral veins almost reaching the distal wing border; anal vein not extending beyond CU cell. Hind wing with Sc+R extending shortly beyond the point where they connect to M, which extends as a spectral vein to the wing distal border; basally M+Cu does not continue as a tubular vein beyond the junction with 1M; anal vein drastically reduced; seven submedian hamuli.

*Male*.—(N= 4); HW 0.92–0.98; HL 0.80–0.85; ML 0.21–0.24; SL 0.29–0.30; WL 1.89–2.04; PL 0.90–0.95; PPL 0.41–0.49; GL 1.82–1.89; TL 6.07–6.41; CI 114.29–115.15; SI 30.00–31.58. Slightly smaller and slenderer than conspecific gynes. Color black with appendages and gaster somewhat lighter. Integument opaque and densely areolate-rugose, except for the postpetiole and gaster, which are smooth and shining; appendages very finely punctate. Dorsum of head and mesosoma densely covered by whitish, fine, suberect hairs, sparser over the dorsum of the metasoma; appendages with short, subdecumbent hairs.

Head broadest across large bulging compound eyes (situated at the head midlength) rather suddenly narrowed in front of eyes and tapering moderately anterad; median portion of vertexal margin weakly convex; occipital corners rounded; ocelli prominent. Mandible relatively developed, subtriangular, with slightly curved outer borders, rapidly converging in apical half; gently down curved; masticatory border bearing circa seven serial teeth, with the apical tooth much more developed than the others. Clypeus broad and truncate in front. Frontal lobes not so developed as in the conspecific gynes and workers, but concealing the antennal insertions. Frontal carinae short and not expanded laterally, forming a short and shallow antennal scrobe. Antennae long and slender with 13 segments; scape very short, only about twice as long as broad.

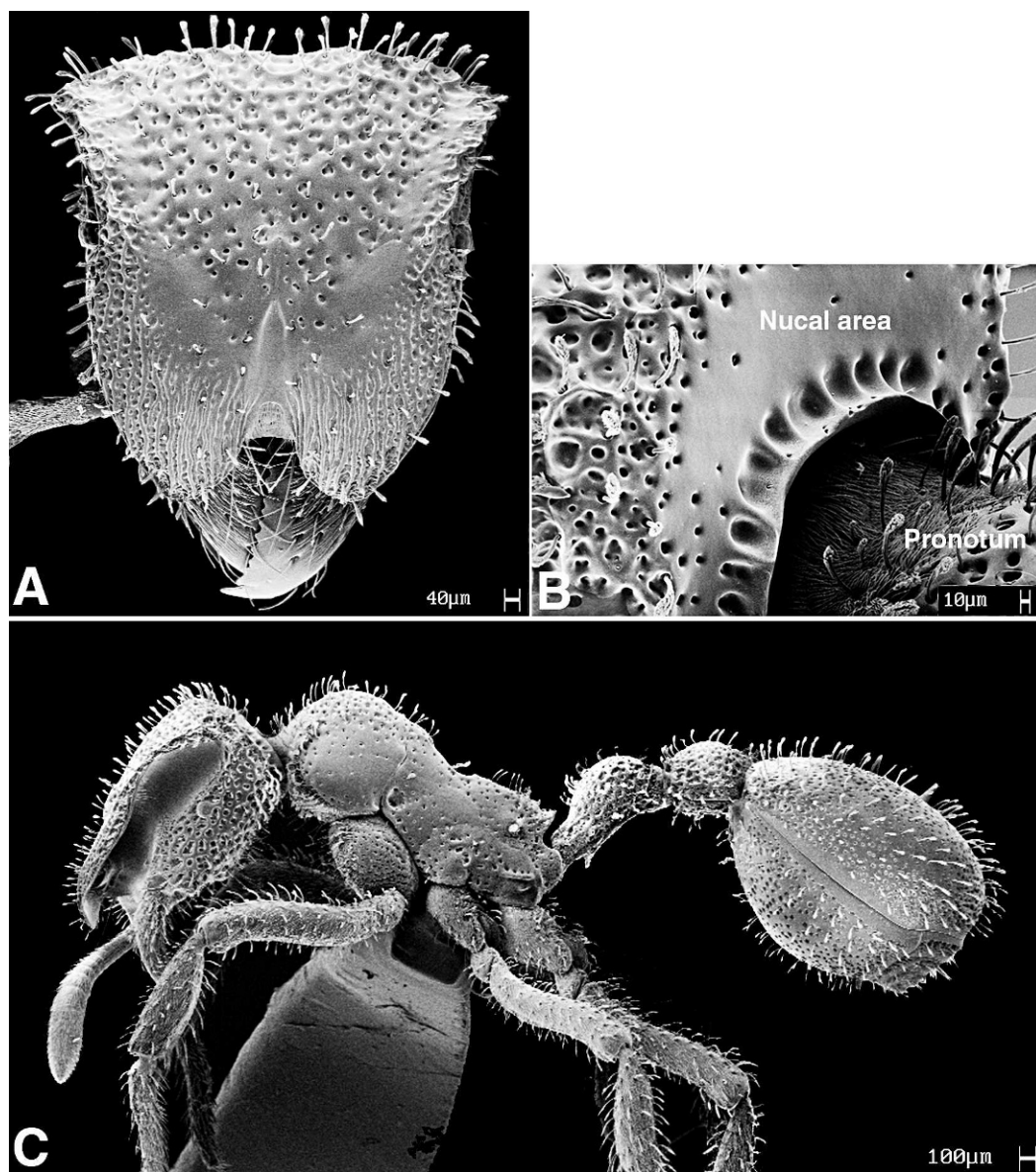


Fig. 4. *Stegomyrmex vizottoi* Diniz, worker (SEM). A, head in full face view; B, close-up view of nugal area; C, habitus.

Prescutum with more or less distinct anteromedian carina; notauli shallow and complete, with transversal costulae. Parapsidal furrows as fine shining lines; parapsides more or less impressed behind, but each with a sharp, raised posterolateral margin. Prescutellum separated from scutellum by an impression bearing short

longitudinal rugae. Scutellum narrow posterad. Metanotum narrow, with blunt median tumosity. Propodeum with dorsal face flat, steeply sloping posterad, and unarmed. Legs slender, middle and hind tibiae without apical spurs; tarsal claws slender and simple. Wings brownish, with opalescent bluish reflections; venation as in the gynes.

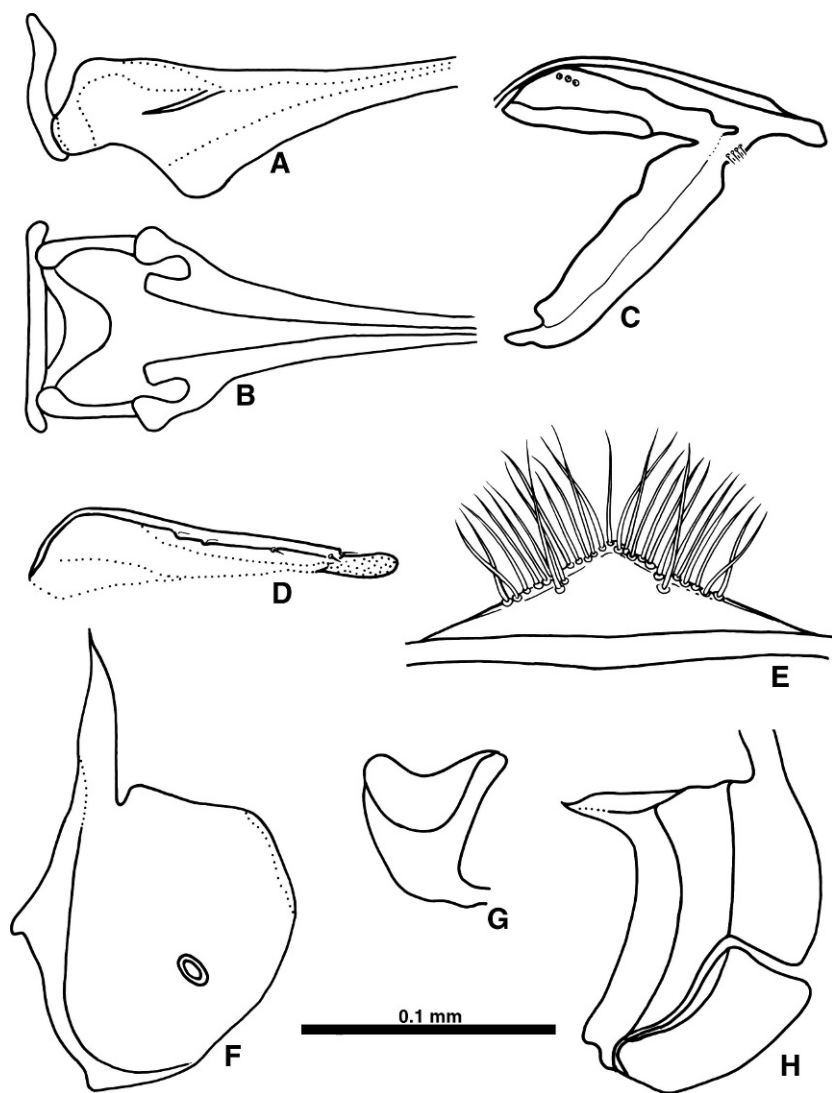


Fig. 5. *Stegomyrmex vizottoi* Diniz, worker sting apparatus. A, sting and furcula in profile; B, sting and furcula in dorsal view; C, oblong plate; D, gonostylus; E, anal plate; F, spiracular plate; G, triangular plate; H, quadrate plate.

Petiole clavate, with anterior peduncle distinct and long, low, rounded node; anteroventral projection vestigial. Postpetiole as broad as long in dorsal view and slightly broader posteriorly than anteriorly, attached to gaster by almost its full width. Gaster somewhat elongate.

*Comments.*—This species is uniquely characterized by the combination of relatively large size (TL  $\geq$  6.00 mm), mesosoma partially sculptured but for the lateral faces which are almost entirely

smooth and shining, and propodeum relatively narrow in dorsal view. *Stegomyrmex vizottoi* is the only species in the genus for which both sexes and castes are known. It has been registered from localities in northern Argentina, Paraguay, and states of Santa Catarina, Paraná, and São Paulo, southeastern Brazil (Fig. 7).

Diniz and Brandão (1993) published observations on the foraging and nesting habits of *Stegomyrmex vizottoi* from Mirasol, São Paulo, Brazil. They observed that

workers are specialized predators of spirobolid millipede eggs and forage solitarily, moving slowly in shaded areas, probing in small cracks and cavities in the soil. The ants seem to use their faces like a shovel, tucking their antennae in the antennal scrobes and pushing soil away with the face. When a millipede egg is found, it is grasped by the undersurface of the mandibles and pressed against the gular face of the worker's head, which then returns to the nest. These ants are virtually unnoticed to the naked eye, not only because they forage individually, but because of their slow movements, and because as they age their integument becomes covered by a thin but hard layer of mud. Moreover, workers can feign death for several minutes when disturbed.

Diniz and Brandão (1993) were the first to examine a *Stegomyrmex* nest in detail. The *S. vizottoi* small and perfectly rounded nest entrance (0.4 cm in diameter) was in a vertical soil bank, leading to a single sinuous tunnel extending about 40 cm to a secondary chamber, in the roof of which they found a funnel leading to the main chamber. Along the tunnel, which had several small dead ends, they found three enlargements, where the returning workers apparently stop to clean the eggs before reaching the secondary chamber. The cleaning process continues at the secondary chamber, and the eggs are piled in the main chamber only when completely cleaned. The main chamber contained the colony dealate gyne, its brood and a pile of fully cleaned millipedes' eggs. The secondary chamber contained the millipede egg shells, never found in the main chamber. The total worker population in this particular nest was 76. A second nest contained some 300 workers, 22 alate gynes, seven dealate gynes, and brood. Colonies transferred to gypsum laboratory nests with conditions and architecture similar to that of natural nests, adapted easily to the new conditions and even constructed the funnel-like structure linking the secondary to

the main chamber. It is interesting to note that in the relatively mild winters in southeastern Brazil, populations of colonies decrease sharply even in the laboratory, and the ants close the nest's entrance, relaying entirely on the millipede eggs collected in the previous season for nutrition during the winter time, the eggs being taken from the pile one at a time, to be consumed by all individuals arranged in a circle. This helps to make these ants unnoticed for several months a year, contributing to their rareness status.

*Examined material* [All deposited in MZSP].—

**BRAZIL: Paraná:** Rio Azul (1.000 m) x.1959 (F. Plaumann) (1 paratype worker) (MZSP collection n. 3147); **Santa Catarina:** Blumenau, P.E. Nascentes (27°06'15"S, 49°09'14"W) (Winkler samples) 30.iii.2001 (Silva, R.R. and Eberhardt, F.) (2 workers); São Bento do Sul, APA Rio Vermelho (26°21'51"S, 49°16'16"W) (Winkler samples) (Silva, R.R. and Eberhardt, F.) (8 workers and 1 gyne); Seara (24°07'S, 52°18'W) (Winkler sample) v-xii.1998 (Rogério R. Silva) (1 worker); **São Paulo:** Anhembi, Faz. Barreiro Rico (in gizzard of *Conopophaga lineata* Wied, 1831) ii.1964 (E. Dante) (MZSP collection n. 3470) (1 paratype worker); Mirassol (collected manually in soil) 10.x.1971 (Diniz, J.L.M.) (MZSP collection n. 11029) (JLMD collection n. 361) (1 paratype worker); xii.1976 (Diniz, J.L.M.) (JLMD collection n. 1226) (2 paratype gynes); 13.ii.1987 (Diniz, J.L.M.) (MZSP collection n. 10924) (1 worker); same data (JLMD collection no. 544), (1 worker); (20° 50'S, 49° 30'W) (nest in soil) 11.xi.1991 (J.L.M. Diniz) (2 workers and 13 males); Ribeirão Preto, Mata Santa Tereza, 10.xii.1985 (C.G. Froelich) (1 worker).

### Accounts of the other *Stegomyrmex* species

#### *Stegomyrmex connectens* Emery, 1912

*Stegomyrmex connectens* Emery, 1912: 51. **Holotype gyne.** PERU: Vilcanota [MCSN] (not examined).

*Comments.*—*Stegomyrmex connectens* is the type species of the genus and remains known only by a single gyne collected in



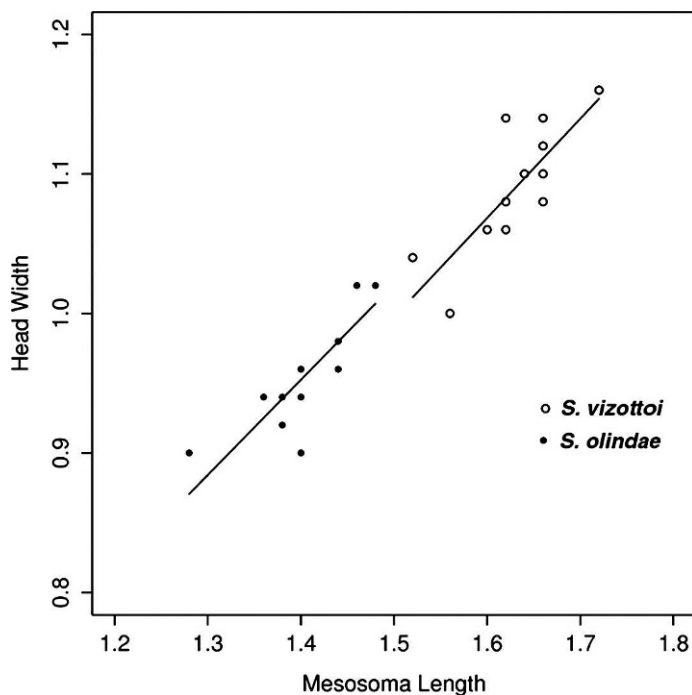


Fig. 6. The relationship between head width and mesosoma length for the worker caste in *S. vizottoi* Diniz and *S. olindae* n. sp. The best-fitting regression line is plotted for each species. There is no significant difference for regression slope or elevation of the two lines. However, there is a significant difference between head width ( $F^{1,28} = 81.554$ ,  $P = 0.000$ ) or mesosoma length ( $F^{1,28} = 163.75$ ,  $P = 0.000$ ) between the species.

Vilcanota, Peru, and a male tentatively assigned to this species, from Mapiri, Bolivia. In the original description, Emery (1912) mentioned that the male might belong to a different *Stegomyrmex* species, although he decided to describe it as *S. connectens*. Diniz (1990) examined this specimen and noticed that it presents some important morphological differences in comparison to the conspecific gyne, mainly in wing venation, pilosity, and by the absence of a second anteroventral spine in the petiolar peduncle. These differences, and the disjunct distribution of the gyne and male specimens, may indicate that they indeed do not belong to the same species.

The gyne of *S. connectens* can be immediately recognized and separated from the other species in the genus by the presence of two anteroventral projections in the petiolar peduncle.

#### *Stegomyrmex manni* Smith, 1946

*Stegomyrmex manni* Smith, 1946: 288. **Holotype worker.** PANAMA: Canal Zone, Barro Colorado Island, ix.1941, (James Zetek) (Zetek code 4879) (USNM code 57305) [USNM] (not examined). Serna, 2002: 217 (first record for Colombia).

*Stegomyrmex connectens* Emery, 1912: 101 (in part). Hölldobler and Wilson, 1986: 16 (pilosity features).

**Comments.**—*Stegomyrmex manni* has been registered in the forest floor of mature rainforests in Costa Rica, Panama, and Colombia. The combination of the relatively high promesonotum in side view, propodeal spines directed posteriorly, and propodeal spiracles strongly projected laterally separate this species from the other in the genus.

Hölldobler and Wilson (1986) illustrated and discussed the special soil-binding setae of *S. manni* (cited as *S. connectens*).

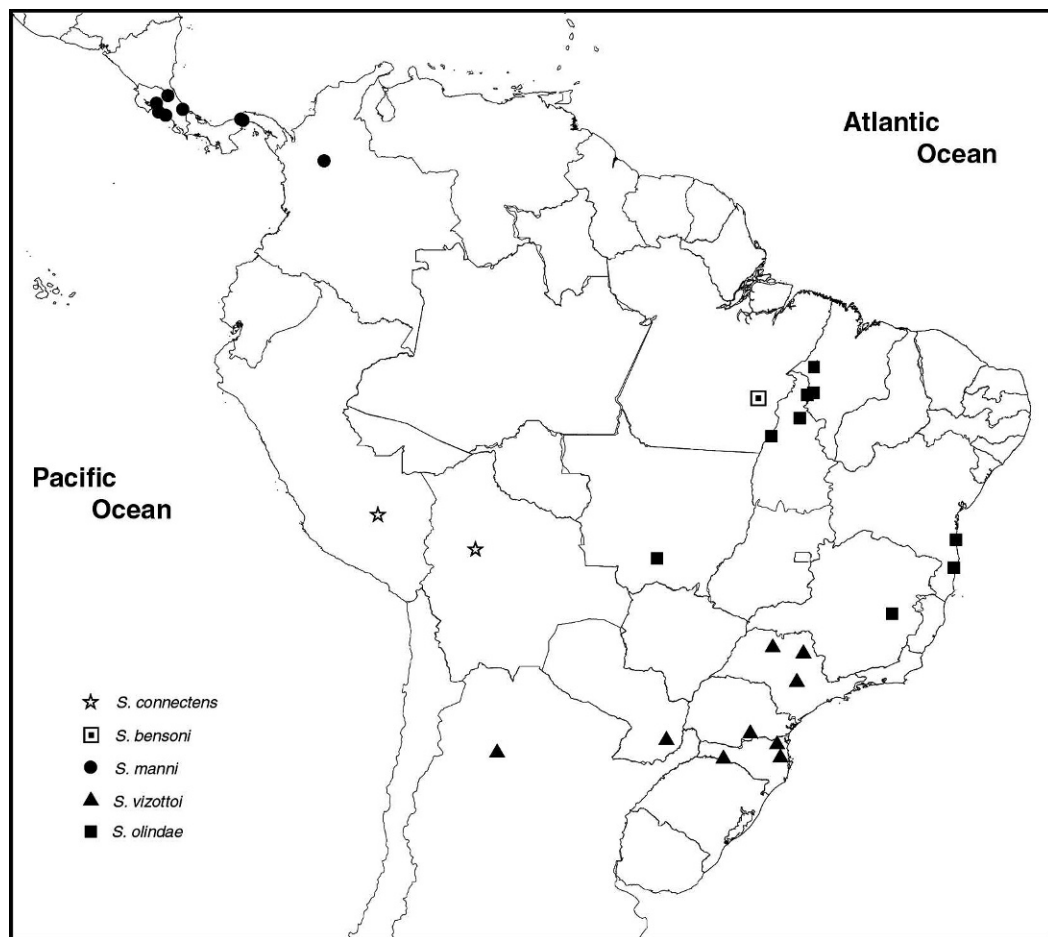


Fig. 7. Distribution map for the known *Stegomyrmex* species.

Longino (2007) published very good pictures of *S. manni* workers. He found specimens of *S. manni* in Winkler samples of sifted litter from the forest floor collected at Manuel Antonio National Park, Carara Biological Reserve, Peñas Blancas east of Monteverde, and Hitoy Cerere Biological Reserve, all in Costa Rica. According to him, Ronald Vargas collected an alate gyne at La Selva Biological Station.

#### ACKNOWLEDGEMENTS

We thank Renata Andrade for depositing in the MZSP ant collection the single known specimen of *S. bensoni*. Lara M. Guimarães took the SEM images and Gláucia Marconato made the *Stegomyrmex bensoni* drawing. Dr. Rogério Rosa da Silva kindly conducted

the statistical tests and prepared Fig. 6; Rosa da Silva and one of us (RMF) collected stegomyrmecine specimens in different expeditions supported by OIKOS Pesquisa Aplicada Ltda; we would like to make a special reference to Dr. Fábio Olmos and Dr. José Fernando Pacheco, who arranged these trips. We would also like to thank several individuals, institutions and agencies that helped or supported other collecting trips that yielded material we studied. The present work was in part supported by the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq).

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