

## REVISION OF THE TERMITOPHILOUS TRIBE PSEUDOPERINTHINI (Coleoptera : Staphylinidae)

with a discussion of some integumentary  
glands and the relationships of  
termitophiles and their hosts<sup>1</sup>

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*Abstract:* The tribe Pseudoperinthini is herein redefined and the characters which separate this tribe from the other tribes of Aleocharinae are discussed. The single previously known genus, *Pseudoperinthus*, is redescribed. Three new genera are herein described, *Malayinthus*, *Indinthus*, and *Austrointhus*. Both previously known species are redescribed and illustrated. In addition 4 new species are described: *Malayinthus emersoni* (Sarawak), *Austrointhus gayi* (Australian Capital Territory), *Austrointhus graveolus* (Queensland), and *Indinthus emersoni* (Sarawak). New geographic and host data are added for all species except *Pseudoperinthus malayanus*.

The gland structures of *Austrointhus gayi* are described. Both the tergal and poststernal glands are very reduced and this species possesses type 3 gland cells scattered throughout the hypodermis.

The relationships between the genera and the species are discussed and the host relationships are discussed as correlated to the relationships between the termitophiles. All of these termitophiles are host-specific at the species level.

Over the past several years, due to the collecting efforts of A. E. Emerson, F. J. Gay, and Kumar Krishna, many additional specimens of the tribe Pseudoperinthini have been accumulated. Some of the specimens sent to us by F. J. Gay were fixed in alcoholic Bouin's solution. This made possible the description of the glands present in *Austrointhus* and the comparison of them to glands previously found in other termitophiles and in free-living species.

The description of the new material necessitated the revision of the whole tribe. It is, therefore, the purpose of this paper to describe the new genera and species and to completely revise the genera of the subfamily.

The methods of study used here have been described before by Kistner (1968), Pasteels (1968a), and by Kistner & Pasteels (1969). All measurements given in this paper are in mm unless indicated differently.

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We are also grateful to Emerson, Gay, and Krishna for host determinations that are cited in the text of this paper. Further thanks are given to A. E. Emerson for reading this manuscript and making helpful suggestions.

The initials given in parentheses above are used in the text to indicate the deposition of specimens studied. Specimens retained in the collections of the authors are indicated (DK) or (JP).

We give particular thanks to David Harwood, Lynette Hawver, Herbert Jacobson, Lynn Royce, and Virginia Sleppy, all Shinner assistants at Chico State College, for technical assistance involved in this study.

#### Tribe PSEUDOPERINTHINI Cameron

Subfamily Pseudoperinthinae Cameron, 1939: 1.

Tribe Pseudoperinthini Seevers, 1957: 247.

This tribe is most closely related to the Myrmedoniini from which it is distinguished by its very unique head structure as well as the elongate labium. The relationship to the Myrmedoniini is shown by the margined mesocoxal acetabulae, the distinct mentum, the distinctly margined maxillary acetabulae, the shape of the maxillae, and the 4-5-5 tarsal formula.

The head characteristic is the most unusual. The vertex is produced into a sharply marked cariniform arcade anteriorly. This arcade covers the expanded clypeus beneath it and the antennal fossae which are large in this tribe. The insertion of the antennae, even though they are below this arcade still follow the distinctly aleocharine pattern in that they are inserted near the medial borders of the eyes and between these borders and the insertion of the anterior arms of the tentorium (ie., near the anterior tentorial pits).

All of the genera are limuloid and look superficially similar. Hence we are presenting a facies photograph of only 1 genus, *Pseudoperinthus*.

Though there are many similarities between the Pseudoperinthini and the Perinthina as their names imply, the 4-5-5



Fig. 1. *Pseudoperinthus malayanus*, dorsal appearance of entire beetle. Scale arbitrary.

tarsal formula, the lack of coeloconic sensillae on the terminal segments of the antennae, as well as the vertexal arcade serve to differentiate the 2 groups.

#### KEY TO GENERA

1. Mandibles with indentations in the lateral borders, shaped as in fig. 2E. .... 2  
Mandibles without lateral indentations ..... 3
2. Antennae with petioles indistinct, covered by extensions of the sides of segments, shaped as in fig. 2H ..... **Malayinthus**  
Antennae with most petioles distinct, not covered by extensions of the sides of segments ..... **Pseudoperinthus**
3. Antennae with petioles distinct, shaped as in fig. 8A ..... **Indinthus**  
Antennae with petioles indistinct, covered by extensions of the sides of segments (fig. 5D) ..... **Austrointhus**

#### Genus **Pseudoperinthus** Wasmann

*Pseudoperinthus* Wasm., 1916: 194.—Cameron, 1939: 1.—Seevers, 1957: 247.

Most closely related to *Malayinthus* from which it is distinguished by the less compact antennae i. e., the petioles of the segments are not covered by lateral extensions of the segments, by the smaller 4th segments of the maxillary palpi, and by slight differences in the mandible shape. This genus was studied from dried type material only, so the description given below is not nearly as complete as that of the rest of the genera of this paper.

Overall shape as in fig. 1. Head capsule wider than long with vertex produced into a sharp demarcation at anterior border which produces an arcade. This arcade covers expanded clypeus and the insertion points of antennae. Capsule is otherwise oval in shape with large well-developed eyes with many laterally and anteriorly directed facets. Infra-orbital carina present. Head capsule normally covered posteriorly by pronotum. Antennae 11-segmented, shaped as in *Malayinthus* but with petioles of apical as well as basal segments distinct, not covered by extensions of sides of segments. Antennae inserted into deep fossae beneath vertexal arcade. Gula short with sides diverging from anterior to posterior; submentum short and fused to gula. Mentum distinct from submentum; about equal in length to submentum. Mandibles nearly symmetrical, with an indentation in lateral borders; shaped much as in *Malayinthus*, but with finer apical teeth. Maxillae shaped as in *Malayinthus* except that the terminal segments of the palpi are very fine and thin whereas those of *Malayinthus* are thicker; palpi 4-segmented. Maxillary acetabulae distinctly margined. Labium shaped much as in *Malayinthus*; palpi 3-segmented. (Wasmann thought that the palpi were 2-segmented, but even on dried specimens careful search reveals 3 segments, the 3rd segment is where Wasmann's figure 16F shows an indentation on the 1st segment). Labrum shaped as in *Malayinthus*.

Pronotum wider than long, strongly arched dorsoventrally, shaped as in fig. 1. Hypomera strongly produced medially such that they extend in a full third the width of the pronotum from each side. Prosternum evenly rounded between legs, with anterolateral articulation processes of normal length. Prothoracic coxal cavities closed behind by membrane; no trace of mesothoracic peritremes visible. Elytra with broadly expanded reflexed lateral edges, other-

wise without distinction. Metasternum about equal in length to mesosternum. Both of them reduced in size. Mesosternal intercoxal process incomplete, pointed. Mesocoxal acetabulae completely margined. Pro-, meso-, and metalegs shaped much as in *Malayinthus*; tarsal formula 4-5-5.

Abdomen not physogastric, shaped as in fig. 1. Segment I represented only by the tergite fused to the metanotum. Segment II represented only by a tergite. Segments III-VII with 1 tergite, 1 sternite, and 2 pairs paratergites each. Segment VIII represented by a tergite and sternite only. Segment IX trilobed, but otherwise not visible for study in the dried specimens. ♀ spermatheca unknown. ♂ genitalia unknown.

Type-species: *Pseudoperinthus malayanus* Wasmann.

**Pseudoperinthus malayanus** Wasmann Fig. 1.

*Pseudoperinthus malayanus* Wasm., 1916: 195, pl. 4, fig. 16A-B, pl. 5, fig. 16C-H-Naturhistorisch Mus. Maastricht, (Sumatra, Tandjong Slamet, with *Eutermes laborator* Haviland).—Seevers 1957: 247, [Changed genus of host to *Lacessititermes laborator* (Haviland)].

As presently conceived, *Pseudoperinthus* is a monobasic genus, hence the characteristics given below as specific are based on experience with other genera.

Color yellowish brown throughout, head a little darker than rest of body, appendages a little lighter than rest of body. Dorsal surface of head, pronotum, elytra, and abdominal tergites with an even covering of fine yellow short setae. Dorsal surface of pronotum with additional numerous long macrosetae. Five macrosetae additionally on each elytron. Macrochaetotaxy of abdominal tergites III-VIII as follows: 6, 6, 6, 6, 4-2, 4-4. Abdominal tergite II was not visible on specimens examined. ♂ genitalia unknown, and ♀ spermatheca unknown.

Measurements: Pronotal length, 0.35-0.37; elytra length, 0.20-0.22. Number measured, 2.

MATERIAL EXAMINED: Holotype and 2 paratypes (NHM, FMNH).

Genus **Malayinthus** Kistner and Pasteels, new genus

Most closely related to *Pseudoperinthus* from which it is distinguished by the shape of the antennae, the shape of the mandibles, and the larger 4th segment of the maxillary palpus. The antennal segments have indistinct petioles because the sides of the segments completely overlap them. Easily distinguished from *Austrointhus* and *Indinthus* by the shape of the mandibles.

Overall shape as in *Pseudoperinthus*. Head capsule wider than long with a well-developed vertexal arcade typical of the tribe. Straight edge of vertexal arcade gives head capsule an overall subtriangular appearance. Eyes present and well-developed with many anteriorly and laterally directed facets but with majority of facets directed anteriorly. Antennae inserted between eyes under vertexal arcade in large prominent antennal fossae which are located very near to anterior tentorial pits. Head normally inserted so that pronotum overlaps rear edges of capsule as in fig. 1. Antennae 11-segmented, shaped as in fig. 2H, with lateral edges of segments completely overlapping petioles. Gula short, with sides diverging slightly from anterior to posterior. Submentum about 1/2 length of gula and fused to it. Mentum distinct and about length of submentum, shaped as in fig. 2C. Mandibles asymmetrical, shaped as in fig. 2E and 2F with lateral edges strongly indented. Maxillae shaped as in fig. 2D, palpi 4-segmented, with

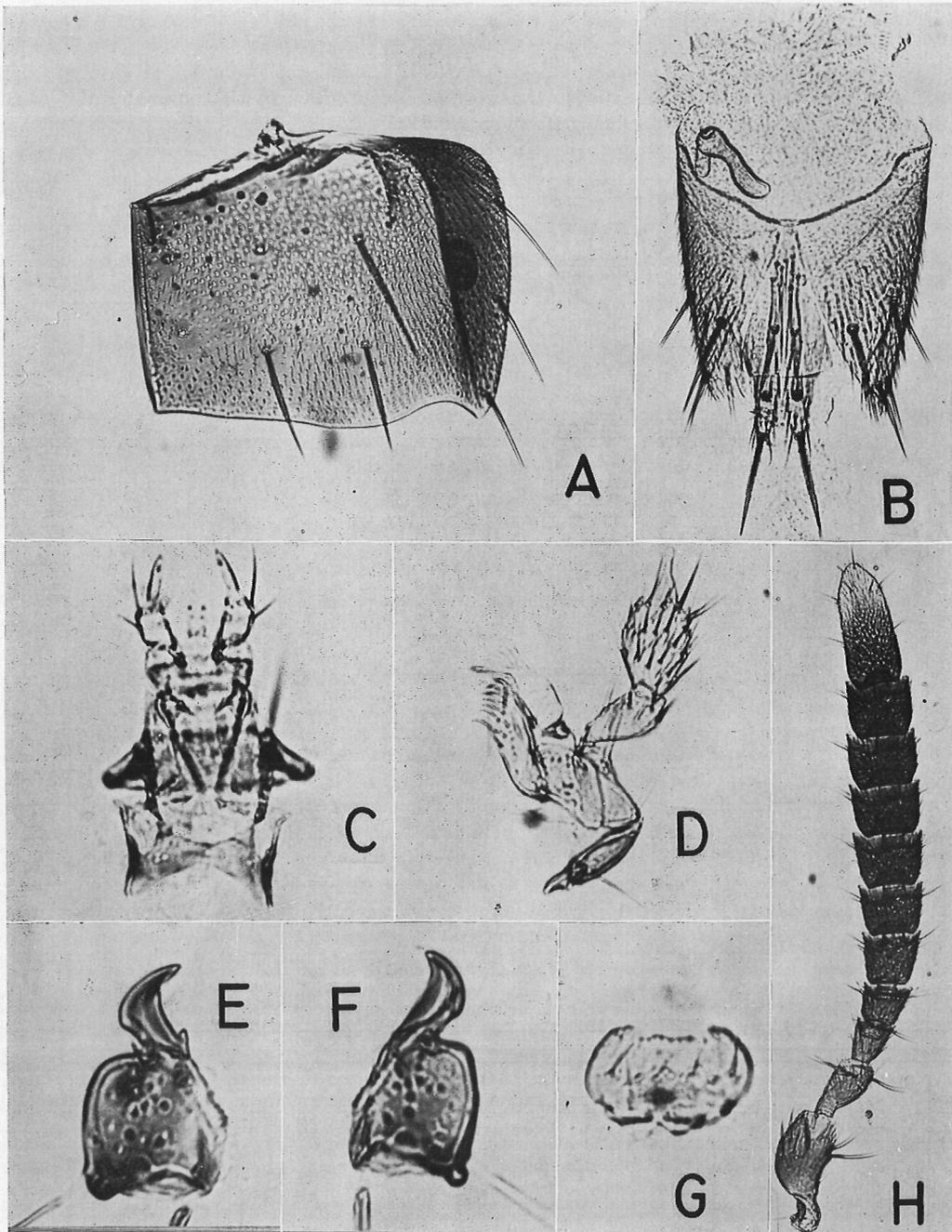


Fig. 2. *Malayinthus emersoni*: A, elytron; B, abdominal segment IX with spermatheca; C, labium and mentum; D, maxilla; E, left mandible; F, right mandible; G, labrum; H, antenna. Scale arbitrary.

apical segment broad. Maxillary acetabula distinctly margined. Labium shaped as in fig. 2C; palpi 3-segmented. Labrum shaped as in fig. 2G.

Pronotum wider than long, shaped as in *Pseudoperinthus* (fig. 1). Pronotum strongly arched dorsoventrally, with a double sinuate posterior border. Dorsal surface of pronotum without further distinction. Hypomera broadly developed medially so that they extend medially about 1/3 width of pronotum. Prosternum short with a very feeble carina developed between legs, with anterolateral articular processes of normal length. Prothoracic coxal cavities closed behind by membrane with no hint of mesothoracic peritremes present. Elytra without distinction, shaped as in fig. 2A, with lateral border strongly reflexed ventrally. Wings present, of normal size, with usual staphylinid venation. Metasternum about the same length as the mesosternum, both short. Mesosternal intercoxal process broad, incomplete, pointed, and acarinate. Mesothoracic coxal cavities deeply set into the metasternum and with acetabulae completely margined. Pro-, meso-, and metalegs shaped as in fig. 3C, 3D, and 3A, 3B respectively; tarsal formula, 4-5-5.

Abdomen not physogastric, shaped as in *Pseudoperinthus*. Segment I represented only by the tergite fused to the metanotum. Segment II represented only by a tergite. Segments III-VII with 1 tergite, 1 sternite, and 2 pairs of paratergites each. Segment VIII represented by a tergite and sternite alone. Dorsal margin of abdomen occurs between sternites and outer paratergites. Segment IX trilobed with a distinctive shape as in fig. 2B. Female spermatheca sclerotized, presumed variable by species. ♂ genitalia unknown.

Type-species: *Malayinthus emersoni* Kistner and Pasteels, n. sp.

#### **Malayinthus emersoni** Kistner and Pasteels, new species      Fig. 2, 3.

Since this genus is presently monobasic, the characters here isolated as specific are based on experience with other genera.

Color reddish brown throughout. Dorsal surface of head, pronotum, elytra, and abdomen with a covering of very fine short setae. Dorsal surface of head without further chaetotaxy. Dorsal surface of pronotum with many long yellow setae. These setae appear to be arranged in rows across pronotum; rows of about 5 in number. Pronotum also with a lateral marginal row of setae, but these are extremely short compared to other macrosetae on pronotum. Elytra with a marginal row of 3 macrosetae; disk with 2 lateral rows of 3 setae each. Macrochaetotaxy of abdominal tergites II-VIII: 10, 6, 6, 6, 4-4, 4-4. All sternites with an apical row of variable numbers of darker setae. Spermatheca shaped as in fig. 2B. ♂ genitalia unknown.

Measurements: Pronotal length, 0.34-0.37; elytral length, 0.22-0.26. Number measured, 5.

Holotype (No. 13600), Sarawak, 1°38' N, 113°35' E, 240 m, 4. II. 1963, W. King & Alfred Emerson. In Kistner, coll'n. Paratypes: 4, same data as holotype (DK).

Notes: The host termite colony was determined to be *Hospitalitermes hospitaloides* (Holmgren) by A. E. Emerson. Specimens of the host colony are in the Emerson Collection of the American Museum of Natural History, New York. A few duplicate termites are in the collection of Kistner.

#### **Genus Austrointhus** Kistner and Pasteels, new genus

Closely related to *Indinthus* from which it is distinguished by the shape of the antennae wherein the petioles are all covered by extensions of the sides of the segments.

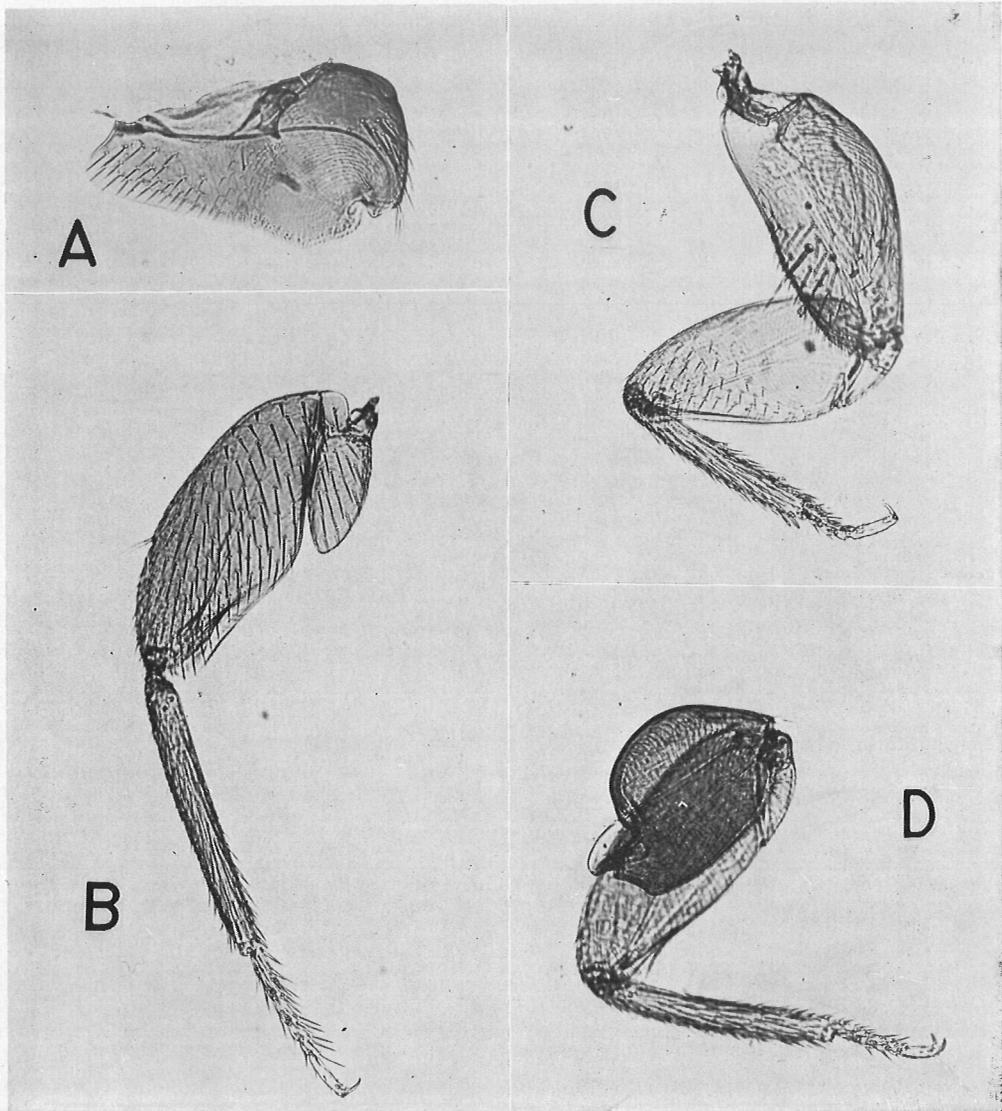


Fig. 3. *Malayinthus emersoni*: A, metacoxa; B, rest of metaleg; C, proleg; D, mesoleg. Scale arbitrary

There are also differences in the shapes of the procoxae, of the labrum, and the labium. Easily distinguished from *Pseudoperinthus* and *Malayinthus* by the shape of the mandibles which lack lateral indentations.

Overall shape as in *Pseudoperinthus* (fig. 1). Head wider than long, essentially oval in shape, with a well-developed vertexal arcade typical of tribe. Eyes large and well-developed with many laterally and anteriorly directed facets. Head inserted so that the pronotum covers posterior part of capsule. Infraorbital carina present. Antennae 11-segmented, shaped as in fig.

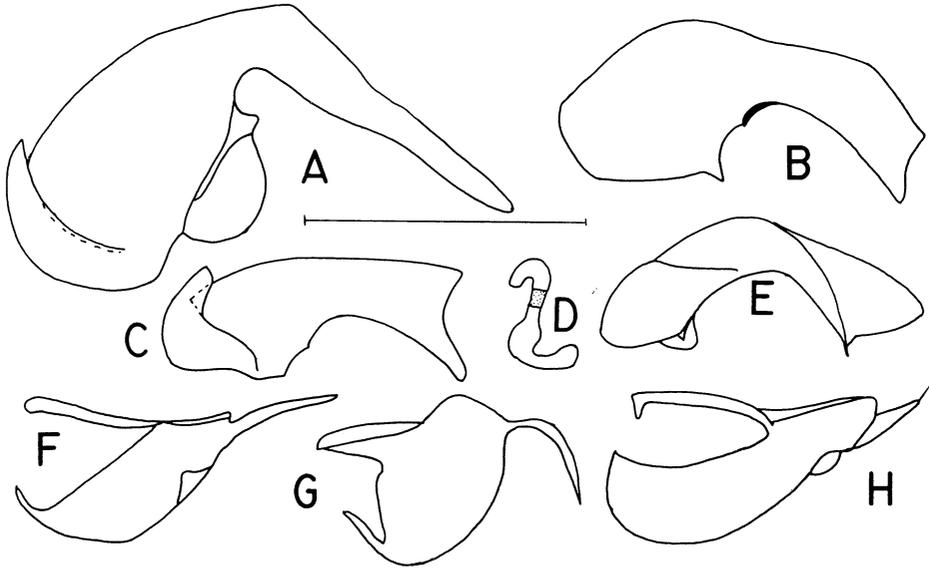


Fig. 4. Median lobes of ♂ genitalia: A, *Austrointhus graveolus*; B, *Indinthus fletcheri*; C, *I. emersoni*; E, *Austrointhus gayi*. Spermatheca: D, *Indinthus fletcheri*. Lateral lobes of ♂ genitalia: F, *Indinthus fletcheri*; G, *I. emersoni*; H, *Austrointhus gayi*. Scale represents 0.25 mm.

5D, inserted under vertexal arcade very near to anterior tentorial pits. Gula short with sides diverging from anterior to posterior. Submentum shorter than gula, somewhat expanded anteriorly. Mentum distinct from submentum, shaped as in fig. 5E. Maxillary acetabula margined. Mandibles asymmetrical, shaped as in fig. 5H and 5I, without lateral indentations. Maxillae shaped as in fig. 5F; palpi 4-segmented. Labium shaped as in fig. 5E; palpi 3-segmented, margins between 1st and 2nd segments of palpi not perfectly clear in all specimens. Labrum shaped as in fig. 5G.

Pronotum wider than long, strongly arched dorsoventrally. Hypomera broadly produced such that they extend inward about 1/4 the width of pronotum on each side. Prosternum short but flat, slightly rounded between legs but acarinate. Procoxal cavities closed behind by membrane, without a trace of sclerotized mesothoracic peritremes. Elytra shaped as in fig. 5J; lateral edges broadly reflexed ventrally, although not nearly as reflexed as *Malayinthus* or *Pseudoperinthus*. Wings present, of normal size, and with the usual staphylinid venation. Metasternum about same length as mesosternum; both short. Mesocoxal acetabulae completely margined. Mesosternal intercoxal process incomplete, sharp, and acarinate. Pro-, meso- and metalegs shaped as in fig. 5A, 5C, and 5B respectively; tarsal formula 4-5-5.

Abdomen not physogastric, shaped as in *Pseudoperinthus*. Segment I represented only by the tergite fused to metanotum. Segment II represented only by a tergite. Segments III-VII with 1 tergite, 1 sternite, and 2 pairs of paratergites each. Segment VIII represented by a sternite and tergite only. Dorsal margin of abdomen occurs between sternites and outer paratergites. Segment IX of ♂ shaped as in fig. 6A, with long anterior apodemes. Segment IX of ♀ shaped as in fig. 6B and 6C, lacking anteriorly directed apodemes. ♂ genitalia bulbous, variable by species. Spermatheca of ♀ sclerotized, presumed variable by species.

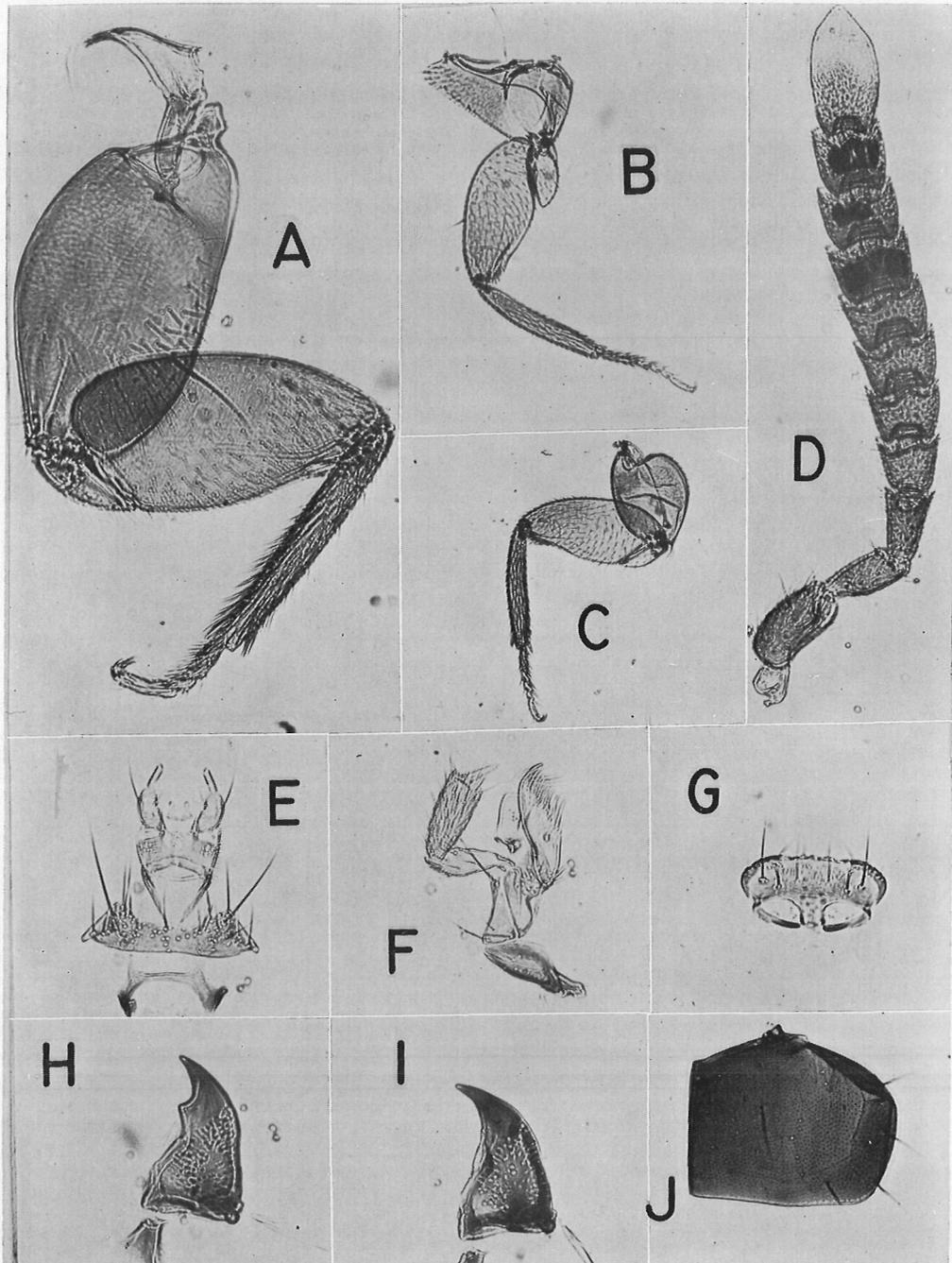


Fig. 5. *Austrointhus gayi*: A, proleg; B, metaleg; C, mesoleg; D, antenna; E, labium and mentum; F, maxilla; G, labrum; H, left mandible; I, right mandible; J, elytron. Scale arbitrary.

Type-species: *Austrointhus gayi* Kistner & Pasteels, n. sp.

KEY TO SPECIES OF AUSTRINTHUS

- 1. Chaetotaxy of abdominal tergites VII and VIII: 2-6, 4-4; pronotum with a lateral row on each side of 6 macrosetae ..... **gayi**
- Chaetotaxy of abdominal tergites VII and VIII: 6, 2-6; pronotum with a lateral row on each side of 3 macrosetae ..... **graveolus**

*Austrointhus gayi* Kistner and Pasteels, new species      Fig. 4E, 4H; 5; 6.

Distinguished from *A. graveolus*, the only other known species of this genus, by its larger size, different chaetotaxy, as well as the shape of the ♂ genitalia.

Color reddish brown throughout. Dorsal surface of head, pronotum, elytra, and abdomen with a fine even covering of very short yellow setae. Dorsal surface of head with no further chaetotaxy. Dorsal surface of pronotum with a lateral row of 6 macrosetae and about 8 macrosetae scattered over disk. Elytra with lateral rows of 3 macrosetae and another 3 to 4 scattered on disks. Macrochaetotaxy of abdominal tergites II-VIII as follows: 2, 6, 6, 6, 6, 2-6, 4-4. All sternites with an apical variable row of macrosetae. ♂ genitalia shaped as in fig. 4E and 4H. Median articulation point for lateral lobes seems to vary as to extent of sclerotization. Spermatheca shaped as in fig. 6D.

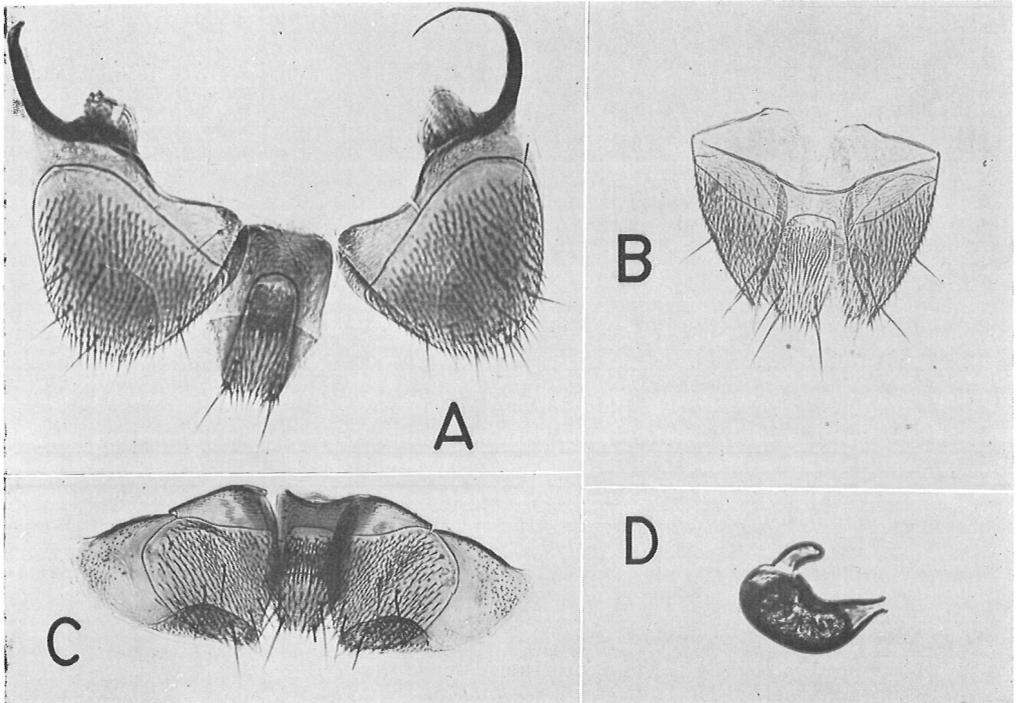


Fig. 6. *Austrointhus gayi*: A, abdominal segment IX of ♂ unfolded; B, abdominal segment IX of ♀ folded; C, abdominal segment IX of ♀ unfolded; D, spermatheca. Scale arbitrary.

Measurements: Pronotal length, 0.50-0.56; elytral length, 0.23-0.27. Number measured, 8.

Holotype (No. 13599), Australia, A. C. T., Downer, 20. II. 1961, J. H. Calaby. In Australian National Insect Collection, Canberra. Paratypes: 2, Australia, A. C. T., Downer, 14. II. 1961, Calaby (CSIRO, DK); 3, Black Mountain, 3. III. 1961, F. J. Gay (CSIRO, DK); 3, Canberra, 12. XI. 1965, Gay (CSIRO, DK); 2 (sectioned), Canberra, 12. XI. 1965, Gay, (JP); 5 (1 sectioned), Canberra, 7. XI. 1968, Gay (CSIRO, JP); 1, N. S. W., 8 km E of Michelago, 17. VII. 1969, Gay (CSIRO).

*Notes:* The host termites of all the above specimens were determined to be *Nasutitermes exitiosus* (Hill) by F. J. Gay. Specimens of the hosts are in the Australian National Insect Collection, Canberra.

***Austrointhus graveolus*** Kistner and Pasteels, new species      Fig. 4A.

Distinguished from *A. gayi* by its smaller size, different chaetotaxy, as well as the shape of the genitalia.

Color reddish brown throughout. Dorsal surface of head, pronotum, elytra, and abdomen with a fine even covering of very short yellow setae. Dorsal surface of head with no further chaetotaxy. Dorsal surface of pronotum with a lateral row of 3 macrosetae and no macrosetae scattered over disk. Elytra with lateral rows of 3 macrosetae and no other setae scattered on the disks. Macrochaetotaxy of abdominal tergites II-VIII as follows: 2, 6, 6, 6, 6, 6, 2-6. All sternites with an apical variable row of rather short macrosetae. ♂ genitalia shaped as in fig. 4A. Spermatheca unknown.

Measurements: Pronotal length 0.30; elytral length, 0.23. Number measured, 1.

Holotype (No. 13604), Australia, Queensland, Cardwell Range, 9. VI. 1962, F. J. Gay. In the Australian National Insect Collection, Canberra.

*Notes:* The host termite of the above was determined to be *Nasutitermes graveolus* (Hill) by F. J. Gay. Specimens of the host are in the Australian National Insect Collection, Canberra.

**Genus *Indinthus*** Kistner and Pasteels, new genus

Most closely related to *Austrointhus*, from which it is distinguished by the shape of the antennae with its distinct petioles which are not covered by lateral extensions of the segments as well as the shape of abdominal segment IX. Distinguished from *Pseudoperinthus* and *Malayinthus* by the shape of the mandibles which lack the lateral indentation.

Overall shape as in *Pseudoperinthus* (fig. 1). Head capsule wider than long with vertexal arcade typical for tribe. Shape of head otherwise oval with well-developed eyes with many anteriorly and laterally directed facets. Head inserted under pronotum in such a way that the pronotum overlaps posterior border. Antennae 11-segmented, shaped as in fig. 8A, with petioles of each segment distinct and not covered by extensions of sides of segments. Gula with sides diverging from anterior to posterior. Submentum expanded and fused to gula. Mentum distinct and about same length as submentum, shaped as in fig. 9A. Mandibles asymmetrical, somewhat variable in shape by species, shaped as in fig. 7B and 7D. Note that what seems to vary is the shape of the mandibular teeth of left mandibles while right mandibles maintain the same shape. Maxillae shaped as in fig. 7A; palpi 4-segmented. Maxillary acetabulae distinctly margined.

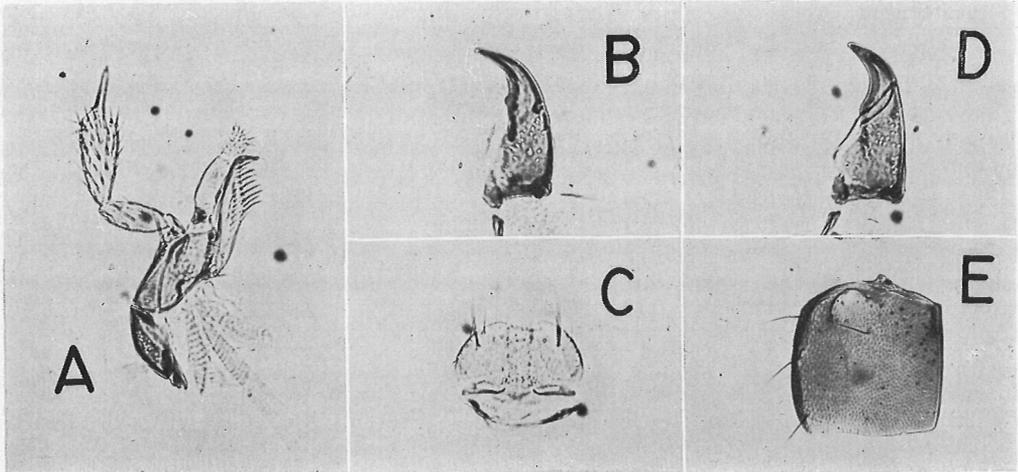


Fig. 7. *Indinthus emersoni*: A, maxilla; B, left mandible; C, labrum; D, right mandible; E, elytron. Scale arbitrary.

Labium shaped as in fig. 9A; palpi 3-segmented. Labrum shaped as in fig. 7C.

Pronotum wider than long, with a double sinuate posterior border, strongly arched dorso-ventrally. Hypomera widely developed medially so as to cover about 1/4 width of pronotum from each side. Prosternum acarinate and evenly rounded between legs, with anterolateral articulation processes of normal length. Prothoracic coxal cavities closed behind by membrane with no trace of mesothoracic peritremes in them. Elytra without distinction, shaped as in fig. 7E, with only moderately expanded reflexed borders laterally. Wings present, of normal size, with usual staphylinid venation. Mesosternum and metasternum about same length, both short. Mesocoxal acetabulae deeply set and completely margined. Mesosternal intercoxal process incomplete, pointed, and acarinate. Pro-, meso-, and metalegs shaped as in fig. 8B, 8C, and 8E respectively; tarsal formula, 4-5-5.

Abdomen not physogastric, shaped as in *Pseudoperinthus*. Segment I represented only by tergite fused to metanotum. Segment II represented only by a tergite. Segments III-VII with 1 tergite, 1 sternite, and 2 pairs of paratergites each. Segment VIII represented by a tergite and a sternite only. Dorsal margin of abdomen occurs between sternites and outer paratergites. Segment IX trilobed, shaped as in fig. 8D, anterior apodemes of ♂ not very conspicuous. ♀ spermatheca sclerotized, presumed variable by species. ♂ genitalia bulbous, variable by species.

Type-species: *Indinthus fletcheri* Cameron.

#### KEY TO SPECIES OF INDINTHUS

1. Macrochaetotaxy of abdominal tergites II-IV: 2, 4, 4; median lobe of ♂ genitalia shaped as in fig. 4B ..... **fletcheri**
- Macrochaetotaxy of abdominal tergites II-IV: 0, 2, 2; median lobe of ♂ genitalia shaped as in fig. 4C ..... **emersoni**

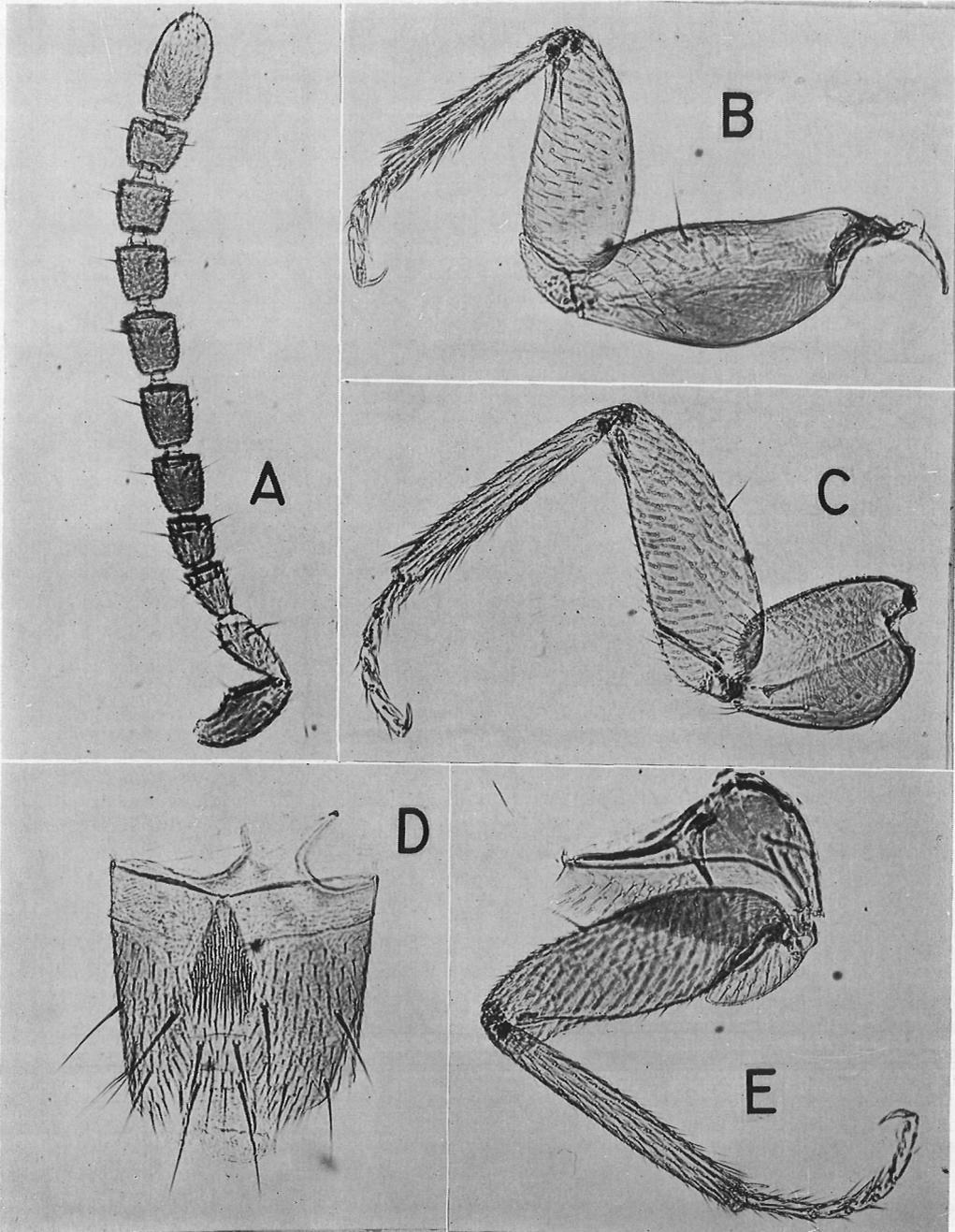


Fig. 8. *Indinthus emersoni*: A, antenna; B, proleg; C, mesoleg; D, abdominal segment IX of ♂; E, metaleg. Scale arbitrary.

***Indinthus fletcheri*** (Cameron), n. comb. Fig. 4B, D, F; 9.

*Pseudoperinthus fletcheri* Cam., 1939: 3, fig. 1, 2—British Museum (Nat. Hist.), London (India, Coorg, Mercara with *Eutermes* sp.).—Seevers, 1957: 248 (listed).

Distinguished from *Indinthus emersoni* by the shape of the ♂ genitalia and the chaetotaxy.

Color reddish brown throughout. Dorsal surface of head, pronotum, elytra, and abdomen with a fine but even covering of extremely short yellow setae. Head with no further chaetotaxy. Mandibles shaped as in fig. 9B and 9C. Pronotum with a lateral row of 4 long setae on each side, with 2 setae in medial sector of anterior border, with 2 median setae on disk, and with 2 longer setae on posterior margin toward middle. Elytra with 3 lateral setae, 1 setae on disk of each. Macrochaetotaxy of abdominal tergites II–VIII as follows: 2, 4, 4, 4, 4, 4, 4. All sternites with an apical row of a variable number of long setae. Median and lateral lobes of ♂ genitalia shaped as in fig. 4B and 4F respectively. Spermatheca shaped as in fig. 4D.

Measurements: Pronotal length, 0.40–0.43; elytral length, 0.25–0.30. Number measured, 15.

**MATERIAL EXAMINED.** INDIA: Mysore: 12, just outside of Mercara, forest on Bangalore Rd, 12. III, 1969, K. Krishna, ex brown nest on tree, No. K12 and K13 (DK). Kerala: 148, 1.6 km ex Aranya Nivas near Thekkaday, 18. X, 1960, A. E. Emerson, ex 3 separate colonies (DK); 66, 3.2 km S. of dam, Periyar Lake, 840 m, 21. X, 1960, Emerson (DK); 67, Engels, Assmoth (DK).

**Notes:** All of the host termites were determined to be *Nasutitermes indicola* (Holmgren). The Kerala specimens were determined by A. E. Emerson while the Mercara specimens were determined by K. Krishna. Specimens of all the hosts are in the termite collections of the American Museum of Natural History, New York. These are the first host records of this species.

***Indinthus emersoni*** Kistner and Pasteels, new species Fig. 4C, G; 7; 8.

Distinguished from *Indinthus fletcheri* by the shape of the ♂ genitalia as well as the chaetotaxy.

Color reddish brown throughout. Dorsal surface of head, pronotum, elytra, and abdomen with an even but fine covering of extremely short fine yellow setae. Head without further chaetotaxy. Mandibles shaped as in fig. 7B and 7D. Pronotum with 4 longer setae on lateral

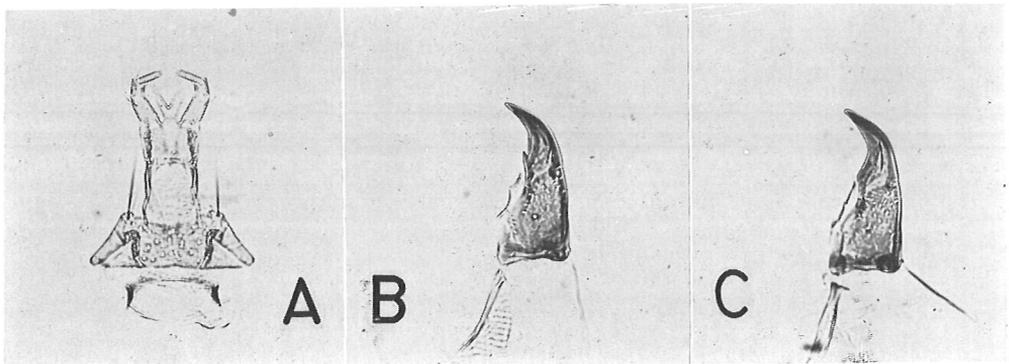


Fig. 9. *Indinthus fletcheri*: A, labium and mentum; B, left mandible; C, right mandible. Scale arbitrary.

border, 1 additional seta toward middle of disk. Elytra with 3 lateral setae each. Macrochaetotaxy of abdominal tergites II-VIII as follows: 0, 2, 2, 4, 4, 4, 4. ♂ genitalia shaped as in fig. 4C and 4G. ♀ unknown.

Measurements: Pronotal length, 0.40; elytral length, 0.36. Number measured, 1.

Holotype (No. 13567), Sarawak: 1°38' N, 113°35' E, 240 m, 4. II, 1963, W. King & A. E. Emerson. In D. H. Kistner coll'n.

Notes: The host termites were determined to be *Hospitalitermes hospitaloides* (Holmgren) by Emerson. Specimens of the host colony are in the Emerson Collection of the American Museum of Natural History, New York.

#### Glandular Structures in *Austrointhus gayi*

The tergal gland, defensive in free-living species, is very reduced here. In fact, we did not even find its reservoir or its gland cells; but a very reduced tergal gland can very easily be missed and we did not possess enough specimens to make all the necessary sections for this search. An "in toto" preparation of a cleared specimen has permitted us to recognize the aperture of the reduced reservoir at the anterior border of the tergite VII. This aperture takes only 1/8 of the total width of this tergite measured at the anterior border. In *Drusilla* (= *Astilbus*), a non-obligate myrmecophile, this aperture extends more than one-half the width of the anterior border of the tergite VII (Pasteels 1968a).

The post-pleural glands are also very reduced. We found only about 10 cells in each gland. These cells are located just against the pleurite of the abdominal segment VIII. Their cell reservoir is between 4 to 10  $\mu\text{m}$  in size.

The reduction of both the post-pleural and the tergal gland is frequent in termitophilous aleocharines. But such a strong reduction was observed only in very evolved termitophiles like the Corotocini. This suggests that the Pseudoperinthini could also be a very ancient termitophilous group.

The other parts of the primary glandular system of *Austrointhus* seem unmodified when compared to those of free-living species.

*Austrointhus* possesses some type 3 gland cells found mostly laterally in the hypodermis of the head (fig. 10C), the pronotum, the elytra (fig. 10B), and the abdomen (fig. 10A) where they are found under both the tergites and the sternites. Such type 3 gland cells are secondary structures, evolved independently in 2 other termitophilous groups, described in some Termitogastrina (Pasteels 1968b) and in *Coptophilus* (Kistner & Pasteels 1970). These cells could perhaps act during host-guest interactions; however, nothing is known about the behavior of *Austrointhus* nor of any other Pseudoperinthini, so interpretation of the type 3 cells is presently impossible.

*Austrointhus* does not possess a sclerotized glandular reservoir at the anterior edge of the tergite VII nor the large gland cells associated with it. This sclerotized reservoir is not present in any other Pseudoperinthini. However, such reservoirs and gland cells were always found in the Corotocini and in the Perinthina, at least in the African species (Pasteels 1969, Pasteels & Kistner 1969). This confirms the conclusion already reached after the study of the external anatomy of these beetles, that the Perinthina and the Pseudoperinthini are 2 independently evolved groups of termitophiles. Their similar

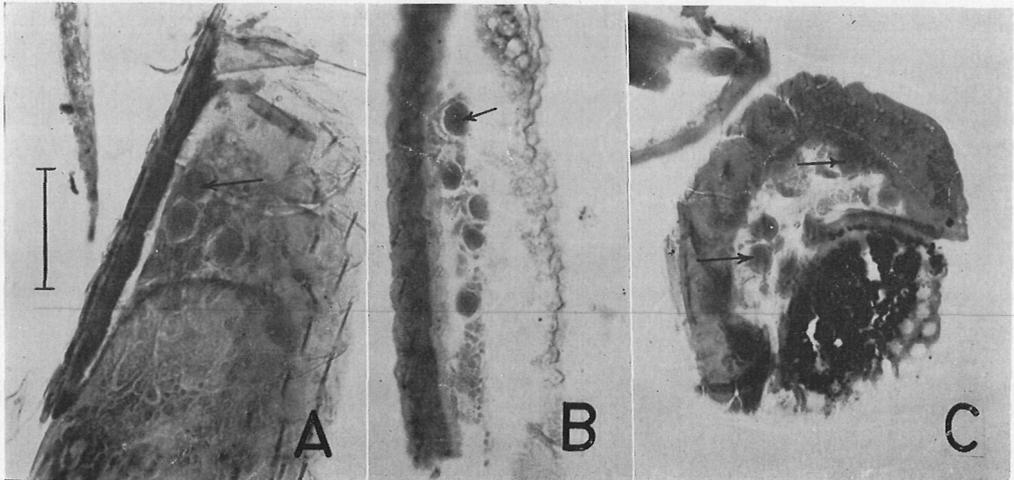


Fig. 10. *Austrointhus gayi*: A, tangential section through lateral part of sternite V; B, longitudinal section through lateral part of elytra; C, sagittal section through head, several type 3 cells with homogenous secretion may be seen in hypodermis, some of these cells are indicated by arrows. All the sections stained with azocarmine. Scale represents 50  $\mu$ m.

general appearance thus represents convergence.

#### Relationships Between the Genera

All of the genera are highly specialized, but the genus *Indinthus* would appear to be the most primitive. In this genus the antenna is more like that of a free-living staphylinid and the mandibles do not have the peculiar indentations characteristic of some of the other genera. Most closely related to *Indinthus* would be *Austrointhus*. In this genus the mandibles are still not modified but the antenna now is more compact with the sides of the segments completely overlapping the petioles. Coming from a stock previous to the branching off of *Austrointhus* would be the genus *Pseudoperinthus* which has an antenna with distinct petioles but has also the highly modified mandibles. Most closely related to *Pseudoperinthus* then would be *Malayinthus* which has the completely compacted antenna with the petioles completely covered as well as the highly modified mandibles. It is hardly worthwhile with so few genera and species to put this through the computer as we are certain the relationships outlined above would be forthcoming.

#### Host Relationships

All of the species in this study are host-specific at the species level. A summary of the host relations by termite species is presented in Table I. If we match up the relationships of the genera of termitophiles with the phylogeny of the termites (Ahmad 1950), we find a reasonably good fit. The most primitive genus is both with *Nasutitermes* and with *Hospitalitermes* and the most derived genera are with *Hospitalitermes* and *Lacessititermes* with the genus found with *Lacessititermes* being somewhat more primitive than the genus found with *Hospitalitermes*. The genus found with *Nasutitermes* in Australia is more advanced than that found with *Nasutitermes* in India.

Table I. Host relationship of the Pseudoperinthini.

Termite	Termitophile
Nasutitermitinae	
<i>Nasutitermes exitiosus</i> (Hill)	<i>Austrointhus gayi</i>
<i>Nasutitermes graveolus</i> (Hill)	<i>Austrointhus graveolus</i>
<i>Nasutitermes indicola</i> (Holmgren)	<i>Indinthus fletcheri</i>
<i>Lacessititermes laborator</i> (Haviland)	<i>Pseudoperinthus malayanus</i>
<i>Hospitalitermes hospitaloides</i> (Holmgren)	<i>Malayinthus emersoni</i>
	<i>Indinthus emersoni</i>

The capture of this tribe in Australia would seem to indicate that the origin of the Pseudoperinthini must have been before the Cretaceous or otherwise *Nasutitermes* in Australia would not be expected to have this particular kind of termitophile. An ancient origin of the tribe is consistent with the highly evolved and aberrant shape of the genera found in this tribe.

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## **BOOK REVIEW**

### Migration and dispersal of insects by flight.

By Cecil George Johnson

Methuen, London, 1969. 763 pages, 217 illustrations. 150 s= £7.50 (Barnes & Noble, New York; price in United States, \$ 24.00).

This book is a great landmark for knowledge of insect flight, migration and dispersal. It treats the theories of migration and dispersal in great detail and provides exhaustive documentation. Although passive dispersal is not treated as such, the book contains a great deal of reference to the literature on the entire subject. Many new ideas and theories are presented, relating to the role of dispersal in the annual or longer cycles of populations.

An important thesis of this book is that a great deal of transport of insects that has been considered passive in the past is actually a combination of flight with wind dispersal. Johnson stresses the thought that flight is much more significant than has usually been thought in the past.

The book treats a great amount of detail in clearly arranged and subdivided chapters. There are many graphs and other diagrams illustrating much of the detail of data presented. There are 217 illustrations, maps and diagrams, and about 1300 references.

In general, errors seems to be at a minimum. One error noticed is on page 660 where an article is wrongly attributed to Gressitt and Nakata (1964), whereas it is properly attributed to Harrell and Yoshimoto on page 662.

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