

OCCASIONAL PAPER NO. 129

Records of the Zoological Survey of India

The South Asian wood-destroying termite, *Odontotermes feae* (synonym *O. indicus*). Identity, biology and economic importance (Termitidae, Macrotermitinae)

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Edited by the Director, Zoological Survey of India
1991

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Published : March 1991

PRICE : Inland : Rs. 40.00

Foreign : £ 4.00 \$ 6.00

Printed in India by Saakhhar Mudran, 4, Deshapran Sasmal Road, Calcutta-33
Produced by the Publication Division and Published by the Director,
Zoological Survey of India, Calcutta.

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INTRODUCTION

Wasmann (1896) first described this species (his *Termes Feae*) based on soldiers and workers from Carin Cheba, Burma. Since then it has been reported from various localities in South and Southeast Asia (vide infra, Geographical Distribution). Holmgren (1913a, b) described all the castes (imago, soldier and workers major and minor). Recently, however, its identity has been confused by M. L. Thakur (1981) who relegated several examples of true *O. feae* to a supposedly new species, *O. indicus* Thakur on inconsequential and minor characters. We have shown that *O. indicus* is not a valid species but merely a junior synonym of *O. feae*.

O. feae is one of the most important wood-destroying termites in the region of its distribution. Here, its identity, synonymy, geographical range, biology and economic importance are discussed in detail. The body measurements and indices were taken as defined by Roonwal (1970b).

Abbreviations used : Coll., collected by ; Im, imago ; S, soldier ; W, worker.

II. SYSTEMATIC ACCOUNT

Odontotermes feae (Wasmann 1896)

(Figs. 1-10 ; Pl. 1-2 ; Tables 1-3)

(Synonym *Odontotermes indicus* Thakur 1981)

1. Synonyms, etc.

(a) *Termes feae* Wasmann 1896

1896. Wasmann, *Ann. Mus. Civ. Stor. Nat. Genova*, (2) 16 (36), pp. 625,626. S, W.
Type-locality : Burma (Carin Cheba).

1904. Desneux, *Genera Insectorum (Isoptera)*, 25, p. 37.

1941. Beeson, *Ecology and Control of Forest Insects of India and the Neighbouring Countries, Dehra Dun*, p. 551. (Reprint Ed., 1961, Delhi, pp. 415-416).

1953. Ratan Lal and Menon, *Catal. Indian Insects (Isoptera)*, Pt. 27, p. 77.

(b) *Odontotermes feae* (Wasmann)

1912. Holmgren, *J. Bombay nat. Hist. Soc.*, 21 (3), pp. 786, 787. S, W (major, minor).

1913a. Holmgren, *J. Bombay nat. Hist. Soc.*, 22 (2), pp. 110, 111. Im, S, W.

1913b. Holmgren, *K. Svenska Vetenska. Akad. Handl.*, 50 (2), p. 129. Im, S, W (major, minor).

1914. Silvestri, *Rec. Indian Mus.*, 8 (5), p. 428.

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- 1962b. Roonwal and Chhotani, *Abstrs., 2nd All-India Congr. Zool. (Varanasi)*, p. 85.
- 1962b. Mathur and Sen-Sarma, *J. Timbers Dryer's Preserv. Assoc. India*, 8 (1), pp. 3-5.
1962. Mathur and Thapa, *Indian Forest Leaflet (Ent.)*, No. 167, p. 63.
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1974. Sen-Sarma and Thakur, *J. Indian Plywood Industr. Res. Inst.*, 4 (3), pp. 123, 124.
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1975. Akhtar, *Bull. Dept. Zool. Univ. Panjab (N. S.)*, Art. 7, pp. 75-79.
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- 1978b. Roonwal, *Proc. Indian natnl. Sci. Acad.*, (B) **43** (5), pp. 161, 162.
1979. Sen-Sarma and Thakur, *Indian Forest Rec. (N. S.), Ent.*, **13** (1), pp. 24, 25.
1979. Roonwal, *Termite Life and Termite Control in Tropical South Asia*, Jodhpur, pp. 17, 41, 51, 62, 82, 118, 119, 121, 125.
1980. Lahiri and Ghosh, *Rec. zool. Surv. India*, **76**, p. 67.
1981. Thakur, *Indian Forest Rec. (N. S.) Ent.*, **14** (2), pp. 50-53, 152.
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1982. Bose and Das, *Rec. zool. Surv. India*, **80**, p. 207.
1983. Maiti, *Rec. zool. Surv. India, Occas. Paper No. 42*, pp. 97-100.
1983. Sen-Sarma and Thakur, *Indian Forester*, **109** (12), p. 874.
1984. Bose, *Rec. zool. Surv. India, Occas. Paper*, No. 49, pp. 179-181.
- 1984a. Verma, *Indian J. Forestry*, **7** (1) p. 82.
- 1984b. Verma, *Rec. zool. Surv. India*, **81** (3-4), p. 248.
1985. Nair and Verma, *Forest Ecol. & Managem.*, **12**, pp. 296, 297.
1985. Chhotani and Bose, *Rec. zool. Surv. India*, **82** (1-4), p. 58.
1985. Thakur, *Indian J. Forestry*, **8** (1), p. 39.
1986. Verma, *J. Indian Acad. Wood Sci.*, **17** (1), pp. 46, 48-51.
1987. Verma, *Indian J. Forestry*. **10** (1), pp. 13-15.
- (c) *Odontotermes indicus* Thakur 1981
1976. Thakur, *Indian Forestry*, **102**, (8), pp. 501-503, Nomen nudum.
1977. Verma and Thakur, *Newslet. zool. Surv. India*, **3** (5), p. 261. Nomen nudum.
1980. Thakur, *Sociobiology*. **5** (2), pp. 121, 124, 127. Nomen nudum.
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1983. Thakur, *Oriental Insects*, **17**, p. 55.
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1986. Verma, *Annals Ent.*, 2 (2), p. 46.

2. Material

A large collection, 238 separate lots, present in the Forest Research Institute, Dehra Dun, the Northern Regional Station, Zoological Survey of India, Dehra Dun, the Desert Regional Station, Zoological Survey of India, Jodhpur, and the National Collection with the Zoological Survey of India, Calcutta was available. It was from India, Bhutan, Bangladesh, Burma and Sri Lanka.

The Indian examples were from the following States :—Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Goa, Karnataka, Madhya Pradesh, Maharashtra, Meghalaya, Orissa, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal; also from Bhutan and Bangladesh.

3. Description of Species

1. IMAGO (Figs. 1-3 ; Pl. 1 ; and Table 1) :

Head-capsule castaneous brown to deep reddish brown ; antennae light reddish brown ; postclypeus and legs rusty yellow ; labrum

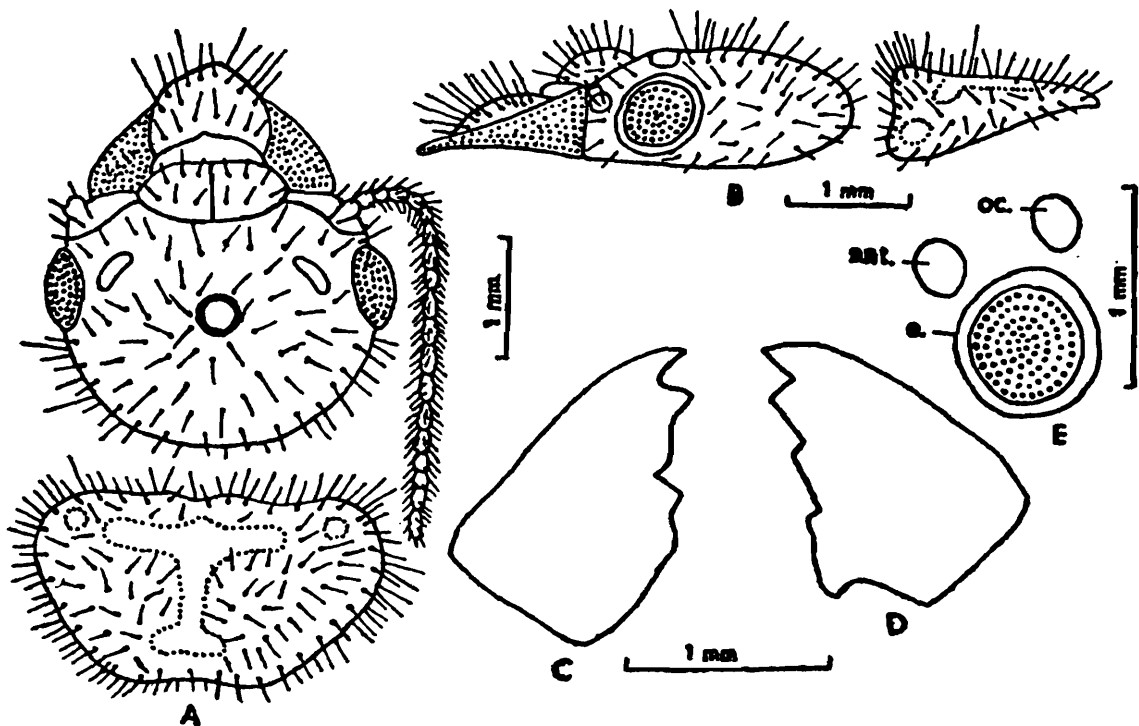


Figure 1. *Odontotermes feae*. Imago (Dehra Dun, U. P., India). A. Head and pronotum, in dorsal view. B. Ditto, in lateral view. C. Left mandible. D. Right mandible. E. Portion of head (Lateral view), showing eye, antennal base and ocellus. ant., antennal base ; e., eye ; oc., ocellus.

yellow, with a transverse yellow-brown band a little above the middle ; pronotum brown, slightly paler than head-capsule, with a yellowish, T-shaped mark in the centre and two suboval spots on the anterolateral corners ; mesonotum paler than pronotum ; abdominal tergites brown, sternites pale yellow. Head and pronotum moderately and abdomen densely pilose. Total body-length without wings ca. 13.75-15.20 mm, with wings ca. 24.00-25.50 mm.

Head-capsule subcircular, much wider than long ; widest across the eyes ; frons weakly depressed. Fontanelle small (diameter ca. 100 μ m), subcircular, pale brown, surrounded by a ring-like rim, slightly raised from the head-surface and lying almost in the middle of the head-capsule. Ocelli moderately large, subovate, separated from eyes by about their short diameter. Antennae with 19 segments ; segment 2 cylindrical, distinctly longer than 3 ; 3 shorter than 4 but subequal to 5 ; 6 slightly shorter than 7 ; 7-10 subequal ; 11-18 almost of same length, longer than the preceding segments ; the last one ovate. Postclypeus greatly swollen, fairly hairy, length almost half its width. Anteclypeus subtrapezoid ; anterior margin protruding medially. Labrum subsquarish, weakly converging anteriorly to a pointed margin ; hairy, hairs on anterior margin long.

Table 1. *Odontotermes feae*. Body—measurements (in mm) of imagoes.

Body—parts			Range (mm)
1. Total body-length with wings	...	...	24.00 — 25.50
2. Total body-length without wings	..	...	13.75 — 15.20
3. Head-length to tip of labrum	...	...	2.95 — 3.40
4. Head-length to lateral base of mandibles	...	...	1.65 — 2.20
5. Max width of head	...	...	2.65 — 2.90
6. Height of head	...	...	1.00 — 1.20
7. Max. diameter of eyes (with ocular sclerite)	...	...	0.65 — 0.78
8. Min. diameter of eyes (with ocular sclerite)	...	...	0.58 — 0.70
9. Max. diameter of ocellus	...	...	0.30 — 0.38
10. Min. diameter of ocellus	...	...	0.18 — 0.26
11. Min. eye-ocellus distance	...	...	0.18 — 0.26
12. Length of pronotum	...	...	1.30 — 1.48
13. Max. width of pronotum	...	...	2.30 — 2.60
14. Length of forewing with scale	...	...	21.00 — 23.00
15. Length of forewing without scale	...	...	19.60 — 21.75
16. Length of forewing scale	...	...	1.25 — 1.35
17. Length of hindwing with scale	...	...	19.50 — 21.00
18. Length of hindwing without scale	...	...	18.00 — 19.40
19. Length of hindwing scale	...	...	1.13 — 1.20

Left mandible with a finger-like apical tooth slightly longer than the 1st marginal; 1st marginal broader than apical; 2nd marginal

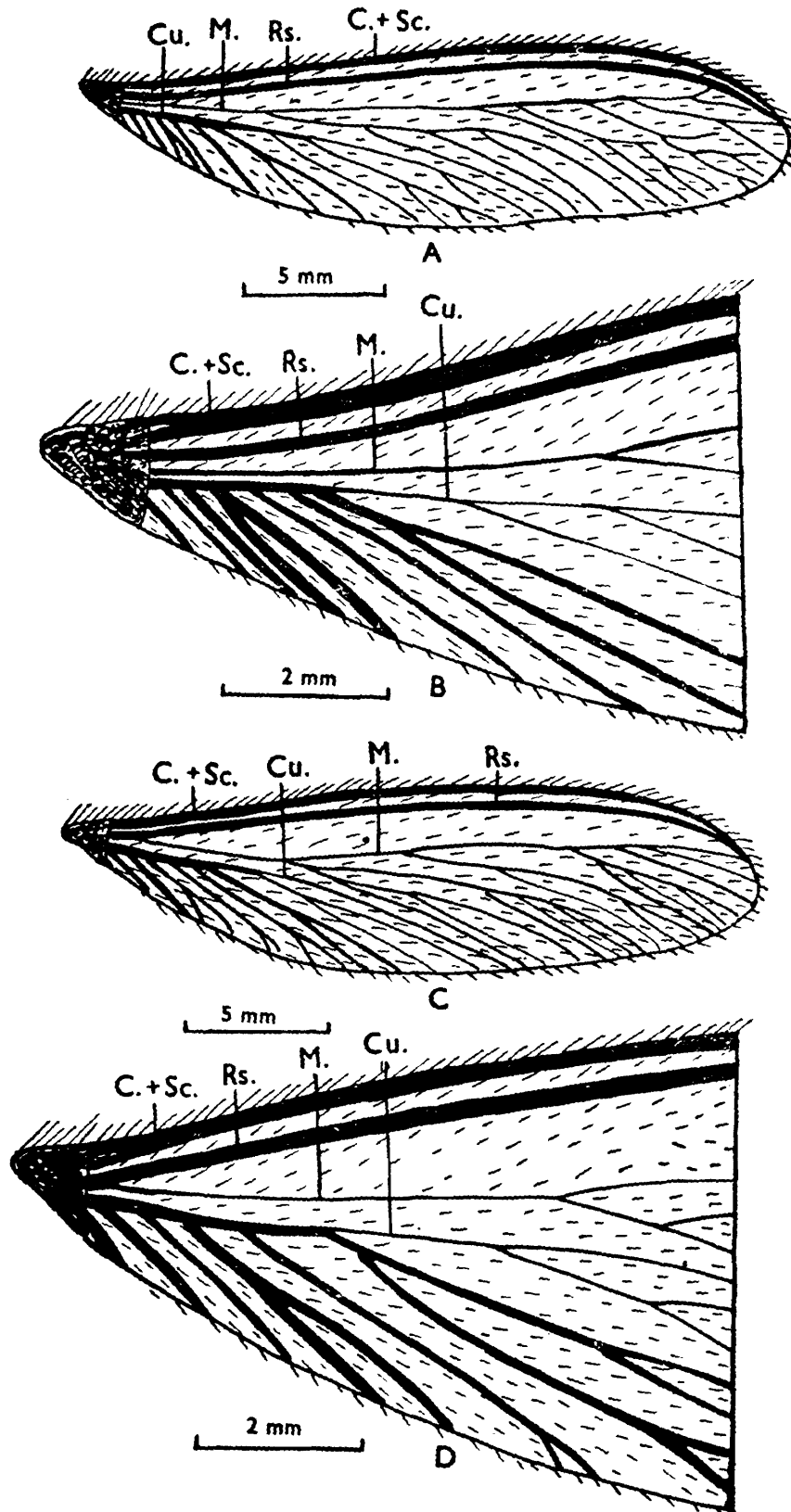


Figure 2. *Odontotermes feae*. Wings of imago (Dehra Dun). A. Forewing with scale. B. Forewing, basal part enlarged. C. Hindwing with scale. D. Hindwing basal part enlarged. C., Costa; Cu., Cubitus; M., Media; Rs., Radial sector; Sc., Subcosta.

smaller, widely separated from the 1st ; 3rd marginal small. Right mandible with an apical and two marginal teeth ; apical finger-like ; 1st marginal triangular, almost as long as the apical, with its posterior margin longer than the anterior ; 2nd marginal smaller than 1st, with a long posterior margin.

Pronotum trapezoid, narrower than head-capsule ; anterior margin slightly raised, with a weak median notch ; posterior margin also weakly notched in the middle. Legs short, slender ; apical tibial spurs 3 : 2 : 2 ; tarsi 4-segmented. Wings (Fig. 2) long, hairy all over, specially on margin. Forewing : Costa-subcosta fused, prominent, running along the anterior margin of wing. Radius short, arising independently but fusing with costa-subcosta a short distance outside the wing scale. Radial sector thick, prominent and strongly chitinised, running close to and parallel with the costa-subcosta ; unbranched. Radial streak present, arising from the proximal third of the wing. Media arising independently of the radial sector inside the scale ; with 14-15 branches. Cubitus with 15-18 branches. Hindwing : Venation generally as in forewing ; but media separating from the radial sector a little outside the wing scale, otherwise as in forewing. Abdomen cylindrical. Cerci 2-segmented, length ca. 0.33-0.35 mm.

Microsculpturing on wings (Fig. 3) : Wings transparent, slightly pale brown, the anterior two veins thick and brown, the rest paler. Length with scale : Forewing 21.00 to 23.00 mm ; hindwing 19.50 to 21.00 mm. With 4 to 5 rows of hairs (length 140-180 μm) on anterior margin and with 2 to 3 rows of hairs (length 120-160 μm) on posterior margin ; hairs on membrane smaller. Microsculpturing present on both surfaces of wings and consists of papillae and rods. Papillae pointed ; in 8-10 rows on the anterior margin ; size 4-12 μm x 4-8 μm ; density 7605 to 9126/ mm^2) ; in 6-7 rows on the posterior margin ; size 4-10 μm x 4-6 μm ; density 7098 to 8112/ mm^2). Rods thick (length 8-15 μm ; density 5070 to 6084/ mm^2).

2. SOLDIER (Figs. 4-6 ; Pl. 1 ; Table 2)

Head-capsule deep yellow to reddish brown ; labrum and post-clypeus reddish yellow ; mandibles deep reddish brown basally, blackish brown elsewhere ; thorax and abdomen creamy yellow to rusty yellow. Head-capsule and body moderately pilose. Total body-length with mandibles ca. 6.50-9.00 mm.

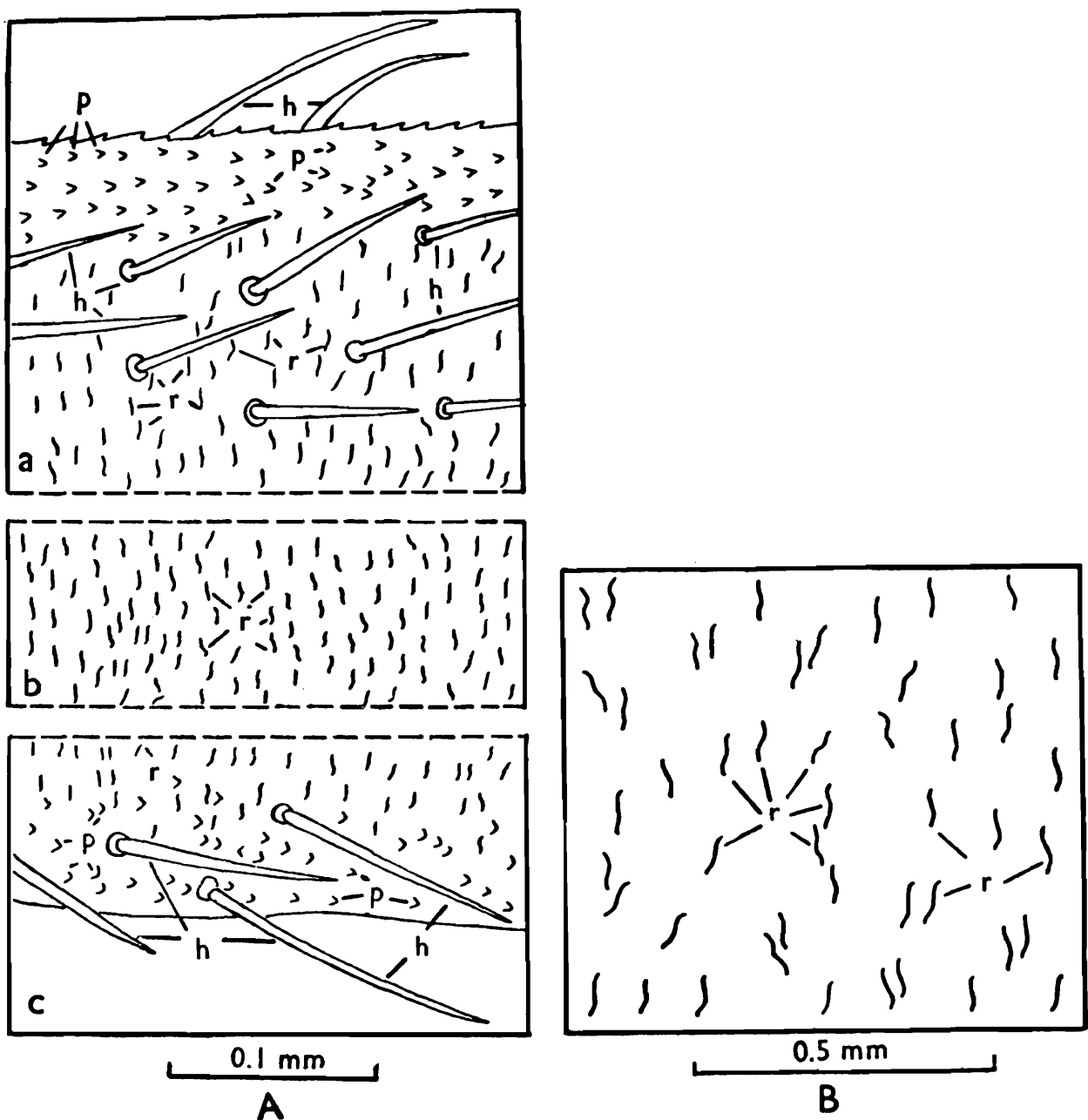


Figure 3. *Odontotermes feae*. Wing microsculpturing on forewing. A (a). On anterior margin of wing, showing papillae, rods and hairs. A (b). In middle of wing, showing rods. A (c) On posterior margin of wing, showing rods, papillae and hairs. B. On wing membrane in middle, enlarged; showing rods. h, hairs; p, papillae; r, rods.

Head-capsule subrectangular, longer than wide, widest near the posterior third; posterior margin rounded. Antennae with 17 segments; segment 2 about twice as long as 3; 3 shortest; 4 longer than 5; 6 shorter than 7. Postclypeus indistinctly separated from frons. Anteclypeus whitish, narrow and apilose. Labrum subtriangular, the sides sloping anteriorly to a pointed tip. Mandibles sabre-shaped; stoutly built; slightly longer than half the head-length. Left mandible with a medium sized tooth lying near the middle of

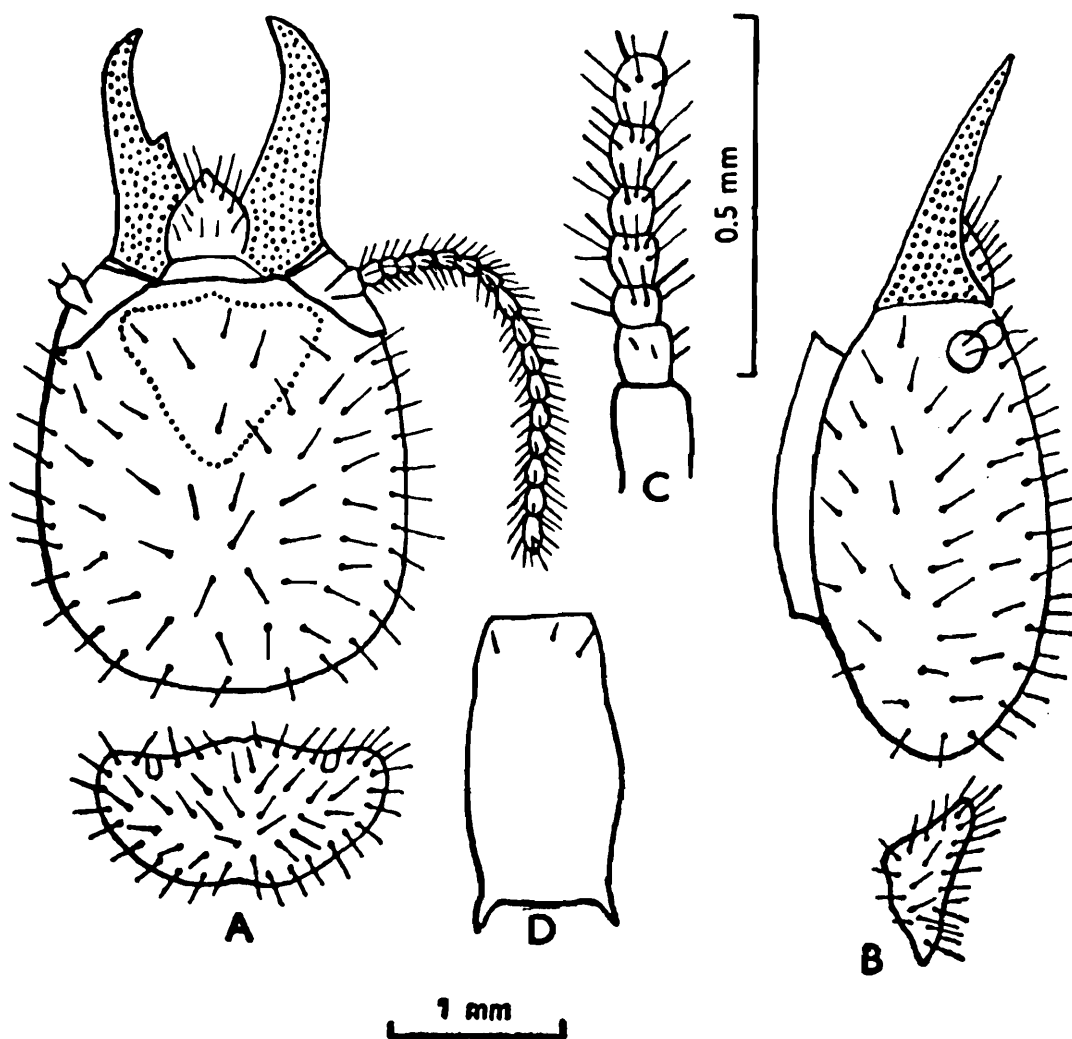


Figure. 4, *Odontotermes feae*. Soldier (Dehra Dun). A. Head and pronotum, in dorsal view. B. Ditto, in side view. C. Antenna, enlarged near base. D. Postmentum, in situ.

the inner margin (tooth index 0.50-0.55). Right mandible with a minute crenulation near the upper edge of basal third. Postmentum subrectangular, much longer than broad; swollen near the basal

Table 2. *Odontotermes feae*. Body-measurements (in mm) of soldiers.

Body—parts			Range (mm)
1. Total body-length with mandibles	...	...	6.50 — 9.00
2. Length of head with mandibles	...	...	3.45 — 4.75
3. Length of head to lateral base of mandibles	...	...	2.25 — 3.10
4. Max. width of head	...	...	1.80 — 2.50
5. Width of head at lateral base of mandibles	...	...	1.20 — 1.60
6. Width of head at lateral base of antenna	...	...	1.63 — 2.20
7. Height of head	...	...	1.10 — 1.70
8. Head Index I (Max. head-width/Head-length to lateral base of mandibles)	...	...	0.76 — 0.87

9. Head Index II (Height of head/Max. width of head)	...	...	0.56 — 0.69
10. Head Index III (Height of head/Head-length to lateral base of mandibles)	...	...	0.48 — 0.58
11. Head Index IV (Head-width at lateral base of mandibles/Max. width of head)	...	...	0.58 — 0.67
12. Head Index V (Head-width at lateral base of antenna/Max. width of head)	...	...	0.84 — 0.93
13. Max. length of left mandible	...	...	1.20 — 1.65
14. Max. length of right mandible	...	...	1.20 — 1.65
15. Distance of tooth from tip of left mandible	...	...	0.62 — 0.90
16. Mandible tooth Index	...	...	0.50 — 0.55
17. Head-Mandible Index I (Length of left mandible/Head-length to lateral base of mandible)	...	...	0.51 — 0.59
18. Head-Mandible Index II (Length of left mandible/Max. head-width)	...	...	0.62 — 0.73
19. Min. (median) length of postmentum	...	...	1.30 — 2.00
20. Max. width of postmentum	...	...	0.73 — 0.93
21. Width of postmentum at anterior margin	...	...	0.45 — 0.60
22. Postmentum Index I (Width/Length)	...	...	0.43 — 0.58
23. Postmentum Index II (Min. width/Max. width)	...	...	0.56 — 0.70
24. Length of pronotum	...	...	0.75 — 1.00
25. Max. width of pronotum	...	...	1.40 — 1.83
26. Pronotum—Head-width Index.	...	..	0.64 — 0.80
27. Pronotum Index (Length/Width)	...	...	0.49 — 0.61

third. Pronotum weakly saddle-shaped; anterior lobe much smaller than the posterior; anterior margin with a weak median emargination; posterior margin weakly to deeply notched medially. Mesonotum broader than pronotum; posterior margin substraight. Legs slender, long and hairy; tibial spurs 3 : 2 : 2; tarsi 4 segmented. Abdomen short, subcylindrical, rather densely hairy. Cerci 2-segmented, ca. 0.10 mm long; styli unsegmented, ca. 0.08 mm long.

3. WORKERS : Are dimorphic.

(a) *Worker Major* (Fig. 7A ; Pl. 1 ; Table 3) :

Head-capsule and postclypeus pale yellow to rusty yellow, frons paler; antennae pale yellow; rest of the body creamy yellow. Head-capsule sparsely, thorax and abdomen moderately pilose. Total body-length ca. 5.00-6.50 mm. Head-capsule subsquarish, widest near the base of antennae; sides subparallel, converging posteriorly to a rounded posterior margin. Fontanelle as in imago, but smaller

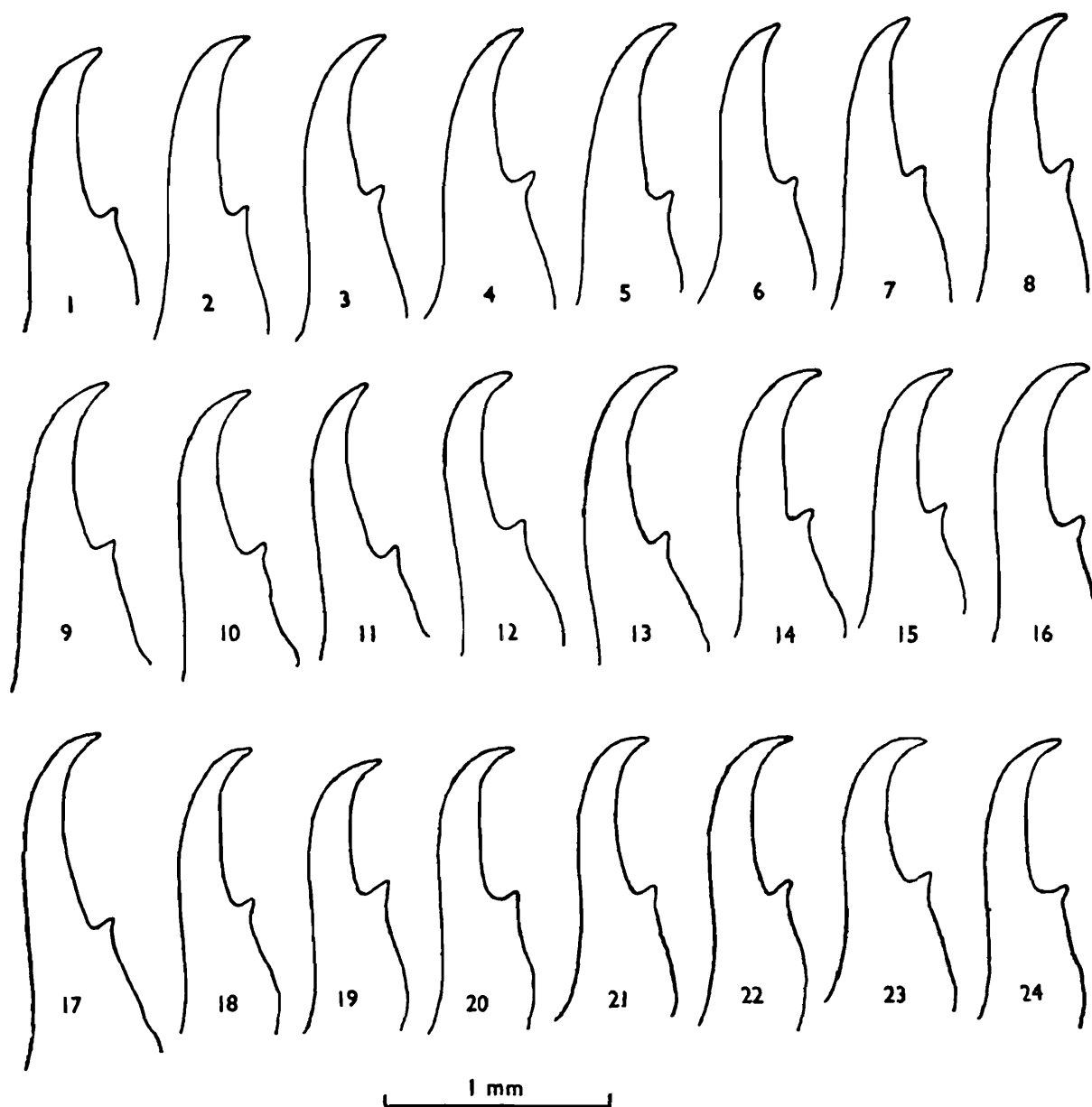


Figure 5. *Odontotermes feae*. Soldier. Left mandible from different localities in India and Sri Lanka. INDIA : Assam : 1, 2 (Tinsukia : Makum) ; 3 (Napuk Rest House, Sibsagar) ; 4, 5 (Silonijan forest range) ; 6 (Amsoi) ; 7, 8 (Margherita). Nagaland : 9 (Dhimapur). Bihar : 10-11 (Rogot). Kerala : 12 (Nilambur ; 13 (Machad forest range, Trichur) ; 14 (Thenmala) ; 15 (Parambikulum) ; 16 (Kondazhin). Maharashtra : 18-19 (Bombay, "*Odontotermes indicus*", paratypes). Uttar Pradesh : 20-24 (Dehra Dun, all from same colony). SRI LANKA : 17 (Vakaneri).

(diameter ca. $90\ \mu\text{m}$) and slightly depressed from the head surface. Antennae with 19 segments ; segment 2 cylindrical, much longer than 3 ; 3 subequal to 4 ; 5 shortest ; 6 shorter than 7. Postclypeus weakly swollen ; length less than half its width. Anteclypeus subtrapezoid, hyaline ; anterior margin subround. Mandibles as in imago.

Table 3. *Odontotermes feae*. Body-measurements (in mm) of workers.

Body—parts		Worker Major (Range, mm)	Worker Minor (Range, mm)
1. Total body-length	...	5.00 — 7.00	3.50 — 4.70
2. Head-length to tip of labrum	...	2.05 — 2.50	1.70 — 2.00
3. Head-length to lateral base of mandibles	...	1.50 — 1.85	1.10 — 1.48
4. Max. width of head	...	1.68 — 2.10	1.15 — 1.50
5. Height of head	...	0.60 — 0.85	0.48 — 0.63
6. Length of pronotum	...	0.48 — 0.65	0.35 — 0.53
7. Max. width of pronotum	...	0.85 — 1.20	0.58 — 0.90

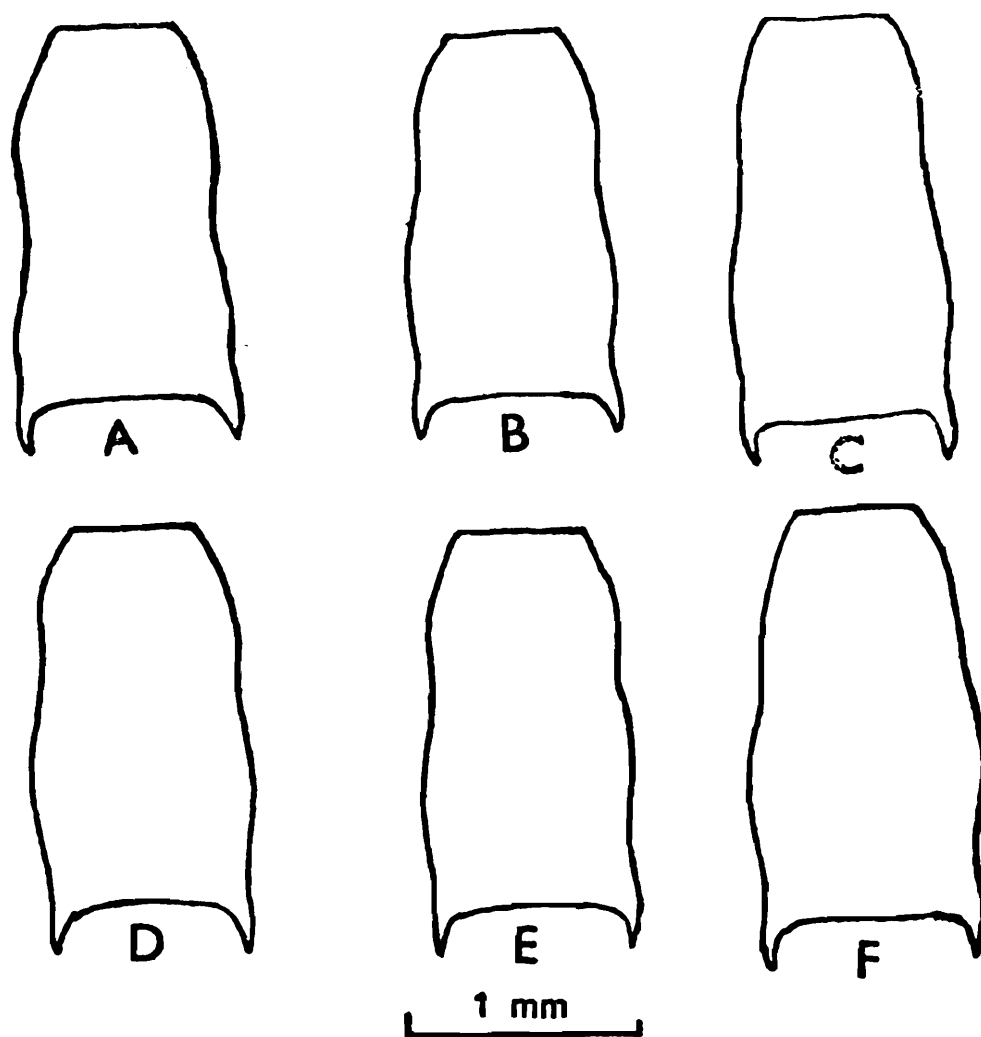


Figure 6. *Odontotermes feae*. Soldier (from different localities in India). Postmentum. *Uttar Pradesh* : A. Rajaji National Park (Dholkhand forest). B. Dudhwa National Park (Kela, Forest Rest House). *Haryana* : C. Baragaon Reserve Forest. *Maharashtra* : D. Pune. *Keerala* : E. Thermala. *Nagaland* : F. Dhimapur.

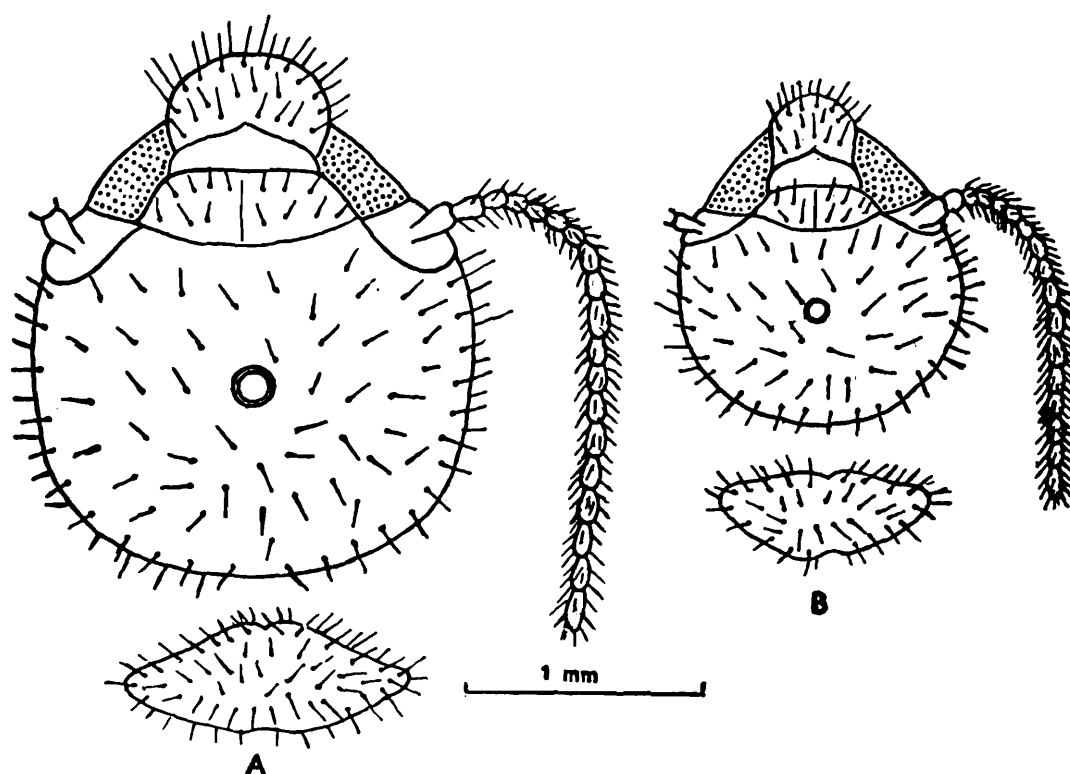


Figure 7. *Odontotermes feae*. Worker (Dehra Dun). Head and pronotum of dorsal view. A. Worker major. B. Worker minor.

Pronotum saddle-shaped ; much narrower than head ; anterior and posterior margins distinctly notched medially. Mesonotum broader than pronotum ; posterior margin weakly notched medially. Meta-notum broader than pronotum ; posterior margin substraight. Legs long, slender and hairy ; tibial spurs 3 : 2 : 2 ; tarsi 4-segmented. Abdomen subcylindrical. Cerci 2-segmented, ca. 0.15 mm long ; styli unsegmented, ca. 0.08 mm long.

(b) *Worker Minor* (Fig. 7B ; Pl. 1 ; Table 3) :

Resembles worker major but is smaller and paler ; antennae with 17-18 segments.

4. Taxonomic Remarks

Odontotermes indicus has been separated by Thakur (1981, p. 75) from *O. feae* in soldiers on minor and inconsequential characters, all of which fall well within the narrow range of the latter. First, the supposed differences in the angle of tooth (acute angled vs right angled) in the left mandible do not hold good and there is much

variation in local populations and also in specimens from eastern India (Fig. 5). Secondly, the postmentum in *O. indicus* is claimed to be "comparatively more swollen and broader near the posterior third" than in *O. feae*. Actually, the range of the swollen part is very narrow (maximum width 0.73-0.93 mm) in the entire material, and no separation is possible. There is no justification whatever for separating *O. indicus*, and it is treated here as a junior synonym of *O. feae*.

5. Geographical Distribution

Odontotermes feae is widely distributed (Fig. 8) in South and Southeast Asia, e.g., in India, Nepal, Bhutan, Bangladesh, Sri Lanka, Burma, Thailand and Vietnam. Its detailed distribution is given below :—

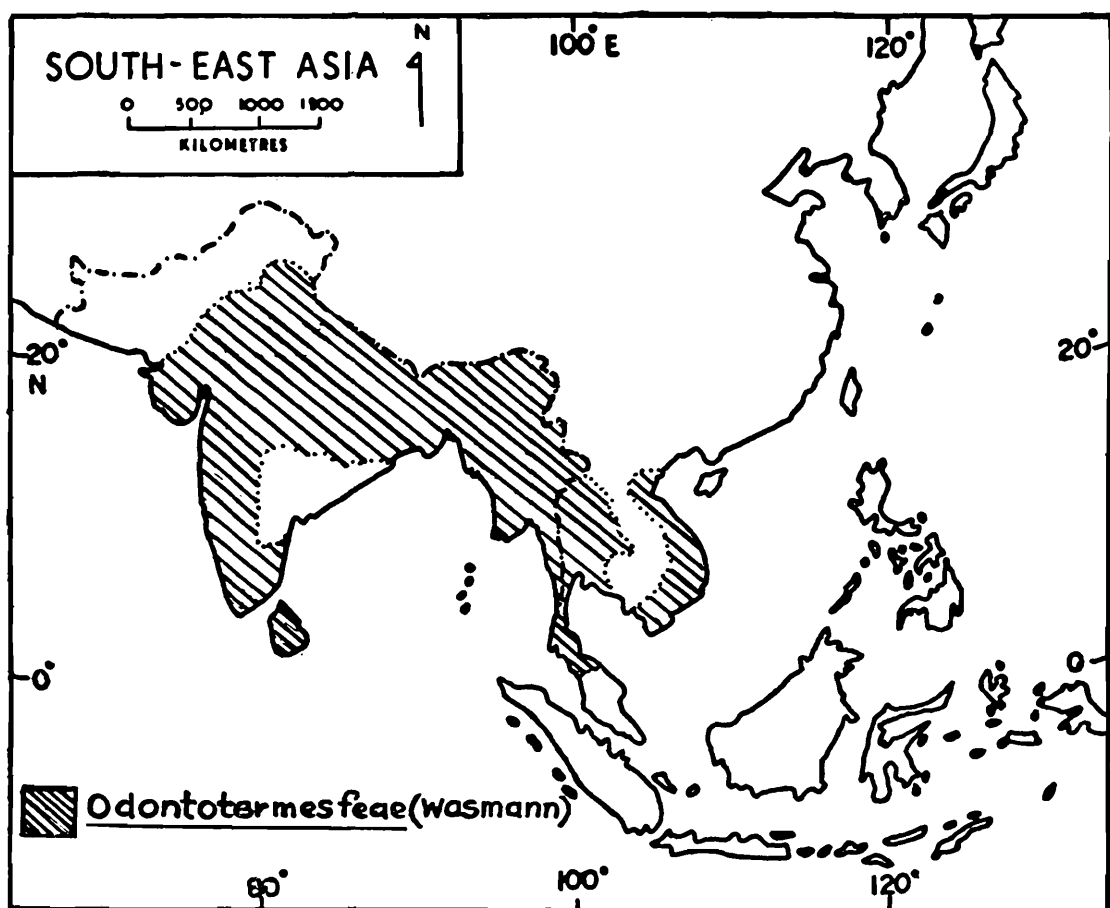


Figure 8. *Odontotermes feae*. Map of South-East Asia, showing distribution of *O. feae* (areas shaded in diagonal lines).

INDIA

Widely distributed all over except in the extreme north (Jammu and Kashmir) and the Western Desert region (the Thar or Indian

Desert) of Rajasthan in the west. A more detailed distribution in the states (arranged alphabetically) is as follows :—

1. *Andhra Pradesh* Balapallai (1000 ft., Cuddapah district).
2. *Arunachal Pradesh* Abor Hills, Hornbill, Namdapha, Gibbon Land, Miao forest and vicinity, and Kameng Frontier Division.
3. *Assam* : Siloni (Golaghat) and Barjan forests, Margherita (Digboi), Amsoi, Kohora, Makum (Tinsukia), Siloni and Palasbari (Kamrup district), Sadiya (Lakhimpur district), Sibsagar, Napuk, Sala forest (Sibsagar district), Silchar (Cachar district), Kaziranga National Park (Darrang district), Sonai Rupa Sanctuary (Sibsagar and Nowgong district).
4. *Bihar* : Ranchi ; Porahat (Rogot) and Giokera forest, Chaibasa, Barkela, Runгла Garden, Daltonganj, Belta and Saranda forests, Hajipur, Barkala, Maner, Fatwah Sonarae.
5. *Goa, Daman and Diu* *Goa* : Valpoi, Mollwum (Kollay), Sangeum (Satida and Bhati forests). *Daman* : Bhimpur village.
6. *Gujarat* : Silvassa (Khanoa forest).
7. *Haryana* Baragaon forest (Karnal district).
8. *Himachal Pradesh* : Nahan.
9. *Karnataka* : South Mangalore, Shimoga (Anesare eucalyptus plantations), Hunsur, Bangalore, Siddapur, Belgaum, Dandeli, Dharwar, Hassan, Coorg (Mercara and Margalli, 3500 ft.), on road between Mysore and Mercara, Satellite Island (South Kanara), Bababuddin Hills (4000-4700 ft.),
10. *Kerala* : Achancouil, Bavali, Idamalayar, Kottoor, Nilambur, Thenmala, Paramintulu, Kallar, Trichur, Vazhachal, Potta, Varavur, Kondazhi, Parambikulum (Dhoni), Olavakkot (Palghat) forest.
11. *Madhya Pradesh* : Bilaspur district (Bilaspur and Surh villages), Raipur district (Dhokal), Sodhol (Jaisinghnagar forest), Jabalpur district (Jabalpur, Garjtal), Sarguja district (Mainpat and Ambikapur), Balaghat and Mandla districts.
12. *Maharashtra* : Pune, Kharakavasla, Khedshivpuri, Bombay, Khandala, Kandawati, Genesh Park, Nagla Wada and Manchard forest, Kurloshi village (Khed).

13. *Manipur* : Kongpokpi, Khuigaivok, Moreh forest.
14. *Meghalaya* : Garo Hills, Rongrengiri, Amuka village, Bank of Napak Hill, Anogiri, Charikuty, Damra, Darugiri, Debrangiri, Deoripathar, Holaidanga, Rongsogri, Songsok, Tura, Wagtsi, Khasi Hills, Shillong, Mawryngkreng, Umran, Umsa Nongkharai, Umsing, Umtham.
15. *Nagaland* : Dhimapur.
16. *Orissa* : Barkuda Is. (Chilka Lake), Badrama, Mazipara, Mahanadi Bank, Rayasadar (Koraput district).
17. *Punjab* : Sangrur.
18. *Rajasthan* : Sirohi district (Mt. Abu and vicinity).
19. *Tamil Nadu* : Madras, Coimbatore, Coonoor, Topslip, Shevaroy Hills (4200 ft.), Yercaud, Mylar, Chalakudy.
20. *Tripura* : Agartala, Ambasa forest, Belonia, Tiliamura, Choraibari, Paratia, Ganganagar, Kanchanpur, Khujmura.
21. *Uttar Pradesh* : Widely recorded from the districts of Dehra Dun, Tehri, Pauri, Nainital (Mukteshwar), Saharanpur, Pilibhit, Lakhimpur Kheri and Gorakhpur.
22. *West Bengal* : Widely recorded from Calcutta and the districts of Murshidabad, Bankura, 24-Parganas, Nadia, Midnapore and Bardwan.

NEPAL

Hurex-Tal.

BHUTAN

Samchi and Thimphu (2300-2500 m).

BANGLADESH

Rangamati, Shishak forest, Dariadighi, Ukhia forest, Madhupur, Adampur, Chittagong, Cox's Bazar, Sylhet, Rajendrapur (Dacca) Mainimukhi (Chittagong Hill Tract), Faridpur district.

SRI LANKA

Vakaneri.

BURMA

Maymyo, Meitkyina, Carin Cheba (type-locality of *O. feae*), Maibung (E of R. Salween) and Karen state.

THAILAND

Near Ka-chong, Tung Sa-long Luang, Makhan, Mac Sod.

VIETNAM

Ba-Na.

III. BIOLOGY AND ECONOMIC IMPORTANCE

The biology and economic importance of *Odontotermes feae* has been studied by several authors, especially the following, and a brief account is given below :—Ahmad (1965), Akhtar (1975), Annandale (1923), Assmuth (1913, 1915), Becker (1962b, c), Beeson (1941), Bose (1984), Chatterjee (1972), Chatterjee et al. (1967), M. I. Chaudhry, Ahmad et al. (1972), Holmgren (1913a), Maiti (1985), Mathur and Sen-Sarma (1962), Nair and Varma (1985), Patel and Patel (1952), Roonwal (1970a, 1976, 1978b, 1979), Roonwal and Chhotani (1961, 1962 a, b, 1966, 1978), Sen-Sarma (1972, 1978), Sen-Sarma and Thakur (1974, 1983), Sen-Sarma et al. (1975), Silvestri (1923), Srivastava et al. (1962), M. L. Thakur (1980, 1981), M. L. Thakur and Sen-Sarma (1980), R. K. Thakur (1985) and Verma (1985, 1986 a, b, 1987).

1. *Habits and Habitat*

O. feae is mainly a subterranean burrower, preferring humid areas, and generally nests under-ground, but sometimes builds earthen mounds above the ground. It is one of the most important Indian termites destroying woodwork in buildings, timber in storage yards, logs and tree stumps in forests and the bark of living trees. It infests leaves or debris lying on the ground, and the undersides of cattle and elephant dung heaps which it eats out hollow. It also affects the seedlings of plantation crops and attacks some agricultural crops. The workers bore irregular, longitudinal tunnels in wood and cover the attacked wood with a thick, broad sheet of mud plaster about 2.5 mm above the wood surface, leaving a clear space for movement. These earthen sheets are supported by small irregular partition walls which separate the broad intercommunicating chambers. The outer surface is rough and warty, the inner somewhat smooth. Workers and soldiers freely move about in these flat chambers. When disturbed, the soldiers emit a white, sticky stuff which sets to a gummy

mass in a few minutes. The attacked wood is eaten away irregularly to various depths, working from the surface inwards, not even the hard portions of the annual rings being left in tact ; broad patches of untouched wood are left behind inbetween. The fillings are quite distinctive ; the cavities are filled with coarse, earthy material from the surrounding ground, leaving narrow tunnels interrupted at short intervals by wide chambers. The mud fillings, when dry, are friable.

2. *Underground Nesting and Mound Formation*

(a) *Underground nest*

O. feae habitually lives in a single large, complex, concentrated, subterranean nest without any external opening ; sometimes, however, it builds a mound above the ground (vide infra).

There is no external indication of the presence of the underground nest except at swarming time (usually once a year). Shortly before swarming begins, usually at dusk, the workers open several holes on the ground surface from which the winged alates issue forth one by one, thus betraying the presence of the nest (Holmgren, 1913a). The nest covers a surface area of about 4 to 5 metres in diameter and is about a metre deep. The nest contains large, irregular, vertical chambers separated by thick walls and are interconnected by means of large galleries. The fungus garden is cultivated in a large, somewhat dome-shaped chamber which lies about 75 cm below the ground level ; the fungus combs are arranged in tiers. The royal chamber lies eccentrically, about 38 cm away from the fungus chamber and a little deeper than the latter, and contains a king and a queen (Mathur and Sen-Sarma 1962).

(b) *The mound*

Though habitually nesting underground in India, *O. feae* occasionally builds a mound above the ground. This was first demonstrated by Roonwal and Chhotani (1962, 1966 ; summary in Roonwal 1970a, 1978b) who found a single mound on the Barkuda Island (Chilka Lake, Orissa, India) (curiously, the same small island where the species habitually nests underground (Holmgren 1913a, Annandale 1923). The mound was made of soft, reddish earth and stood in an open space near a *pipal* tree (*Ficus religiosa* Linn.). It was a low, sprawling, roughly dome-shaped structure with a few prominences (maximum height 65 cm, maximum basal diameter 200 cm, basal circumference 565 cm). Several large, roundish holes, ca. 5-10 cm

in diameter, were present on the surface and led to tunnels ending in vaults (diameter ca. 8-20 cm) where fungus combs were lodged. The mound is thus of the multi-locular type (as in *O. redemanni*). The fungus combs (Pl. 1) are small (diameter ca. 60-130 mm), rounded, soft, fragile, spongy and pale brown mottled with grey spots; they are convex above and either flat or slightly concave below, and are honey-combed all over with irregular, wavy cavities. The royal chamber lies eccentrically in the mound about ground-level and is not separable from the mound material. The royal cell (length 105 mm, width 100 mm, height 33 mm) is narrow in cross-section, with a flat floor and an arched roof, its longer axis lying north-south; the inside walls are smooth. It contained a large, physogastric queen (length of abdomen ca. 6.4 cm; the head pointing south), a small dealated king (length 13 mm) and a few soldiers and workers. Soldiers and workers were also found throughout the mound, and nymphs and eggs were generally present in the fungus combs in the vicinity of the royal chamber.

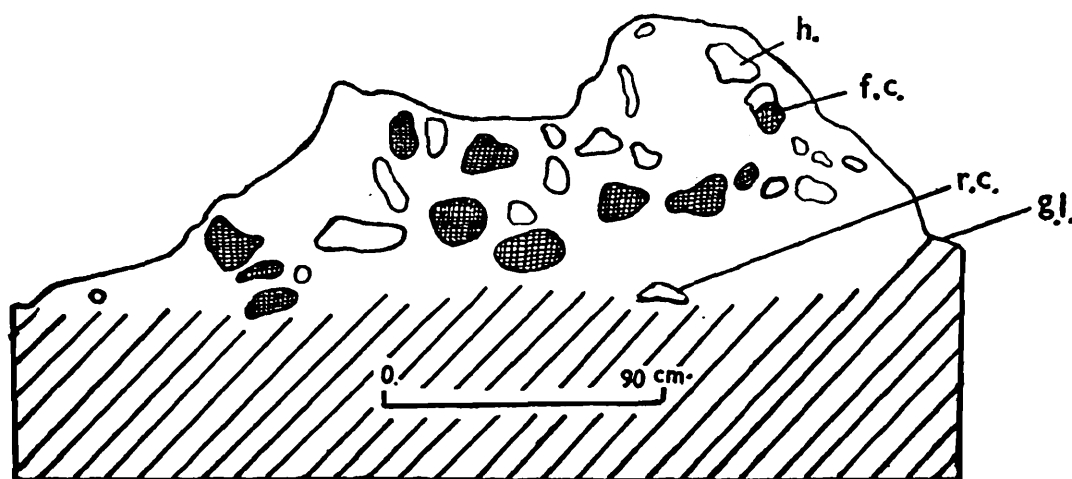


Figure 9. *Odontotermes feae*. A mound, in vertical section; diagrammatic. Barkuda Island, Chilka Lake (Orissa, India). Ex. Roonwal and Chhotani. 1966.) f.c., fungus combs; g.l., ground-level; h., hole; r.c., royal cell.

In the eastern part of its distributional range, *O. feae* seems to build a mound habitually. Thus, in Bangladesh, (formerly East Pakistan) M. I. Chaudhry et al. (1972) state that "it is a common mound-building termite, occurring in humid areas of East Pakistan." Several mounds were observed at Madhupur and Sripur. The mounds were large, solid and dome-shaped (height at Madhupur ca. 4 feet, girth 19 feet); numerous galleries were present throughout the mound;

fungus gardens were present and contained many eggs and nymphs. The royal chamber lay in the middle of the mound above ground-level; it was flat below and low and dome-shaped above and contained many communicating holes.

Ahmad (1965) also mentioned a mound in Thailand (Ka-Chong, from where soldiers and workers were obtained; the mound lay at the base of a tree, but no other details were given.

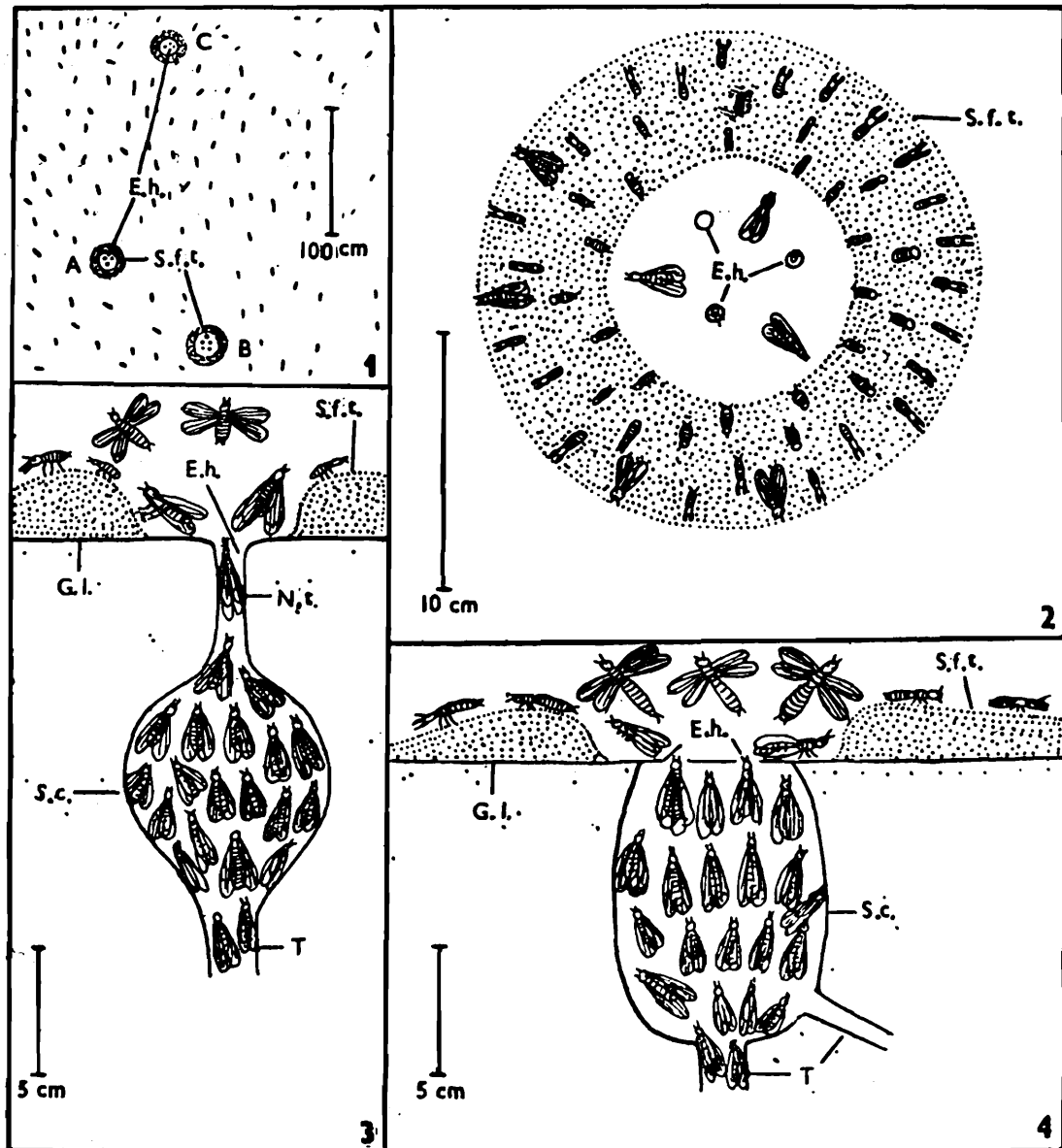


Figure 10. *Odontotermes feae*. Swarming locations and swarming chambers, excavated at Dehra Dun (Uttar Pradesh, India); traced from emergence (swarming) holes. (Ex Verma, 1987.) (1) Three swarming locations (A, B, C,) on the ground surface. (2) Swarming location A, enlarged, showing emergence holes, workers, soldiers, imagoes, and flight tower built of earth. (3) Swarming chamber, tunnel, and flight tower, in vertical section at swarming location A. (4) Ditto, at swarming location B. E.h., emergence holes; G.l., ground-level; N.t., neck tunnel; S.c., swarming chamber; S.f.t., flight tower; T., tunnel.

3. *Swarming* (Fig. 10)

Details of the swarming of winged imagoes of *O. feae* from subterranean nests have been recorded by Holmgren (1913a, Bombay) and Verma (1987, Dehra Dun), the latter account being more detailed and also supported by clear illustrations.

In Dehra Dun (N. India) swarming occurred on 22 August 1985 between 5.30 P.M. to 8.30 P.M. ; The preceding day and night before swarming experienced heavy rainfall, but the swarming day itself was clear and sunny except for a little rain in the morning. Several hundred imagoes were swarming from 12 emergence holes lying within a radius of 150 cm and grouped in three lots, A, B, C, with 3, 5 and 4 holes in each lot respectively, and separated from one another by a distance of ca. 150-215 cm. The emergence holes themselves were about 10 mm in diameter. The swarms were causing trouble to traffic on a nearby road. Each hole leads underground to a wide, subglobular (8 cm x 10 cm) swarming chamber either directly or through a small, ca. 4-5 cm long neck. Each group (A, B, C) of emergence holes was surrounded by a raised, circular platform of heaped, excavated earth, the flight tower, which was about 5 cm wide and 3-4 cm high. The tower had apparently been constructed by the workers shortly before swarming began, but the actual process of construction was not observed. On this tower, the workers and soldiers had stationed themselves, probably for guard duty, in four irregular rows, with 10-12 individuals in each row, the heads of all facing away from the swarming hole. At the inner end the swarming chamber led into a tunnel (ca. 20 cm in diameter) which entered the nest ; through it the imagoes were assembling into the swarming chamber which was full of imagoes (no workers and soldiers were present there), all struggling to come out. They emerged at the rate of about 80-90 per minute from 3 holes ; thus, during a span of about 3 hours that the swarming lasted, an estimated over 50-60 thousand imagoes would have emerged from the 12 swarming holes in the site. On emergence, the imagoes either climbed on to the flight tower or, by a short flight, to the top of a nearby grass blade about 15-30 cm high. From there, after a moment's rest, they flew away well above the tall, about 20-23 metres high, eucalyptus trees nearby and disappeared from view.

The swarming individuals consisted of both sexes. After flying for an hour or so, they were apparently attracted to light, descended

to the ground and ran about in tandem pairs, a male closely following a female. After descending to the ground, most of the imagoes shed their wings, so that the tandem pairs were mostly dealated, but a few had retained the wings. Some tandem pairs were brought to the laboratory for observation ; they ran about in tandem for the whole night. (In the field, presumably, each pair finds a suitable hole or crevice in the ground for copulation and starting a fresh colony).

Predators : Verma abserved that during flight in Dehra Dun the imagoes were preyed upon by several predators, viz., the common crow (*Corvus splendens* Vieillot), the red-vented bulbul (*Pycnonotus cafer* Linn.), small bats and dragon-flies ; on the ground they were preyed upon by the common myna (*Acridotheres tristis* Linn.).

The earlier account of swarming, as provided by Holmgran (1913, Bombay), is substantially different from that given above by Verma. Swarming was observed in Bombay on 12th November about sunset, 6.30 P.M. In a ground space of about 4-5 metres in diameter, winged imagoes were emerging from about 15-20 apparently freshly opened holes (each being circular and about 10-15 mm in diameter) and the whole area was teeming with these individuals, both sexes being present among them. (Earlier, there was no indication of the presence of a nest and the ground was smooth.) Workers were moving about in the area in all directions, but not a single soldier was present. Imago after imago emerged from these holes in close succession, and after running about on the ground for a very short time they flew away and disappeared. After about 45 minutes the emergence of imagoes ceased. The workers then returned to the holes and started closing them, but shortly before this the soldiers made their *first appearance* at the holes ; hitherto they were noted to be completely absent inspite of the most careful search. Many soldiers were now seen in every hole, lining the circular rim and protruding their heads just above the rim but without actually coming out fully. The workers wedged their way through these soldiers and gradually closed the holes with convex lids of earthy material ; soon all the holes were closed, the ground was smooth again and all signs of the presence of the nest were obliterated. It is difficult to say whether these difference in the details of swarming in Dehra Dun and Bombay are geographical or ecological in nature, until more observations from other areas become available.

The swarming time and season have been recorded by several workers, viz., Assmuth (1913), Holmgren (1913a), Annandale (1923), Silvestri (1923), Mathur and Sen-Sarma (1962) and Verma (1987). Swarming usually occurs at dusk (ca. 5.30 or 6.30 P.M.) onward depending upon location, and may last for two or three hours, sometimes the whole night until 7 A.M. the next morning. The swarming imagoes are attracted to light. According to Annandale (1923), on the Barkuda Is., Chilka Lake, Orissa, swarming occurs only in wet weather and probably does not begin until rain is actually falling, but the imagoes continue to issue forth from the swarming holes after rainfall has ceased. According to Verma (1987), in Dehra Dun, there was heavy rain on the day prior to swarming, but the swarming day itself was bright and clear.

Swarming probably occurs only once a year, but the swarming season seems to vary with the geographical location from early June to the last week of November, as follows, being rather late in the deep south and, curiously, as early as the first week of June in Orissa :—

Uttar Pradesh (Dehra Dun, Verma 1987) 22 August.

Orissa (Barkuda Is., Chilka Lake, Annandale 1923, Silvestri 1923) : June 2 to 13.

Maharashtra (Bombay and vicinity ; Assmuth 1913, Holmgren 1913a) According to Assmuth, it swarms “shortly after the close of the rainy season, usually in the last third of September” (p. 381) ; Holmgren records swarming from 22 October to 20 November.

Karnataka (Holmgren and Holmgren 1917, road between Mysore and Mercara) : 15 November.

Tamil Nadu (Holmgren and Holmgren 1917, Coimbatore) 11 October and 15 November.

4. *Inquinilism*

Closely associated with the nests of *O. feae* are some other species of termites ; these associations do not amount to true commensalism but are cases of *inquinilism* ; the associated species share the same habitation and it is possible in some cases to determine which is the host species and which the guest. (For a general discussion on *inquinilism* in termites, vide Noirot, 1970.)

Assmuth (1915) observed that with every nest of *O. feae* in Chota Nagpur (Bihar), where this species abounds, in garden, field or forest, colonies of *Microtermes obesi* (his "anandi" which is a junior synonym of *obesi*) were associated ; there was no exception. But in buildings where *O. feae* was found attacking the woodwork such as beams and rafters, such an association with *M. obesi* was altogether wanting. From examination of the feeding pattern of damaged parts and the mud fillings, Assmuth concluded that *O. feae* came first on the spot and served as a 'host' and *M. obesi* always came later, using the galleries and nesting space of the former.

In the Madhupur forest, Bangladesh, M. I. Chaudhry et al. (1972) found that three termite species (*Macrotermes serrulatus*, *Hypotermes xenotermitis* and *Microtermes pakistanicus*) were nesting in the mounds of *O. feae*.

Mathur and Sen-Sarma (1962) state that *M. obesi* (their "anandi") at Dehra Dun (U. P.), *Odontotermes faeoides* at Coorg (Karnataka) and *Macrotermes serrulatus* at Metkyina (Burma) have frequently been found in association with *O. feae*, but the nature of this association is not mentioned.

Verma (1986a) records that in a small log (of unknown species ; length 2 m diameter 0.5 m) lying on the floor of a sal forest (*Shorea robusta*) in the Rajaji Wild Life National Park (Saharanpur District, Uttar Pradesh), *O. feae* (his *O. "indicus"*) was living in close association with seven other species of termites, viz., *Coptotermes heimi*, *Heterotermes indicola*, *Microcerotermes beelsoni*, *Odontotermes assmuthi*, *O. distans*, *O. microdentatus* and *Microtermes obesi*. Verma (1986b) also records the association of *O. feae* with the following termite species in different parts of India, as follows :—(i) Bihar (Chaibasa) : with *Odontotermes guptai*. (ii) Himachal Pradesh (Nahan, Sirmour District) : with *Microtermes unicolor*. (iii) Maharashtra : with *Trinervitermes biformis*. In these latter cases the nature of the "association" is not clear. Such association may simply result from a concentration of species having similar ecological requirements for a favourable microclimate.

5. Economic Importance

Odontotermes feae is one of the most economically important termites of the Indian Region, especially as regards the destruction it causes to woodwork in buildings. In addition, it affects many

agricultural crops (wheat, sugarcane, etc.) in fields and orchards, forest trees, eucalyptus and plantation crops such as tea.

It also damages the bark and sapwood of several species of living trees, viz., *Aquillaria agallocha*, *Butea monosperma*, *Dalbergia latifolia*, *Dipterocarpus indicus*, *D. pilosus*, *D. turbinatus*, *Ficus* sp., *Garuga pinnata*, *Gmelina arborea*, *Grevillea* sp., *Mangifera indica*, *Madhuca longifolia* var. *latifolia*, *Pterocarpus marsupium*, *Shorea robusta*, *Syzygium cumini*, *Tectona grandis*, *Terminalia crenulata*, *T myriocarpa* and *Vitex altissima*. Several species of *Eucalyptus* (*E. cameldulensis*, *citriodora*, *rostrata* and *tereticornis*) are damaged as seedlings in nurseries and as young plants, especially by the ring-barking of the roots below the ground, resulting in the death of plants; the bark above the ground-level is also partly eaten up. (For more details, vide Assmuth 1913, 1915, Beeson 1941, Chatterjee et al. 1967, M. I. Chaudhry, Ahmad et al. 1972, Holmgren 1913a, Mathur and Sen-Sarma 1962, Nair and Varma 1985, Patel and Patel 1952, Peswani and Katiyar 1972, Roonwal 1970a, 1979, Roonwal and Chhotani 1961, 1967a, Sen-Sarma 1978, Sen-Sarma et al. 1975, Sen-Sarma and Thakur 1974, 1982 and Thakur and Sen-Sarma 1980.)

IV SUMMARY

1. *Odontotermes feae* (Wasmann) is an important wood-destroying termite in South Asia. Its identity is established, and *O. indicus* Thakur shown to be its junior synonym.

2. Taxonomic descriptions of its various castes (imagoes, soldiers and workers major and minor) are provided.

3. Its biology and economic importance are discussed. Its underground nest and its earthen mound (which it builds occasionally) are described. The swarming season and the time and method of swarming are described in detail. The occurrence of other inquiline termites is mentioned. Its economic importance as a wood-destroyer and as attacking crops is discussed.

V ACKNOWLEDGEMENTS

We are indebted to the following of persons for assistance in various ways :—To Dr. Pratap Singh for facilities to study the collections in the Entomology Branch of the Forest Research Institute, Dehra Dun. To Dr. O. B. Chhotani and Dr. P. K. Maiti (Zoological Survey of India, Calcutta) for supplying useful information about types, etc. To Dr. N. S. Rathore and Mrs. Nina Tak (Zoological Survey of India, Jodhpur) for assistance with some of the illustrations.

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PLATES

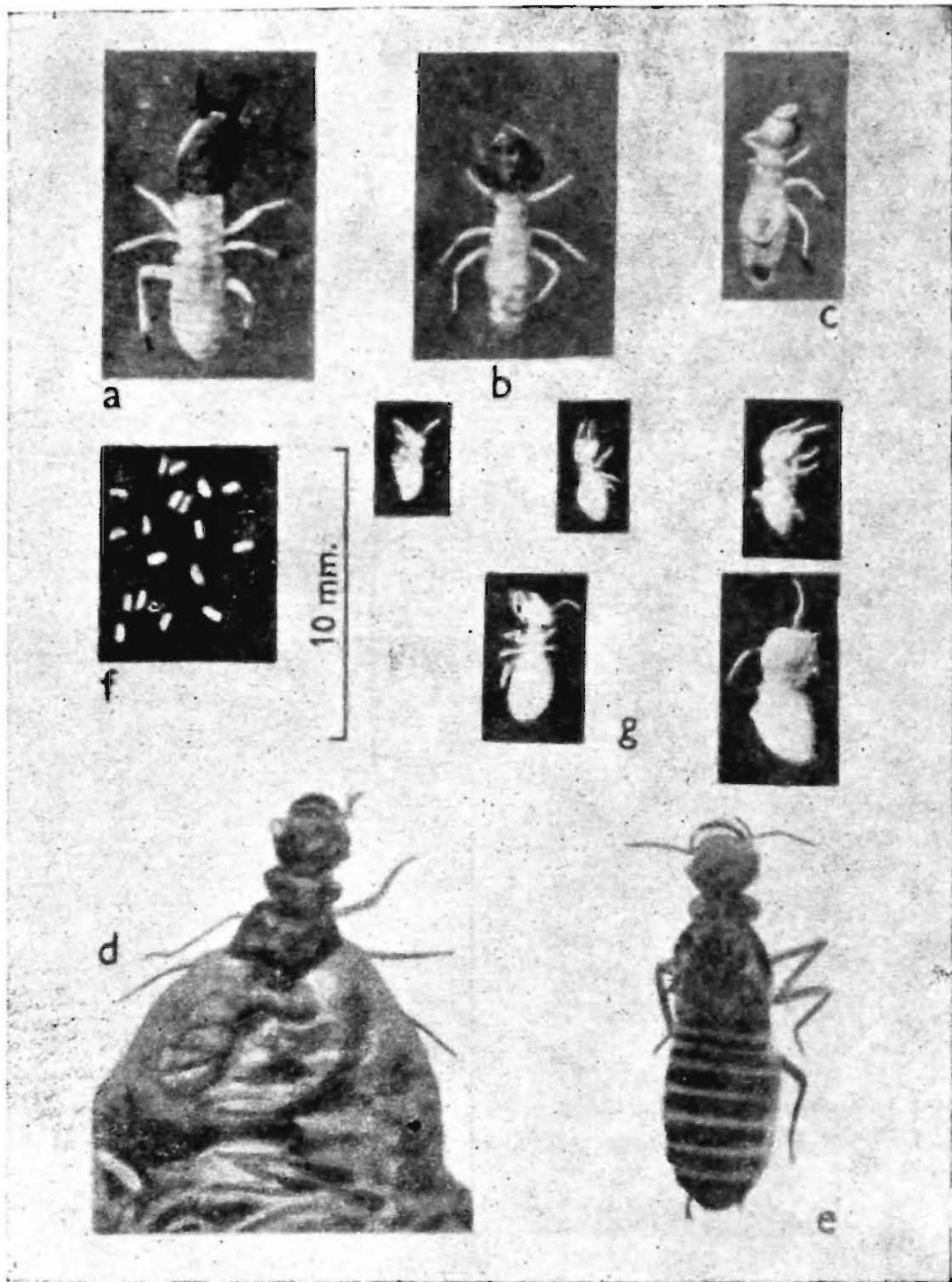


Plate 1. *Odontotermes feae*. Various castes (taken out from the mound shown in Pl. 2). Barkuda Island, Chilka Lake. (a) Soldier. (b) Worker major. (c) Worker minor. (d) Physogastric queen (only head and anterior part of abdomen shown). (e) King (dealated male). (f) Eggs. (g) Five nymphs in various stages of growth. (Ex Roonwal and Chhotani, 1966).

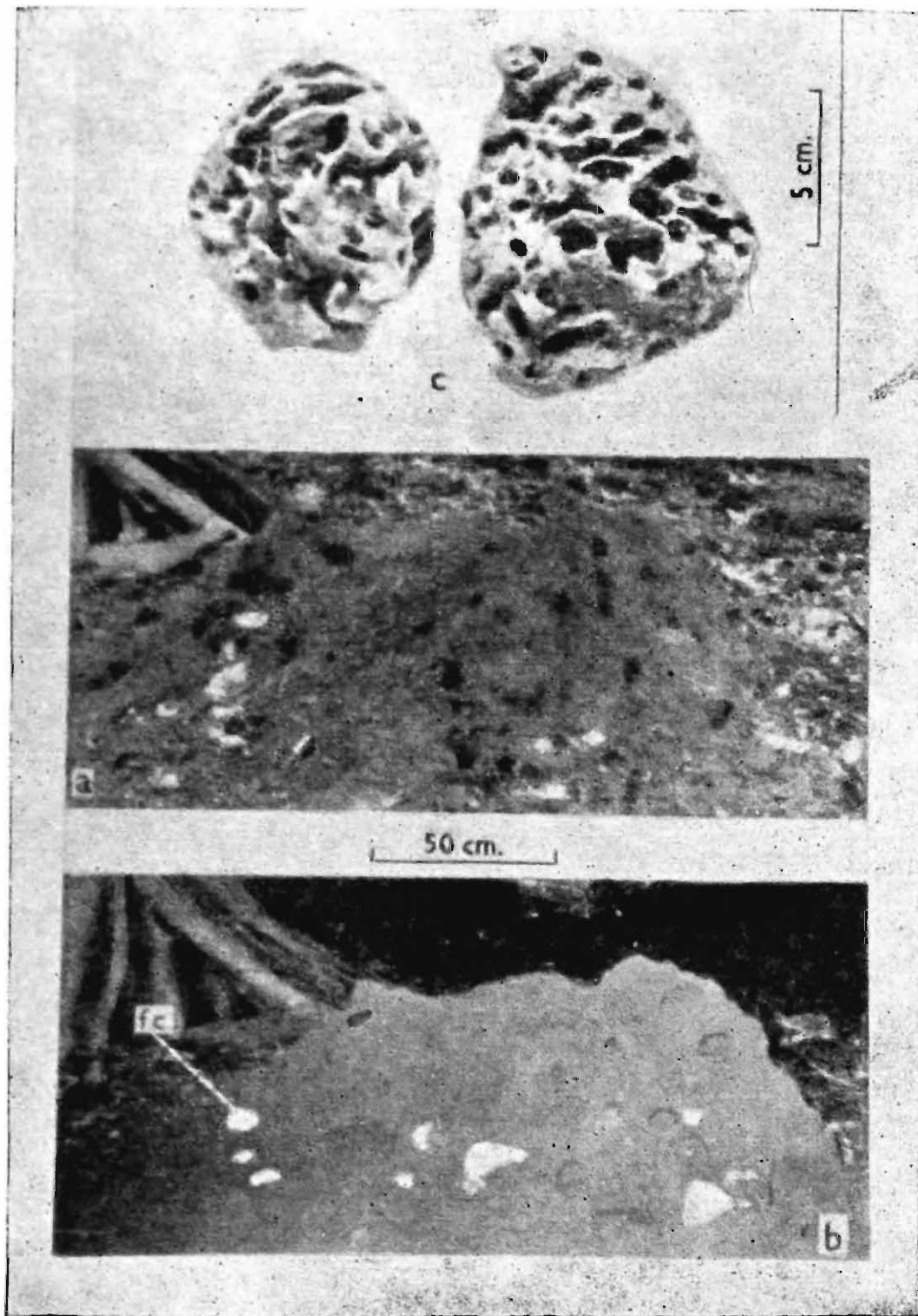


Plate 2. *Odontotermes feae*. Mound and fungus combs. Barkunda Island, Chilka Lake. (a) Mound, as seen from outside. (b) Same, in vertical section. (c) Two fungus combs. (Ex Roonwal and Chhotani, 1966.) f.c., fungus combs.