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THE HIMALAYAN TERMITE, *ARCHOTERMPOSIS WROUGHTONI* (SYNONYMS *RADCLIFFEI* AND *DEODARAE*). IDENTITY, DISTRIBUTION AND BIOLOGY

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(With 4 Tables, 41 Text-figures and 2 Plates)

INTRODUCTION

The family Termopsidae (by some regarded as a subfamily of the family Hodotermitidae) is a small and primitive family of Oriental and Nearctic termites with three living genera, viz., *Archotermopsis* Desneux, *Hodotermopsis* Holmgren and *Zootermopsis* Emerson. The first one alone occurs in the Indian Region where it is represented by a single living species, *A. wroughtoni*, confined to the North-West Himalayas. A fossil form, *A. tornquisti* von Rosen, occurs in Baltic Amber (Upper Eocene or Lower Oligocene) of Eastern Europe.

A. wroughtoni has been well studied as regards morphology, but its taxonomy and distribution have in recent years been confused by the claim of a supposedly new species (really a junior synonym). Its true identity and distribution are discussed in some detail, and its biology has been summarised.

Abbreviations used : Termite castes : Im., imago (alate), Ny., nymph ; S., soldier ; Pw., pseudoworker.

Genus **Archotermopsis** Desneux

1904. Subgenus *Archotermopsis* (of genus *Termopsis* Heer), Desneux, *Genera Insectorum*, Fasc. **25**, *Isoptera, Fam. Termitidae*, pp. 13-14 (Fig. 3, imago head).

1949. Genus *Archotermopsis*, Snyder, *Smithson. misc. Colls.*, Washington, **112**, pp. 56 ; and 361-362.

Type of genus (by monotypy) : *Archotermopsis wroughtoni* Desneux, 1904, Kashmir (N. India).

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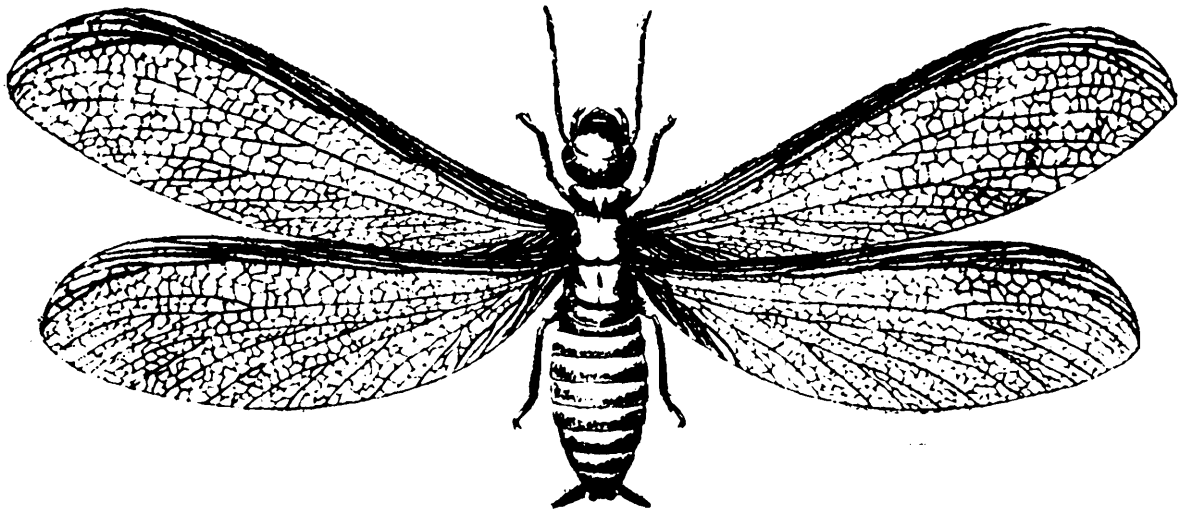
ROONWAL, BOSE & VERMA PLATE X



Archotermopsis wroughtoni. Imago, male. Bhowali. (Ex. Imms.).

ROONWAL, BOSE & VERMA PLATE XI

Archotermopsis wroughtoni Galleries excavated in dead log of deodar, *Cedrus deodara*. Right half, outer zone of sapwood. A pseudoworker and a soldier are also seen. (Ex. Imms.)

Systematic Account

Archotermopsis wroughtoni (Desneux)

(Text-figs. 1-41 ; Pls. X, XI)

(Syns. *radcliffei* Radcl. and *deodarae* Ch. & Th.)

1. *Synonymies, etc.*

1. Termopsis radcliffei Radcliffe

1904. (Sept.), Radcliffe, *Indian Forester*, **30** (9) : 412-414. Type-locality ; Kashmir (India).

2. Termopsis wroughtoni Desneux

1904a. (Feb. 15). Desneux, *J. Bombay nat. Hist. Soc.*, **15** : 445-446. Im., S. Type-locality : Kashmir Valley (India).

1904b. (Mar. 29). Desneux, *Annal. Soc. ent. Belge.*, **48** : 280-285. India.

1934. Margabandhu, *J. Bombay nat. Hist. Soc.*, **37** : 711. Kashmir (India).

3. Termopsis (Archotermopsis) wroughtoni Desneux

1904. (Nov. 15). Desneux, *Genera Insectorum* (*Isoptera*), Fasc. **25** : 13-14, Fig. 3, and Pl. 1, Fig. 3. N. India, including Kashmir.

1906. (Sept. 20). Desneux, *J. Bombay nat. Hist. Soc.*, **17** : 293-298. Fuller description.

1909. Lefroy, *Indian Insect Life*, **1** : 116, 119. Kashmir, India.

4. Archotermopsis wroughtoni (Desneux)

1911. Holmgren, *K. Sv. Vet. Acad. Handl.*, **46** (6) : 36, 2 pls. Im, S. and W. Kashmir, India.

1912. Fletcher, *Agric. J. India*, **7** (3) : 222-223.

1913. Holmgren, *K. Sv. Vet. Akad. Handl.*, **50** (2) : 31-32.

1919. Imms, *Philos. Trans. roy. Soc. Lond.*, (B) **209** : 75-180, 6 pls. Hazara and Kashmir in the west to Kumaon in the east (alt. ca. 4000-5000 ft.). Morphology and biology.

1920. Cutler, *Quart. J. micros. Sci.*, **64** : 383-412. Protozoa.

1920. de Mello, *Bull. Soc. Port. Sci. nat.* (Lisbon), **8** : 189-198. Protozoa.

1921. Cutler, *Quart. J. micros. Sci.*, **65** : 247-264. Protozoa.

1922. Hegh, *Les Termites*, 45-46. Kashmir, India.

1924. Cleaveland, *Biol. Bull.*, **44** : 191-193, Protozoa.

1941a. Beeson, *Indian Forest Rec.* (*Ent.*), **4** : 53.

1941b. Beeson, *Ecology and Control of Forest Insects of India, etc.*, Dehra Dun, : 539-540. (Reprint Ed. 1961, Delhi : 415-416.)

1949. Snyder, *Smithson. misc. Colls.*, **112** : 55. North India.

1953. Rattan Lal and Menon, *Catal. Indian Insects*, Pt. 27, *Isoptera* : 6-7.

1953. Roonwal and Pant, *Indian Forest Leaflet* (*Ent.*), No. 12 (Pt. 3) : 46. Himalayas and foothills (India).

1954. Choudhry, *Pakistan J. Forestry*, **4** : 31-32.

1955. Saleem, *Biologia* (Lahore), 2 (1) : 34-39. Murree Hills (Punjab, Pakistan). Protozoa.

1955. Ahmad, *Biologia* (Lahore), **1** : 208-210. Hazara Dist. (Pakistan) and Muzaffarabad Dist. (Kashmir, India).

1955. Weidner, in *Die Termiten* (Ed. Schmidt), : 37, 50. Kumaon to Kashmir.

1956. Roonwal, *J. zool. Soc. India*, **7** (1955) : 107-114 ; and in *Taxonomist's Glossary of Genitalia* (Ed. Tuxen) : 34-38. Genitalia.

1958. Bhasin, Roonwal and Singh, *Indian Forest Bull.* (*Ent.*) (N. S.), No. 171 (2) : 102.

1962. Mathur and Thapa, *Indian Forest Leaflet* (*Ent.*), No. 161 : 6.

1967. Chatterjee and Thakur, *Indian Forest Rec.* (N. S.) (*Ent.*), **11** (1) : 8-10.

1967. Harris, *Acta Mus. Morauise* (*Sci. nat.*), **52** (Suppl.) : 211, 214. E. Afghanistan.

1970. Roonwal, In *Biology of Termites* (Eds. Krishna and Weesner), Vol. 2 : 328-329.

1970. Roonwal and Bose, *Sci. and Cult.*, **36** : 673. Serrations on tibial spines and spurs.

1972. Choudhry and Ahmad, *Termites of Pakistan* (Final Technical P. L. 480 Report) : 9. NW Pakistan.

1973. Chhotani and Bose, *Zool. Anz.*, **190** : 233.

1974. Akhtar, *Pakistan J. Zool.*, **6** : 90-91.

1977. Chhotani, *Proc. 8th int. Congr. int. Un. Study soc. Ins.* : 116.

1978. Roonwal, *Mem. School of Entom.* (St. John's College, Agra), No. 6 : 102.

1980. Sen-Sarma and Thakur, *Indian Forest Rec.* (N. S.) (*Ent.*), **14** (1) : 7-8.

1981. Roonwal, *Proc. Indian natnl. Sci. Acad.*, (B) **47** (4) : 469-470. Microsculpture on wings.

1983a. Roonwal, *Zool. Anz.*, **211** : 138-139. Microsculpture on wings ; serrations on tibial spines and spurs.

1983b. Roonwal, *Proc. Indian natnl. Sci. Acad.*, (B) **49** : 377-378.

1984. Roonwal, *Mem. ent. Soc. India*, No. 9 : 11, etc., Abdomen and genitalia.

5. **Archotermopsis deodarae** Chatterjee and Thakur

1967. Chatterjee and Thakur, *Indian Forest Rec.* (N. S.) (*Ent.*), **11** (1) : 10-18, pl. 1, S. Pw. and imago nymph. Kashmir Valley (India). **(New synonymy.)**

2. *Material Examined*

1. *At the Forest Research Institute, Dehra Dun.*

(1) Sev. S., Bhowali (ca. 1746 m. alt., Kumaon Hills, U. P.), 15. viii.1913, ex. "Chir pine".

(2) Im., S., Pw., Bardyar (ca. 2440 m. alt.) (near Chakrata, Dehra Dun Dist. U. P.), 17.vi.1915.

(3) 1 S., 2 Pw., Kunain (near Chakrata, Dehra Dun Dist., U. P.), 10.v.1917, ex *Cedrus deodara*.

(4) 1 S., 1 Pw., Larabatach (near Chakrata, Dehra Dun Dist., U. P.), 2315 m. alt., 9.vi.1924.

(5) S., Pw., Tulu, Garhwal, U. P., x.1932, ex rotten *Pinus longifolia* stump.

(6) Im., S., Pw., Mundali (Chakrata Hills, U. P.), 14. iv. 1933, ex *Cedrus deodara* and *Abies* sp.

(7) Im., Pw., Airadeo (Almora Dist., U. P.) 27.v.1937, ex. *Pinus longifolia*.

(8) 1 S., deodar forest, Achabal, Anantang (Kashmir, India), 19. v.1962, ex rotton stumps of *Cedrus deodara*, Holotype of *A. deodarae* Ch. and Th.

(9) S., Pw. and Ny. Ditto. Paratypes of *A. deodarae* Ch. and Th.

2. *At the Indian Agricultural Research Institute, New Delhi.*

Five vials, Im. (alates), S. and Pw., Yusimarg (Kashmir, India), 2255 m alt., 1923, as follows :—

(1) 3 Im., 5.viii.1923. "at light". (2)—(5). Four vials, Im., S., Pw., 8 viii.1923, ex "in rotton log".

3. *At the Zoological Survey of India, Calcutta.*

(1) 1 S., 3 Im., 3 Pw., Yusimarg (ca. 33.30 N. lat., 74.25. E long.), 25 miles SW of Srinagar, Kashmir, India, 2000 m., 8 viii.1923, ex "in rotten long".

(2) 1 S., 1 Pw., Mundali near Chakrata (Dehra Dun Dist., U. P.), 14.iv.1933, ex *Abies* sp.

(3) 2 S., 4 Pw., Mundali, 16.iv.1933, ex *Cedrus deodara*.

(4) 1 Im., Manali (Kulu Valley, Himachal Pradesh), 6.vii.1956, "at light"

4. *At the Northern Regional Station, Zoological Survey of India, Dehra Dun.*

(1) 1 Im., sev. S. and Pw., Jharmala-Mari Road (2 km from Jharma Forest Rest House, Uttar Kashi Dist., U. P.), 10.vi.1981, ex. wood.

(2) 1 Im., 3 S., sev. Pw., Ditto, 11.vi.1981, ex. rotten wood.

(3) 1 Im., 15 S., sev. Pw., Ditto, 13.vi.1981, ex rotten pine stump.

(4) 2 Im., Kanatal (2350 m, Tehri Dist., U. P.), 24.vi.1981, ex swarm at light in heavy rain, 8 P.M.

5. *At the American Museum of Natural History, New York. (Formerly with Prof. A. E. Emerson, Chicago.)*

(1) 1 Im., 1 S., Kashmir Valley (India).

(2) 1 Im., Jhajra (Dehra Dun Dist., U. P., 843 m), 13.xi.1915.

(3) 1 S., 1 Ny., Bardyar (near Chakrata, Dehra Dun Dist., U. P.), 2400 m, 17. v.1915.

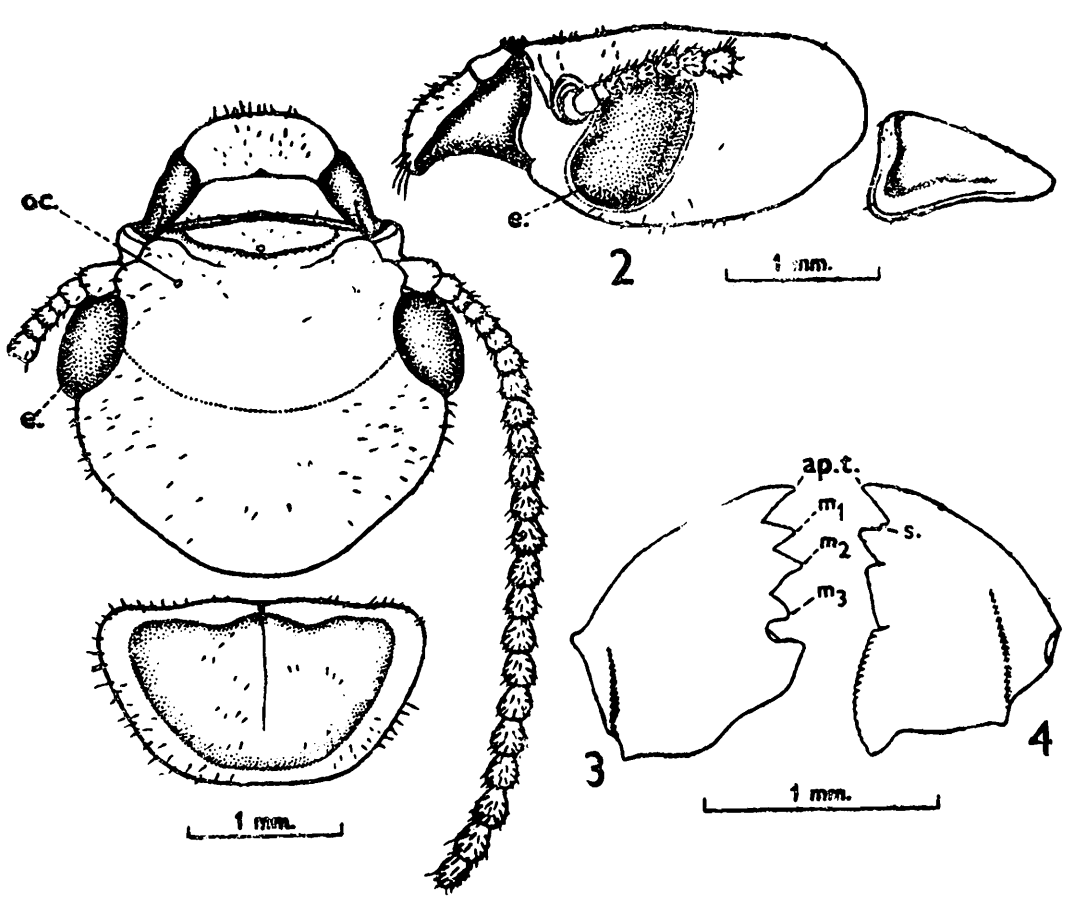
(4) 1 Im., 2 S., sev. Ny., Ditto.

(5) 1 Im. (dealate), 1 S., sev. Ny., Chakrata (Dehra Dun Dist., U. P.), 2500 m, 26.iv.1933.

3. *Description of Species*

1. IMAGO (Table 1 ; Text-figs. 1-13 and 20-23 ; and Pl. 1)

Head reddish brown to pale brown ; anteclypeus hyaline ; postclypeus and mandibles dark brown ; labrum, antennae, thoracic terga,



Text-figs. 1-4. *Archotermopsis wroughtoni.* Imago.

1. Head and pronotum, in dorsal view. 2. Same, in side view. 3. Left mandible. 4. Right mandible.

ap. t., apical tooth ; oc., ocellus ; e., eye ; ml—m3, first to third marginal teeth ; s. subsidiary tooth.

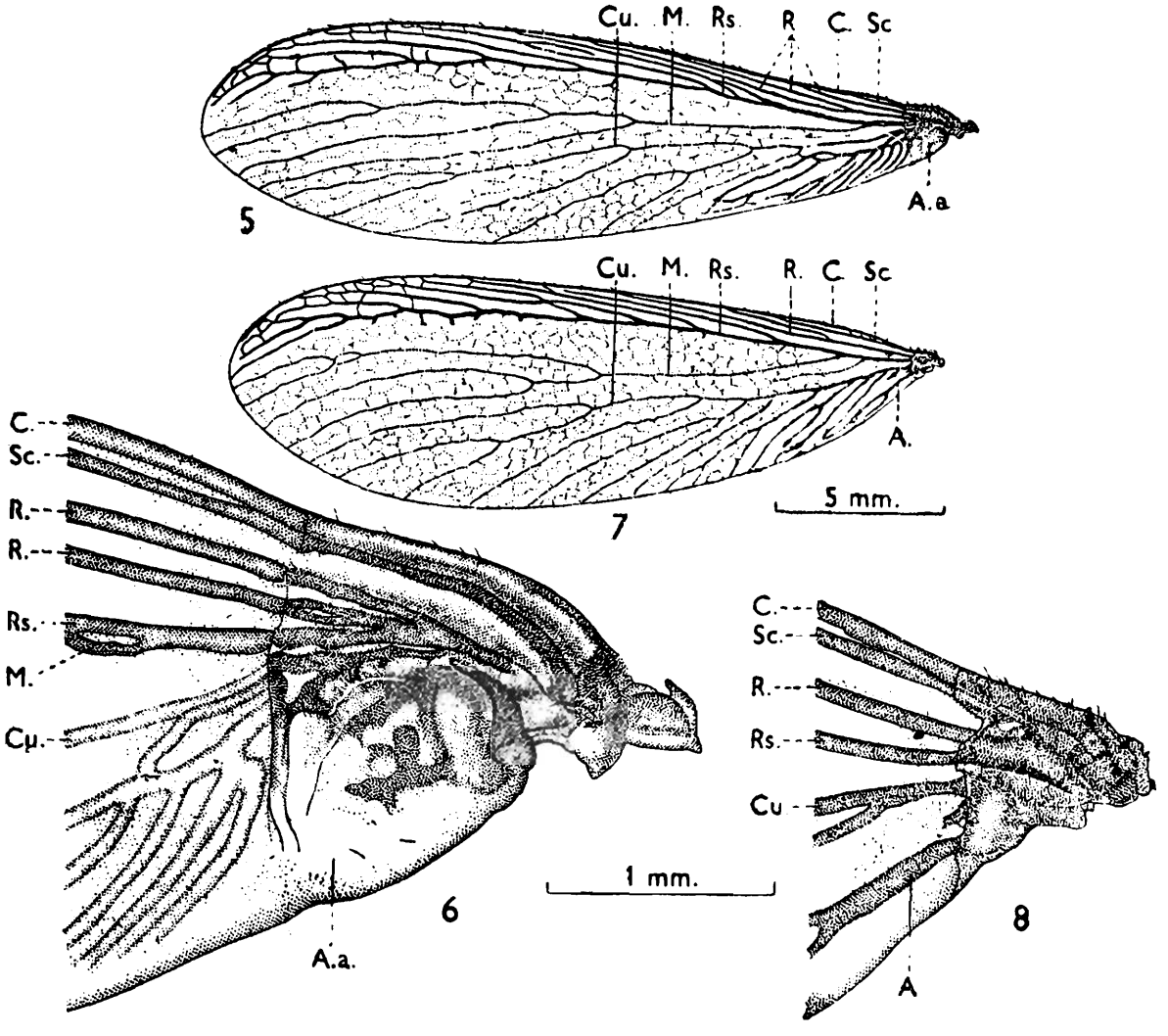
legs, wings and abdomen pale golden yellow ; wing veins darker. Head and body moderately pilose. Total body-length with wings 23.6-26.0, without wings 10.7-14.0 mm. Head-capsule subcircular, a little broader than long (maximum width 2.25-2.70 mm, head-length to base of mandibles 1.88-2.40 mm), broadest at level of eyes, whence curving to a rounded posterior margin ; a faint semicircular suture-like line present on head-dorsum between eyes, dividing the head into almost

TABLE 1. *Archotermopsis wroughtoni*. Measurements of imago.

Body-parts		Range (mm)
1. Total body-length with wings	...	23.6 — 26.0
2. Total body-length without wings	...	10.7 — 14.0
3. Length of head to lateral base of mandibles	...	1.88 — 2.40
4. Maximum width of head (with eyes)	...	2.25 — 2.70
5. Maximum height of head	...	1.20 — 1.35
6. Maximum length of labrum	...	0.50 — 0.75
7. Maximum width of labrum	...	0.83 — 1.05
8. Maximum diameter of eyes (with ocular sclerite)	...	0.85 — 1.10
9. Minimum diameter of eyes (with ocular sclerite)	...	0.57 — 0.77
10. Minimum eye-antennal distance	...	0.08 — 0.13
11. Maximum length of pronotum	...	0.97 — 1.22
12. Maximum width of pronotum	...	1.80 — 2.22
13. Length of forewing with scale	...	20.50 — 22.50
14. Length of forewing scale	...	1.00 — 1.70
15. Length of hindwing with scale	...	18.80 — 20.50
16. Length of hindwing scale	...	0.75 — 1.20

equal anterior and posterior halves. Fontanelle absent Eyes large, subreniform, anterior margin shallowly incurved, posterior margin substraight. Ocelli as indistinct spots on head-dorsum. Antennae with 19-25 segments ; 1 longest ; 2 about half of 1 ; 3 shortest ; 4 to last progressively increasing in length. Anteclypeus hyaline, subtrapezoidal, apilose ; anterior margin straight with a slight median projection. Postclypeus narrow, a little depressed ; not well differentiated from frons ; with a few short, bristle-like haris near anterior margin. Labrum large, subquadrangular, much broader than long, with rounded, slightly bulging sides ; with a few long haris at anterior margin and short ones on body. Left mandible with a long, finger-liks apical and 3 marginal teeth ; 1st marginal shorter than apical, also finger-like ; 2nd subequal to 1st and subtriangular ; 3rd shortest and directed backwards. Right mandible with a finger-like apical and 2 well developed marginal teeth and, in addition, a small subsidiary tooth at the front end of the first marginal ; molar plate striated and forming about half of

toothed margin of mandible. Pronotum subtrapezoidal, flat, narrower than head, much broader than long ; anterior margin weakly convex, with a weak median notch ; anterior angles broadly rounded ; sides curving to a substraight posterior margin without a median notch ; with a row of hairs on margins and a few shorter ones on body. Mesonotum suboval, a little broader than long ; broader than pronotum. Metanotum suboval, as broad as mesontum. Wings covered on the both upper and lower surface with microscopic, cuticular, distally directed papillae (size 6-8 μm$\times$4-6 μm) ; 4-5 such rows of thorny papillae present on the anterior margin and single rows of rounded to subscrescentic ones on the larger veins (Text-fig. 10) (vide Roonwal 1981, 1983b). Forewing ca. 22.5 mm long. Membrane covered with an irregular reticulum of fine cross-veins, forming cells. Basal scale large, separated from rest of wing by an incomplete suture ; roots of all principal veins lying inside scale. Costa (C) arising at base of scale

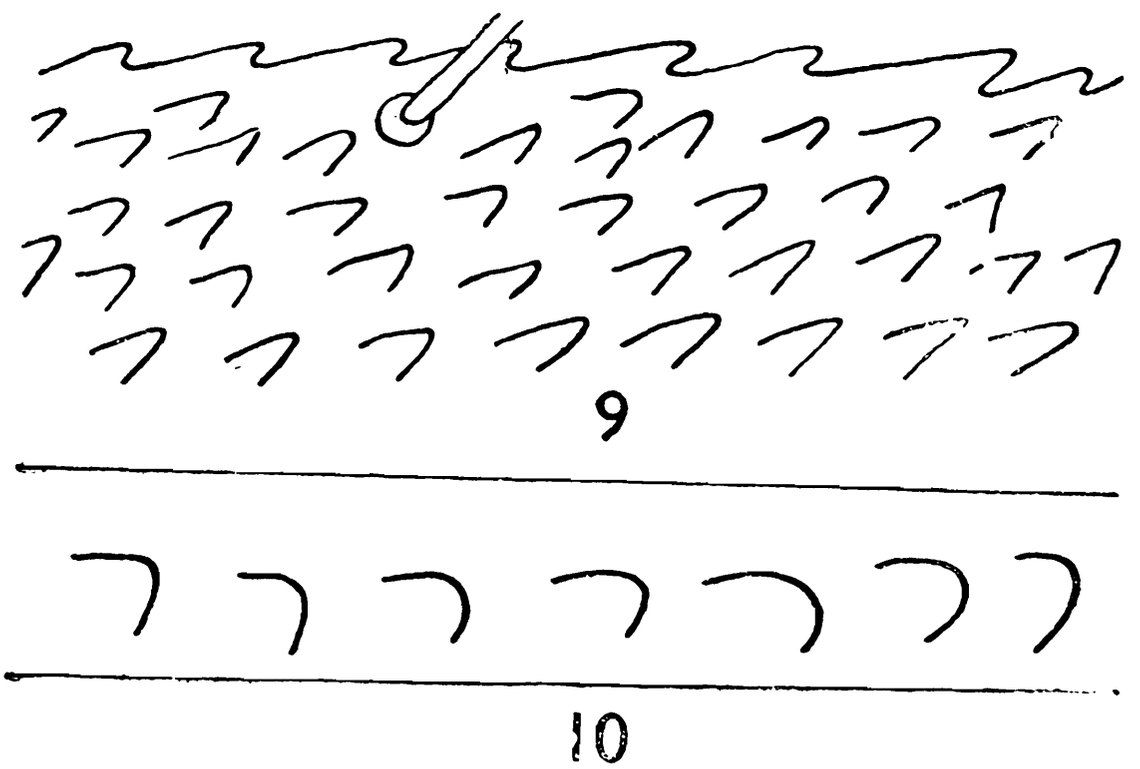


Text-figs. 5-8. *Archotermopsis wroughtoni*. Wings.

5. Left forewing. 6. Same, basal scale, enlarged. 7. Left hindwing.
8. Same, basal scale enlarged.

A., anal ; A. a., anal area ; C., costa ; Cu., cubitus : M., media ; R., radius ; Rs., radial sector ; Sc., subcosta.

and running all along anterior margin. Subcostata (Sc) short and quickly joining the costa. Radius (R) and radial sector (Rs) arising jointly inside scale and separating inside scale. R dividing inside scale into two main branches (R1, R2) ; R1 quickly joining the costa ; R2 dividing into two branches which run to costal border before middle of wing. Rs. with 5-6 prominent branches, some with interconnecting, oblique cross-veins and loops. Media (M) thin, hyaline, arising jointly with Rs, separating just outside the scale and branching into 6-7 branches running to distal margin of wing. Cubitus (Cu) with 6 branches running to posterior margin of wing. Anal area



Text-figs. 9-10. *Archotermopsis wroughtoni*. Parts of dorsal surface of forewing, to show microsculpturing by cuticular papillae. ,Greatly enlarged. 9. Anterior margin of wing. Thorny papillae in several rows. 10. Lower down, part of a vein ; papillae becoming more rounded, almost subcrescentic.

small ; vein (A) absent. Hindwings 20.5 mm long. Reticulated as in forewing. Scale small and with incomplete suture. Main veins arising, as in forewing, within the scale. C and Sc almost as in forewing. R and Rs arising jointly within scale and dividing into two at the scale margin. R dividing in two branches which meet the costal border before middle of wing. Rs dividing outside scale into 7-8 branches running to costal border of distal marging of wing, the branches, in turn, giving off smaller branches with intercalated veinlets and loops. M thin, hyaline, arising outside scale from Rs and dividing into 4 branches. Cu arising independently inside scale and giving off 13-14 branches to the lower margin of wing. Anal arising independently inside scale

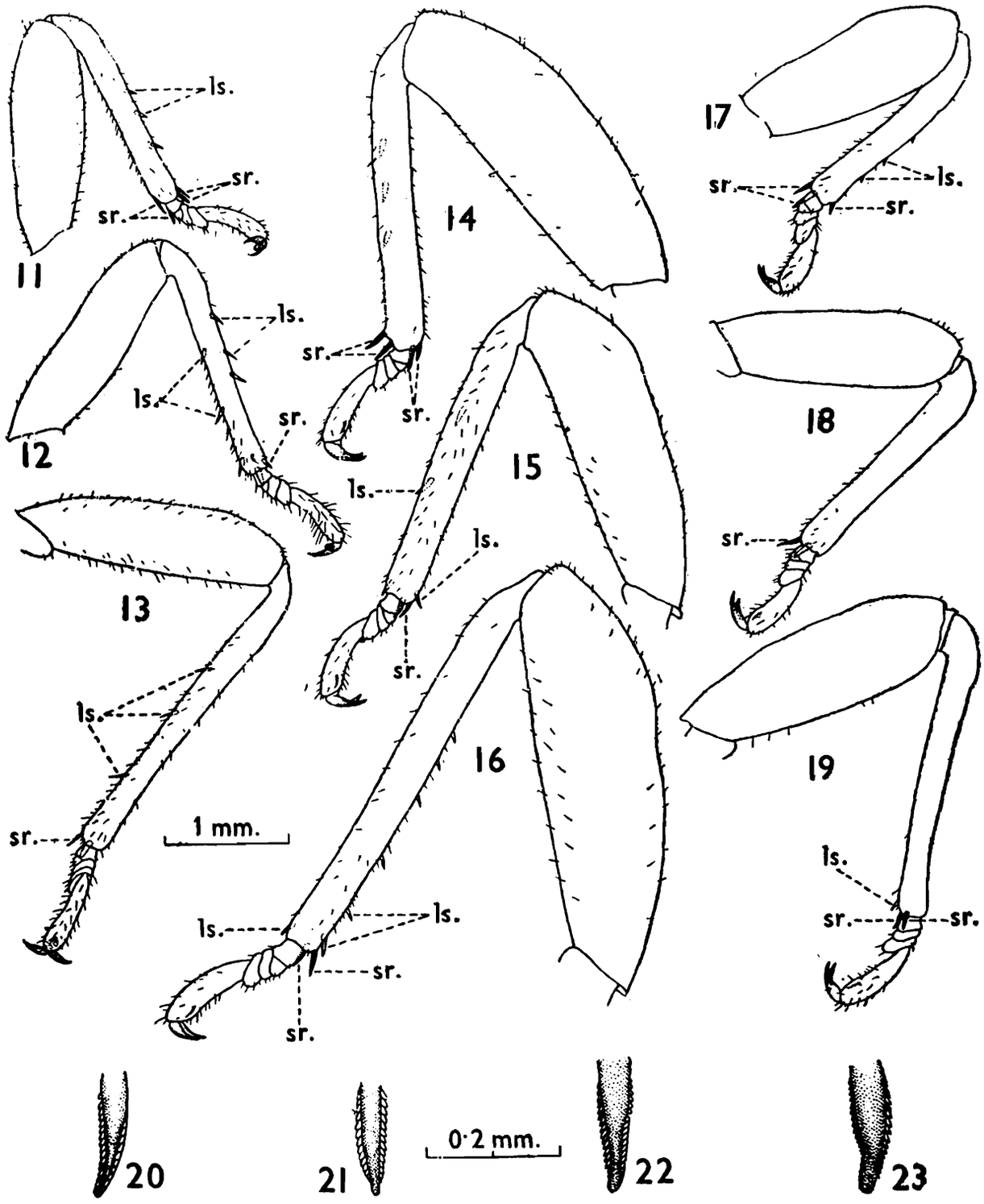
and present as a small 2-branched vein near wing base. Legs Long, stout, lightly pilose. Tarsi imperfectly 5- segmented (4 visible above, 5 below) ; with pulvilli ; arolium present between claws. Fore tibia with 3-4 spines on outer margin and 4 apical spurs ; middle tibia with 2-4 spines on inner margin, 1-3 spines on outer margin and 3-4 apical spurs ; hind tibia with 4-6 spines on inner margin and 2 apical spurs. Apical tibial spur formula thus variable. 4 : 3-4 : 2. Outer and inner edges of apical spurs and larger tibial spines bear several microscopic (size 27-54 μm × 18-54 μm), lamellar, cuticular papillae (26—36 on a spur) (Roonwal and Bose 1970, Roonwal 1983a, and in press). Abdomen oval, elongate, moderately hairy. Cerci (on 10th sternum) long, 6- to 8-jointed ; length 1.00-1.48 mm. Styli (on 9th sternum) in male, one-jointed, ca. 0.40-0.58 mm long, extending beyond tip of abdomen ; absent in female. Sternum 7 enlarged in female and covering 8 and 9 ; narrower in male (vide Roonwal 1984).

2. SOLDIER (Table 2 ; and Text-figs. 14-15 and 24-31)

Head anteriorly deep reddish brown, posterior part of head, pronotum and legs paler ; labrum pale yellowish to creamish brown,

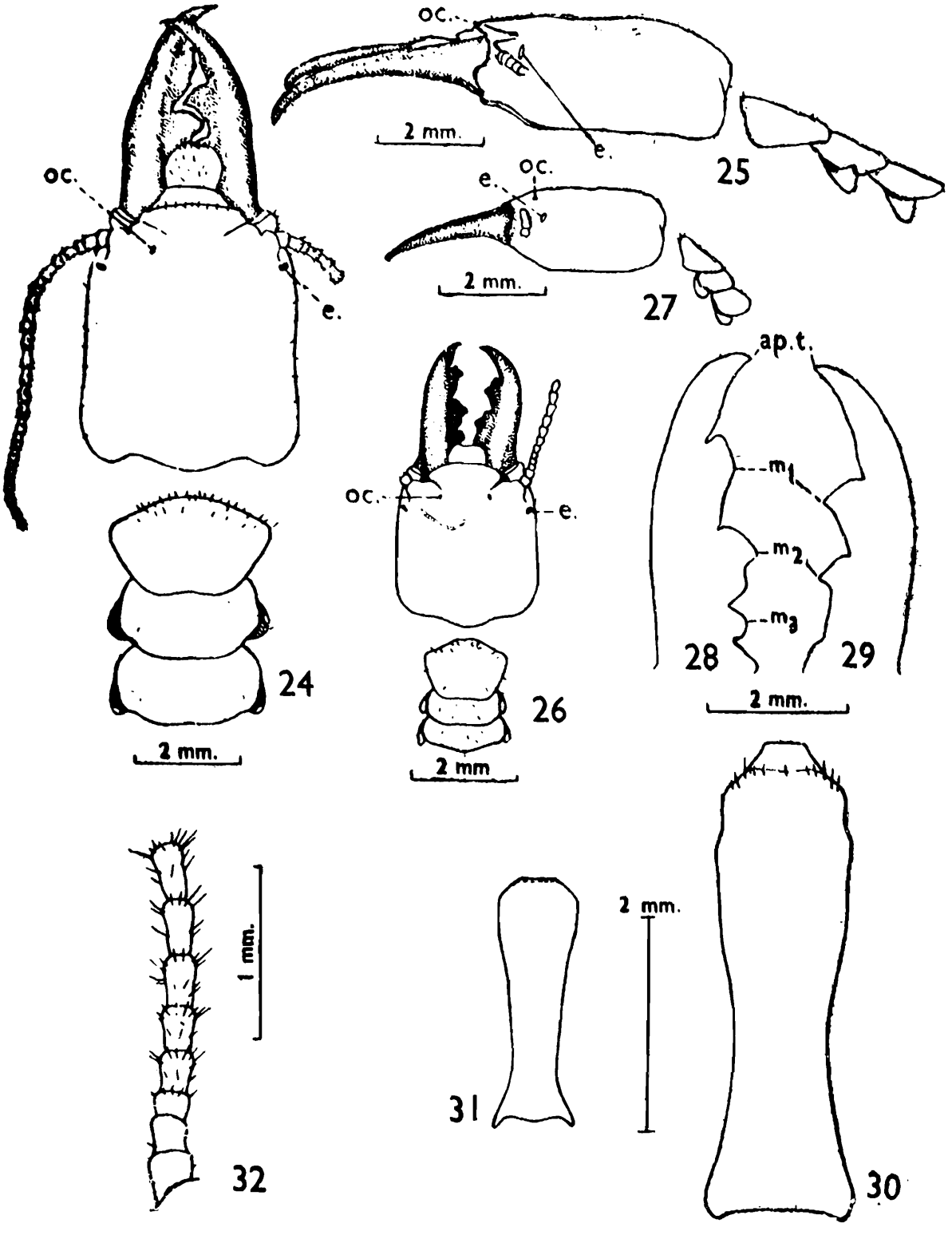
TABLE 2. *Archotermopsis wroughtoni*. Measurements of soldier.

	Body-parts		Range (mm)
1.	Total body-length	...	11.4 — 21.1
2.	Length of head with mandibles	...	6.37 — 7.00
3.	Length of head to lateral base of mandibles	...	2.80 — 5.20
4.	Maximum width of head	...	2.55 — 4.60
5.	Width of head-capsule at anterior end	...	2.10 — 3.90
6.	Maximum height of head	...	1.43 — 2.15
7.	Head Index I (Width/Length)	...	0.85 — 0.95
8.	Head Index II (Height/Width)	...	0.45 — 0.56
9.	Head Index III (Height/Length)	...	0.41 — 0.51
10.	Maximum length of labrum	...	0.33 — 0.80
11.	Maximum width of labrum	...	0.63 — 1.10
12.	Length of mandibles from upper base of condyle to tip :		
	Left mandible	...	2.10 — 4.80
	Right mandible ...	...	2.20 — 4.40
13.	Minimum median length of postementum	...	2.23 — 4.43
14.	Maximum width of postementum	...	0.70 — 1.20
15.	Width of postementum at waist	...	0.43 — 1.00
16.	Maximum length of pronotum	...	0.95 — 1.95
17.	Maximum width of pronotum	...	1.53 — 3.03
18.	Pronotum-Head Index (Pronotum-width/Head-width)	...	0.60 — 0.70
19.	Pronotum Index (Length/Width)	...	0.59 — 0.70



Figs. 11-23. *Archotermopsis wroughtoni*. Legs of imago, soldier and pseudoworker. 11-13. Fore, middle and hind legs respectively of imago. 14-16. Fore, middle and hind legs respectively of soldier. 17-19. Fore, middle and hind legs respectively of pseudoworker. 20-23. Apical tibial spurs of fore leg of imago, greatly enlarged to show the marginal serrations (papillae).
ls., lateral spine of tibia ; sr., apical tibial spurs.

anteclypeus paler ; mandibles blakish red ; antennae reddish brown proximally, paler distally ; rest of thorax and body pale creamish yellow. Head and body sparsely pilose ; total length with mandibles ca. 11.4-21.1 mm. There is an enormous degree of size variation, but



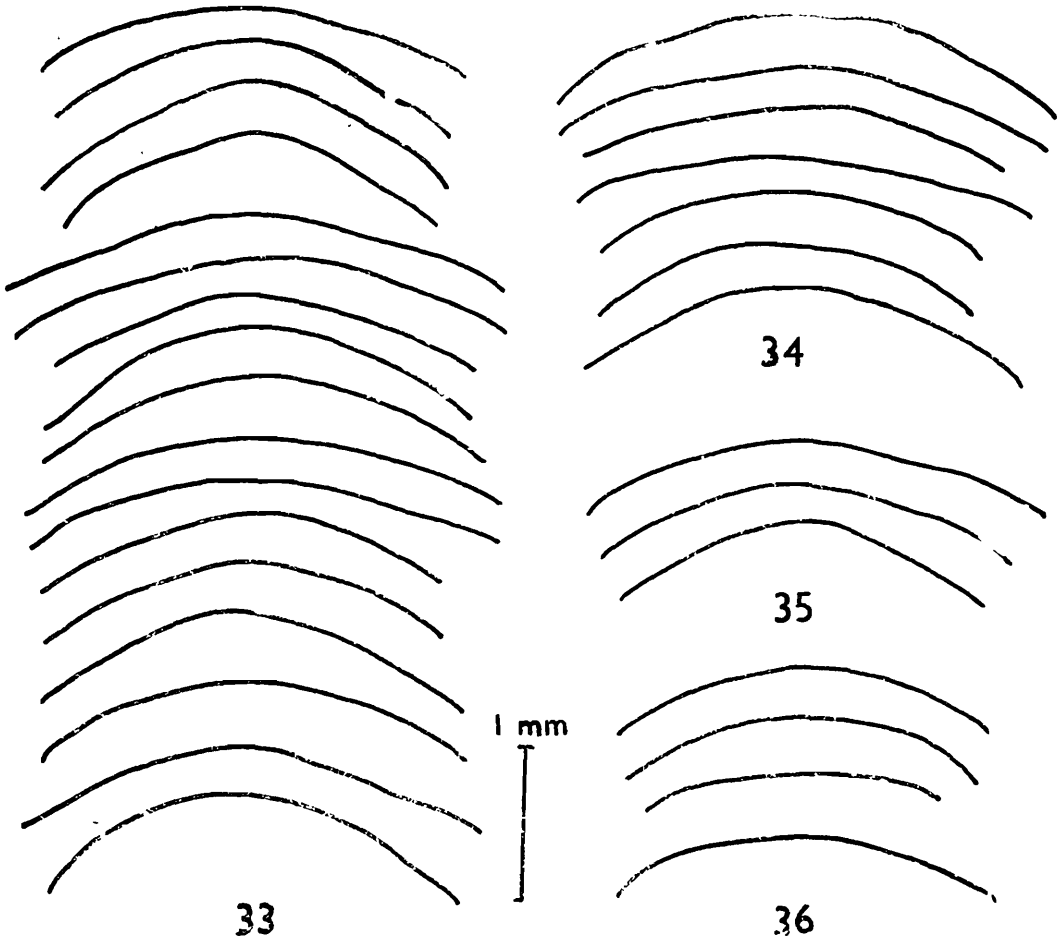
Text-figs. 24-32. *Archotermopsis wroughtoni*, Soldier, large and small (there is a graded size series, and no separation into major and minor soldiers is possible). 24. Head and thorax of large soldier, in dorsal view ; note the pleural processes of meso- and metanota. 25. Same, in side view. 26. Same, small soldier, in dorsal view. 27. Same, in side view. 28. Left mandible of large soldier. 29. Same, right mandible. 30. Postmentum of large soldier, in ventral view. 31. Same, of small soldier. 32. Basal part of antenna of large soldier. ap. t., apical tooth of mandible ; e., eye ; m1—m3, first to third marginal teeth of mandible ; oc., ocellus.

there is a graded series and no separation into major and minor soldiers is possible. Head-capsule subsquarish, a little longer than broad (head-length to base of mandibles 2.80-5.20 mm ; maximum head-width 2.55-4.60 mm) ; slightly narrowing anteriorly, broader posteriorly ; posterior margin with a pair of shallow depressions. Fontanelle absent. Eyes present as a pair of small, lateral, brown patches just below base of antennae. Ocelli present as a pair of small, whitish spots on head-dorsum in level of antennae. Antannae with 22-27 segments ; 1 longest ; 2 about half of 1 ; 3 shortest ; 4 longer than 3, subequal to 5 ; 6 longer than 5, shorter than 7, or 6-12 subequal and longer than 5 ; 13 to the last gradually decreasing in size. Anteclypeus narrow, trapezoidal, apilose ; much broader than long. Postclypeus not clearly differentiated from frons, somewhat depressed, with a few very short hairs on anterior margin and on body. Labrum subsquarish ; sides swollen ; broader than long ; broadest in middle (maximum length 0.33-0.80 mm ; maximum width 0.63-1.10 mm) ; anterior margin with a shallow, median incurving ; with several short, bristle-like hairs at tip and on body. Mandibles long and stout, basally broad, distally strongly incurved and pointed. Right mandible with an apical and 2 marginal teeth on inner margin ; apical long, incurved, pointed and finger-like ; 1st marginal small, blunt and pointed upwards, with a curved, elongated posterior margin ; 2nd larger and more pointed laterally. Left mandible with an apical and 3 marginal teeth ; apical long, incurved pointed and finger-like ; 1st marginal large and pointed laterally ; 2nd also large and pointed laterally ; 3rd present as a small tooth at the beginning of the molar plate. Postmentum long, narrow and with a gentle waist below the middle (median length 2.23-4.43 mm, maximum width 0.70-1.20 mm) ; with a few hairs near anterior end, the latter projecting as a short, blunt, hyaline tip ; anterior margin straight ; posterior angles rounded ; posterior margin weakly concave. Pronotum flat, with sides slightly sloping downwards, rhomboidal, much broader than long (maximum width 1.53-3.03 mm, maximum length 0.95-1.95 mm) ; sides converging towards posterior margin ; anterior margin substraight to covvex, without a median notch ; posterior margin substraight, with a weak median notch ; a few hairs present around margins and on body. Mesonotum suboval, much broader than long ; broader than pronotum ; margin with a weak median incurving ; sparesely pilose. Below both meso- and metanota the pleura expanded laterally to form small, subtriangular flaps (the epimera). Legs long, stout, pilose ; tibial spines almost as long as spurs ; tarsi with 5 imperfect segments as in imago. Fore tibia with 3-5 spines on inner margin and 3-4 apical spurs ; middle tibia with 1-3 spines on

inner margin, 2-4 spines on outer margin and 2-3 apical spurs ; hind tibia with 2-6 spines on inner margin and 2 apical spurs. Apical tibial spur formula variable, thus : 3-4 : 2-3 : 2. Outer and inner edges of spurs and larger spines bear several microscopic (size smaller than in imagoes) papillae (12-13 on a spur). Abdomen oblong, sparsely pilose. Cerci (on 10th sterum), ca. 1.85-2.40 mm long, with 6-7 joints. Styli (on 9th sternum), one-jointed, ca. 0.53-0.93 mm long ; present in both sexes. Sexes separable ; in female sternum 7 enlarged and covers 8 ; normal in male.

3. PSEUDOWORKER (Table 3 ; and Text-figs. 17-19 and 39-40)

Posterior part of head and mandibles deep creamish yellow ; mandibular teeth darker ; anterior part of head, labrum, thorax and legs



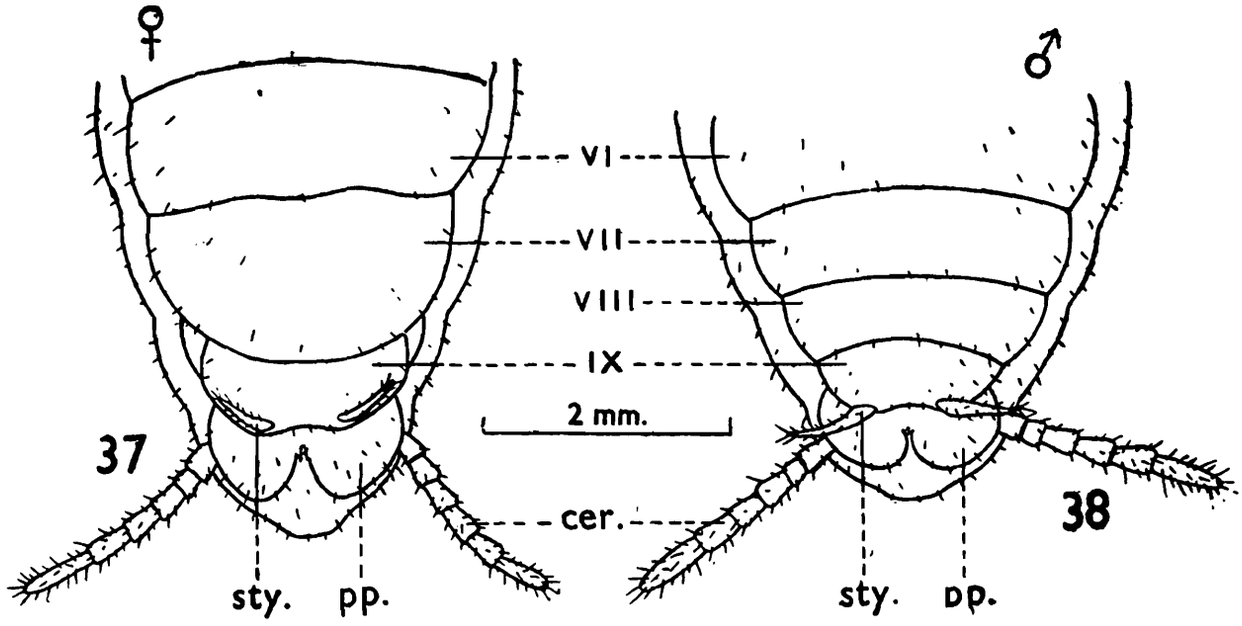
Text-figs. 33-36. *Archotermopsis wroughtoni*, soldier. Anterior margins of pronotum of soldiers from various populations. 33. Jharmala Dhar (Dist. Uttar Kashi, U. P.). 34. Mundali (near Chakrata, U. P.). 35. Bardyar (near Chakrata, U. P.). 36. Achhabal (Anantang, J. & K.) (*A. deodarae* Ch. & Th.).

paler ; antennae pale creamish yellow ; anteclypeus whitish, hyaline ; abdomen pale creamish white. Head and body sparsely pilose. Total length ca. 7.8-13.1 mm. Head-capsule subquadrate, much broader than

TABLE 3. *Archotermopsis wroughtoni*. Measurements of pseudoworker

Body-parts		Range (mm)
1. Total body-length	...	7.8 — 13.1
2. Length of head to tip of labrum	...	1.95 — 3.25
3. Length of head to lateral base of mandibles	...	1.45 — 2.38
4. Maximum width of head	...	1.70 — 2.60
5. Maximum height of head	...	0.90 — 1.40
6. Maximum length of labrum	...	0.43 — 0.68
7. Maximum width of labrum	...	0.60 — 1.10
8. Maximum length of pronotum	...	0.63 — 1.15
9. Maximum width of pronotum	...	1.45 — 1.90

long (maximum width 1.70-2.60 mm) ; length to lateral base of mandibles 1.45-2.38 mm) ; sides slightly converging ateriorly ; posteriorly rounded ; posterior margin with a weak median bulge. Fontanelle absent. Eyes present as a pair of small, lateral, brownish patches below



Text-figs. 37-38. *Archotermopsis wroughtoni*, soldider : Ventral views of hind end of abdomen. 37. Female (7th sternum enlarged). 38. Male.
cer., cerci ; pp., paraproct ; sty., styli. VI—IX., 6th-9th sterna.

antennal sockets. Ocelli absent. Antennae with 19-23 segments ; 1 longest, 2 a little longer than half of 1 ; 3-4 or 6 short, subequal ; from 5 or 7 gradually increasing in size to the ovate, apical segment. Mandibles as in imago, except that the teeth are somewhat shorter and more blunt. Pronotum broader than long and narrower than head (maximum length 0.63-1.15 mm; maximum width 1.20-1.90 mm); anteriorly and laterally somewhat upturned and weakly saddle-shaped ; anterior margin weakly convex, with a weak median notch ; posterior margin substraight, with a shallow medial depression ; sides substraight and strongly

narrowing posteriorly. Meso- and metanotum as in soldier ; below both these the pleura giving out small, subtriangular flaps (the epimera). Legs long, sparsely pilose ; apical tibial spur formula variable, thus : 4 : 2-3 : 2. Outer and inner edges of spurs and larger spines bear some microscopic, cuticular papille, smaller and fewer (4-5 on a spur) than in soldiers. Abdomen broadly elongate. Cerci 5- to 7-jointed, ca. 0.85-1.25 mm long. Styli short, one-jointed, ca. 0.63-0.70 mm long. Sexes separable ; sternum 7 enlarged in female ; smaller in male.

4. *Taxonomic Remarks*

A. wroughtoni has date priority over *radcliffei*. *A. deodarae* has been separated from *wroughtoni* (in soldiers) on minor and inconsequential characters all of which fall well within the range of the latter. The supposed differences in the anterior margin of soldier pronotum (misprinted as "interior" in Chatterjee and Thakur, 1967) (with a weak depression in *deodarae*, vs. convex) do not hold good and there is a wide range even in local populations (Text-gs. 33-36).

5. *Geographical Distribution* (Table 4 ; and Text-fig. 41)

Oriental (temperate region), just entering the Palaearctic (eastern Afghanistan). North-West Himalayas in India, northern Pakistan and eastern Afghanistan. Associated with coniferous forests ; at ca. 900-3000 m attitude above m.s.l., mostly above 1250 m. Details are as follows :

TABLE 4. List of known localities of *Archotermopsis wroughtoni*.

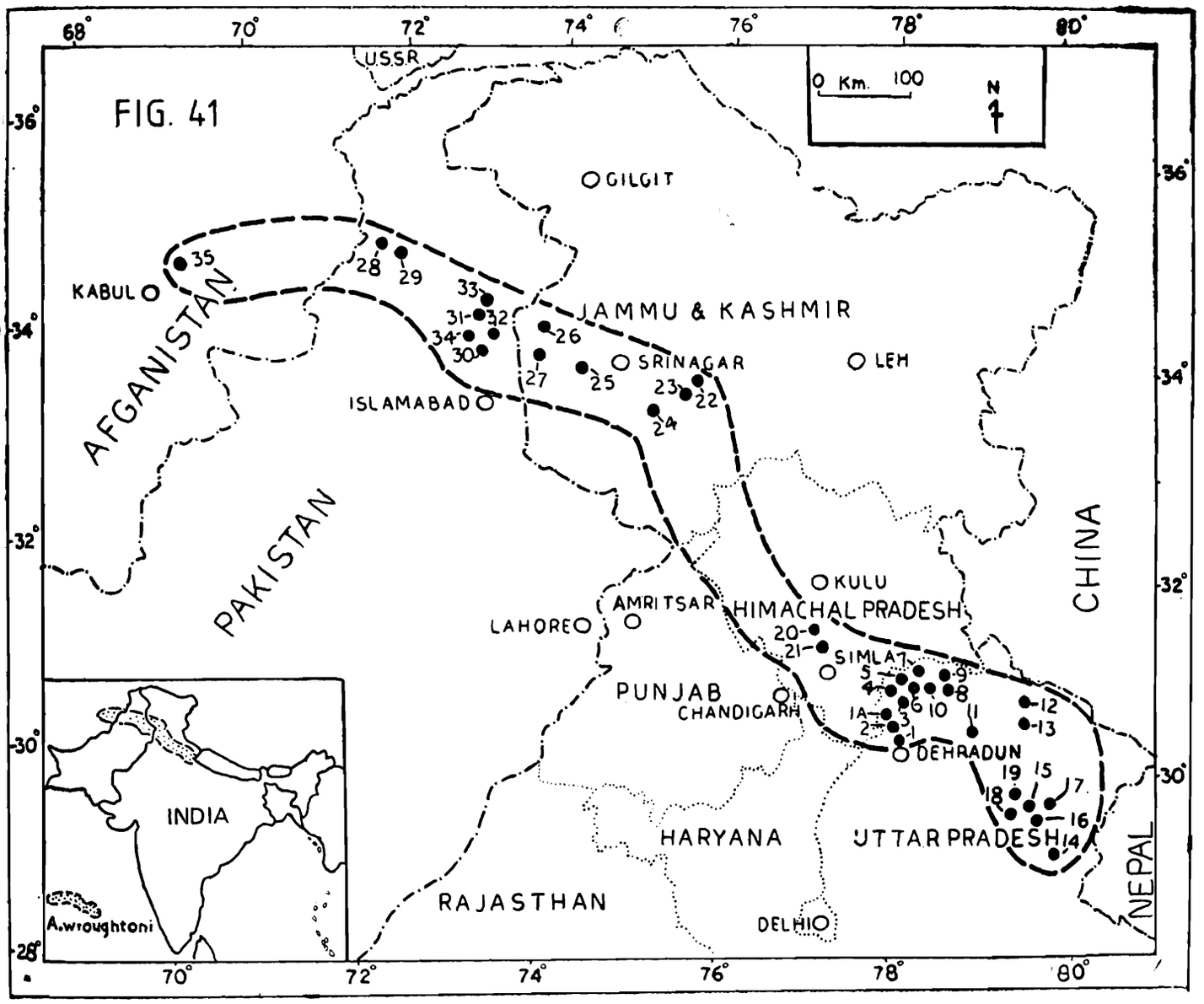
Country/State	District	Approx. latitude (N)	Approx. longitude (E)	Approx. altitude (metres)
1	2	3	4	5
		(A) INDIA		
		(a) *Uttar Pradesh*		
1. Jhajra	Dehra Dun	30.19	78.02	900
1a. Bardyar (not Bodyar)	„	30.43	77.51	2440
2. Chakrata	„	30.42	77.52	2200
3. Deoban	„	30.45	77.52	2800
4. Kanasar	„	30.47	77.50	2150
5. Kunain	„	30.48	77.53	2300
6. Mundali	„	30.50	77.57	2600
7. Nada	„	30.48	78.02	1600

TABLE 4 (*Concluded*)

1	2	3	4	5
8. Jharmala-Dhar	Uttar Kashi	30.58	78.05	1940
9. 2 km. from Jharmala F.R.H. on Jharmala-Mori Road	„	30.59	78.04	1600
10. Uttar Kashi	„	30.45	78.28	1150
11. Kanatal	Tehri	30.25	78.20	2350
12. Kunwari Pass (not Kauri Pass)	Chamoli	30.27	79.34	3900
13. Ramni	„	30.24	79.30	2100
14. Bhowali	Nainital	29.22	79.31	1750
15. Airadeo	Almora	29.45	79.35	2100
16. Almora	„	29.40	79.40	1650
17. Bajwar	„	29.36	79.41	1200
18. Chaubhattia	„	29.37	79.28	2120
19. Dalmoti (not Dharmoti)	„	29.38	79.30	1600
(b) *Himachal Pradesh*				
20. Manali (Kulu Valley)	—	31.07	77.00	2000
21. Tikkar (near Narkanda)	Mahasu	31.30	77.10	2450
(c) *Jammu and Kashmir*				
22. Achabal (Anatnag)	Srinagar	33.41	75.13	1650
23. Pahalgam	„	34.01	75.20	2130
24. Yusimarg	—	33.30	75.00	2000
25. Gulmarg	Baramula	34.03	74.95	2700
26. Chakar	Muzaffarabad	34.15	73.55	—
27. Lun Bagla	„	34.10	73.50	—
(B) PAKISTAN				
28. Gumrat (Dir)	—	35.07	71.45	—
29. Kalam (Swat)	—	34.42	72.30	—
30. Hazara	Hazara	34.10	73.15	—
31. Kaghan	„	34.45	73.30	—
32. Mahandri (near Kaghan)	„	34.46	73.30	—
33. Naran	„	34.50	73.40	—
34. Shogran (near Kaghan)	„	34.45	73.29	—
(C) AFGHANISTAN				
35. Barikot (NE of Kabul)	Nengrahar Prov.	34.50	69.20	1000

INDIA (states of Uttar Pradesh, Himachal Pradesh and Jammu and Kashmir).

Uttar Pradesh : Mostly the hilly areas of Kumaon, Garahwal and Chakrata area. Bardyar, Deoban, Kanasar, Kunain, Larabatach, Mundali, Nada, Jhajra (near Dehra Dun), Bhowali (Nainital Dist.), plentiful. Kanatal, Kunwari Pass, Ramni, Tehri and Tulu, Uttar Kashi (Garhwal area), Airadeo, Almora, Bajwa, Chaubhattia, Dalmoti (not Dharmoti) and Ranikhet (Almora Dist.).



Text-fig. 41. Map of North India and neighbouring countries, to show the distribution localities of *Archotermopsis wroughtoni*. (Localities are serially numbered as in Table 4 in text.)

Himachal Pradesh : Manali (ca. 31.09 N. lat., 77 E long.) in Kulu Valley, 2000, m ; Tikkar near Narakanda (Mahasu Dist.), 2450 m.

Jammu and Kashmir : Kashmir Valley (Achalabal, Anantang, Gulmarg, Pahalgan, Yusimarg) : Muzaffarabad Dist. (Lun Bagla, Chakar).

PAKISTAN (NW mountain area) : Hazara District : Kaghan Vally Shorgran, Kaghan, Dunga Gali, Chhangla Gali, Naran, Mahandri, Gumrat (Dir), Kalam (Swat), Murree Hills.

AFGHANISTAN (eastern part) : Barikot (Nengrahar Province, eastern Afghanistan, NE of Kabul near Pakistan border), 1000 m (Harris 1967).

BIOLOGY

The biology of *A. wroughtoni* has been studied by Radcliffe (1904), Imms (1919), and Chaudhry and Ahmad (1972) ; and we have, in addition, field notes from various collections.

1. *Habitat*

The species is found under bark and inside the dead and decaying stumps and logs of fallen conifers (deodars and pines), e. g., *Cedrus deodara*, *Abies pindrow*, *Pinus excelsa*, *Pines longifolia*, *Pinus roxburghii*, *Pinus wallichiana* and *Picea morinda*. It does not attack sound felled timber or living trees.

2. *Habits*

It bores irregular, longitudinal tunnels in decayed wood. The galleries mostly run longitudinally along the grain of the wood and end just beneath the bark (Pl. 2). No outside earth encrustations are produced on the surface and there is no outward sign of the termite's presence in the wood. When necessary, the galleries are closed with masticated ligneus or excrementous material cemented with saliva.

Colonies are generally small (perhaps 30 or 40 individuals). They seem to be confined to the wood but there is no well marked nest. A soil connection is wanting. The castes consist of soldiers, pseudo-workers* and reproductives. (There are no true or mature workers, and the immature workers perform the latter's duties.)

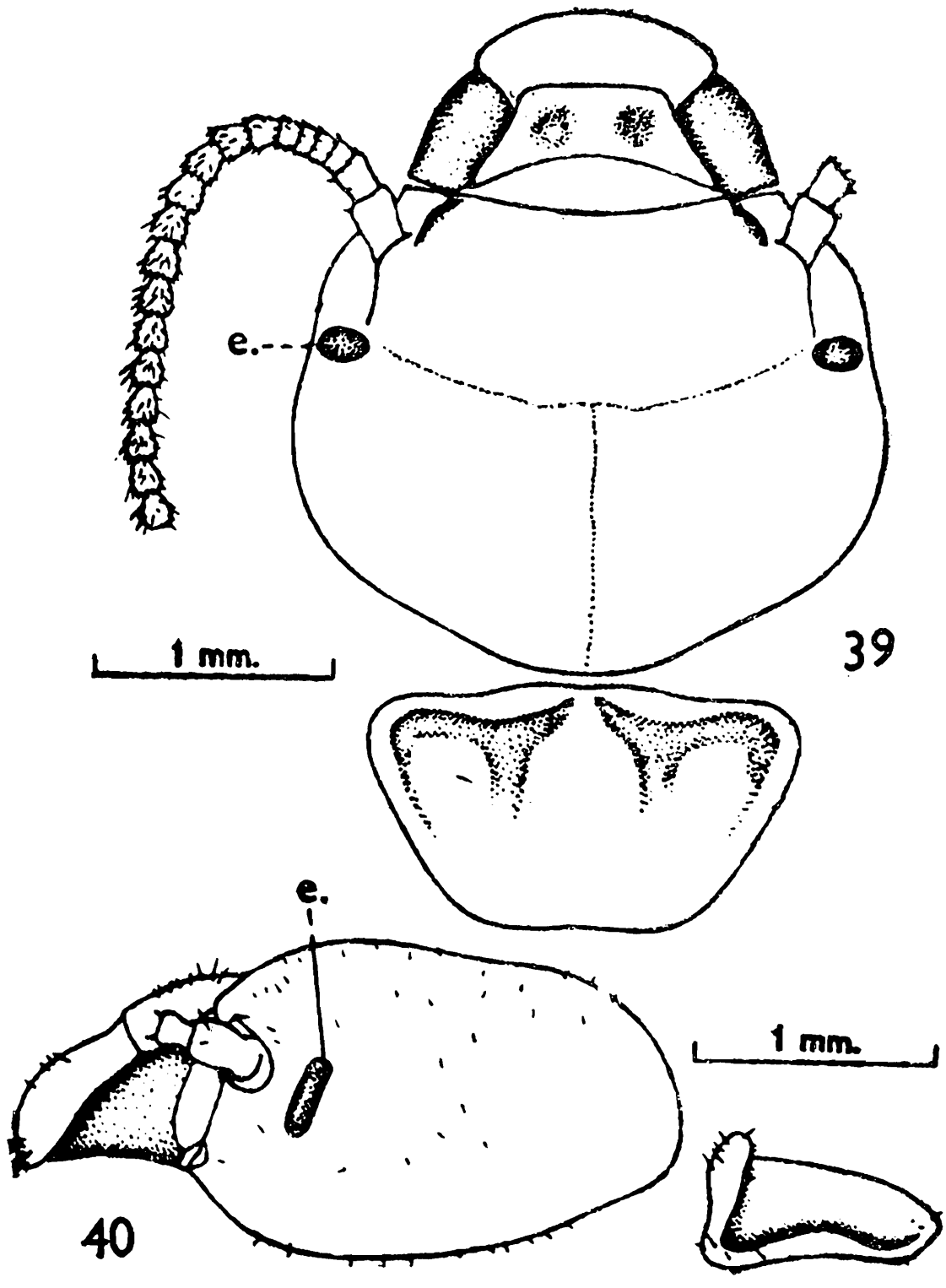
*According to Imms (1919), the majority of the colonies were without examples which could definitely be called pseudoworkers. In Bhowali, in May and June, he found 30 of them in one colony and 40 in another, and he believed that they occur seasonally. They had well developed gonads and one individual even laid eggs in captivity ; he, therefore, regarded them as "gynecoids." These eggs are similar in size and form to those laid by queens.

The centre of the colony is occupied by eggs (which may lie in layers of excreta) and very young larvae, and close by are found the reproductives (kings and queens). Imms sometimes found three or four kings and queens together, and believed that this had resulted from the confluence of neighbouring colonies. No true neotenics have been found. A large tree trunk may harbour several groups of eggs and larvae and several queens. Surrounding them are found the older larvae and nymphs, and soldiers are most numerous near the periphery. The fully formed alates at first remain in the centre of the colony, but later on they move to the periphery of the tunnels which lead to the exterior.

3. *Breeding and swarming*

The queen seems to lay eggs for a considerable part of the year, and young larvae have been found in February and July. During June and July older larvae and nymphs as well as winged adults are found in abundance. The eggs are whitish and ovoid (diameter ca. 0.45-0.50 mm), and have a smooth surface without any sculpturing. They are laid in groups of 10-25 in small, rounded chambers (ca. 8-9 mm in diameter) gnawed out of the wood in the central part of the colony. They are laid close to one another but are not held together by means of a secretion ; and are sometimes covered by layers of excreta.

Swarming : Fully winged individuals seem to remain in the nest for sometime before swarming out. Swarming occurs at irregular intervals during the monsoon (June to August). Exceptionally, a swarm was noted by Imms in Bhowali (Kumaon) two weeks before the regular monsoon arrived, but just before swarming a heavy local rain-shower of half on hour's duration had occured, and it is probable that high temperature and high humidity induced the swarming. Swarms are composed of both sexes ; they emerge from tree trunks on hill slopes and first fly a few hundred metres before alighting. Swarming generally occurs in clear weather in the afternoons, but there is a record from Kanatal (Tehri Dist., U. P., 2400 m) of swarming in the night at 8 P. M. in heavy rain. It is possible that the swarming period and hours may vary with location and altitude. We have the following dates and records from collection notes : (i) Uttar Pradesh : Tehri Dist. (Kanatal, 2400 m). 24th June, 8 P. M. (ii) Himachal Pradesh : Manali (Kulu Valley), 6th July. (iii) Kashmir Valley : Yusimarg, 2255 m, 8th August. (iv) Afghanistan : Barikot, 1000 m., 11th August.



Text-figs. 39-40. *Archotermopsis wroughtoni*. Pseudoworker, head and pronotum.
39. In dorsal view. 40. In side view.
e., eye.

4. *Food*

They mostly feed on moist decaying wood, solid excretory matter ejected from the anus of other members of the colony, fluid diet ejected by older larvae and cast off exuvial skins ; they also occasionally eat up the dead members of their colony. In captivity they imbibe drops of water sprinkled near the tunnels. The older larvae (4 mm long and upwards), nymphs and pseudoworkers feed mostly

on decaying wood and solid excretory matter. The soldiers, due probably to the form of their mandibles, seem to prefer the softest and the most decaying portions of the wood. The "unfertilized winged adults" take much less food than the nymphs. The young larvae (under 4 mm in length) and the kings and queens are fed upon a fluid substance of uncertain origin provided by the older larvae and pseudoworkers.

5. *Convulsive movements in colony*

According to Imms (1919) at times members of a colony exhibit convulsive movements in captivity. These movements mostly occurred after the individuals were disturbed. The whole body quivers, and this is repeated at irregular intervals. This may be a warning singal of danger.

6. *Intestinal Protozoa*

An abundant fauna of symbiotic flagellate Protozoa (families Trichonymphidae and Lophomonadidae) occurs in the hind intestine of *A. wroughteni* (Imms 1919, Cutler 1920, 1921, de Mello 1920, 1927, Saleem 1955, Uttangi and Joseph 1962, summary ; Tiwari's list, 1977, is very incomplete). The Protozoa occur in abundance and help in the digestion of wood. They seem to be less common in imagoes than in the other castes and in larvae and nymphs. Six species have been found, as follows :

ORDER HYPERMASTIGIDA

1. *Pseudotrichonympha pristina* (Imms 1919). (Saleem 1955, places it in a new genus, *Prototrichonympha*.)

ORDER POLYMASTIGIDA

2. *Trichomonas termitis* Cutler 1919.
3. *Microjoenia axostylis* Cutler 1920.
4. *Joenopsis cephalotricha* Cutler 1920. (Saleem 1955, places it in a new genus, *Parajoenopsis*.)
5. *Joenopsis polytricha* Cutler 1920.
6. *Ditrichomonas termitis* Imms 1919.

SUMMARY

1. The identity of *Archotermopsis wroughtoni* (Desneux) is clarified in relation to its junior synonyms (*radcliffei* Radcliffe and *deodarae* Chatterjee and Thakur).

2. Taxonomic descriptions are provided for the various castes (imagoe, soldier and pseudoworker).

3. Its geographical distribution is given. It extends from the Kumaon and Kulu Valleys in NW India (the Himalayan area) via the Kashmir Valley to Hazara and Murree Hills in NW Pakistan and to SE Afghanistan. At 900-3000 m attitudes. Associated with coniferous forests.

4. Its biology is discussed briefly, especially habitat, breeding, swarming and food. A list of the six flagellate Protozoa symbionts which occur in the hind gut is given.

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