Evolution and Systematic Significance of Wing Micro-sculpturing in Termites (Isoptera)
VIII. Subfamily Amitermitinae of Family Termitidae

M L ROONWAL\textsuperscript{1} and S C VERMA\textsuperscript{2}

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(1) Of the Amitermitinae, 9 genera and 40 species from various regions of the world were studied: Eurytermes, Alyscotermes, Anoplotermes, Speculitermes, Doonitermes, Euhamitermes, Drepanoterms, Eremoterms and Microceroterms.

(2) Micro-sculpturing on both wing surfaces consists of a dense covering of two types of structures, viz., (i) thin, pointed papillae which are directed distally and are present on the anterior and posterior wing margins; and (ii) micrasters of both nonasteroid (1-6 arms) and asteroid (5-8 arms) types.

(3) Evolutionary trends are discussed. The presence of only the simple, nonasteroid micrasters in the majority of the Amitermitinae genera suggest the primitive nature of this subfamily within the family Termitidae.

(4) Micro-sculpturing is of assistance in distinguishing the lower taxa (genera and species) but is less helpful for the higher taxa (families and subfamilies).

Key Words: Wing micro-sculpturing, Amitermitinae, Termites, Isoptera, Evolution

Introduction

In the present series (Roonwal et al. 1967–1979 and in press; vide References at the end) on the evolution, etc. of wing micro-sculpturing in the Isoptera, several new types of structures have been discovered. The present part deals with the large and widespread subfamily Amitermitinae of the family Termitidae. It is the most primitive of the Termitids and presents certain simplified features of micro-sculpturing especially regarding the micrasters.

For synonymies and taxonomic details of species names, Snyder’s (1949) world catalogue is referred to. For species described later, the appropriate first reference and recent revisions are indicated. For sub-family

\textsuperscript{1}Desert Regional Station, Zoological Survey of India, Paota, Jodhpur
\textsuperscript{2}Northern Regional Station, Zoological Survey of India, Dehra Dun
classification, Snyder's (1949) simpler arrangement has been followed in preference to that of Sands (1972).

Material and Methods
Winged imagoes from the following regions were examined: West, South and Southeast Asia, Africa, South America, Australia, New Guinea, the Pacific Ocean (Solomon Islands) and the Indian Ocean (Seychelles Islands). In all, 9 genera and 40 species were studied, as follows:

Eurytermes (1 sp.), Alyscotermes (1 sp.), Anoplotermes (4 spp.), Speculitermes (3 spp.), Doonitermes (1 sp.), Euhamitermes (3 spp.), Drepanotermes (1 sp.), Eremotermes (4 spp.) and Microcerotermes (22 spp.). The previously used techniques were employed, and densities of micro-structures refer to the middle portion of wing on the dorsal surface.

Results
The various genera and species of the sub-family Amitermitinae are now discussed in some details.

Genus (1) Eurytermes Wasmann
Of this small oriental genus, one species was available.
Wings (with scale): 10–11 × 2.5 mm; transparent, colourless, veins brown. Hairs: Anterior vein and margin with many hairs, 50–60 μm long; 1–2 rows on second vein, and a few small hairs on posterior margin; none on membrane.

Evolution and Systematic Significance
Wing micro-sculpturing: Consists of papillae and micrasters. Papillae: 1–2 rows of pointed, thorny papillae on anterior margin, size 6 μm × 3 μm; a row of similar but smaller ones (4–5 μm × 1–2 μm) on posterior margin. Micrasters: Numerous nonasteroid (2–4 arms) micrasters present all over. Size 4–8 μm × 4–6 μm. Density 9280/mm².

Genus (2) Alyscotermes Sands
This soldierless African genus contains but two species of which one was available.
1. Alyscotermes kilimanjariicus (Sjöestedt 1907) (figures 1N–P). [Syns.: Microtermes (? Procutitermes) mfolozii Fuller; and M. (Cutitermes) natalensis Holmgren] (Snyder, 1949, p. 106, Anoplotermes kilimanjariicus; Sands, 1972, Alyscotermes kilimanjariicus, synonym.) Imagoes from South Africa: “Canjeni on the south bank of White Mfoloz River, Zululand” (mfolozii); and “Rail, Natal” (natalensis).
Wings (with scale): 10–11 × 3 mm; transparent, pale brown to yellowish brown. Hairs: 3–5 rows (length 30–65 μm) on anterior margin and 1–2 rows on posterior margin; also a row on each vein and a few scattered hairs on membrane.

Genus (3) Anoplotermes F. Mueller
Of this moderate-sized, widespread, soldierless genus, four species from South America and Africa were available.
1. *Anoplortermes brevipilus* Emerson 1925 (figures 1A–C, and pl. 1 A) (Snyder 1949, p. 104.) Imagoes from South America: “Oko River, tributary of Cayumi R., 37th mile, British Guiana” (= Guyana).

Wings (without scale): 6.5–7 × 2 mm; transparent, yellowish brown, veins pale brown. Hairs: A row each on anterior and posterior margins; a few hairs on membrane. Length 35–60 μm.

Wing micro-sculpturing: Consists of papillae and micrasters. **Papillae:** 2–3 rows of pointed papillae (4–6 μm × 3–4 μm) on anterior and posterior margins. **Micrasters:** Thick, simple, nonasteroid types (1–3 arms) present all over. Size 5–10 μm × 1–7 μm. Density 5330–5660/mm². (Also see Roonwal & Rathore 1977.)

2. *Anoplortermes pacificus* F. Mueller 1873 (figures 1D–F) (Snyder 1949, p. 107.) Imagoes from South America: Novo Horizonte, Sao Paolo Province, Brazil.

Wings and hairs as in *A. brevipilus* above.

Wing micro-sculpturing: Consists of papillae and micrasters. **Papillae:** 3–5 rows of pointed papillae on anterior margin, the deeper ones of the arrowhead-type; size 4–6 μm × 3–4 μm; 2–3 rows of smaller, simpler ones on posterior margin. **Micrasters:** Almost as in *A. brevipilus*. Size 5–8 μm × 1–6 μm. Density 6,000–6,250/mm². (Also see Roonwal & Rathore 1977.)

3. *Anoplortermes* sp. l (figures 1G–J) (Mathur & Thapa 1962, p. 39, "*Anoplortermes capensis* (Emerson)", probably MS name only.) Imagoes from South Africa: Kentani, Cape Province.

Wings (without scale): 10–12 × 3 mm; transparent, yellowish brown, veins pale brown. Hairs: 4–5 rows on anterior and 2–3 rows on posterior margin; a few scattered hairs on membrane; length 50–70 μm.

Wing micro-sculpturing: Consists of papillae and micrasters. **Papillae:** 7–12 rows of pointed papillae on anterior margin, the deeper ones of arrowhead-type; size 6–8 μm × 4–6 μm; 2–3 rows of smaller and simpler ones on posterior margin. **Micrasters:** As in *A. brevipilus*. Size 4–7 μm × 2–6 μm. Density 5000/mm².

4. *Anoplortermes* sp. 2 (figures 1K–M) (Mathur & Thapa 1962, p. 40, "*Anoplortermes laescheri* (Emerson)", probably MS name only.) Imagoes from Eastern Africa: Hoima, Uganda.

Wings (without scale): 11 × 3 mm; transparent, yellowish brown, veins pale brown. Hairs: 5–7 rows on anterior and 3–4 rows on posterior margin; a row on each vein, and a few scattered hairs on membrane, 20–70 μm long.

Wing micro-sculpturing: Consists of papillae and micrasters, as in *A. pacificus*. **Papillae:** 6–8 μm × 4–6 μm. **Micrasters:** 4–6 μm × 5–7 μm; density 5,000/mm².

**Genus (4) Speculitermes** Wasmann

Of this small oriental and neotropical genus, three species were available.


Wings (with scales): 15 × 4 mm; transparent, glassy, colourless, veins dull white. Hairs: 1–3 rows on anterior margin, 65–70 μm long; a row on second vein and a row of smaller ones (40–50 μm long) on posterior margin; membrane hairless.

Wing micro-sculpturing: Consists of papillae and micrasters. **Papillae:** A row a minute (0.5 μm × 0.5 μm), pointed papillae on anterior and posterior margins. **Micrasters:** Simple, nonasteroid type (with 1–2 arms, mostly 1-armed) all over. Size 3–4 μm × 1–3 μm. Density 3200–4000/mm².

2. *Speculitermes silvestrii* (Emerson 1925) (figure 2D; and pl. 1B, C) (Snyder 1949, p. 110.) Imagoes from South America: Ongelijk in Surinam (Dutch Guiana).

Wing micro-sculpturing: *Papillae*: Not examined but probably present, as in *S. rongrensis*. *Micrasters*: as in *S. rongrensis*, but with 1-3 arms; size 5-12 μm × 2-5 μm; density 3,850/mm². (Also see Roonwal & Rathore 1977.)

Genus (5) *Doonitermes* Chatterjee & Thakur

A single species was available of this small oriental genus.


Wings (without scale): 15-17 × 3.5-4 mm; transparent, colourless, veins pale yellowish brown. Hairs: 6-7 rows on anterior margin (length 80-100 μm), a row of scattered ones on second vein, and 2-3 rows of smaller hairs on posterior margin; membrane hairless.

Wing micro-sculpturing: Consists of papillae and micrasters. *Papillae*: 1-2 rows of thin or thick, pointed, spiny papillae on anterior margin (4-5 μm × 3-4 μm) and a row of small, pointed ones on posterior margin. *Micrasters*: Simple, thick, nonasteroid type (1-4 arms) present all over. Size 5-8 μm × 1-4 μm. Density 7250/mm².

Genus (6) *Euhamitermes* Holmgren

Of this small oriental genus, three species were available.

1. *Euhamitermes lighti* Snyder 1933 (figures 2H-J) (Snyder 1949, p. 112.) Imagoes from South Asia (India): Asarori Forest near Dehra Dun, Uttar Pradesh.
Wings (without scale): 11–12×2–3 mm; transparent, colourless, veins dull white. Hairs: 2 rows on anterior margin (length 50–60 μm), a scattered row on second vein, and 1–2 rows of smaller ones on posterior margin; a few scattered hairs on membrane.

Wing micro-sculpturing: Consists of papillae and micrasters. Papillae: 1–2 rows of small, pointed papillae on anterior margin (3–4 μm × 3–4 μm) and a row of similar but smaller ones on posterior margin. Micrasters: Small, simple, colourless, hyaline and non-asteroid type (1–4 arms) all over membrane. Size 4.6 μm × 1.4 μm. Density 7250/mm².


Wings (without scale): 11 × 3 mm; transparent colourless, anterior veins brown. Hairs: As in E. lighti; 70–75 μm long.

Wing micro-sculpturing: Consists of papillae and micrasters. Papillae: A row of small, pointed papillae on anterior margin (3 μm × 0.5–1 μm) and a row of similar but smaller ones on posterior margin. Micrasters: Simple, small, non-asteroid type (2–4 arms) present all over. Size 2.2.5 μm × 4.5 μm. Density 3600–4000/mm².


Wings, hairs and micro-sculpturing (papillae and micrasters) generally as in E. Urbanii. Micrasters non-asteroid (2–3 arms); size 2–2.5 μm × 4–5 μm; density 4000–4800/mm².

Genus (7) Drepanotermes Silvestri

Of this small palaearctic and oriental genus, two species were available, and two others are discussed briefly but were not examined.

1. Drepanotermes dehradun (Roonwal & Sen-Sarma 1960) (Roowal & Sen-Sarma 1960, p. 63) mentioned the presence of “numerous micrasters” on wings of imagoes from Dehra Dun (India). We could not re-examine the examples for papillae, but they are probably present, as in E. paradoxalis below.

2. Drepanotermes fletcheri Holmgren & Holmgren 1917 (figure 2N; and pl. 1E.) (Snyder 1949, p. 131; and Roonwal & Sen-Sarma 1980, p. 63, revision of genus.) Imagoes from South Asia (India): Coimbatore, Tamil Nadu.

Wing micro-sculpturing: Papillae: Probably present as in E. paradoxalis below, but not examined. Micrasters: Numerous brown, thin micrasters all over, mostly non-asteroids (3–5 arms) and a few (5%) astersoids (5 arms). Size 3.7 μm × 2.5 μm. Density 6300/mm². (Also see Roonwal & Rathore 1977.)

3. Drepanotermes indicatus Silvestri 1911 (Snyder 1949 p. 131.) Examples of this African species were not available to us.
Plate I A-F Photomicrographs of wing micro-sculpturing in some Amitermiteae (views of dorsal surface of hindwings). A, Anoplotermes brevipes; B, Speculitermes silvestrii, low magnification; C, Same, highly magnified; D, Speculitermes sinhalensis; E, Eremotermes fletcheri; F, Eremotermes Paradoxalis

4. *Eremoternes paradoxalis* Holmgren 1913 (figures 2 O-R; and pl. 1F). (Snyder 1949, p. 132; and Roonwal & Sen-Sarma 1960, p. 83, revision of genus.) Imagoes from South Asia (India): Jodhpur (Rajasthan) and Delhi.

Wings (without scale): 6.5–8 × 1.5–2 mm; transparent, colourless, veins brown; membrane granular due to numerous brown micrasters. Hairs: 1–3 rows on anterior margin (length 35–50 µm), 1–2 rows of smaller hairs on posterior margin, and a few scattered ones on distal third of wing membrane.

Wing-micro-sculpturing: Consists of papillae and micrasters. Papillae: A row of small, thin, pointed papillae on anterior margin (size 4–6 µm × 3–4 µm), and a similar row of smaller ones on posterior margin. Micrasters: Thin, brown ones present all over, both nonasteroid (4–5 arms) and asteroid (5–6 arms), mostly the former. Size 3–8 µm × 3–8 µm. Density 5670–6000/ mm².

**Genus (9) Microcerotermes Silvestri**

Of this large, widespread genus, 22 species were available from West, South and Southeast Asia, South America, New Guinea, Australia and the Indian and Pacific Ocean islands. Wings are only moderately hairy, and micro-sculpturing consists of small, pointed, distally directed papillae on the anterior and posterior margins (the anterior ones being usually larger, but in a few cases, e.g., *M. palestinensis* and *M. serratus*, the posterior ones are larger) and micrasters on the rest of the wing membrane (described earlier in some species, vide Roonwal, Verma & Rathore 1974).

Micrasters are of both the nonasteroid and asteroid types, with 1–8 arms. Usually both types, in varying proportions, are present in different species, but in some the nonasteroid type alone is present (*M. cavus, M. diversus*). Sizes vary as about 4–9 µm × 1–9 µm. Micraster densities, per mm², on a single wing surface vary from moderate (4455, *M. cavus*) to high (10870, *M. strunckii*).


Wing micro-sculpturing: 1–3 rows of pointed papillae on anterior margin and a row of similar but smaller ones on posterior margin. Both nonasteroid (3–6 arms) and asteroid (5–6 arms) micrasters present all over, mostly nonasteroids; size 5–8 μm × 3–7 μm; density 6,075–6,615/mm².

2. Microcerotermes arboresus Emerson 1925 (figure 3D) (Snyder 1949, p. 133.) Imagoes from South America: Corupano, Venezuela.

Wing micro-sculpturing: 1–2 rows of pointed, spiny papillae on anterior margin and similar rows of smaller ones on posterior margin. Both nonasteroid (4–5 arms) and asteroid (5 arms) micrasters present all over, mostly nonasteroids; size 5–8 μm × 3–8 μm; density 6,210/mm².

3. Microcerotermes baccus Snyd. 1933 (figures 3E and 4A, B) (Snyder 1949, p. 133.) Imagoes from South Asia (India): Dehra Dun and Chakrata, Uttar Pradesh.

Wings (with scale): 6 × 1.5 mm; thin, transparent, veins dull white. Hairs: 2–3 rows on anterior margin, a few on second vein, and 1–2 rows on posterior margin, 40–60 μm long.

Wing micro-sculpturing: 2–3 rows of short, pointed, spiny papillae on anterior margin (4–6 μm × 3–4 μm) and a row of similar but smaller ones on posterior margin. Both nonasteroid (5 arms) and asteroid (5–6 arms) micrasters, mostly the latter, present all over; size 5–8 μm × 5–8 μm; density 6075–6480/mm².


Wing micro-sculpturing: 1–2 rows of pointed, spiny papillae on anterior and posterior margins. Both nonasteroid (5–6 arms) and asteroid (5–8 arms) micrasters present all over, mostly asteroids; size 5–9 μm × 5–8 μm; density 6885/mm².


Wings (without scale): 6.5 × 2 mm; transparent, pale yellow, veins dark brown. Hairs: 2–3 rows on anterior margin, a row on second vein and on posterior margin; a few hairs on membrane; length 60–80 μm.

Wing micro-sculpturing: Papillae: 1–3 rows of spiny papillae on anterior margin (4–5 μm × 3 μm) and a row of small ones on posterior margin. Micrasters: Dark brown; both nonasteroids (1–5 arms) and asteroids (5–6 arms) present all over, mostly the former. Size 4–8 μm × 6–8 μm. Density 9420/mm².

6. Microcerotermes burmanicus Ahmad 1947 (figure 3G) (Snyder 1949, p. 135.) Imagines from South Asia: Moulmein Forest Division, Burma.

Wing micro-sculpturing: Papillae as in M. biroi above. Both nonasteroid (3–5 arms) and asteroid (5–6 arms) micrasters present, mostly asteroids; size 5–9 μm × 5–8 μm; density 5805–6075/mm².

7. Microcerotermes cameroni Snyder 1934 (figure 3H) (Snyder 1949, p. 135.) Imagines from South Asia (India): Cochin, Kerala.

Wing micro-sculpturing: Papillae as in M. biroi above. Both nonasteroid (4–6 arms) and asteroid (5–6 arms) micrasters present all over, mostly asteroids; size 5–8 μm × 5–6 μm; density 5,670–6,210/mm².

8. Microcerotermes cavus Hill 1942 (figure 3I) (Snyder 1949, p. 135.) Imagines from Australia: 70 miles west of Cobar, New South Wales.

Wing micro-sculpturing: Pointed papillae present on anterior and posterior margins. Only nonasteroid micrasters (3–5 arms) present all over, no asteroids; size 5–8 μm × 3–6 μm; density 4455–4590/mm².

9. Microcerotermes crassus (Snyder 1934) (figure 3J) (Snyder 1949, p. 136.) Imagines from South Asia: Metikyina, Burma.
Wing micro-sculpturing: Pointed papillae present on anterior and posterior margins. Both nonasteroid (3–6 arms) and asteroid (5–6 arms) micrasters present all over, mostly nonasteroids; size 5–8 μm × 5–6 μm; density 6,210–6,480/mm².

10. Microcerotermes depokensis Kemner 1932 (figure 3K) (Snyder 1949, p. 137.) Imagoes from Southeast Asia: Depok, Java (Indonesia).

Wing micro-sculpturing: Papillae as in M. biroi above. Both nonasteroid (4–5 arms) and asteroid micrasters present all over, mostly asteroids; size 5–9 μm × 3–9 μm; density 6885/mm².

11. Microcerotermes distinctus Silvestri 1909 (figure 3L) (Snyder 1949, p. 137.) Imagoes from Australia.

Wing micro-sculpturing: Pointed papillae present on anterior and posterior margins. Both nonasteroid (3–5 arms) and asteroid (5–7 arms) micrasters present all over, mostly nonasteroids; size 5–8 μm × 3–8 μm; density 6210/mm².

12. Microcerotermes diversus Silvestri 1920 (figure 3M) (Snyder 1949, p. 137.) Imagoes from West Asia: Rustam Farm, Baghdad, Iraq.

Wing micro-sculpturing: Pointed papillae present on anterior and posterior margins. Nonasteroid micrasters (1–4 arms) present all over; no asteroids; size 3–6 μm × 2–5 μm; density 4860–5130/mm².


Wing micro-sculpturing: 1–2 rows of small, pointed, spiky papillae on anterior margin, apparently none on posterior margin. Both nonasteroid (4–6 arms) and asteroid (5–6 arms) micrasters present all over, mostly nonasteroids; size 6–8 μm × 5–7 μm; density 5535–5670/mm².


Wings (with scale): 6 × 1.5 mm; transparent, colourless, front vein yellowish brown, other veins almost colourless. Hairs: 2–3 rows on anterior margin, a row on second vein, and a row on posterior margin; none on membrane; length 40–60 μm.

Wing micro-sculpturing: Papillae: A row of small (3–4 μm × 2 μm) ones on anterior margin; apparently none on posterior.

Microasters: Both nonasteroid (1–6 arms) and asteroid (5 arms) types, mostly the former, present all over. Size 4–6 μm × 1–6 μm. Density 7250/mm².

15. Microcerotermes nervosus Hill 1927 (figure 3O) (Snyder 1949, p. 142.) Imagoes from Australia: Marrakai, Northern Territory.

Wing micro-sculpturing: 1–2 rows of pointed papillae on anterior margin; a similar row of smaller ones on posterior margin. Both nonasteroid (3–5 arms) and asteroid (5 arms) micrasters present all over, mostly nonasteroids; size 5–8 μm × 3–6 μm; density 4955–5130/mm².


Wing micro-sculpturing: Pointed papillae present on anterior and posterior margins. Both nonasteroid (1–6 arms) and asteroid (5–8 arms) micrasters present all over, mostly asteroids; size 5–8 μm × 2–8 μm; density 8775–9045/mm².

17. Microcerotermes palestinensis Spaeth 1964 [(figure 3Q) (Spaeth 1964, Israel J. Zool., 13, p. 27.) Imagoes from West Asia: Ben-Shemen, Herzl Forest, Israel.

Wing micro-sculpturing: A row of minute, pointed papillae present on anterior margin and a similar row of somewhat larger ones.
on posterior margin. Both nonasteroid (3–5 arms) and asteroid (5 arms) micrasters present all over, mostly nonasteroids; size 6–8 μm × 3–6 μm; density 4590–4860/mm².


Wing micro-sculpturing: Pointed papillae present on anterior and posterior margins. Both nonasteroid (1–6 arms) and asteroid (5–6 arms) micrasters present all over, mostly nonasteroids; size 5–9 μm × 2–8 μm; density 6885–7695/mm².

19. Microcerotermes serratus (Froggatt 1897) (figure 3F) (Snyder 1949, p. 145.) Imagoes from Australia: Stapleton, Northern Territory; and Townsville, Queensland.

Wing micro-sculpturing: A row of minute, pointed papillae present on anterior margin and a row of similar but larger ones on posterior margin. Both nonasteroid (4–5 arms) and asteroid (5–6 arms) micrasters present all over, mostly asteroids; size 5–9 μm × 5–8 μm; density 7560–8370/mm².

20. Microcerotermes strunckii (Soerensen 1884) (figures 41-K) (Snyder 1949, p. 146.) Imagoes from South America: Matto Grosso, Brazil.

Wings (without scale): 7–8 × 2–2.5 μm; transparent, colourless, veins pale brown. Hairs: 3–4 rows on anterior margin, a row on second vein, and 1–2 rows on posterior margin; length 60–80 μm.

Wing micro-sculpturing: Papillae: A row of small, pointed papillae on anterior margin (3–4 μm × 2–3 μm) and a row of similar but smaller ones on posterior margin. Micrasters: Densely present all over; both nonasteroids (2–6 arms) and asteroids, mostly the latter. Size 4–6 μm × 6–8 μm. Density 10870/mm².

21. Microcerotermes subtilis (Wasmann 1897) (figure 3T) (Snyder 1949, p. 146.) Imagoes from Indian Ocean (Seychelles IIs.): La Misera, Maha.

Wing micro-sculpturing: 1–2 rows of papillae on anterior margin and similar rows of smaller ones on posterior margin. Both nonasteroid (4–6 arms) and asteroid (5–7 arms) micrasters present all over, mostly nonasteroids; size 6–9 μm × 5–8 μm; density 8505–8640/mm².

22. Microcerotermes turneri (Froggatt 1897) (figure 3U) (Snyder 1949, p. 147.) Imagoes from Australia.

Wing micro-sculpturing: Papillae as in M. subtilis above. Both nonasteroid (4–5

Figure 4 A–K Portions of dorsal surface of forewings of some Microcerotermes, to show micro-sculpturing (papillae and micrasters). A–B: M. beesoni, anterior and posterior margins respectively. C–D: M. bugnioni, anterior and posterior margins respectively. E: Same, micrasters enlarged and rearranged. F–G: M. minor, anterior and posterior margins respectively. H: Same, micrasters enlarged and rearranged. I–J: M. strunckii, anterior and posterior margins respectively. K: Same, micrasters enlarged and rearranged

b, hairs; m, micrasters; p, papillae.
arms) and asteroid (5–6 arms) micrasters present all over, mostly asteroids; size 6–8 \( \mu m \times 5–6 \mu m \); density 7560–8235/mm².

Discussion and Conclusions

Evolutionary trends

Amitermitinae, which is the most primitive of the four subfamilies of the highly evolved family Termitidae, is characterised by the comparative simplicity of wing micro-sculpturing of which only two types are present, viz., the distally directed papillae and the nondirectional micrasters. Hairs are present in moderate numbers on the anterior and posterior wing margins, few occurring on the membrane.

The papillae are normally of a single type, e.g., pointed and spiky, but in the genus *Anoploterme* the arrowhead-type is also present in some species (*A. pacificus*). Sizes of papillae vary from small (5–12 \( \mu m \times 2–5 \mu m \)) to minute (0.5 \( \mu m \times 0.5 \mu m \), *Speculitermes rongrionis*). Papillae occur only on the anterior and posterior margins of wings, the anterior papillae being generally larger than the posterior ones, but the reverse occurs in a few species (*Microcerotermes palestinensis* and *M. serratus*). Occasionally, they seem to be absent on the posterior margin (*Microcerotermes los-banosensis* and *M. minor*).

Micrasters vary in size as about 3–10 \( \mu m \times 1–7 \mu m \) and are usually thick except in *Eurytermes*, *Drepanoterme*, *Eremoterme* and some species of *Euharmiterme* where they are thin. Both nonasteroid and asteroid types occur, the former exclusively in the primitive genera and both in the higher ones (table 1). In structure and complexity (figure 5) they conform to the 10 types (I–X, with 1–8 arms) in two groups (nonasteroid and asteroid), as categorised by Roonwal, Verma and Rathore (1974). In *Speculitermes rongrionis* they are extremely simple, with only 1–2 arms, mostly “one-armed” (thick rods). Densities (per mm²) vary from low (3200–4000, *Speculitermes rongrionis*; 4400–6250, *Alyscoterme kilimandjaricus*) to high (10500, *Drepanoterme ruficeps*; 10870, *Microcerotermes struikii*).

On the whole, the Amitermitinae retains its primitive character, in contrast to the next higher subfamily Termitinae where micrasters attain their greatest development.

Systematic significance

Generic differences are at once apparent in the micrasters, especially among distant genera. Thus, the lower genera, especially the *Anoploterme* complex (*Alyscoterme, Anoploterme, Speculiterme*) stand out by their having only very simple, nonasteroid micrasters (sometimes largely 1-armed and rod-like, *S. rongrionis*), in contrast to the higher ones (*Microcerotermes*) with more elaborate, asteroid micrasters as well. *Euryterme, Eremoterme, Drepanoterme* and some Eutamiterme are characterised by thin micrasters in contrast to thick ones in all the rest. Specific differences are also apparent. Thus, on the whole, micro-sculpturing provides good characters for separating the
Table 1  Summary of types of wing micro-sculpturing in the subfamily Amitermiinae (of family Termitidae)

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<th>Micrasters</th>
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<tr>
<td>Doonitermes</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Euhamitermes</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Drepanditermes</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Eremotermes</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Microcerotermes</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
</tbody>
</table>

-absent; +present

lower taxonomic categories but are less satisfactory for the higher ones (families and subfamilies), though phylogenetic trends are unmistakable.

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