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and *Mayriella* (Formicidae: Myrmicinae)

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Abstract: The sting apparatus and pygidium are described for eight of 20 *Lordomyrma* species and one of five *Mayriella* species. The apparatus of *L. epinotalis* is distinctly different from that of other *Lordomyrma* species. Comparisons with other genera suggest affinities of species of *Lordomyrma* to species of *Cyphoidris* and *Lachnomyrmex*, while *Mayriella abstinens* Forel shares unusual features with those of *Proatta butteli*.

Introduction

This paper describes the sting apparatus in eight species of *Lordomyrma* that were once members of four different genera. The stings of five *Lordomyrma* species were partially described by Kugler (1978), but at the time three were considered to be in the genus *Prodicroaspis* or *Promeranoplus* (*Promeranoplus rouxi* Emery, one an undetermined species of *Promeranoplus*, and *Prodicroaspis sarasini* Emery). These genera are now considered synonyms of *Lordomyrma* (Hölldobler and Wilson 1990, p. 14; Bolton 1994, p. 106). In addition, during a revision of *Rogeria* (Kugler 1994) I transferred *L. tortuosa* Mann, *L. levifrons* Mann, and *L. striatella* Mann from *Rogeria* to *Lordomyrma* partly on the basis of sting apparatus anatomy. On the other hand, *L. epinotalis* Mann was transferred to *Lordomyrma* on the basis of external characters. Here I extend and summarize what is known of the sting apparatus in this expanded concept of *Lordomyrma*.

Mayriella is a small genus from Australian and eastern Oriental zoogeographic regions (Brown 1973). Its phylogenetic relationships are unclear. Hölldobler and Wilson (1990) did not assign it to a tribe; Bolton (1994 p. 106) "dubiously included" it with *Lordomyrma* in the Stenammini.

The sting apparatus is a complex character system that can be used for phylogenetic analysis of ant genera (Kugler 1978, 1991; Bolton 1976; Baroni Urbani *et al.* 1992). Here I use it to search for genera related to *Lordomyrma* and *Mayriella*.

Methods

Sting apparatuses were dissected, cleared in hot lactophenol solution, then further dissected

into two halves and a separate sting. The stings were mounted in glycerin jelly for ease of precise positioning and repositioning for different views. The other sclerites were usually mounted in Canada balsam.

Voucher specimens identified with the label "Kugler 1995 Dissection voucher" or "Voucher specimen, Kugler study 1976" are deposited in the Museum of Comparative Zoology, Cambridge, Massachusetts.

Most preparations were drawn and measured using a Zeiss KF-2 phase contrast microscope with an ocular grid. Accuracy is estimated at plus or minus 0.001mm at 400X magnification.

Definitions of terms (See also figure labels and Kugler 1978, 1991, 1992). The sensilla formula of the oblong plates is the range in number of intervalvifer sensilla, ramal sensilla, and fulcral arm sensilla found on oblong plates. Intervalvifer sensilla are located near the articulation with the triangular plate. Ramal sensilla detect movement of the slender rami on the anterior edge of the oblong plate. Fulcral arm sensilla are located in the base of the fulcral arm. The sensilla formula of the gonostyli is the range in number on the proximal segment followed by the range on the distal segment. The regions of the sting are defined by internal structure (Fig. 7). Moving anteriorly from the sting tip, the boundary between the sting shaft and the valve chamber is the point where the inner wall of the sting shaft meets the outer sting wall. Continuing anteriorly, the boundary between the valve chamber and the sting bulb is the point where the inner and outer walls of the sting separate again. The StingL is the sum of the lengths of the three sting regions. The Index of Reduction is a measure of the length of the sting relative to the size of the ant (sting shaft length / pronotal width).

Lordomyrma

Specimens examined. *L. caledonica* André (3 workers) New Caledonia, Mt. Mou, E. O. Wilson, leg. *L. epinotalis* Mann (1 worker) British Solomon Islands, Star Harbor, W. M. Mann, leg. *L. levifrons* Mann (1 worker) Fiji, Viti Levu, Tholo-I-Suva, N. L. H. Krauss, leg. *L. punctiventris* Wheeler (1 worker) Australia, Queensland, Broken River, 6km S. Eungella, W. L. & D. E. Brown, leg. *L. rouxi* (2 workers) New Caledonia, Ciu, E. O. Wilson, leg. *L. sarasini* (2 workers) New Caledonia, Ciu, E. O. Wilson, leg. *L. striatella* Mann (1 worker) Vanua Ava, W. M. Mann, leg. *L. tortuosa* Mann (1 worker) Fiji, Viti Levu, N. L. H. Krauss, leg.

Spiracular plate (Figs. 2, 3). Rectangular in most species (Fig. 2); with an obvious posterodorsal lobe only in *L. rouxi* (Kugler 1978 Fig. 120), *L. caledonica*, and *L. sarasini*. In *L. epinotalis*, the plate is less rectangular because the anterior apodeme has a large process (Fig. 3). Medial connection membranous in all but *L. tortuosa*, where it is a narrow, weakly sclerotized band. Spiracle small.

Quadrangle plate (Figs. 1-3). Most species with a tapered anterodorsal corner (Fig. 2), but sometimes pollicate. In a *L. tortuosa* specimen the plate on one side has a pollicate corner, but the other has a tapered corner (Fig. 1); neither looks distorted by the preparation. In some species, the dorsal edge of the apodeme is not thickened (Fig. 2), but it is thickened in *L. rouxi* and *L. sarasini*, and produces a small lateral lobe in *L. epinotalis* (Fig. 3) and *L. punctiventris*. The body of the plate projects below the level of the apodeme. The body is larger or subequal in area with the apodeme in most species, but distinctly smaller in *L. epinotalis*.

Anal plate. Very weakly sclerotized so that edges of the "plate" are not visible. With 0-2 setae.

Oblong plate (Figs. 1-3). Anterior apodeme short, blunt. Posterior arm short, with thick, strongly curved dorsal ridge and little or no subterminal tubercle. No postincision separates the posterior and ventral arms. Ventral arm short; fulcral arm usually fusiform (Fig. 1), but with a thick dorsal ridge in *L. striatella* (Fig. 2), and linear in *L. epinotalis* (Fig. 3). Sensilla formulae are similar (3-5, 3-8, 0-2), with only the largest apparatus (*L. rouxi*) having more than 5 ramal sensilla).

Gonostylus (Figs. 3, 4). In most species, clearly two segmented, with distal segment longer and narrower than the proximal; setae few and with no clear dorsoterminal chaeta or companion seta (Fig. 4). In *L. levifrons*, the distal segment is heavily

sclerotized, but often the two segments are not very well delimited. In *L. epinotalis* the segments are indistinct, with the proximal portion longer than the distal, which has an acute membranous apex (Fig. 3). Sensilla formulae similar in all species: 3-7, 1-4.

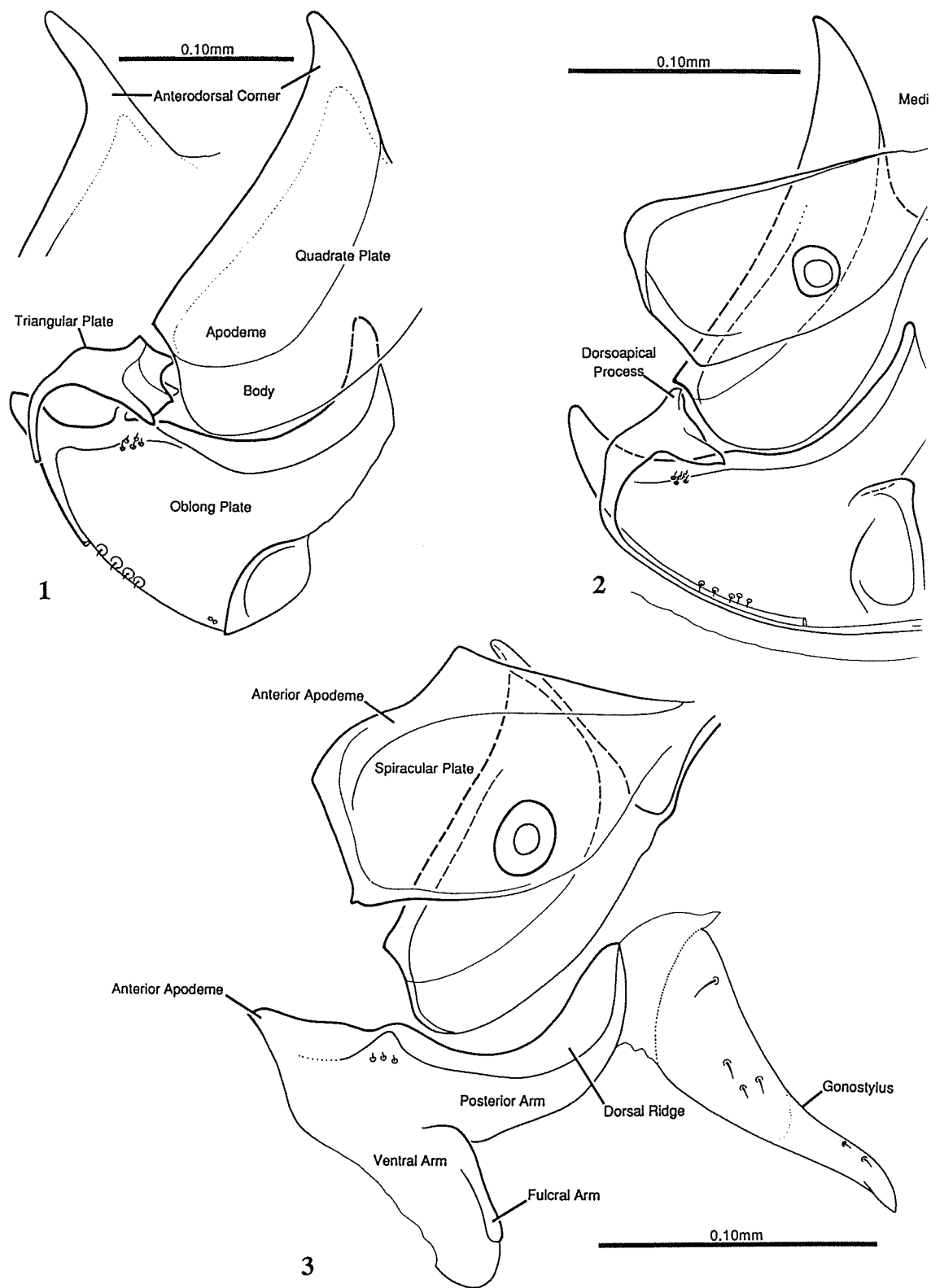
Triangular plate (Figs. 1, 2). Dorsoapical and ventroapical processes sometimes look short and truncate (Fig. 1), but sometimes appear subacute (Fig. 2). Since both shapes are seen in preparations of *L. punctiventris*, *L. rouxi*, and *L. sarasini*, the apparent shape may depend on the orientation of this thick plate on the slide. Medial tubercle visible in at least one preparation of all species except *L. levifrons* and *L. epinotalis* (may be present in these also, but just not visible in my preparations). Only *L. rouxi* has a dorsal tubercle.

Lancets (Figs. 5, 6). Base of each lancet with a single well developed valve. Lancet terminus is quite variable: sclerotized, cuneiform, and possibly able to pierce in *L. caledonica*, *L. rouxi*, and *L. sarasini* (Fig. 5); filamentous in *L. levifrons*, *L. punctiventris*, *L. striatella*, and *L. tortuosa* (Fig. 6); weak and spatulate in *L. epinotalis*.

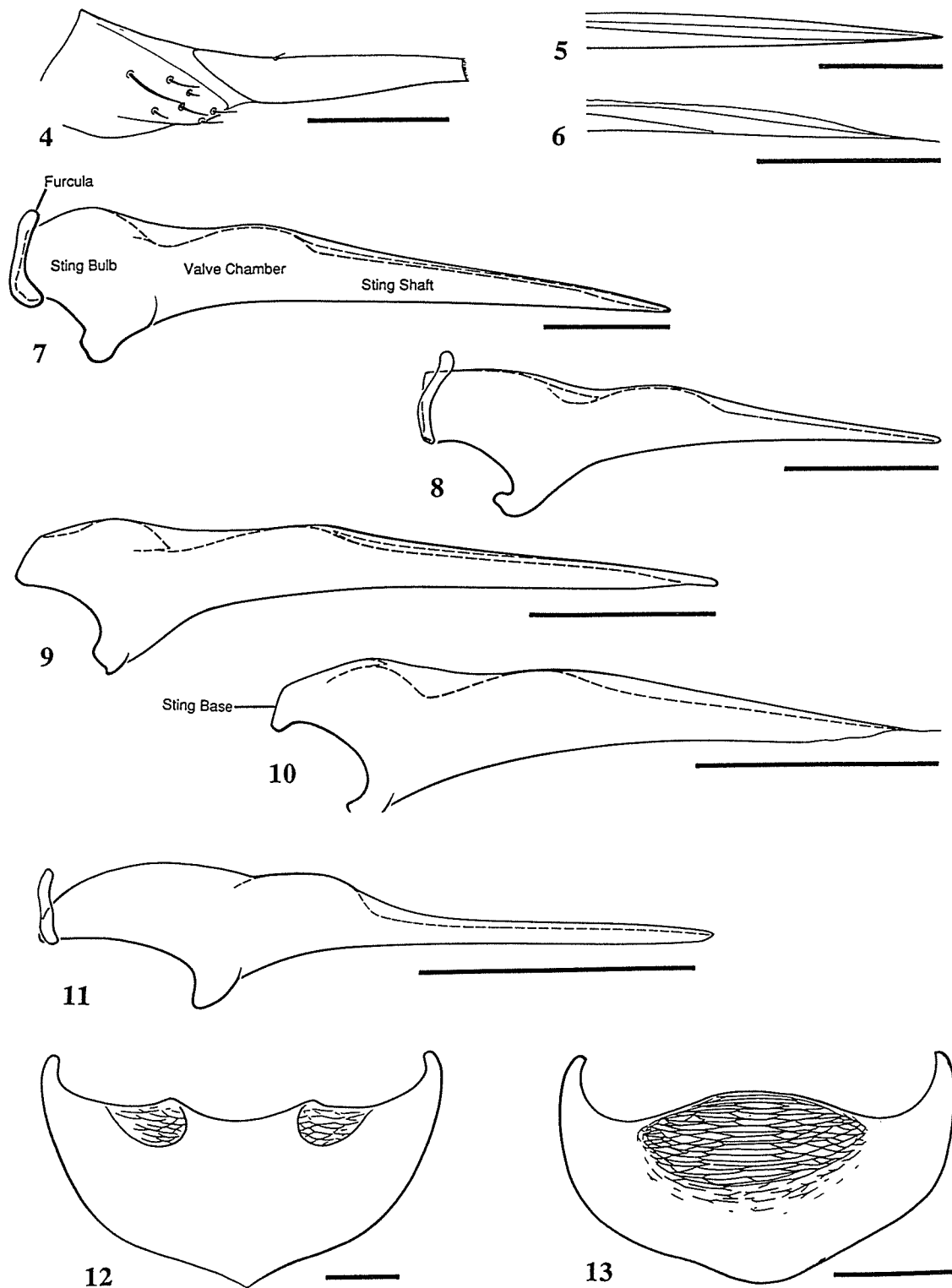
Sting (Figs. 7-11). Most species: wedge-shaped in both lateral and ventral views; sting bulb and valve chamber little differentiated in external view (Figs. 7-10); internal ridge of sting base vestigial. Variation occurs in the height of the sting base and size of the basal notch and in the shape of the sting apex. Sting apex is strong and evenly tapered in *L. rouxi* (Fig. 7 and Kugler 1978, Fig. 127), strong with slightly reduced sides in *L. sarasini* (Fig. 9), weak with very reduced sides in *L. levifrons*, *L. punctiventris*, *L. striatella*, and *L. tortuosa* (Fig. 10), or strong with flared sides in *L. caledonica* (Fig. 8 and Kugler 1978, Fig. 129). The sting of *L. epinotalis* (Fig. 11) is quite different, with a larger, convex sting bulb and slender sting shaft. Its sting shaft seems weak and unable to pierce. The sting shaft of all species examined ranges from 49% (*L. caledonica*, Fig. 8) to 56% (*L. sarasini*, Fig. 9) of StingL. The sting bulb is 22-24% of StingL in most, but 29% in *L. caledonica* (Fig. 8) and 28% in *L. epinotalis* (Fig. 11). The Index of Reduction runs from 0.24 (*L. caledonica*) to 0.31 (*L. striatella*), indicating the sting is quite small relative to the size of the ant.

Furcula (Figs. 7, 8). In all species a simple arc or V shape, with no dorsal arm.

Pygidium (Figs. 12, 13). In *L. caledonica*, *L. tortuosa*, *L. levifrons*, *L. punctiventris*, *L. rouxi*, and *L. striatella* with a pair of lateral depressions that may contain weak reticulation near the ante-



Figs. 1-3. Lateral views of *Lordomyrma* spp. sting apparatus sclerites. 1. *L. tortuosa* anterodorsal corner of the left quadrate plate; right quadrate plate, triangular plate, and oblong plate. 2. *L. striatella* spiracular plate, quadrate plate, triangular plate, oblong plate, and base of lancet. 3. *L. epinotalis* spiracular plate, quadrate plate, oblong plate, and gonostylus.



Figs. 4-13. *Lordomyrma* spp. sting sclerites and pygidia. All scale lines = 0.10 mm. 4. *L. rouxi* lateral gonostylus. 5. *L. rouxi* lateral lancet apex. 6. *L. tortuosa* lateral lancet apex. 7. *L. rouxi* lateral sting and furcula. 8. *L. caledonica* lateral sting and furcula. 9. *L. sarasini* lateral sting. 10. *L. striatella* lateral sting. 11. *L. epinotalis* lateral sting and furcula. 12. *L. caledonica* dorsal view of pygidium. 13. *L. epinotalis* dorsal view of pygidium.

rior edge (Fig. 12). In striking contrast, *L. epinotalis* has an enlarged median reticulate-striate area on the anterior edge of the plate (Fig. 13). No clear reservoirs were seen in any species, but they could have been lost in preparation.

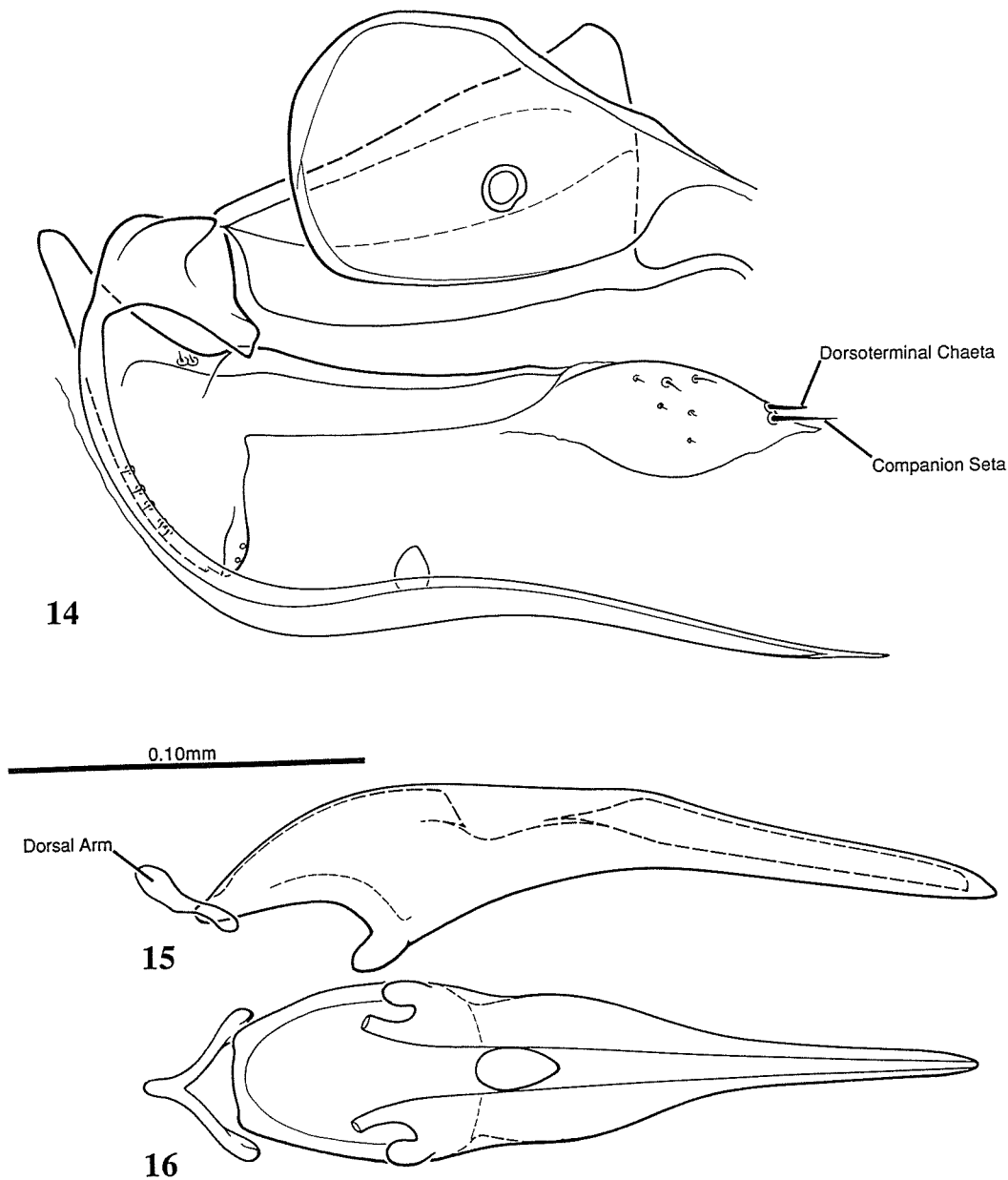
Mayriella

Specimens examined. Six workers of *M. abstinens* Forel, from Australia: ACT: Booroomba

Rocks. 1200m. 35° 33'S, 148° 59'E. 16-III-1992 S. Shattuck #2665.

Spiracular plate (Fig. 14). Spiracle small. Anterior apodeme narrow. Plate narrows mesad then abruptly narrowing to a membranous medial connection.

Quadrate plate (Fig. 14). Body nearly uniform in width. Apodeme becomes wider dorsad and its anterior ridge becomes wider and weaker. An-



Figs. 14-16. *Mariella abstinens* sting apparatus. 14. Lateral view of spiracular plate, quadrate plate, triangular plate, oblong plate, gonostylus, and lancet. 15. Lateral view of sting and furcula. 16. Ventral view of sting and furcula.

terodorsal corner blunt, not prominent. Dorsal edge of apodeme without medial or lateral lobes.

Anal plate. Oval, very weakly sclerotized, its edges not always distinct from surrounding membrane. Posterior edge with 4-6 long setae.

Oblong plate (Fig. 14). Anterior apodeme long and tapered. Posterior arm slender, with weak dorsal ridge, and no terminal tubercle; not separated from ventral arm by a postincision. Ventral arm with rather long, narrow fulcral arm that is well sclerotized only in the ventral half. Sensilla formula: 2-3, 4-5, 0-2.

Gonostylus (Fig. 14). Short, nearly membranous, single-segmented. With two separate patches of sensilla: 5-6 proximal plus a dorsoterminal chaeta and companion seta.

Triangular plate (Fig. 14). Body wide basally, then abruptly narrowed to the ramus. No dorsal or medial tubercles.

Lancet (Fig. 14). Valve single, small. Lancet apex needle-like; no barbs.

Sting (Figs. 15, 16). StingL = 0.20-0.23. Sting neither highly developed nor strongly reduced (Index of Reduction = 0.52-0.57). Sting shaft short, about 45% to 47% of StingL; well sclerotized; apex acute, without dorsal flange. Valve chamber low, 16%-17% of StingL. Roof of valve chamber held below dorsal surface of sting by a strong, wide transverse ridge and median tubercle, so the chamber is very weakly differentiated from sting shaft and sting bulb externally. Sting bulb moderate in height and length, about 37%-38% of StingL. Sting base not transversely arched and with weak basal ridge; anterolateral processes reduced to corners.

Furcula (Figs. 15, 16). Shaped like an inverted Y. Dorsal arm prominent.

Pygidium. Anterior edge with two patches of microreticulate sculpture that meet at midline. This sculpture suggests the presence of pygidial glands, but the sculpture is effaced and no convincing reservoirs appear in any of the five pygidia examined.

Discussion

With the exception of *L. epinotalis*, all of the *Lordomyrma* species examined have several distinctive characters within the myrmicines: 1) gonostyli two segmented, with distal segment longer and narrower than the proximal; setae few and with no terminal sensilla (Fig. 4), and 2) cuneiform sting with little or no basal ridge (Figs. 7-10). But *L. epinotalis*, which looks unequivocally *Lordomyrma* in external anatomy, differs markedly from the

other species in its sting apparatus: 1) spiracular ridge with a thick prominence on its anterior apodeme, 2) linear fulcral arm of the oblong plate, 3) distal segment of gonostylus not so elongate, 4) spatulate lancets, 5) sting bulb longer and sting shaft more differentiated from the rest of the sting, and 6) single patch of anterior pygidial sculpture.

This is now the fourth case in which quite different sting apparatuses are found among species of the same genus. Two kinds of stings have been found also in species of *Monomorium* (subgenera *Holcomyrmex* and *Monomorium* (Kugler 1978)), *Pheidologeton* (Kugler 1986), and *Rogeria* (Kugler 1994). On the other hand, other genera presently seem quite uniform, e.g. *Gnamptogenys* (Kugler 1991), *Tetramorium* (Kugler 1978, Bolton 1976), and *Crematogaster* (Kugler 1978).

Bolton (1994) placed *Lordomyrma* in the Tribe Stenammini, while Hölldobler and Wilson (1990) placed it in the Pheidolini. I have examined the sting apparatus in 13 of Hölldobler and Wilson's 19 Pheidolini genera and 9 of Bolton's 18 Stenammini genera. *Lordomyrma* species other than *epinotalis* do have some similarities with *Stenamma*, *Cyphoidris*, and *Lachnomyrmex*, which are members of Hölldobler and Wilson's Pheidolini as well as Bolton's Stenammini. All three genera have elongate anterodorsal corners of the quadrate plate like those of *Lordomyrma* spp. In addition, species of *Cyphoidris* and *Lachnomyrmex* have gonostyli with elongate distal portions (no clear segments), few setae, and no dorsoterminal chaeta. But, on the other hand, species of *Cyphoidris* and *Lachnomyrmex* differ greatly from those of *Lordomyrma* in sting and lancet shape. Moreover, quadrate plates like those in species of *Lordomyrma* are also found in the Pheidologetini and Cephalotini (Kugler 1978, Kugler 1986). Finally, the sting of *Lordomyrma epinotalis* is most similar to those of species of *Monomorium* subgenus *Monomorium* (Solenopsidini). Thus, while suggesting an affinity of *Lordomyrma* with *Cyphoidris* and *Lachnomyrmex*, (Stenammini or Pheidolini, depending on one's classification), the sting apparatus does not provide unequivocal support.

Mayriella abstinens has an unusual feature in its sting: a thick transverse ridge in the valve chamber plus a median tubercle. Of the specimens I have examined, a large median tubercle is found in species of *Cardiocondyla*, *Tranopelta*, and *Lophomyrmex*. A thick, wide ridge is present in species of *Terataner*, *Oligomyrmex*, and *Pheidologeton*. *Tranopelta* is also most similar in overall sting

shape. But only *Proatta butteli* has the combination of ridge and tubercle. Another unusual character is the shape of the end of the lancet. This is found in some *Tetramorium* species, *Cardiocondyla elegans*, and in *Proatta butteli*. Thus, these characters, likely to be apomorphic, are shared only by species of *Mayriella* and *Proatta*. In addition, *Proatta butteli* has a similar Y-shaped furcula (likely symplesiomorphy), gonostyli (possible reduction convergence), triangular plate, and a short but piercing sting. Bolton (1994) placed *Mayriella* and *Proatta* in the Stenammini. My analysis of the sting apparatus also indicates a relationship between those genera.

Acknowledgments

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