

## Wing microsculpturing in the Brazilian termite family Serritermitidae (*Serritermes serrifer*, Isoptera), and its bearing on phylogeny

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**Abstract.** The results of our studies on the Brazilian family Serritermitidae are presented here. Microsculpturing is simple and consists of a few rows of small, tongue-shaped papillae on the anterior and posterior wing margins and a few rows of angular arrowheads in the anterior one-third of the wings. Hairs are almost absent, a few small ones being scattered on some of the veins. The bearing of wing microsculpturing on the phylogeny of the Serritermitidae is discussed. It is concluded that the family arose as a lone sideline from the common ancient rhinotermitid stock. The other line from this stock gave rise to the Stylotermitidae on the one hand and the Rhinotermitidae on the other.

**Keywords.** Wing microsculpturing; Isoptera; Serritermitidae; *Serritermes serrifer*; phylogeny

### 1. Introduction

In a long series of papers, Roonwal and co-workers (1967–1983) have published the results of studies on wing microsculpturing in all the major families and subfamilies of termites except two tiny single-genus families, the Serritermitidae (neotropical, Brazil) and the Indotermitidae (oriental). The occurrence of a thick carpet of eight different types of microsculpturing elements on both wing surfaces has been demonstrated, with densities as high as over 12500/mm<sup>2</sup>.

Imagoes of *Serritermes serrifer* (Bates in Hagen), the sole representative of this rare and unique neotropical (Brazilian) family, have, after years of effort, recently become available, and the results of its study are presented here.

### 2. Materials and methods

Imagoes collected from Coxipo de Ponte (about 5 km SE of Cuyaba, Mato Grosso Province, Brazil; lat. 15°35' S, long. 56°00' W) were studied. Glycerine mounts of wings gave excellent delineation of the microsculpturing elements.

### 3. Results

#### 3.1 Family SERRITERMITIDAE Holmgren

Various authors have placed the subfamily Serritermitinae in either the family Rhinotermitidae or the Termitidae. Emerson (1965, p. 17) raised it to family rank

(characters later elaborated by Emerson and Krishna 1975), and we accept that status (also vide Krishna 1970; Weidner 1970).

Genus *Serritermes* Wasmann

*Serritermes serrifer* (Bates in Hagen)

*Wings* (figures 1–3)

Wings small (size without scale: forewing 5.1 × 1.2 mm; hindwing 4.0 × 1.3 mm), transparent, colourless, veins somewhat dark yellowish; almost hairless, a few small hairs (length 28–40 μm) scattered on some of the veins; margins smooth and totally hairless; at the distal end the margin is wavy and rugose (figure 3C). Venation variable. In the two pairs of wings examined by us the media is absent (according to Emerson and Krishna 1975, it is present in some wings and absent in others).

*Microsculpturing* (figures 2 and 3)

Consisting of papillae and arrowheads on both the dorsal and ventral wing surfaces. No micrasters or any other type present.

**Papillae:** Consisting of 2 or 3 rows of distally directed, tongue-shaped papillae on anterior margin of first vein (costal-subcosta), and 1 or 2 rows of similar but smaller papillae on the posterior margin. Size of anterior papillae 6–11 μm × 4–5 μm. Density (in the concerned region) ca 6400/mm<sup>2</sup>.

**Arrowheads:** Consisting of 3 or 4 rows of distally directed, angular, pointed, arrowhead-like bodies on the second vein (radius) and 2 or 3 rows of similar but smaller

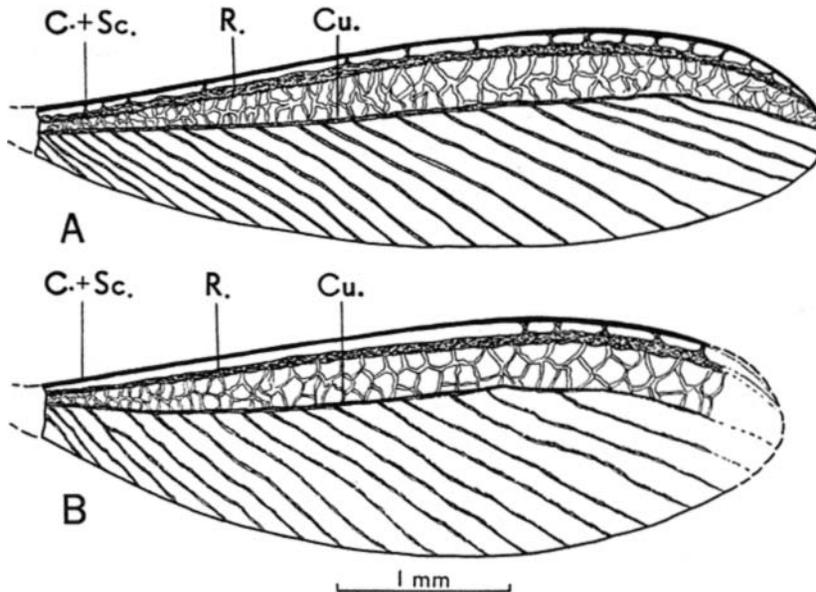
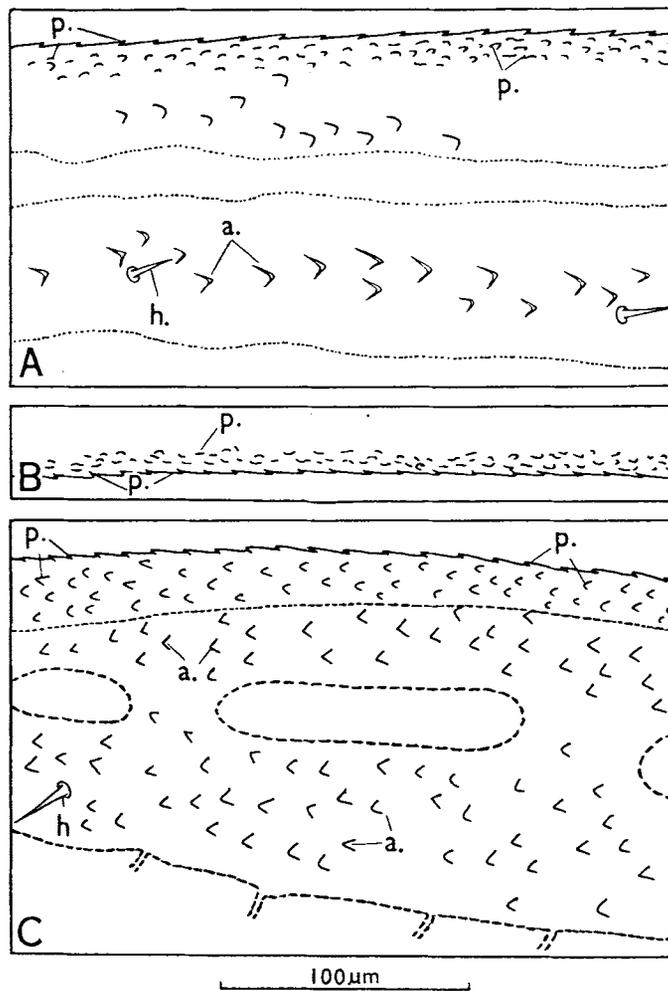


Figure 1. *Serritermes serrifer*. Right wings. A. Forewing. B. Hindwing. C + Sc, Costa-subcosta (costal margin of Emerson); R, radius (radial sector of Emerson); Cu, cubitus.



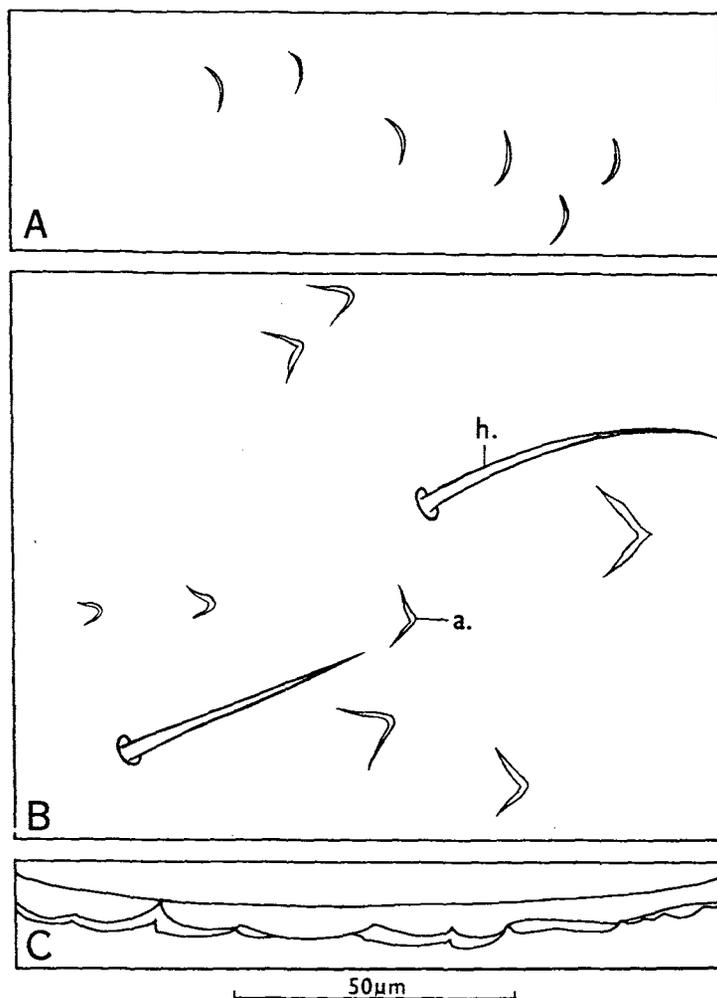
**Figure 2.** *Serritermes serrifer*. Portions of right wings, magnified to show microsculpturing. **A.** Middle of anterior margin of forewing, dorsal surface. Papillae (on anterior edge of first vein) and arrowheads (on first and second veins), **B.** Same, posterior margin (papillae), **C.** Middle of anterior margin of hindwing, ventral surface. a., arrowheads; h., hairs; p., papillae.

structures on the first vein below the papillae. Size (on the second vein)  $8\text{--}11\ \mu\text{m} \times 6\text{--}9\ \mu\text{m}$ . Density (on second vein)  $\text{ca } 3060/\text{mm}^2$ . Arrowheads mostly V-shaped with a sharp, narrow to broad angle, and with a thick base and pointed tips; those on the first vein tend to be smaller and somewhat subresentic.

#### 4. Discussion

##### 4.1 General

No information was hitherto available on wing microsculpturing in *Serritermes serrifer*. Emerson and Krishna (1975) gave a preliminary and incomplete account as follows:



**Figure 3.** *Serritermes serrifer*. Portions of right forewing, dorsal surface, greatly magnified to show microsculpturing. A. On first vein (below anterior edge), B. On second vein. C. Distal margin to show rugosity of outer edge. a., arrowheads; h., hairs.

(i) Hairs are “absent on the costal margins, inner margins, membranes, and strong veins beyond the humeral suture . . .” (p. 12). The absence of hairs was regarded as a derivative (*i.e.* secondary) condition. (ii) Wing membranes “lack punctations” (p. 16). The precise meaning of punctation was, however, not made clear, and further down the same page they mentioned the presence of “rounded punctations or micrasters” in several genera of other families, *e.g.* *Coptotermes*, *Psammotermes*, *Heterotermes*, *Termitogeton*, *Stylotermes* and *Parastylotermes*. Some, but, not all, of these genera possess true, multi-armed, asteroid micrasters, and it is clear that these authors neither distinguished punctations from micrasters, nor gave their precise meaning.

The presence of weak papillae and simple arrowheads (and no other form of microsculpturing) provide valuable clues to the phylogenetic affinities of the Serritermitidae, as discussed below.

## 4.2 Phylogeny

*Serritermes serrifer* is a rare and peculiar species whose phylogenetic position has been the subject of much diversity of opinion. Hagen (1858) placed it with the Kalotermitidae (his *Calotermes serrifer* Bates). Wasmann (1897) erected for it a new subgenus *Serritermes* (of genus *Calotermes*), while Silvestri (1901, 1903) raised it to full generic rank. Holmgren (1911) placed it in a new subfamily, Serritermitinae (of his family Mesotermitidae = Rhinotermitidae). Subsequent authors placed the Serritermitinae either with the Rhinotermitidae (Grassé 1949) or the Termitidae (Snyder 1949). Emerson (1965) raised it to family rank. Emerson and Krishna (1975) regarded it as close to the rhinotermitid subfamily Psammotermitinae (genera *Psammotermes* and *Glossotermes*). They concluded (p. 28) that "the Serritermitidae can be traced backward to an origin from the base of the Psammotermitinae, and in sequence back to the primitive rhinotermitid stem, to the hodotermitid-rhinotermitid stem, or to the primitive isopteran stem that arose from primitive blattoids possibly as early as Permian times."

We may now discuss briefly the significance of the more important characters, including wing microsculpturing, which have a bearing in determining the phylogenetic positions of the Serritermitidae.

The very small size of this termite, its characteristics imago-worker mandibles with a single marginal tooth (versus two or three in others), the peculiar, long, sword-like, serrated soldier mandibles (figure 4A) and the soldier pronotum (figure 4D) with a very deep, median indentation in both the anterior and posterior margins are characters which distinguish *Serritermes* from all other genera.

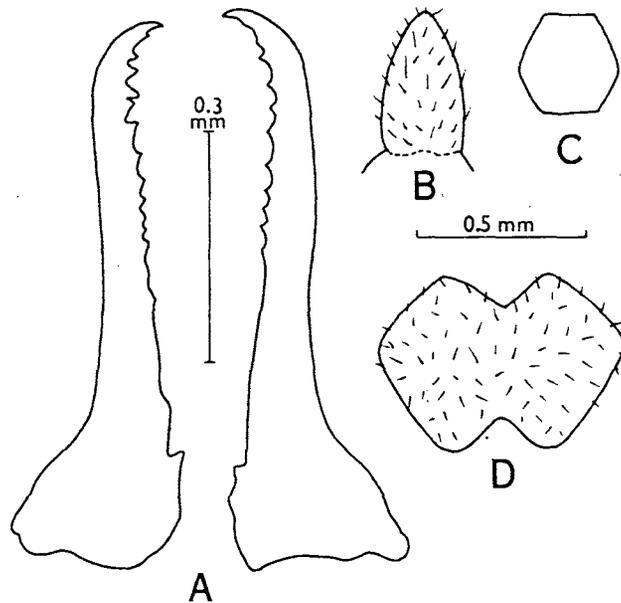


Figure 4. *Serritermes serrifer*. Soldier. A. Mandibles. B. Labrum. C. Postmentum. D. Pronotum.

Several characters suggest a rhinotermitid or a stylotermitid affinity. The simple, elongate, tongue-shaped soldier labrum (figure 4B) recalls the similar labrum of the primitive rhinotermitids (*Psammotermes*, *Coptotermes*), but lacks the pair of long apical bristles. The differences from the latter genera are also emphasised by the small hexagonal postmentum in *Serritermes* (figure 4C) and a long one in the other two.

Regarding wing microsculpturing, unlike the Psammotermitinae (Roonwal *et al* 1979b) where only pimpules are present in addition to the papillae, there are no pimpules in *Serritermes* but only arrowheads in addition to the universally occurring papillae. Arrowheads first appeared in the family Stylotermitidae (*Stylotermes*, Roonwal *et al* 1979a; Roonwal 1981, 1983b) and are present in considerable abundance in addition to pimpules and papillae. They are only occasionally present in a few Rhinotermitidae and Termitidae (Roonwal 1983b), but their main concentration seems to be in the Stylotermitidae. Their presence, in fair abundance, in the Serritermitidae would thus suggest its affinity with the Stylotermitidae, but this is offset by the important fact that the tarsi are 3-segmented in all the three legs of the Stylotermitidae (Roonwal 1975) and 4-segmented in all the legs of the Serritermitidae (figures 5 A–D).

Emerson and Krishna (1975) have suggested that the origins of the Serritermitidae can be traced back not only to the primitive rhinotermitid stem at the base of the Psammotermitinae, but even earlier, near the primitive blattoid stock. The two most primitive families which also arose from primitive blattoid stocks are the Mastotermitidae (*Mastotermes*) and the Termopsidae (*Archotermopsis*). But the Serritermitidae can be separated from these primitive genera by the fact that the apical tibial spurs are naked in *Serritermes* (Figure 5E) and clothed with scaly papillae in the other two.

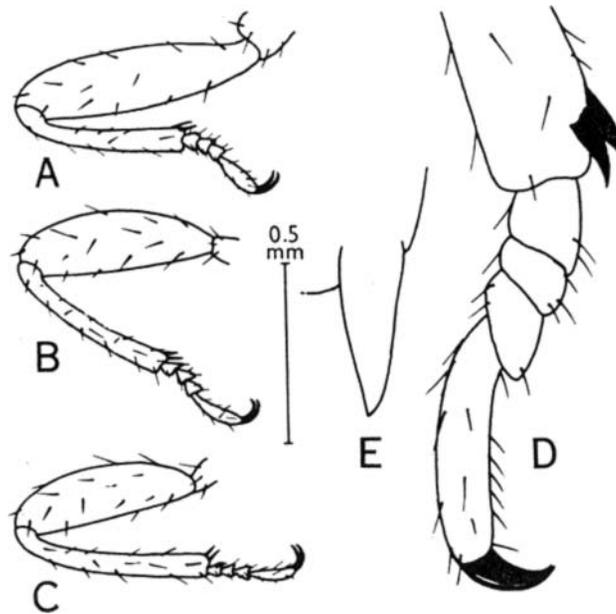


Figure 5. *Serritermes serrifer*. Soldier, legs of left side. A. Foreleg. B. Middle leg. C. Hindleg. D. Lower part of hindleg, more magnified. E. An apical tibial spur.

On the whole, it may be concluded that the Serritermitidae, while being a primitive and isolated family, differs from the most primitive ones and has close affinities with the Rhinotermitidae, especially the Psammotermitinae. It seems (also vide Roonwal 1983b, p. 367, chart) that the ancestral rhinotermitid stock (with 4-segmented tarsi and potentiality for varied sorts of wing microsculpturing) evolved into two main lines (figure 6), viz (i) a lone serritermitid line (with 4-segmented tarsi and simple wing microsculpturing consisting of only papillae and arrowheads); and (ii) a rhinotermitid-stylotermitid line with (initially) 4-segmented tarsi and varied types of microsculpturings. This latter line further evolved into two branches: (a) A small Stylotermitidae branch (with a simple wing microsculpturing consisting of only 3 kinds, e.g. papillae, pimpules and arrowheads, and with the number of tarsal segments reduced to 3); and (b) a large Rhinotermitidae branch with 4-segmented tarsi and wing microsculpturing consisting of 5 types of structures, e.g. papillae, arrowheads, pimpules, tubercles and micrasters, though all the five do not occur together in the same species.

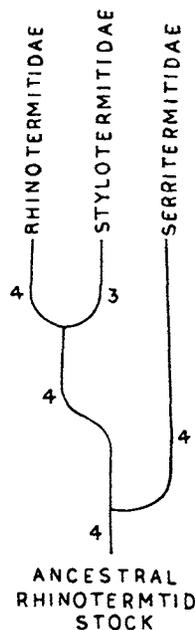


Figure 6. Diagram to illustrate the probable phylogeny of the Serritermitidae from the ancient rhinotermitid stock. Numerals indicate the number of tarsal segments (for details see text.)

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