

MISCELLANEOUS PUBLICATION
OCCASIONAL PAPER NO. 42

Records of the Zoological Survey of India

**TERMITE FAUNA (ISOPTERA)
OF WEST BENGAL, INDIA,
THEIR RECOGNITION, BIOLOGY AND ECOLOGY**

by
P. K. MAITI

**Issued by the Director
Zoological Survey of India, Calcutta**

RECORDS
OF THE
ZOOLOGICAL SURVEY OF INDIA

MISCELLANEOUS PUBLICATION

OCCASIONAL PAPER No. 42

TERMITE FAUNA (ISOPTERA) OF WEST BENGAL,
INDIA, THEIR RECOGNITION, BIOLOGY AND ECOLOGY

By

P. K. MAITI

Zoological Survey of India, Calcutta



Edited by the Director, Zoological Survey of India

1983

© Copyright 1983, Government of India

Published in October, 1983

PRICE : Inland : Rs. 60·00
Foreign : £ 7·50 \$ 13·00

PRINTED IN INDIA BY THE BANI PRESS, 16 HEMENDRA SEN STREET,
CALCUTTA-700 006 AND PUBLISHED BY THE DIRECTOR,
ZOOLOGICAL SURVEY OF INDIA, CALCUTTA-700 012

RECORDS
OF THE :
ZOOLOGICAL SURVEY OF INDIA

MISCELLANEOUS PUBLICATION

Occasional Paper

No. 42

1983

Pages 1—152

CONTENTS

	PAGE
INTRODUCTION	1
PHYSIOGRAPHY, CLIMATE, NATURAL, UNIT, ETC. OF WEST BENGAL	1
HISTORICAL REVIEW AND PRESENT STATUS OF TERMITE FAUNA	2
MATERIAL AND METHOD	7
LIST OF COLLECTING LOCALITIES	7
CLASSIFICATION AND ABBREVIATIONS USED	14
KEY, SYSTEMATIC ACCOUNT AND ZOOGEOGRAPHY	15
<i>Key for Identification</i>	15
<i>Systematic Account</i>	27
Family I. KALOTERMITIDAE	
Subfamily : KALOTERMITINAE	
Genus (1) <i>Neotermes</i> Holmgren, 1911	
1. <i>Neotermes bosei</i> Snyder	27
2. <i>Neotermes buxensis</i> Roonwal and Sen-Sarma	30
3. <i>Neotermes kalimpongensis</i> Maiti	31
4. <i>Neotermes mangiferae</i> Roonwal and Sen-Sarma	33
Genus (2) <i>Glyptotermes</i> Froggatt, 1896	
5. <i>Glyptotermes caudomunitus</i> Kemner	33
6. <i>Glyptotermes chinpingensis</i> Tsai and Chen	35
7. <i>Glyptotermes krishnai</i> Maiti and Chakravarty	37
8. <i>Glyptotermes sensarmai</i> Maiti	38

	PAGE
Genus (3) Cryptotermes Banks, 1906	
9. <i>Cryptotermes dudleyi</i> Banks	... 40
10. <i>Cryptotermes havilandi</i> (Sjöstedt)	... 42
Family II. RHINOTERMITIDAE	
Subfamily (i) HETEROTERMITINAE	
Genus (4) Heterotermes Froggatt, 1896	
11. <i>Heterotermes indicola</i> (Wasmann)	... 44
Genus (5) Reticulitermes Holmgren, 1913	
12. <i>Reticulitermes assamensis</i> Gardner	... 47
Subfamily (ii) COPTOTERMITINAE	
Genus (6) Coptotermes Wasmann, 1896	
13. <i>Coptotermes heimi</i> (Wasmann)	... 48
14. <i>Coptotermes kishori</i> Roonwal and Chhotani	... 51
15. <i>Coptotermes travians</i> (Haviland)	... 53
Subfamily (iv) RHINOTERMITINAE	
Genus (7) Parrhinotermes	
16. <i>Parrhinotermes khasu</i> Roonwal and Sen-Sarma	... 54
Family (III) STYLOTERMITIDAE	
Genus (8) Stylotermes Holmgren and Holmgren, 1917	
17. <i>Stylotermes bengalensis</i> Mathur and Chhotani	... 55
18. <i>Stylotermes parabengalensis</i> Maiti	... 56
Family IV. TERMITIDAE	
Subfamily (i) APICOTERMITINAE	
Genus (9) Eurytermes Wasmann, 1902	
19. <i>Eurytermes buddha</i> Bose and Maiti	... 56
Genus (10) Speculitermes Wasmann, 1902	
20. <i>Speculitermes deccanensis paivai</i> Roonwal and Chhotani	58
21. <i>Speculitermes roonwali</i> sp. nov.	... 59
Genus (11) Euhamitermes Holmgren, 1912	
22. <i>Euhamitermes chhotanii</i> sp. nov.	... 63
Genus (12) Synhamitermes Holmgren, 1912	
23. <i>Synhamitermes quadriceps</i> (Wasmann)	... 68

	PAGE
Genus (13) Microcerotermes Silvestri, 1901	
24. <i>Microcerotermes beelsoni</i> Snyder	... 70
25. <i>Microcerotermes cameroni</i> Snyder	... 74
Subfamily (ii) TERMITINAE	
Genus (14) Angulitermes Sjöstedt, 1924	
26. <i>Angulitermes longifrons</i> sp. nov.	... 77
Genus (15) Dicuspiditermes Krishna, 1965	
27. <i>Dicuspiditermes incola</i> (Wasmann)	... 82
Genus (16) Pericapritermes Silvestri, 1914	
28. <i>Pericapritermes ceylonicus</i> (Holmgren)	... 84
29. <i>Pericapritermes dunensis</i> (Roonwal and Sen-Sarma)	... 86
30. <i>Pericapritermes tetraphilus</i> (Silvestri)	... 87
Subfamily (iii) MACROTERMITINAE	
Genus (17) Macrotermes Holmgren, 1909	
31. <i>Macrotermes estherae</i> (Desneux)	... 89
32. <i>Macrotermes gilvus</i> (Hagen)	... 91
33. <i>Macrotermes khajuriae</i> Roonwal and Chhotani	... 92
Genus (18) Odontotermes Holmgren, 1910	
34. <i>Odontotermes assmuthi</i> Holmgren	... 94
35. <i>Odontotermes feae</i> (Wasmann)	... 97
36. <i>Odontotermes gurdaspurensis</i> Holmgren and Holmgren	... 101
37. <i>Odontotermes horni</i> (Wasmann)	... 102
38. <i>Odontotermes parvidens</i> Holmgren and Holmgren	... 106
39. <i>Odontotermes redemanni</i> (Wasmann)	... 110
Genus (19) Hypotermes Holmgren	
40. <i>Hypotermes obscuriceps</i> (Wasmann)	... 114
41. <i>Hypotermes xenotermitis</i> (Wasmann)	... 115
Genus (20) Microtermes Wasmann, 1902	
42. <i>Microtermes obesi</i> Holmgren	... 117
Subfamily (iv) NASUTITERMITINAE	
Genus (21) Nasutitermes Dudley, 1890	
43. <i>Nasutitermes gardneri</i> Snyder	... 121
44. <i>Nasutitermes garoensis</i> Roonwal and Chhotani	... 123
45. <i>Nasutitermes jalpaiguriensis</i> Prashad and Sen-Sarma	... 124
46. <i>Nasutitermes sukhnensis</i> Prashad and Sen-Sarma	... 126

	PAGE
Genus, (22) Bulbitermes Emerson, 1949	
47. <i>Bulbitermes emersoni</i> Maiti	... 127
Genus (23) Trinervitermes Holmgren, 1912	
48. <i>Trinervitermes biformis</i> (Wasmann)	... 129
<i>Zoogeography and Speciation</i>	... 131
ECOLOGY	... 133
A. <i>Faunal Zone</i>	... 133
B. <i>Habitat group</i>	... 138
C. <i>Swarming period</i>	... 140
D. <i>Predator</i>	... 140
ECONOMIC IMPORTANCE	... 143
ACKNOWLEDGEMENTS	... 144
SUMMARY	... 144
REFERENCES	... 146

INTRODUCTION

General : Termites (Isoptera) constitute a most fascinating group of social insects specially because of their ubiquity in the tropics, superb architectural ability, cryptobiotic nature of life and enormous economic importance. The diverse physical and climatic features of the Indian subcontinent, offer favourable conditions to support a rich and varied termite fauna. Perhaps, because of its vastness and many other difficulties, the State-wise faunal work had been undertaken by previous workers (Roonwal and Chhotani, 1962 ; Roonwal and Bose, 1964, '70 ; Sen-Sarma and Thakur, 1979 and others) in the recent past. But, West Bengal, a politically defined state of Eastern India, remained unexplored so far as its termite fauna is concerned. The area is probably unparalleled in whole of India, specially due to its contrasting land elevation i.e. from sea-level (Bay of Bengal) up to 3650 m. (Sandakphu and Phalut) in the Himalayas. For sheer diversities in the physiography, climate, vegetation, etc., the area has developed a few natural units within which the study of termites creates enormous interest. Keeping this in view, the author explored the termite fauna as well as studied their ways of life and the present monograph is the output of such an endeavour. It deals with the termite fauna with special reference to taxonomy, zoogeography, field biology, faunal zonation and relation with biotic and abiotic factors. However, any such discussion will not be satisfactory unless it takes into account the physiography, climate, soil, vegetation, etc. of the area concerned. Therefore, these factors are also briefly tabulated.

PHYSIOGRAPHY, CLIMATE, NATURAL UNITS, ETC. OF WEST BENGAL

(A) *Physiography, Climate, etc.*—The State of West Bengal, with its 17 districts (including Calcutta), spreading over an area of 8700 sq. kms. lies approximately between 21°31' and 27°14' N. lat., 86°35' and 89°53' E. long, and the Tropic of Cancer runs across it. The State represents the western part of the great Brahmaputra-Gangetic delta, situated at the culminating point of the three vast well defined geologic regions of India, such as the Peninsular (Southern India), Extra-Peninsular (The Himalayas) and the Indo-Gangetic plains.

Within the State, in North lie the lofty mountain ranges and low hills of the Himalayas with impenetrable evergreen forests at low

elevation and hill streams in the valleys ; along the entire length from North to South, the cultivated Gangetic Plains with small rivers, tanks and ponds ; on the West, the lateritic uplands (eastern extremities of the Peninsula) with scrub jungles ; and in South, the sandy coast with mangrove forests. The Himalayas have its enormous influence on the prevailing climate of the area. As a result, a large variety of climatic conditions from temperate to tropical, from excessively humid to semi-arid, are noticeable in the State. In considering the diversities in physiography and variations in environmental factors, the area can easily be marked into four *Natural Units* (vide, Table 1). For better understanding of the termite population and their ways of life in the State, both biotic and abiotic factors are tabulated precisely under respective unit.

(B) *Natural Units* (vide, Table 1 and Map 1)

HISTORICAL REVIEW AND PRESENT STATUS OF TERMITE FAUNA

Historical Review :

The first record of termites from West Bengal dates back to 1915, when Assmuth reported for the first time the occurrence of two species, namely *Heterotermes indicola* (Wasm.) and *Coptotermes heimi* (Wasm.) from Calcutta. Since then, a number of species as either described or recorded (Holmgren and Holmgren, 1917 ; Snyder, 1933 and 1934 ; Margabandhu, 1934 ; and Dover and Mathur, 1934) from the State, all of which were catalogued by Snyder (1949). However, Rattan Lal and Menon (1953) published a list of all the known species from India including eight from West Bengal, while Roonwal and Pant (1953) reported six more species from the area to bring the total to 14 species as follows : *Neotermes bosei* (Snyder), *Cryptotermes bengalensis* (Snyder) [Syn. of *Crypto. havilandi* (Sjöstedt)], *Coptotermes heimi* (Wasm.), *C. travians* Havil., *Heterotermes indicola* (Wasm.), *Reticulitermes assamensis* Gard., *Odontotermes feae* (Wasm.), *O. obesus* (Ramb.), *O. parvidens* Holmg. & Holmg., *Macrotermes azarelli* (Wasm.) [Syn. of *M. gilvus*], *M. estherae* (Desn.), *Nasutitermes emersoni* Snyder, *N. fletcheri* Holmg. & Holmg. and *N. gardneri* Snyder.

Latter on, Banerjee (1956) recorded as many as ten species from Calcutta, out of which four were real addition to the existing known fauna, namely *Odontotermes horni* (Wasm.), *O. redemanni* (Wasm.), *Hypotermes obscuriceps* (Wasm.) and *Microtermes obesi* (Holmg.). In the same year, Roonwal and Sen-Sarma (1956), reported both *Copto-*

TABLE—1.* Characteristic features of different Natural Units in West Bengal.

Characteristic Features	Natural Units			
	Himalayan and Sub-Himalayan Unit	Gangetic Alluvial Unit	Lateritic Table-Land Unit	Coastal Swampy Unit
1. Soil	Blackish brown in colour, highly acidic, rich in organic matter, Terai alluvium in nature	Gray or grayish white in colour, neutral, rich in calcium and free calcium carbonate, high clay content and low to medium level of organic matter	Reddish in colour, mildly acidic to neutral, fairly rich in iron and aluminium oxides, low organic matter and low water holding capacity	Grayish in colour, alkaline in nature and fairly rich in organic matter
2. Climate	Subtropical to sub-temperate	Moist tropical	Dry tropical	Moist tropical
3. Rainfall (July & August)	635 mm & 488 mm	300 mm & 306 mm	322 mm & 336 mm	409 mm & 410 mm
4. Relative Humidity	69% (March) to 92% (July-August)	46% (March) to 83% (August)	33% (March) to 83% (August)	67% (February) to 85% (July)
5. Temperature (i) Summer (May) (ii) Winter (January)	13-27°C 5-19°C	22-39°C 10-30°C	22-43°C 9-30°C	21-33°C 12-28°C
6. Forest Type	Warm temperate (between 760-1525 m. alt.) and tropical evergreen (foot-hills)	Moist deciduous	Dry deciduous	Mangrove
7. Forest Cover	25-30% (Of the total)	5%	8%	30%

* All the climatological data stated in the table are from "Climatological Tables of Observations in India (1931-1960)".—Indian Meteorological Department, Govt. of India.

termes heimi (Wasm.) and *C. travians* Havil. from Calcutta. The powder-post termite, *Cryptotermes dudleyi* (Banks) was recorded by Sen-Sarma and Mathur (1957) from Sundarbans and *Trinervitermes biformis* (Wasm.) by Mathur and Sen-Sarma (1961). Since then, a number of species and subspecies were described by different authors from the State as follows :—

Stylotermes bengalensis (Mathur and Chhotani, 1959) ; *Nasutitermes jalpaiguriensis* and *N. suknensis* (Prashad and Sen-Sarma, 1959), *Neotermes buxensis* and *N. magniferae* (Roonwal and Sen-Sarma, 1960), *Coptotermes kishori* (Roonwal and Chhotani, 1962a), *Speculitermes deccanensis paivai* (Roonwal and Chhotani, 1962b), *Neotermes kalimpongensis* and *Stylotermes parabengalensis* (Maiti, 1975), *Glyptotermes sensarmai* (Maiti, 1976) and *Bulbitermes emersoni* (Maiti, 1979). However, the species *Odontotermes obesus* (Ramber) reported from the area is *O. redemanni* (Wasm.) [*Vide*, under *O. redemanni*]. The species *Nasutitermes jalpaiguriensis* described by Prashad and Sen-Sarma (1959) was based on specimens from Jalpaiguri which were previously identified as *N. fletcheri*. Thus, to sum up, the following species and subspecies (28) were already known from the State.

1. *Neotermes bosei* Snyder—Bagdogra and Samsing (Darjeeling Dist.).
2. *Neotermes buxensis* Roonwal and Sen-Sarma—Buxa Forest (Jalpaiguri Dist.).
3. *Neotermes kalimpongensis* Maiti—Kalimpong (Darjeeling Dist.).
4. *Neotermes mangiferae* Roonwal and Sen-Sarma—Calcutta.
5. *Glyptotermes sensarmai* Maiti—Atiamochar vill. (Cooch Behar Dist.).
6. *Cryptotermes dudleyi* Banks—Sundarbans (24-Parganas Dist.).
7. *Cryptotermes havilandi* (Sjöstedt)—Sundarbans (24-Parganas Dist.).
8. *Heterotermes indicola* (Wasmann)—Calcutta.
9. *Reticulitermes assamensis* Snyder—Samsing (Darjeeling Dist.).
10. *Coptotermes heimi* (Wasmann)—Kharagpur (Midnapur Dist.) and Calcutta.
11. *Coptotermes kishori* Roonwal and Chhotani—Berhampur (Murshidabad Dist.).
12. *Coptotermes travians* Haviland—Calcutta.
13. *Stylotermes bengalensis* Mathur and Chhotani—Darjeeling Forest Division.
14. *Stylotermes parabengalensis* Maiti—Nagrakata (Jalpaiguri Dist.).

15. *Speculitermes deccanensis paivai* Roonwal and Chhotani—Tollygunj (Calcutta).
16. *Macrotermes gilvus* (Hagen)—Samsing (Darjeeling Dist.).
17. *Macrotermes estherae* (Desneux)—Ghumti (Darjeeling Dist.).
18. *Odontotermes feae* (Wasmann)—Harra (Bankura Dist.).
19. *Odontotermes horni* (Wasmann)—Calcutta.
20. *Odontotermes parvidens* (Holmgren and Holmgren—Samsing (Darjeeling Dist.).
21. *Odontotermes redemanni* (Wasmann)—Calcutta and Halishar (24-Parganas Dist.).
22. *Hypotermes obscuriceps* (Wasmann)—Ghumti (Darjeeling Dist.).
23. *Microtermes obesi* (Holmgren)—Calcutta and Kaliachak, Maldah Dist.).
24. *Nasutitermes gardneri* Snyder—Rangirum (Darjeeling Dist.).
25. *Nasutitermes jalpaiguriensis* Prashad and Sen-Sarma—Jalpaiguri (Jalpaiguri Dist.).
26. *Nasutitermes sukneensis* Prashad and Sen-Sarma—Sukna (Darjeeling Dist.).
27. *Bulbitermes emersoni* Maiti—Tashiding Forest (Darjeeling Dist.).
28. *Trinervitermes biformis* (Wasmann)—Bankura (Bankura Dist.).

Apart from taxonomic work, a few more references dealing with the termites of West Bengal, may be cited. Mukherjee and Chaudhuri (1962) studied the early developmental stages of *Odontotermes redemanni* (Wasm.) collected from Halishahar. Lastly, Ghosh (1964) recorded *Microtermes* sp. [probably *M. obesi* (Holmg.)] as a regular menace in the cultivation of wheat and autumn paddy at Kaliachak in Maldah district.

Present Status

So far 28 species and subspecies of termites, belonging to 13 genera under 3 families, have been known to occur in the state of West Bengal. As a result of the present study, another 20 species have been added to bring to total of 48 species and subspecies, out of which 3 species are new to science. These 48 species and subspecies belonging to 23 genera in 8 subfamilies under 3 families are recorded from more than 100 localities of West Bengal. Some 10 genera are reported here for the first time from West Bengal. A list of 20 species

(including 3 new species) which are a new addition to the termite fauna of West Bengal is given below.

1. *Glyptotermes caudomunitus* Kemner
2. *Glyptotermes chinpingensis* Tsai and Chen
3. *Glyptotermes krishnai* Maiti and Chakraborty
4. *Parrhinotermes khasii* Roonwal and Sen-Sarma
5. *Eurytermes buddha* Bose and Maiti
6. *Speculitermes roonwali* sp. nov.
7. *Euhamitermes chhotanii* sp. nov.
8. *Synhamitermes quadriceps* (Wasmann)
9. *Microcerotermes beelsoni* Snyder
10. *Microcerotermes cameroni* Snyder
11. *Angulitermes longifrons* sp. nov.
12. *Dicuspiditermes incola* (Wasmann)
13. *Pericapritermes ceylonicus* (Holmgren)
14. *Pericapritermes dunensis* (Roonwal and Sen-Sarma)
15. *Pericapritermes tetraphilus* (Silvestri)
16. *Macrotermes khajurii* Roonwal and Chhotani
17. *Odontotermes assmuthi* Holmgren
18. *Odontotermes gurdaspurensis* Holmgren and Holmgren
19. *Hypotermes xenotermitis* (Wasmann)
20. *Nasutitermes garoensis* Roonwal and Chhotani

Thus, the present study shows that the State is very rich in termite fauna. The families of termites reported are Kalotermitidae, Rhinotermitidae, Stylotermitidae and Termitidae, of which Termitidae is most richly represented in the State and consists of 4 subfamilies, 15 genera and 30 species and subspecies (comprising about 65% of the genera and 62% of the species). The termitid genus, *Odontotermes* is most common in the State consisting of 6 species, some of these [*O. feae* (Wasmann), *O. horni* (Wasmann), *O. redemanni* (Wasmann)] are very widespread.

All these species and subspecies mentioned above, have been taken into consideration with regard to their taxonomy, range of variation, distribution (Map 2, 3 and 4), field biology, economic importance, ecology, etc. The species which are already known from the State, but not available for study in the present collection, are dealt with the help of published literature.

A running key for easy identification of families, genera, and species and subspecies, based on the characters of imagos and soldiers, has been

provided. Sections dealing with the faunal zones and ecology, habit and habitat types, economic importance, swarming periods, zoogeography and speciation, and enemies of termites have also been incorporated.

MATERIAL AND METHOD

Material : As a result of extensive surveys carried out in the different areas of West Bengal by the author, a fairly large collection of termites was assembled. This main bulk of collection was augmented by incorporating a very good collection made by the staff of Z. S. I., Calcutta, since the year 1947. The Forest Research Institute, Dehra Dun, had some collection from this State, collected by Dr. M. L. Roonwal and by Dr. P. K. Sen-Sarma, which was made available for study through the courtesy of the Forest Entomologist, F. R. I., Dehra Dun. Small collections were also available from friends and colleagues for study. The monograph is based on these collections.

Method : A total number of 48 species and subspecies based on a large collection made from West Bengal were studied in 80% alcohol under a Stereo-binocular Microscope. The imago-worker mandibles and wings were mounted on slides. The drawings were drawn with the help of a camera lucida.

LIST OF COLLECTING LOCALITIES

(Map 1)

Note : The districts, as well as the individual collecting locality within each district, are arranged alphabetically.

Abbreviations for names of collectors : AKD., Dr. A. K. Das ; APK., Dr. A. P. Kapur ; BS., B. Sinha ; DC., D. Chatterjee ; GKM., G. K. Mondal ; GNS., Dr. G. N. Saha ; GKS., Dr. G. K. Srivastava ; HK., Dr. H. Khajuria ; HSS., H. S. Sharma ; HLP., H. L. Paul ; KDC., K. D. Chatterjee ; KNB., K. N. Baidya ; KSP., K. S. Pradhan ; KR., K. Rai ; LKG., L. K. Ghosh ; MLR., Dr. M. L. Roonwal ; MLT., Dr. M. L. Thakur ; MMG., M. M. Ghosh ; OBC., Dr. O. B. Chhotani ; PCD., P. C. Dhar ; PCG., P. C. Ghosh ; PKM., Dr. P. K. Maiti ; PKS., Dr. P. K. Sen-Sarma ; RKG., R. K. Ghosh ; RNM., R. N. Mukherjee ; RNT., R. N. Tewari ; SMA., S. M. Ali ; SKS., S. K. Saha ; SRB., S. R. Bose ; SS., S. Singh ; VDS., Dr. V. D. Srivastava ; ZSIP., Zoological Survey of India Party.

Serial No.	Name of Localities.	Altitude above mean sea level (in mm.)	Latitude (°N)	Longitude (°E)	Name of Collectors with year of collection (1947-1970)
(1)	(2)	(3)	(4)	(5)	(6)
I. <i>Bankura District</i>					
1.	Bankura		23°15'	87°08'	PKS ('54)
2.	Patrasayar (55 Km. E. of Bankura)		23°15'	86°53'	PKS ('54)
3.	Puranderpur (19 Km. N. of Bankura)		23°19'	87°08'	PKS ('54)
II. <i>Birbhum District</i>					
4.	Bolpur (near Rly. Stn.)		23°39'	87°45'	PKM ('66)
5.	Santineeketan (2 Km. W. of Bolpur Rly. Stn.)		23°39'	87°45'	PKM ('66)
III. <i>Burdwan District</i>					
6.	Asansol (Sree Pally)	126	23°45'	87°00'	PKM ('67)
7.	Burdwan	32	23°20'	87°50'	AKD ('66)
IV. <i>Calcutta</i>					
8.	Calcutta and its vicinity	6	22°35'	88°20'	APK ('55), MMG ('65), MLT ('57), MLR ('53), '57, ('59), PCD ('59), & OBC ('57)
	Baliaghata	...	...	...	PCD ('59)
	Ballygunge	...	...	...	PKM ('63, '70)
	Balvedere (National Library Campus)	...	...	...	MLR ('59)
	Barisha	...	...	...	PCD ('59)
	Behala	...	...	...	SKS ('68)
	Bowbazar	...	...	...	MLT ('57)
	Dhakuria	...	...	...	PKM ('65)
	Eden Garden	...	...	...	MLT ('57)
	Garia	...	...	...	OBC ('57)

Serial No.	Name of Localities.	Altitude above mean sea level (in mm.)	Latitude (°N)	Longitude (°E)	Name of Collectors with year of collection (1947-1970)
(1)	(2)	(3)	(4)	(5)	(6)
	Horticulture Farm	...	...	...	OBC ('57)
	Indian Museum	...	...	...	SMA ('60) ZSIP ('60) BS ('66)
	Jabakusum House	...	...	...	PCD ('61) SS ('62)
	Kasba	...	...	...	DC ('65)
	Kidderpore	...	...	...	OBC ('67)
	Nehru Road (Esplanade)	...	...	...	PKM ('66)
	Park Circus	...	...	...	APK ('54) OBC ('69) ('70)
	Rabindra Sarobar	...	...	...	PKM ('65, '69 '70), RNM('65)
	Sealdah (near Rly. Stn.)	...	...	...	PKM ('65)
	Tollygunge	...	...	...	PKM ('65)
	Ultadanga (near Rly. Stn.)	...	...	...	GNS ('65), KR ('66)
	Zoological Garden	...	...	...	OBC ('57)
V. Cooch Behar Disttict					
9.	Cooch Behar Town	43	26°15'	89°25'	PKM ('66)
10.	Khagribari (Atiamochar Beat, Cooch Behar Forest Range)	40	26°20'	89°35'	PKM ('66)
VI. Darjeeling District					
11.	Coronation Bridge (adjacent forest)	...	26°53'	88°33'	PKM ('66)
12.	Gailikhola Forest (4 Km. SW. of Teesta Bridge)	300	26°58'	88°32'	PKM ('66)
12a.	Teesta Valley Forest	300	26°58'	88°35'	PKM ('66)
13.	Kalimpong	1209	27°02'	88°33'	PKM ('66)
	Bong Bosti (5 Km. E. of Kalimpong)	...	...	...	PKM ('66)
	Chhebo Bosti (3 Km.				

Serial No.	Name of Localities.	Altitude above mean sea level (in mm.)	Latitude (°N)	Longitude (°E)	Name of Collectors with year of collection (1947-1970)
(1)	(2)	(3)	(4)	(5)	(6)
	S. of Kalimpong)	...	...	...	PKM ('66)
14.	Peshok Tea Estate (near Forest Office, 7 Km. W. of Teesta Bridge)	...	27°05'	88°30'	PKM ('66)
15.	Tarkhola Forest S. of Teesta Bridge	300	26°57'	88°30'	HK ('58)
16.	Tashiding Forest (5 Km. NE. of Teesta Bridge)	285	26°57'	88°32'	PKM ('66)
	Singla	400	...	...	HSS ('73)
	Ghoom Bhanjang	1900	...	...	PKM ('73)
	Rambi	...	...	...	HSS ('73)
	Takdah	1500	...	...	PKM ('73)
	Reyang	375	...	...	HSS ('73)
	Rangpo	600	...	...	HSS ('73)
	Nazeok	1363	...	...	GKS & PKM ('74)
	Gorubathan	400	...	...	GKS & PKM ('74)
17.	Chandan Nagar (near Rly. Stn.)	...	22°50'	88°21'	NDS ('65) PKM ('67)
18.	Singur	...	...	...	SRB ('52)
19.	Srirampur (Bosepara)	...	22°45'	88°21'	PKM ('65)
VIII. Howrah District					
20.	Andul	...	22°36'	88°09'	PKM ('67)
21.	Botanical Garden, Sibpur	...	22°37'	88°15'	PKM ('68)
22.	Santragachi (near Rly. Stn.)	...	22°37'	88°13'	RNT ('70)
IX. Jalpaiguri District					
23.	Alipurduar (New Town)	...	26°30'	89°35'	PKM ('66)
24.	Bagracoat	...	26°50'	88°30'	PKM ('66)
25.	Bhagatpore Tea Estate (near Nagrakata Rly. Stn.)	...	26°55'	88°57'	PKM ('66)

Serial No.	Name of Localities.	Altitude above mean sea level (in mm.)	Latitude (°N)	Longitude (°E)	Name of Collectors with year of collection (1947-1970)
(1)	(2)	(3)	(4)	(5)	(6)
26.	Champaguri (5 Km. NW. of Nagrakata Rly. Stn.)	...	26°53'	88°56'	PKM ('66)
27.	Jalpaiguri and vicinity (Kadamtalla Patkata Colony)	83	26°30'	88°40'	PKM ('66) PKM ('66) PKM ('66)
28.	Kamyakhyaguri (near Rly. Stn.)	...	26°29'	89°37'	PKM ('66)
29.	Khunia Junction (Nagrakata Forest)	...	26°55'	88°57'	PKM ('66)
30.	Mal Bazar	...	26°53'	88°48'	PKM ('66)
31.	Murti Beat (10 Km. W. of Nagrakata Rly. Stn.)	...	26°55'	88°57'	PKM ('66)
32.	Nagrakata (near Rly. Stn.)	270	26°50'	88°57'	PKM ('66)
32a.	Pangar Air Port (10 Km. SW. of Jalpaiguri)	...	26°30'	88°49'	PKM ('66)
33.	Paitkapara Tea Estate (14 Km. NE. of Alipurduar)	...	26°29'	89°34'	PKM ('66)
34.	Thaljhorahat (10 KM. NW. of Nagrakata Rly. Stn.)	...	26°58'	88°58'	PKM ('66)
<i>X. Maldah District</i>					
35.	Baisnabnagar	31	...	...	PCG ('67)
<i>XI. Midnapore District</i>					
36.	Bamunia Village (10 Km. W. of Haria Bazar, Tamluk Sub-Division)	...	22°10'	87°50'	PKM ('66)
37.	Gidhni (50 Km. W. of Kharagpur)	...	22°25'	86°53'	PKM ('66)
38.	Gouaberia (near Haldia Port)	...	22°09'	88°04'	AKD ('70)
39.	Kharagpur (near Rly. Stn.)	...	22°22'	87°15'	KSP ('47)

Serial No.	Name of Localities.	Altitude above mean sea level (in mm.)	Latitude (°N)	Longitude (°E)	Name of Collectors with year of collection (1947-1970)
(1)	(2)	(3)	(4)	(5)	(6)
40.	Midnapore and vicinity (Burge Town Gope Forest Keranitalla Rabindra Nagar)	45	22°25'	87°15'	PKM ('65, '69) PKM ('69) PKM ('66) PKM ('66) PKM ('66, '69)
41.	Saibari Village (10 Km. S. of Terapakhia Bazar)	...	22°05'	87°58'	PKM ('66)
42.	Terapakhia Bazar (Tamluk Sub-Division)	...	22°10'	87°58'	PKM ('65)
<i>XII. Murshidabad District</i>					
43.	Berhampur	19	24°02'	88°22'	PKS ('54)
44.	Gocorn (15 Km. W. of Berhampur)	...	24°02'	88°21'	PKS ('54)
45.	Lalbag (10 Km. N. of Berhampur)	...	20°07'	88°22'	PKS ('54)
46.	Ramnagar Village (opposite to the Plassey Monument on W. bank of the river Ganges)	...	23°12'	88°15'	PKM ('66)
<i>XIII. Nadia District</i>					
47.	Kalyani (near University Campus)	...	23°01'	88°25'	PKM ('65)
48.	Kamarhati (1 Km. E. of Muragacha)	...	23°32'	88°25'	SCM ('66)
49.	Krishnanagar City	15	23°24'	88°28'	PKM ('65) ZSIP ('65)
50.	Muragacha Village (near Rly. Stn.)	...	23°32'	88°25'	SCM ('66)
51.	Phulia (13 Km. W. of Ranaghat Rly. Stn.)	...	23°10'	88°25'	PKG ('64) GKM ('66)
52.	Plassy (near Monument)	...	23°46'	88°15'	PKM ('65)
53.	Ranaghat (near Rly. Stn.)	...	23°10'	88°25'	KNB ('66)

Serial No.	Name of Localities.	Altitude above mean sea level (in mm.)	Latitude (°N)	Longitude (°E)	Name of Collectors with year of collection (1947-1970)
(1)	(2)	(3)	(4)	(5)	(6)
XIV. 24-Parganas District					
54.	Agarpara (20 Km. N. of Sealdah Rly. Stn.)	...	23°44'	88°22'	MLR ('52)
55.	Alipur (Horticulture Farm).	...	22°35'	88°18'	OBC ('57)
56.	Bagra (25 Km. N. of Rampur Range H. Q.)	...	22°22'	88°52'	PKS ('54)
57.	Barasat	...	22°43'	88°28'	AKD ('65), '67), LKG ('66)
58.	Barrackpore (23 Km. N. of Sealdah)	...	22°48'	88°22'	OBC ('57, '65)
59.	Baruipur (near Rly. Stn.)	...	22°20'	88°20'	PKM ('66)
30.	Bira (20 Km. N. of Sealdah Rly. Stn.)	...	22°42'	88°23'	LKG ('65)
61.	Gocharan (near Rly. Stn.)	...	...	...	HLP ('54)
62.	Gosaba Village (6 Km. N. of Sajnakhali.)	...	22°09'	88°53'	PKS ('54)
63.	Jaynagar (near Rly. Stn.)	...	22°08'	88°23'	PKM ('65)
64.	Jhingakhali (32 Km. SE. of Rampur H. Q., Sundarbans)	...	22°12'	88°56'	PKS ('54)
65.	J-Plot (48 Km. NE. of Namkhana Range H. Q.)	...	21°58'	88°25'	PKS ('54)
66.	Kakdwip	3	22°20'	88°13'	PKS ('54)
67.	Lakshmikantapur (near Rly. Stn.)	...	22°05'	88°15'	ZSIP ('65)
68.	Naihati (near Rly. Stn.)	...	22°55'	88°23'	MLR ('53)
69.	Namkhana Proper	...	21°50'	88°15'	MLR ('54)
70.	Narainpur Village (6 Km. NE. of Namkhana Range H. Q.)	...	21°50'	88°15'	MLR ('54)
71.	Natagarh (near Sodhpur)	...	22°45'	88°21'	KDC ('60)
72.	Palta (21 Km. S. of Calcutta)	...	22°30'	88°15'	MLR ('52)

Serial No.	Name of Localities.	Altitude above mean sea level (in mm.)	Latitude (°N)	Longitude (°E)	Name of Collectors with year of collection (1947-1970)
(1)	(2)	(3)	(4)	(5)	(6)
73.	Pathar Pratima (25 Km. E. of Namkhana Range H. Q.) ...	...	21°50'	88°23'	PKS ('54)
74.	Sajnakhali (40 Km. S. of Rampur Range H. Q.) ...	...	22°05'	88°53'	PKS ('54)
75.	Sonarpur (15 Km. S. of Sealdah) ...	...	22°25'	88°22'	PKM ('65)
76.	Sorisa (near Ramkrishna Mission School) ...	...	22°20'	88°13'	
77.	Subhasgram (near Rly. Stn.) ...	...	22°22'	88°21'	MLR ('53) PKM ('66)
78.	Sujapur (near Palta) ...	...	22°31'	88°15'	AKD ('70)
79.	Titagarh (near Rly. Stn.) ...	...	22°43'	88°22'	PKM ('65)
80.	Tushkhali (Rampura Proper) ...	...	...	...	PKS ('54)
<i>XV. Purulia District</i>					
81.	Purulia Town (near Central Bus Stand) ...	...	23°11'	86°25'	PKM ('68)

CLASSIFICATION AND ABBREVIATIONS USED

Classification :

The classification of Snyder (1949) [confirmed by Ahmad (1950) on the basis of the study of imago-worker mandibles] has been mainly followed here with modification in the families where more detailed revision has been done by different authors.

Abbreviations used : The following abbreviations have been used in the text.

alt., altitude (above mean sea-level); A. M. N. H., American Museum of Natural History; B. M. N. H., British Museum (Natural History); cm., centimetre; coll., collected by, collection; Dist., District; E., East; ex., from, out of; exs., examples; F. R. I., Forest

Research Institute ; Im., Imago ; km., kilometre ; lat., latitude ; long., longitude ; lit., literature ; m., metre ; max., maximum ; min., minimum ; mm., millimetre N., North ; NW., North-west ; NE., North-east ; Ny., nymph ; Psw., Pseudoworkers ; Rly., railway ; S., Soldier ; S., South ; SE., South-east ; sev., several ; Stn., station ; SW., South-west ; vill., village ; W., worker ; W. B., West Bengal ; Z. S. I., Zoological Survey of India.

KEY, SYSTEMATIC ACCOUNT AND ZOOGEOGRAPHY

Key for identification :

(The character and measurement of the species marked with asterisk are cited from literature)

(i) *Key based on imago characters **

- | | | | |
|--------|---|-----|------------------------|
| A (B). | Fontanelle absent | ... | Family KALOTERMITIDAE |
| 1 (4) | Anterior cutting edge of second marginal tooth of left mandible almost as long as posterior cutting edge of first marginal tooth ; median vein extending upto tip of wing-membrane | | |
| 2 (3) | Anterior margin of forewing scale strongly convex, radial sector with several branches to costal margin of wing ; median vein not as strongly sclerotized as radial sector and radius | ... | Genus <i>Neotermes</i> |
| a (b) | Head-capsule slightly broader than long ; ocelli broadly touching the ocular sclerite ; pronotum with anterior margin deeply concave ; subcosta in forewing longer extending upto proximal 1/4th of wing membrane without scale | ... | <i>N. bosei</i> Snyder |

*The imago caste is unknown to the following species which have been excluded from the key. The species are : *Neotermes kalimpongensis* Maiti, *N. mangiferae* Roonwal & Sen-Sarma, *Glyptotermes krishani* Maiti & Chakraborty, *G. sensarmai* Maiti, *Coptotermes kishori* Roonwal & Chhotani, *Parrhinotermes khasii* Roonwal & Sen-Sarma, *Stylotermes parabengalensis* Maiti, *Erytermes buddha* Bose & Maiti, *Speculitermes deccanensis paivai* Roonwal & Chhotani, *Euhamitermes chhotani* sp. nov., *Angulitermes longifrons* sp. nov., *Pericapritermes dunensis* (Roonwal & Sen-Sarma), *P. tetraphilus* (Silvestri), *Macrotermes khajurii* Roonwal & Chhotani, *Nasutitermes gardneri* Snyder, *N. jalpaiguriensis* Prasad & Sen-Sarma, *N. sukensis* Prasad & Sen-Sarma and *Bulbitermes emersoni* Maiti.

- b (a) Head-capsule as long as broad ; ocelli weakly touching the ocular sclerite ; pronotum with anterior margin weakly concave ; subcosta in forewing much shorter extending upto only 1/8th of wing membrane without scale ... *N. buxensis* Roonwal & Sen-Sarma
- 3 (2) Anterior margin of forewing scale almost straight, radial-sector without any branches to costal margin of wing, median vein as strongly sclerotized as radial sector and radius. ... Genus *Glyptotermes*
- a (b) Head subsquarish, head-length 0.77-0.88, head-width 0.73-0.80 mm. ; antennae with 11-12 segments ; pronotum with anterior margin broadly and deeply concave ... *G. caudomunitus* Kemner
- b (a) Head suboval ; head-length upto tip of labrum 1.31-1.50, head-width 1.09-1.13 mm ; antennae with 13-15 segments ; pronotum with anterior margin weakly concave ... *G. chinpingensis* Tsai & Chen
- 4 (1) Anterior cutting edge of second marginal tooth of left mandible nearly twice as long as posterior cutting edge of first marginal tooth, median vein bending up to join radial sector in middle or beyond the middle of wing-membrane ... Genus *Cryptotermes*
- a (b) Pronotum shallowly concave anteriorly, not notched ; eyes comparatively large ; antennae with 16-18 segments ... *C. dudleyi* Banks
- b (a) Pronotum deeply and angularly notched anteriorly ; eyes comparatively small ; antennae with 14 segments ... *C. havilandi* (Sjöstedt)
- B (A). Fontanelle present
- C (D). Right mandible with a distinct subsidiary tooth at base of anterior cutting edge of first marginal tooth, left mandible with three marginal teeth. ... Family REINOTERMITIDAE
- 5 (6) Second marginal tooth of left mandible as long as first ... Genus *Reticulitermes*
Head dark-brown, subcircular ; ocelli oval, separated from the eye by almost its long diameter ; antennae with 18 segments ; pronotum with a weak median notch anteriorly ... *R. assamensis* Gardner
- 6 (5) Second marginal tooth of left mandible distinctly longer than first.

- 7 (8) Head parallel sided, ocelli dot-like ... Genus *Heterotermes*
 Head-length 0.81-0.85, head-width 0.88-0.92 mm ; second antennal segment longer than third ; pronotum not indented anteriorly ... *H. indicola* (Wasmann)
- 8 (7) Head subcircular or broadly oval ; ocelli larger
- 9 (10) Clypeus not greatly enlarged, apical tooth of left mandible much longer than first marginal ... Genus *Coptotermes*
- a (b) Head-width 1.29-1.36 mm ; pronotum larger, length 0.71-0.78, width 1.19-1.25 mm ... *C. heimi* (Wasmann)
- b (a) Head-width 1.18 mm. ; pronotum smaller, length 0.61, width 1.06 mm ... *C. travians* Haviland
- 10 (9). Clypeus considerably enlarged, apical tooth of the left mandible distinctly shorter than first marginal ... Genus *Parrhinotermes*
 ... *P. khasii* Roonwal and Sen-Sarma*†
- D (C). Right mandible without subsidiary tooth ; left mandible with two marginal teeth, never with three ... Family TERMITIDAE
- 11 (20). Posterior margin of the second marginal tooth of right mandible concave (except in *Synhamitermes* and *Microcerotermes*)
- 12 (17). Right mandible with a deep cut in between first and second marginal teeth
- 13 (14). Head with a large ocellus-like median spot ; left mandible with sharp deep cut margin in between first and second marginal teeth ; right mandible with posterior edge of second marginal tooth distinctly concave ... Genus *Speculitermes*
 Small species ; head-length 0.97-1.00, head-width 1.25-1.27 mm. ; mid-dorsal spot large (0.17-0.20 mm. diameter) ; Y-suture indistinct ; ocelli separated from the eyes by their half of maximum diameter ; pronotum without a median notch ... *S. roonwali* sp. nov.
- 14 (15). Head without large median spot ; left mandible with concave cut in between first and second marginal teeth, right mandible with posterior edge of second marginal tooth substraight

*†Imago unknown in *Parrhinotermes khasii* R. & S.

- 15(16). Left mandible with apical tooth distinctly longer than first marginal tooth, angle between them wide; head not exactly parallel sided; antennae with 15 segments. Head broader than long; ocelli separated from eyes by much less than their maximum diameter; anterior margin of pronotum without any median notch ... Genus *Synhamitermes*
- ... *S. quadriceps* (Wasmann)
- 16(15). Left mandible with apical tooth smaller than first marginal tooth, angle between them narrower; head parallel sided; antennae with 13-14 segments ... Genus *Microcerotermes*
- a (b). Ocelli short and oval, separated from the eyes by their maximum diameter; pronotum slightly more than one-and-a-half times as wide as long ... *M. cameroni* Snyder
- b (a). Ocelli elongately oval, separated from the eyes by about half their maximum diameter; pronotum a little less than one-and-a-half times as wide as long ... *M. beesoni* Snyder
- 17 (2). Right mandible with a shallow concave cut in between first and second marginal teeth
- 18(19). Fontanelle usually long, narrow and slit-like, short diameter 0.05 mm ... Genus *Dicuspiditermes*
- Head-length 1.33, head-width 1.22-1.29 mm.; ocelli separated from the eyes by less than their long diameter; pronotum without any median notch anteriorly ... *D. incola** (Wasmann)
- 19 (18). Fontanelle large and oval, short diameter 0.05-0.10 mm ... Genus *Pericapritermes*
- Head-length to tip of labrum 1.14-1.18, head-width 1.14-1.18 mm.; ocelli separated from the eyes by about half their diameter; postclypeus with anterior margin straight ... *P. ceylonicus* Holmgren*
- 20(11). Posterior margin of the second marginal tooth of right mandible always straight
- 21(28). Left mandible with a deep cut in between first and second marginal teeth
- 22(23). Right mandible with a small subsidiary tooth at base of anterior cutting edge of first marginal tooth; large species ... Genus *Macrotermes*
- a (b). Larger species; head-width 2.93, pronotum-width 2.81 mm.; ocelli separated from the eyes by their short diameter; postclypeus almost half as long as wide ... *M. estherae* (Desneus)*

- b (a). Smaller species ; head-width 2.13-2.51 ; pronotum width 2.36-2.60 mm. ; ocelli separated from the eyes by much less than their short diameter ; postclypeus less than half as long as wide ... *M. gilvus* (Hagen)*
- 23(22). Right mandible without any subsidiary tooth
- 24(27). Wings moderately long ; postclypeus almost of same colour as head-capsule ; antennae with 19-20 segments
- 25(26). Left mandible with a deep cut between 2nd marginal tooth and molar plate : fontanelle raised ... Genus *Odontotermes*
- a (h). Ocelli separated from the eyes by their long diameter or more.
- b (e). Postclypeus about twice as broad as long
- c (d). Pronotum wider, width of pronotum 2.39-2.51 mm ... *O. gurdaspurensis* Holmgren & Holmgren*
- d (c). Pronotum narrower, width of pronotum 2.12-2.37 mm ... *O. parvidens* Holmgren and Holmgren
- e (b). Postclypeus more than twice as broad as long
- f (g). Eyes smaller (maximum diameter 0.55-0.58 mm.) ; pronotum without any emargination both anteriorly and posteriorly ... *O. assmuthi* Holmgren*
- g (f). Eyes larger (maximum diameter 0.58-0.65 mm) ; pronotum with weak emargination both anteriorly and posteriorly ... *O. redemanni* (Wasmann)
- h (a). Ocelli separated from the eyes by about half their long diameter
- i (j). Wings hairy on apical one-fourth ; head dark-brown ; second antennal segment a little longer than third ... *O. horni* (Wasmann)
- j (i). Wings hairy on apical half ; head light castaneous-brown ; second antennal segment almost twice as long as third ... *O. feae* (Wasmann)*
- 26 (25). Left mandible with shallow cut between 2nd marginal tooth and molar plate ; fontanelle not raised ... Genus *Hypotermes*
- a (b). Head wider, head-width 2.28 mm ... *H. obscuriceps* (Wasmann)*
- b (a). Head narrower, head-width 1.89-1.90 mm ... *H. xenotermitis* (Wasmann)*

- 27 (24). Wings unusually long ; postclypeus much paler than rest of head capsule ; antennae with 15-18 segments ... Genus *Microtermes*
- Head almost as long as broad ; ocelli separated from the eyes by almost half their short diameter ; pronotum a little paler and narrower than head, with a weak median notch anteriorly ... *M. obesi* Holmgren
- 28 (21). Left mandible with a concave margin in between first and second marginal teeth. Postclypeus slightly shorter than half its width, strongly arched ; left mandible with the apical and the first marginal teeth subequal and closely placed ... Genus *Trinervitermes*
- Pronotum slightly indented posteriorly ; length of head to lateral base of mandibles 1.20-1.42, width 1.52-1.87 mm. ; length of pronotum 0.92-1.12, width 1.52-1.82 mm ... *T. biformis* (Wasmann)
- (ii) *Key based on soldier characters**
- A (B). Fontanelle absent. ... Family **KALOTERMITIDAE**
- 1 (2). Head highly phragmotic, short, thick and truncated in front ; mandibles comparatively short ... Genus *Cryptotermes*
- a (b). Larger species, head-length 1.40-1.49, head-width 1.23-1.30 mm. ; frontal ridge pushed back and with a median cleft ; mandible longer and narrower ; left mandible with three marginal teeth ... *C. dudleyi* Banks
- b (a). Smaller species, head-length 1.12-1.25, head-width 1.03-1.25 mm. ; frontal ridge lying in front and without a median cleft ; mandible shorter and broader at base ; left mandible with only one marginal tooth ... *C. havilandi* (Sjöstedt)
- 2 (1). Head generally smooth and not sharply truncated in front except in *Glyptotermes krishnai* ; mandible comparatively longer
- 3 (4). Frons bilobed forming V- or U-shaped depression, sloping in front and with distinct anterolateral prominences ; mandibles relatively short ; smaller species ... Genus *Glyptotermes*

*The soldier caste of the species, *Speculitermes deccanensis paivai* Roonwal and Chhotani and *S. roonwali* sp. nov. is unknown, for which these species have been excluded from the key.

- a (b). Head sharply truncated in front ; fore-tibia with a large, thick and conspicuous spur on outer side, much thicker and larger than the inner two ... *G. krishnai* Maiti and Chakrabarty
- b (a). Head gradually sloping in front, fore-tibia with the outer spur as thick and large as the inner two.
- c (f). Smaller species ; head-length 1.23-1.55, head-width 0.85-1.20 mm. ; 10th tergite highly sclerotised and brownish in colour.
- d (e). Head with prominent anterolateral corners ; head-length 1.23-1.25, head-width 0.85-0.87 mm. ; mandibles shorter than half the head-length, head-mandibular length index 0.41-0.42. ... *G. caudomunitus* Kemner
- e (d). Head with weakly projecting out anterolateral corners ; head-length 1.34-1.55, head-width 0.94-1.20 mm. ; mandibles almost half of the head-length, head-mandibular index 0.46-0.49. ... *G. sensarmai* Maiti
- f (c) Larger species ; head-length 2.05-2.27, head-width 1.25-1.40 mm. ; 10th tergite not sclerotised. ... *G. chinpingensis* Tsai and Chen
- 4 (3). Frons not bilobed, weakly sloping in front and with indistinct anterolateral prominences ; mandibles relatively long ; larger species. ... Genus *Neotermes*
- a (d). Head larger ; head-length 3.80-4.20, head-width 2.49-2.80 mm. ; head-capsule elongate, diverging anteriorly ; pronotum as wide as or wider than head-capsule, pronotum-head-width index (i. e. pronotum-width/head-width) 1.00-1.15.
- b (c). Head-capsule elongately rectangular, head-index (width/length) 0.59-0.65 ; Y-suture indistinct. ... *N. buxensis* Roonwal and Sen-Sarma
- c (b). Head-capsule broadly rectangular, head index 0.64-0.75 ; Y-suture prominent ... *N. kalimpongensis* Maiti
- d (a). Head smaller ; head-length 2.97-3.68, head-width 2.28-2.52 mm. ; head-capsule subquarish to rectangular, converging anteriorly ; pronotum narrower than head-capsule, pronotum-head-width index 0.84-1.00

- e (f). Left mandible with a deep notch in between 1st and 2nd marginal teeth ; anterior margin of labrum substraight ; lateral margins of pronotum rounded ... *N. bosei* Snyder
- f (e). Left mandible with a shallow notch in between 1st and 2nd marginal teeth ; anterior margin of labrum somewhat pointed ; lateral margins of pronotum substraight ... *N. mangiferae*
Roonwal and Sen-Sarma
- B (A). Fontanelle present
C (F). Pronotum flat
D (E). Tarsi with 4-segments ... Family
RHINOTERMITIDAE
- 5 (10). Head subrectangular, parallel-sided ; fontanelle small, circular and lying a little in front of middle of head-dorsum
- 6 (9). Labrum elongate, tapering anteriorly, tip hyaline
- 7 (8). Labrum tongue-shaped with a long needle-like hyaline tip ... Genus *Heterotermes*
Head-length 1.40-1.61 ; head-width 0.84-0.91 mm. ; antennae usually with 15 segments ; pronotum emarginate both anteriorly and posteriorly. ... *H. indicola* (Wasmann)
- 8 (7). Labrum tongue-shaped with short hyaline (not needle-like) tip. ... Genus *Reticulitermes*
Moderately large species ; head-length 1.84-2.00, head-width 1.14-1.19 mm. ; pronotum distinctly emarginate posteriorly. ... *R. assamensis* Gardner
- E (D). Tarsi with 3-segments ... Family
STYLOTERMITIDAE
- 9 (6). Labrum short, semicircular, tip not hyaline ; pronotum crescentic in shape ... Genus *Stylotermes*
- a (b). Larger species, head-length 2.60-2.70, head-width 1.75-1.80 mm. ; mandibles longer in relation to head-length, head-mandibular length index 0.65-0.69 ; anterior margin of pronotum weakly notched medially ... *S. bengalensis* Mathur
& Chhotani*
- b (a). Smaller species, head-length 1.92-2.23, head-width 1.19-1.34 mm. ; mandibles shorter in relation to head-length, head-mandibular length index 0.55-0.59 ; anterior margin of pronotum deeply notched medially ... *S. parabengalensis* Maiti
- 10 (5). Head oval, narrowing in front ; fontanelle either large or small, placed far in front
- 11 (12). Fontanelle large ; labrum with a small pointed hyaline tip ; mandibles without distinct teeth ... Genus *Coptotermes*

- a (b). Smaller species, head-length 1.15-1.19, head-width 0.96-1.10 mm. ; waist of postmentum lying below the middle of the line connecting the level of maximum width and the hind margin ... *C. kishori* Roonwal & Chhotani
- b (a). Large species, head-length 1.20-1.1.37, head-width 1.00-1.27 mm. ; waist of postmentum lying in middle of the line connecting the level of maximum width and the hind margin
- c (d). Minimum width of postmentum greater (0.24-0.33 mm.) ... *C. heimi* (Wasmann)
- d (c). Minimum width of postmentum smaller (0.22-0.24 mm.) ... *C. travians* Haviland
- 12 (11). Fontanelle small, labrum without a hyaline tip ; mandibles with distinct teeth ... Genus *Parrhinotermes*
 Head yellowish brown, head-length 1.25-1.30 mm., head-width 1.00-1.10 mm., antennae with 13 segments. ... *P. khasii* Roonwal & Sen-Sarma
- F (c). Pronotum saddle-shaped, with a prominent anterior lobe ... Family *TERMITIDAE*
- 13 (34). Mandibles strong, well developed and functional ; head not produced into a nasus
- 14(27). Head subquarish to subrectangular ; postmentum narrow, not strongly arched at the middle
- 15(22). Mandibles sabre-shaped, more or less symmetrical, curved at tips and used for biting, each with a tooth or serrations
- 16(21). Mandibles with a tooth on inner margin
- 17(20). Mandibular teeth directed anteriorly, at an angle less than right angle
- 18(19). Mandibles very broad at base, with a large broad tooth on each ... Genus *Euhamitermes*
 Head capsule subrectangular, head-length 1.38-1.42, head-width 1.10-1.11 mm. ; left mandible with a small and right with a large prominent teeth ... *E. chhotanii* sp. nov.
- 19(18). Mandibles not very broad at base, with a small tooth on each ... Genus *Eurytermes*
 Head-capsule diverging anteriorly ; head-length 1.70-1.79, head-width 1.00-1.09 mm. ; postmentum waist narrower, contraction index (width at waist/maximum width) 0.45-0.71 ... *E. buddha* Bose & Maiti

- 20(17). Mandibular teeth directed at right angle to the inner margin of mandibles ... Genus *Synhamitermes*
Mandibles on outer margin concave near the middle, apical half weakly incurved ... *S. quadriceps* (Wasmann)
- 21(16). Mandibles serrated, without any definite dentition ... Genus *Microcerotermes*
a (b). Head pale-brown; pronotum with an indistinct median notch; mandible weakly at apex ... *M. beesoni* Snyder
b (a). Head dark-brown; pronotum with a distinct median notch; mandible comparatively strongly hooked at apex ... *M. cameroni* Snyder
- 22(15). Mandibles either slender rod-like or asymmetrical and used for snapping, or for both snapping and biting, without any tooth or serration
- 23(24). Head with a frontal projection, mandibles long, slender, rod-like; labrum deeply cut ... Genus *Angulitermes*
Frontal projection and antero-lateral projection of head large and prominent; length of head to tip of frontal projection 1.34-1.44, width of head 0.85-0.88 mm ... *A. longifrons* sp. nov.
- 24(23). Head without any frontal projection; mandibles distinctly asymmetrical, left twisted, right substraight
- 25(26). Anterolateral corners of head with pointed projections; labrum deeply cut anteriorly with lateral corners produced into long, needle-like projections ... Genus *Dicuspiditermes*
Tip of the left mandible bent inward like a beak; head-length 2.07-2.19, head-width 1.30-1.38 mm ... *D. incola* (Wasmann)
- 26(25). Anterolateral corners of head without any pointed projections; labrum substraight or weakly concave anteriorly ... Genus *Pericapritermes*
a (b). Labrum weakly concave anteriorly Head-length 2.32-2.55 head-width 1.32-1.40 mm. ... *P. dunensis* (Roonwal & Sen-Sarma)
b (a). Labrum almost straight anteriorly
c (d). Smaller species; head almost twice as long as wide, head-length 2.00-2.26, head-width 1.19-1.32 mm. ... *P. ceylonicus* (Holmgren)
d (c). Larger species; head much less than twice as long as wide, head-length 2.42-2.53, head-width 1.32-1.50 mm. ... *P. tetraphilus* (Silvestri)

- 27(14). Head broadly to rectangularly oval, narrowed anteriorly ; postmentum broad, strongly arched at the middle
- 28(31). Mandibles without teeth, basal half of left mandible crenulate
- 29(30). Large species ; labrum with a hyaline tip ; meso- and metanotum prominently expanded laterally ; soldier dimorphic
- ... Genus *Macrotermes*
- a (b). Lateral sides of meso- and metanota broadly rounded. Head-length 1.76, head-width 1.57 mm (soldier, minor)
- ... *M. gilvus* (Hagen)
- b (a). Lateral sides of meso- and metanota angularly rounded
- c (d). Larger species ; head-length 4.45-4.51, head-width 3.90-4.06 mm. ; postmentum slightly wider in the middle than at the anterior end
- ... *M. estherae* (Desneux)
- d (c). Smaller species ; head-length 3.70, head-width 3.00 mm
- ... *M. khajurjai* Roonwal & Chhotani
- 30 (29). Small species ; labrum without a hyaline tip ; meso- and metanota not expanded laterally ; soldier monomorphic
- ... Genus *Hypotermes*
- a (b). Smaller species ; head-length 1.15-1.20, head-width 0.95-1.05 mm. ; labrum oval ; pronotum indistinctly emarginate anteriorly
- ... *H. obscuriceps* (Wasmann)
- b (a). Larger species ; head-length 1.38-1.42, head-width 1.20-1.23 mm. ; labrum broadly rounded apically ; pronotum distinctly emarginate anteriorly
- ... *H. xenotermitis* (Wasmann)
- 31 (28). Left mandible with or without tooth, basal half of left mandible not crenulate
- 32 (33). Large species ; mandibles stout, with a prominent tooth on left mandible ; basal outer margin of mandibles not strongly concave
- ... Genus *Odontotermes*
- a (f). Smaller species ; mandible slender ; tooth on the left mandible lying above the middle
- b (e). Distal articles of the antennae darker than proximal ones ; left mandibular tooth lying at distal third
- c (d). Head rectangularly oval ; head-length 1.53-1.63, head-width 1.30-1.42 mm.
- ... *O. gurdaspurensis* Holmgren & Holmgren
- d (c). Head suboval, narrowed anteriorly ; head-length 1.25-1.57, head-width 1.05-1.30 mm
- ... *O. redemanni* (Wasmann)

- e (b). Distal articles of the antennae not darker than the proximal ones; left mandibular tooth lying a little above the middle; head subrectangular; head-length 1.60-1.75, head-width 1.17-1.30 mm.; mandibles short and stout; pronotum with weak median notch on anterior margin ... *O. assmuthi* Holmgren
- f (a). Larger species; mandibles stout; tooth on the left mandible lying at or below the middle
- g (h). Tooth on the left mandible minute and placed on the basal third ... *O. parvidens* (Holmgren & Holmgren)
- h (g). Tooth on the left mandible large, prominent and placed near the middle
- i (j). Head somewhat rectangular, tip of labrum not pointed; pronotum slightly indented on anterior margin ... *O. horni* (Wasmann)
- j (i). Head distinctly narrowed anteriorly; tip of labrum pointed; pronotum deeply indented on anterior margin ... *O. feae* (Wasmann)
- 33(32). Small species (soldiers much smaller than workers); mandibles thin, with or without denticles; basal outer margin of mandibles strongly concave ... **Genus Microtermes**
- Head moderately hairy; head-length 0.74-0.88 mm, head-width 0.70-0.80 mm; second segment of antennae as long as third and fourth combined; labrum lanceolate-shape; pronotum with deep median notch on anterior margin *M. obesi* Holmgren
- 34(13). Mandibles degenerate, non-functional; head produced into a nasus
- 35(36). Head distinctly constricted behind the antennae; apical spine-like lateral process of mandibles sometimes with a minute tooth (absent in *B. emersoni* Maiti) ... **Genus Bulbitermes**
- Head fairly bulging out laterally; in profile, dorsal margin of head incurved, basal hump fairly prominent; nasus cylindrical; posterior margin of head with an indistinct median emargination ... *B. emersoni* Maiti
- 36(35). Head weakly or not constricted behind the antennae; apical spine-like lateral process of mandibles, if present, neither specially developed nor dentate.
- 37(38). Soldier monomorphic ... **Genus Nasutitermes**

- a (b). Mandibles without any spine-like lateral process ; rostrum darker than head-capsule ; head-dorsum, in profile, with a distinct but shallow concavity behind the rostrum ; rostral-hump weak but prominent ; 3rd antennal segment one-and-a-half to two times as long as 2nd ... *N. gardneri* Snyder
- b (a). Mandible with a spine-like lateral process.
- c (d). Head without any marked constriction behind the antennae ; rostral hump absent ; spine-like process of mandibles long ... *N. garoensis* Roonwal & Chhotani
- d (c). Head with a shallow constriction behind the antennae ; rostral-hump weak but prominent ; spine-like process of mandibles short
- e (f). Head with a minute projection on either side of the base of rostrum ; antennae with 12 segments ... *N. jalpaiguriensis* Prashad & Sen-Sarma
- f (e). Head with projection at the base of rostrum ; antennae with 13 segments ... *N. suknensis* Prashad & Sen-Sarma*
- 38(37). Soldier dimorphic ... Genus *Trinervitermes*
 Rostrum reddish-brown to dark-brown, apex reddish-brown ; posterior bulge of head prominent ; head-length with rostrum 2.25-2.32, head-width 1.29-1.36 mm. (soldier major) ... *T. biformis* (Wasmann)

SYSTEMATIC ACCOUNT

(Maps 2, 3 and 4)

Family I. KALOTERMITIDAE

Genus (1) *Neotermes* Holmgren, 19111. *Neotermes bosei* Snyder

(Fig. 1. Imago, a-c ; Soldier, d and e)

1933. *Kalotermes (Neotermes) bosei* T. E. Snyder, *Proc. U. S. nat. Mus.* 82(16) ; 2-3. S. and Ny. of *Im. Type-locality*. Uttar Pradesh, Mathranwala, ca. 11 km. S. of Dehra Dun.
1949. *Neotermes bosei*, T. E. Snyder, *Smith. misc. Coll.*, 112 : 22, *Im.* and S. India.

1960. *Neotermes bosei*, M.L. Roonwal and P.K. Sen-Sarma, *Indian Counc. agric. Res., Ent. Monogr. No. 1*, 152-161. Im., S. and Psw. India : Uttar Pradesh, Dehra Dun, and its vicinity, ca. 610 m ; West Bengal, Samsing, ca. 550 m.
1961. *Neotermes bosei*, K. Krishna, *Bull. Amer. Mus. nat. Hist.*, 122 (4) :
1977. *Neotermes bosei* M. L. Roonwal and O. B. Chhotani, *Ent. Basil.*, 2 : 44-45. Im. Bhutan.

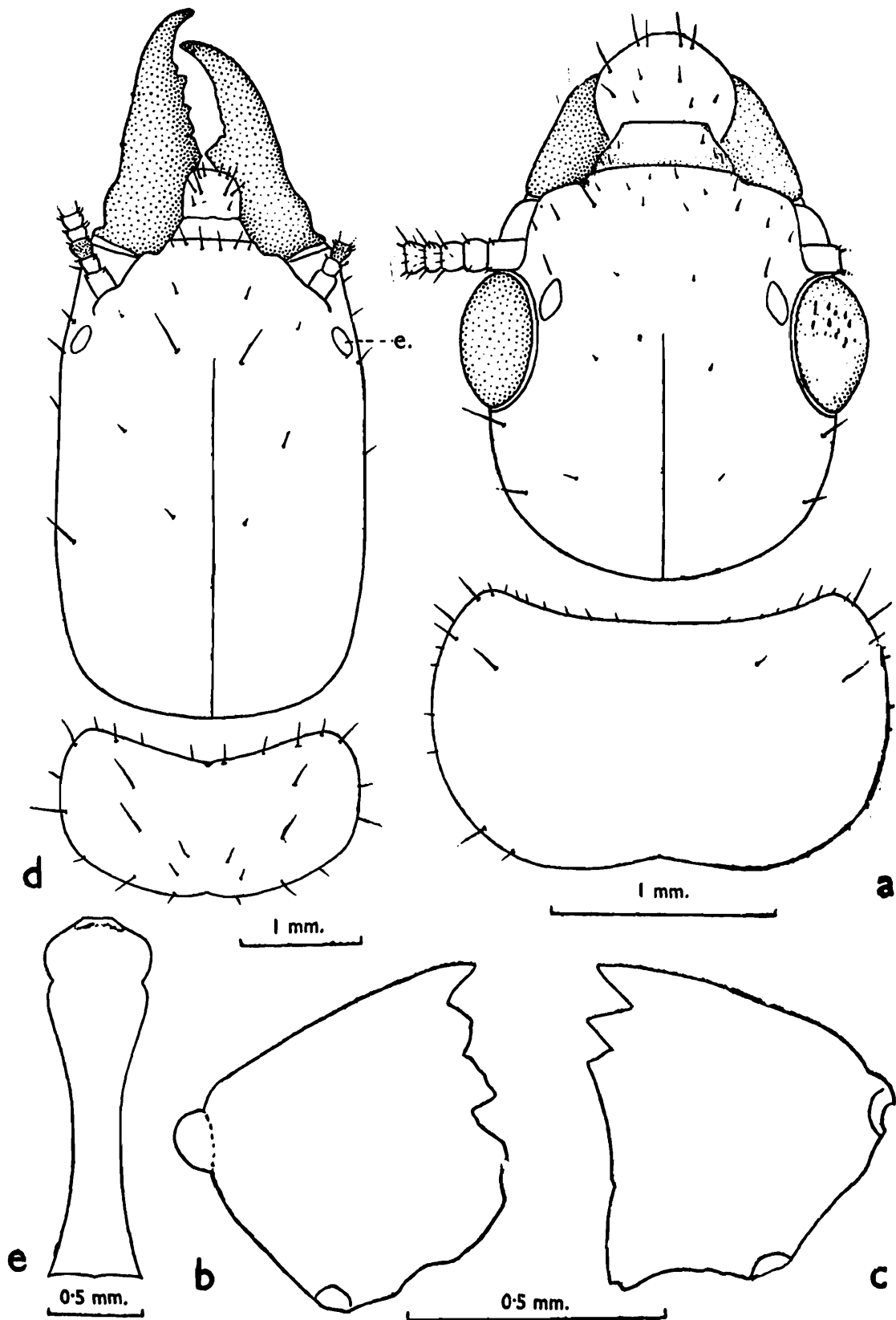


Fig. 1. *Neotermes bosei* Snyder
Specimens from Murti Beat (Jalpaiguri Dist.), P. K. Maiti coll., 7.xi.1966
a-c, Imago. a, Head and pronotum ; b, left mandible ; d and e, Soldier. d, dead and pronotum ; e, Postmentum

Material.—(i) A vial (No. M₈/7.11.66) with 2 Im. (1 deal. and 1 winged), 3 S. and sev. Psw., Murti Beat, E. bank of the river Murti, 10 km. W. of Nagrakata Rly. Stn., Chalsa Forest Range, Jalpaiguri Dist., *P. K. Maiti coll.*, 7. xi. 1966, ex. “standing dead mango (*Mangifera indica* Linn.) tree”. (ii) A vial (No. M₈/11.11.66) with 2 S. and sev. Psw., Khagribari, Atiamocher Beat, Cooch Behar Forest Range, Cooch Behar Dist., *P. K. Maiti coll.*, 11. xi. 1966, ex. “branch of a live mango (*Mangifera indica* Linn.) tree”.

Measurements (in mm.), etc.—(i) *Imagos* (2 exs.) : Body-length (without wings) 10.47-11.30 ; Body-length (with wings) 15.50 ; Length of head to lateral base of mandibles 1.60-1.90 ; Max. width of head (with eyes) 1.80-2.00 ; Max. diameter of compound eye (with ocular sclerite) 0.60-0.64 ; Max. diameter of lateral ocellus 0.24-0.26 ; Min. eye-ocellus distance nil ; Max. length of pronotum 1.04-1.20 ; Max. width of pronotum 2.00-2.16 ; Length of forewing (with scale) 13.00 ; Length of hindwing (with scale) 11.92 ; No. of antennal segments 17-18. (ii) *Soldiers* (5 exs.).—Body length 10.29-11.92 : Length of head to lateral base of mandibles 2.97-3.68 ; Max. width of head 2.28-2.52 ; Length of left mandible 1.80-2.00 ; Max. diameter of eye 0.23-0.29 ; Min. (median) length of postmentum 2.34-2.88 ; Max. width of postmentum 0.77-0.82 ; Max. length of pronotum 1.10-1.20 ; Max. width of pronotum 2.10-2.42 ; No. of antennal segments 16.

Distribution.—*West Bengal* : Cooch Behar Dist., Cooch Behar Forest Range, Atiamocher Beat ; Jalpaiguri Dist., Chalsa Forest Range, Murti Beat (both present record) ; and Samsing (alt. 550 m.) and Bagdogra. *Elsewhere* : *India* : Uttar Pradesh : Dehra Dun (alt. 610 m.) and its vicinity ; Mathranwala, ca. 10 km. S. of Dehra Dun town (type-locality) and *Bhutan*.

Taxonomic Remarks.—The shape of the eyes of soldier varies from oval to elongately oval. The postmentum with its anterior broader part is distinctly to indistinctly bilobed laterally.

Biology.—In West Bengal, the species has been recorded from a dead standing mango tree, *Mangifera indica* at Murti forest, Jalpaiguri District, and from a living mango tree at Atiamocher Forest, Cooch Behar District. Though the species generally bores through dry and rotten portions of wood in standing trees, the adjoining living tissues are not neglected. The species usually makes an irregular network of interconnected, flattened tunnels which lie mostly in the heartwood of the host species. The diameter of these tunnels in cross-section, is usually

about 25-30 mm. and at places are filled with pellets of excreta cemented together along with some wood dust. The faecal pellets are tiny reddish brown, subcylindrical and without any distinct longitudinal ridges, measuring about 3—5 mm. in length.

A piece of wood infested by the species was brought to the laboratory in the month of December, 1966 and kept in the rearing chamber. The emergence of a single alate has been recorded in the first week of February, 1967 after which the colony could not survive due to certain unknown reasons.

2. *Neotermes buxensis* Roonwal and Sen-Sarma (Fig. 2. Imago, a-c ; Soldier, d-f)

1960. *Neotermes buxensis* M. L. Roonwal and P. K. Sen-Sarma, *Indian Council. Agric. Res., Ent. Monogr.* No. 1, 161-166. *Im., S. and Psw.* Type-locality : India : West Bengal : Buxa Forest Division.

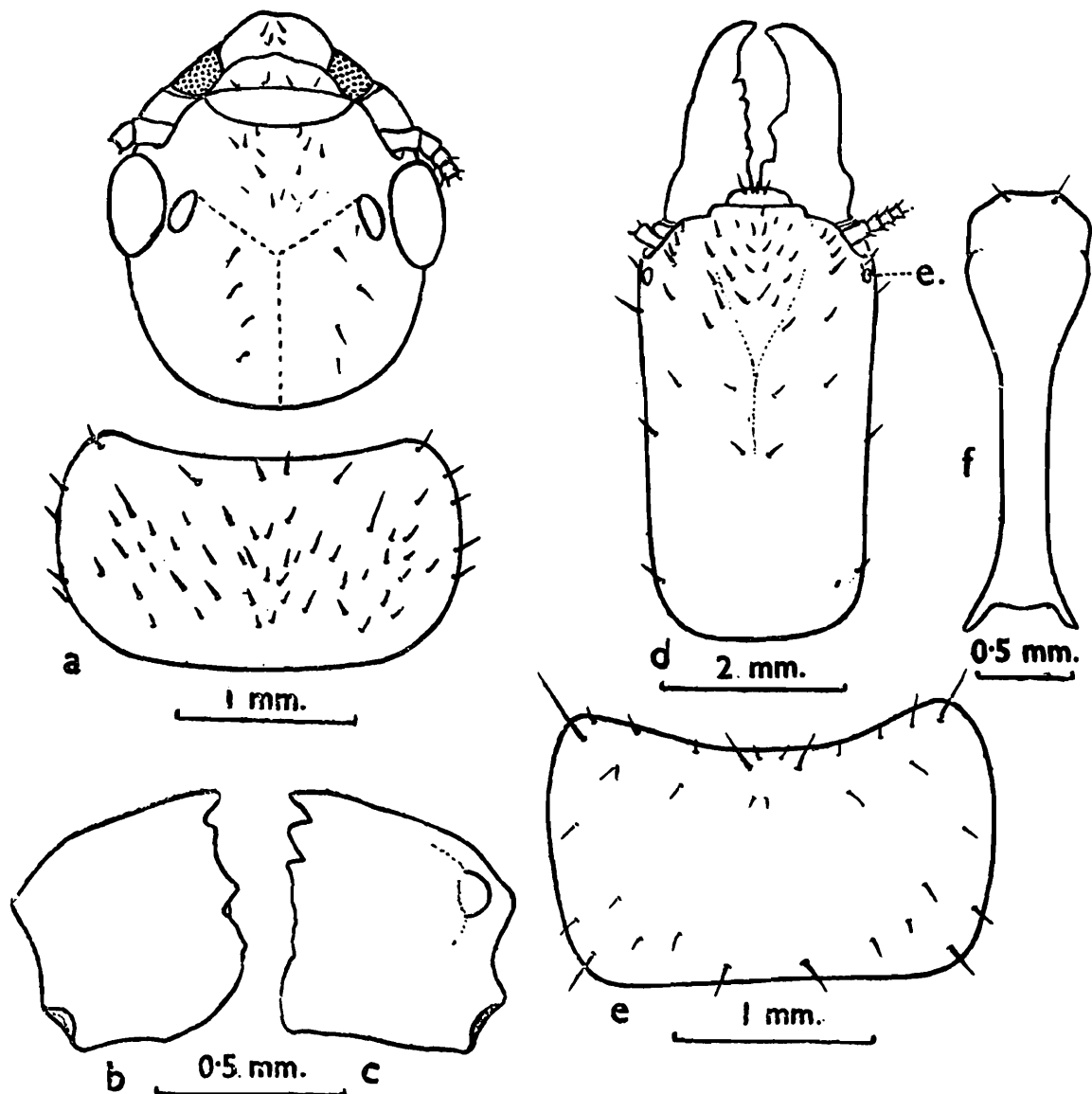


Fig. 2. *Neotermes buxensis* Roonwal and Sen-Sarma (After Roonwal and Sen-Sarma, 1960)

a-c, Imago. a, Head and pronotum ; b, left mandible ; c, right mandible
d-f, Soldier. d, Head ; e, pronotum ; f, postmentum

[Roonwal and Sen-Sarma (1960) described this species based on the specimens collected from Buxa Forest Division. These specimens were originally determined by Snyder (1934) as *Neotermes bosei*]

(a) *Material*.—Paratype soldier, deposited in Z. S. I., Calcutta.

(b) *Measurements* (in mm.), etc.—(i) *Imago* : Body length (without wings) 8-50 ; Body length (with wings) 16-30 ; Length of head to lateral base of mandibles 1.90 ; Max. width of head (with eyes) 1.90 ; Max. diameter of compound eye (with ocular sclerite) 0.65 ; Max. diameter of lateral ocellus 0.23 ; Min. eye-ocellus distance 0.012 ; Max. length of pronotum 1.10 ; Max. width of pronotum 2.20 ; Length of forewing (with scale) 13.90 ; Length of hind wing (with scale) 13.10. (ii) *Soldier* (Paratype) : Body length 13.15 ; Length of head to lateral base of mandibles 4.10 ; Max. width of head 2.49 ; Length of left mandible 2.00 ; Max. diameter of eye 0.30 ; Min. (median) length of postmentum 2.95 ; Max. width of postmentum 0.90 ; Max. length of pronotum 1.35 ; Max. width of pronotum 2.55 ; No. of antennal segments 14.

Distribution.—*West Bengal* : Jalpaiguri Dist., Buxa Forest Division (type-locality) and Darjeeling Dist., Bagdogra : *Elsewhere* : None.

Biology : Not known.

3. *Neotermes kalimpongensis* Maiti

1974. *Neotermes kalimpongensis* P. K. Maiti, *Oriental Ins.*, 9 (2) : 139-143. S. and W.
Type-locality : India : West Bengal, Kalimpong, Bong Basti.

Material.—A vial (No. M1/3,11.66) with 4S. and sev. Psw., Bong basti, Kalimpong, Darjeeling Dist., P. K. Maiti coll., 3.xi. 1966, ex. 'trunk of a log of big live (*Ficus* sp.) tree'.

Measurements (in mm.), etc.—(i) *Imago* : Unknown. (ii) *Soldier* (3 exs.) : Body length including mandibles, ca.13.5-15.4 ; Length of head to lateral base of mandibles 3.80-4.20 ; Max. width of head 2.70-2.80 ; Max. height of head 2.00-2.20 ; Length of left mandible 2.24-2.30 ; Max. diameter of eye 0.32-0.37 ; Min. (median) length of postmentum 2.80-3.00 ; Max. width of postmentum 0.90-0.92 ; Max. length of pronotum 1.37-1.50 ; Max. width of pronotum 2.85-2.90 ; No. of antennal segments 15-16.

Distribution.—*West Bengal* : Darjeeling Dist., Kalimpong, Bong Basti (type-locality). *Elsewhere* : None.

Biology.—*Neotermes kalimpongensis* Maiti is the only species of the genus *Neotermes* recorded so far from higher elevation (1209 m.) in this

state from hilly tracts of Kalimpong. The nest found inside the branch of a live *Ficus* tree, was comprised largely of creamy white pseudo-workers and nymphs, and less of soldiers. The species makes an irregular network of large flattened tunnels which are found mostly in living healthy tissues. The diameter of the tunnels in cross-section usually measures about 30-35 mm. and the tunnels are often found filled at some places with faecal pellets. The pellets are small, blackish brown and subcylindrical, measuring about 5-7 mm in length. The habit of causing extensive damage to living plants indicates that the species is economically important,

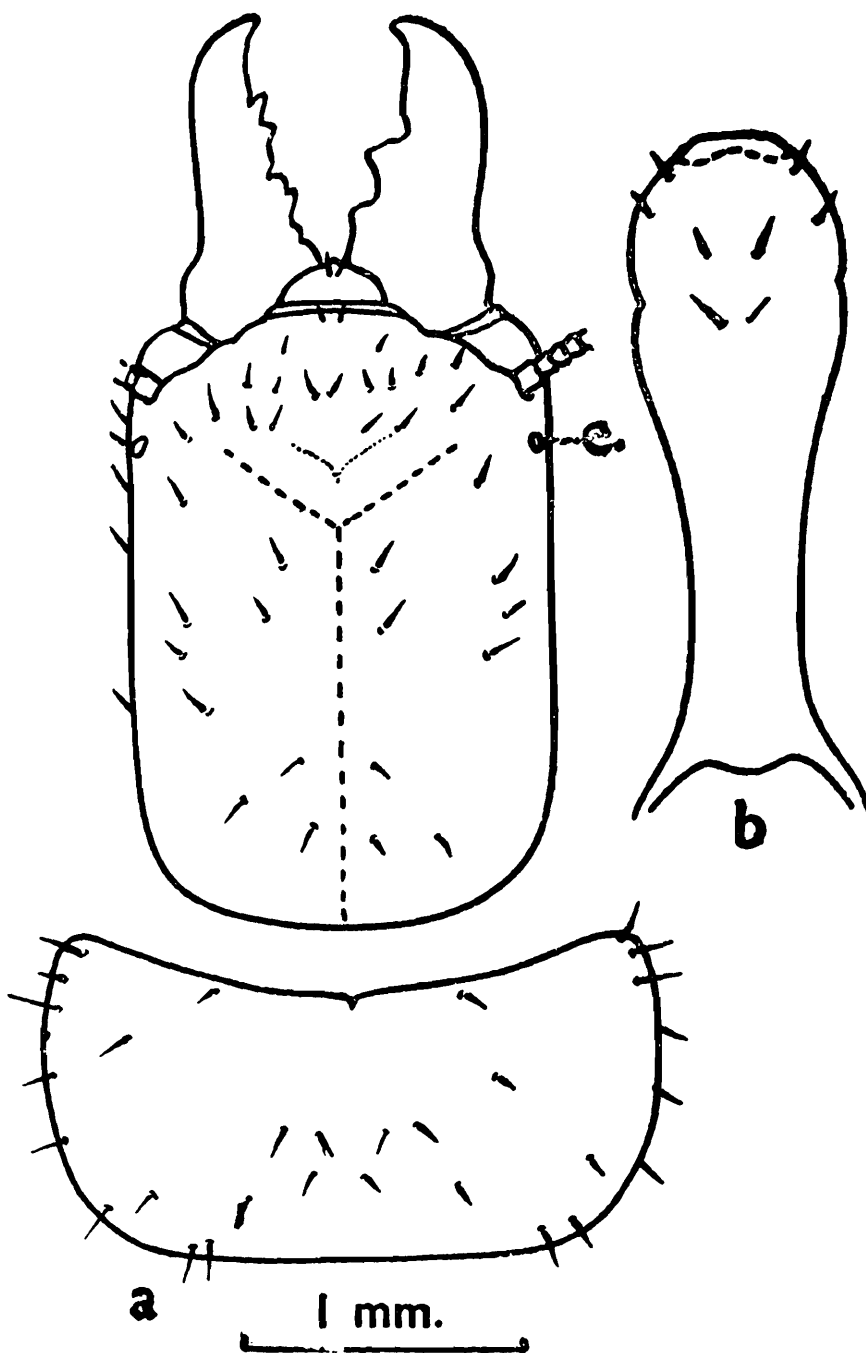


Fig. 3. *Neotermes mangiferae* Roonwal and Sen-Sarma (After Roonwal and Sen-Sarma, 1960)

a and b, Soldier. a, Head and pronotum ; b, postmentum

4. *Neotermes mangiferae* Roonwal and Sen-Sarma

(Fig. 3. Soldier, a and b)

1960. *Neotermes mangiferae* M. L. Roonwal and P. K. Sen-Sarma, *Indian Council. Agric. Res., Ent. Mongr.* No. 1, 208-211, S. and Psw. *Type-locality* : Eastern India (Actually the specimens were collected from a fallen log of *Magnifera indica* Linn. in a timber depot in Calcutta).
1975. *Neotermes mangiferae*, P. K. Sen-Sarma, *et al.*, *Wood Destroying Termites of India*, (F. R. I., Dehra Dun), p. 35, Paratia, Tripura.

Material.—The Paratype soldiers present in Z. S. I., Calcutta, are examined.

Measurements (in mm.), etc.—(i) *Imago* : Unknown, (ii) *Soldiers* (2 Paratypes). Body length 9.85-10.00 ; Length of head to lateral base of mandibles 3.00-3.10 ; Max. width of head 2.45-2.50 ; Length of left mandible 1.55-1.60 ; Max. diameter of eye 0.25-0.27 ; Min. (median) length of postmentum 2.19-2.32 ; Max. width of postmentum 0.75-0.82 ; Max. length of pronotum 1.10-1.13 ; Max. width of pronotum 2.15-2.25 ; No. of antennal segments 15-16.

Distribution.—*India* : Eastern India (type-locality). The specimens were collected from a fallen log in a timber depot in Calcutta. As the source of log was unknown, Roonwal and Sen-Sarma (1960) designated the type-locality as "Eastern India". *Elsewhere* : Tripura.

Biology.—Not known.

Genus (2) *Glyptotermes* Froggatt, 18965. *Glyptotermes caudomunitus* Kemner

(Fig. 4. Imago, a ; Soldier, b)

1932. *Glyptotermes caudomunitus* N. A. Kemner, *Ent. Tidskr.*, 52 (2-3) : 137-138. *Im.*, S. and W. *Type-locality* : Indonesia : W. Java, Depok.
1949. *Glyptotermes caudomunitus*, T. E. Snyder, *Smith. misc. Coll.*, 112 : 46, *Im.* and S. Java.
1961. *Glyptotermes caudomunitus*, K. Krishna, *Bull. Amer. Mus. nat. Hist.*, 122 : 347.

Material.—A vial (No. M8/4.11.56), with 2S., sev. *Im.* and Psw., Gailikhola Forest (305 m.), 4 km. SW. of Teesta Bridge, Darjeeling Dist., P. K. Maiti coll., 4.xi.1966, ex. "scar at the base of an unidentified tree".

Measurement (in mm.) etc.—(i) *Imago* (10 exs.) : Body length (without wings) 3.90-4.20 ; Body length (with wings) 5.48-6.00 ; Length of head to lateral base of mandibles 0.77-0.88 ; Max. width of head (with eyes) 0.73-0.80 ; Max. diameter of compound eye (with ocular

sclerite) 0.20-0.25 ; Max. diameter of lateral ocellus 0.05-0.09 ; Min. eye-ocellus distance 0.02-0.04 ; Max. length of pronotum 0.42-0.47 ; Max. width of pronotum 0.51-0.59 ; Length of forewing (with scale) 4.67-4.92 ; Length of hindwing (with scale) 3.90-4.40 ; No. of antennal segments 11-12. (ii) *Soldier* (2 exs.) : Body length 4.25-5.20 ; Length of head to lateral base of mandibles 1.23-1.25 ; Max. width of head 0.85-0.87 ; Length of left mandible 0.51-0.55 ; Max. diameter of eye 0.14-0.20 ; Min. (median) length of postmentum 0.80-0.84 ; Max. width of postmentum 0.30-0.35 ; Max. length of pronotum 0.49-0.52 ; Max. width of pronotum 0.77-0.80 ; No. of antennal segments 10-11.

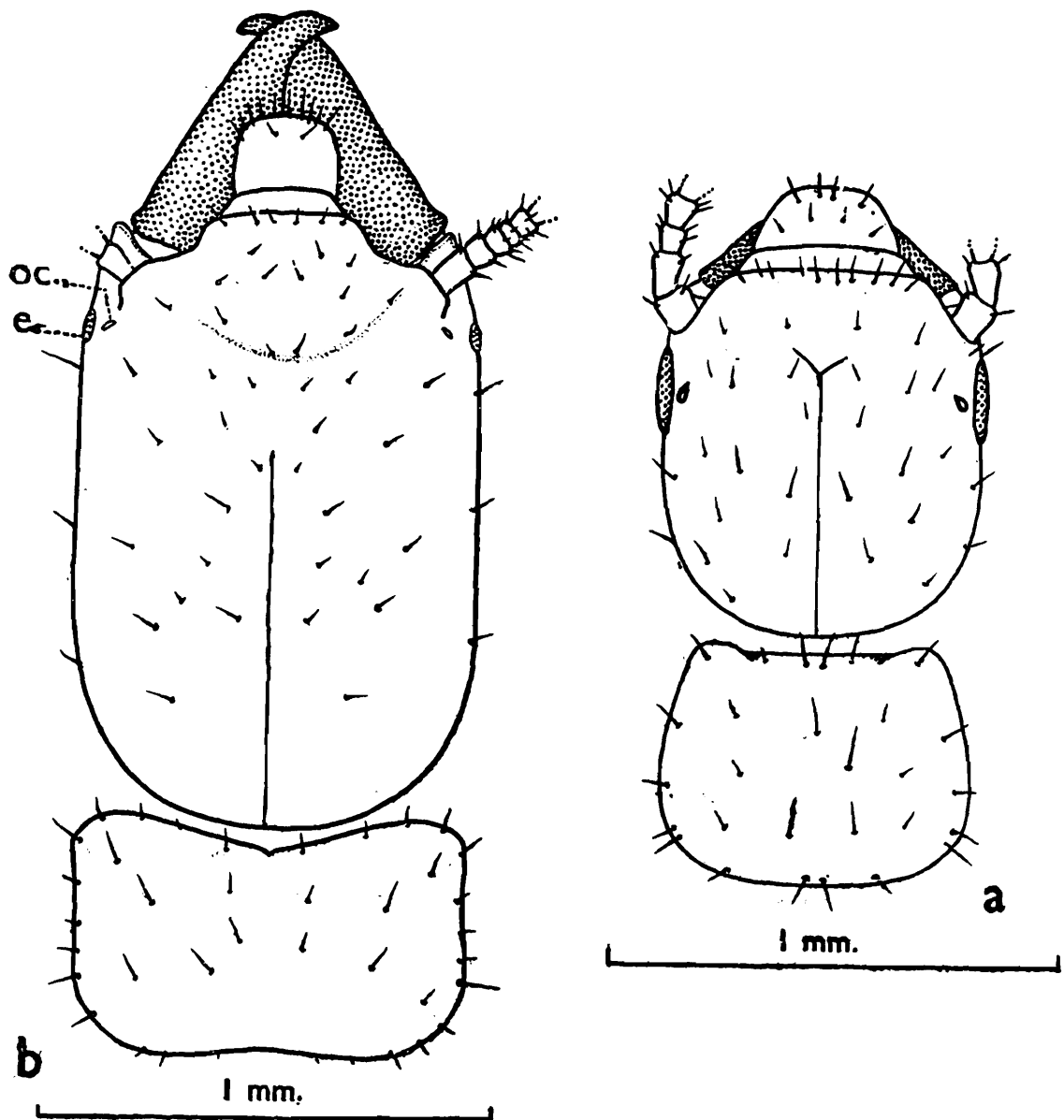


Fig. 4. *Glyptotermes caudomunitus* Kemner
Specimens from Gailikhola Forest (Darjeeling Dist.), P. K. Maiti coll.,
4.xi.1966.

a, Imago. a, Head and pronotum. b, Soldier. b, Head and pronotum

Distribution.—*West Bengal* : Darjeeling Dist., Gailikhola Forest (near Teesta Bridge). Elsewhere : *Indonesia* ; West Java, Depok (type-locality).

Remarks.—The species was originally described from West Java. It is recorded for the first time from India occurring in West Bengal. The soldiers from North Bengal agree with Kemmer's description of soldiers of *G. caudomunitus* except that the antennae of the Indian specimens have 10-11 segments as against 9-10 segments given by Kemmer (1934). The pronotum is also longer than half the width, as against almost half as long as broad given by Kemmer in *G. caudomunitus* from West Java. Dr. K. Krishna has confirmed the identification and compared the imagos from North Bengal with the cotype imago from Java. According to him "the imago from north Bengal has longer pronotum than the imago from Java."

Biology.—The species was found nesting in a rotten portion of the trunk of an unidentified live tree, in the hilly tracts of Darjeeling district. The nest consists of a number of irregular, flattened tunnels which extend even to the healthy tissues of the plant. These tunnels are intercommunicated by small holes.

Though swarming period of the species is unknown, the winged imagos are, however, present in the colony during the month of November.

6. *Glyptotermes chinpingensis* Tsai and Chen

(Fig. 5. Soldier, a and b)

1963 *Glyptotermes chinpingensis* P. H. Tsai and N. S. Chen, *Acta Entom. Sinica*, 12 (2) : 170-172, *Im.* and *S.* *Type-locality* : South China.

Material.—A vial (No. M6/4.11.66), with 6/S. and sev. Psw., Gailikhola Forest, 4 km. SW. of Teesta Bridge (alt. 350 m.), Darjeeling Dist., P. K. Maiti coll., 4.xi.1966, ex. "attacking the base of a standing tree."

Measurements (in mm.,) etc.—(i) *Imagos* (after Tsai and Chen, 1963).—Total length excluding wings 8.85-10.60 ; Length of wings 6.29-7.44 ; Length of head to tip of labrum 1.31-1.50 ; Width of head including eyes 1.03-1.20 ; Length of pronotum 0.61-0.67 ; Width of pronotum 0.97-1.14. (ii) *Soldiers* (6 exs.).—Body-length including mandibles 7.62-8.10 ; Length of head to lateral base of mandible 2.05-2.27 ; Max. width of head 1.25-1.40 ; Length of left mandible 0.93-1.00 ; Max. diameter of eye 0.16-0.20 ; Min. (median) length of postmentum 1.40-1.60 ; Max. width of postmentum 0.43-0.50 ; Max. length of pronotum 0.74-0.85 ; Max. width of pronotum 1.17-1.32 ; No. of antennal segments 13-14.

Distribution.—*West Bengal* : Darjeeling Dist., Gailikhola Forest.
Elsewhere : *South China* (type-locality).

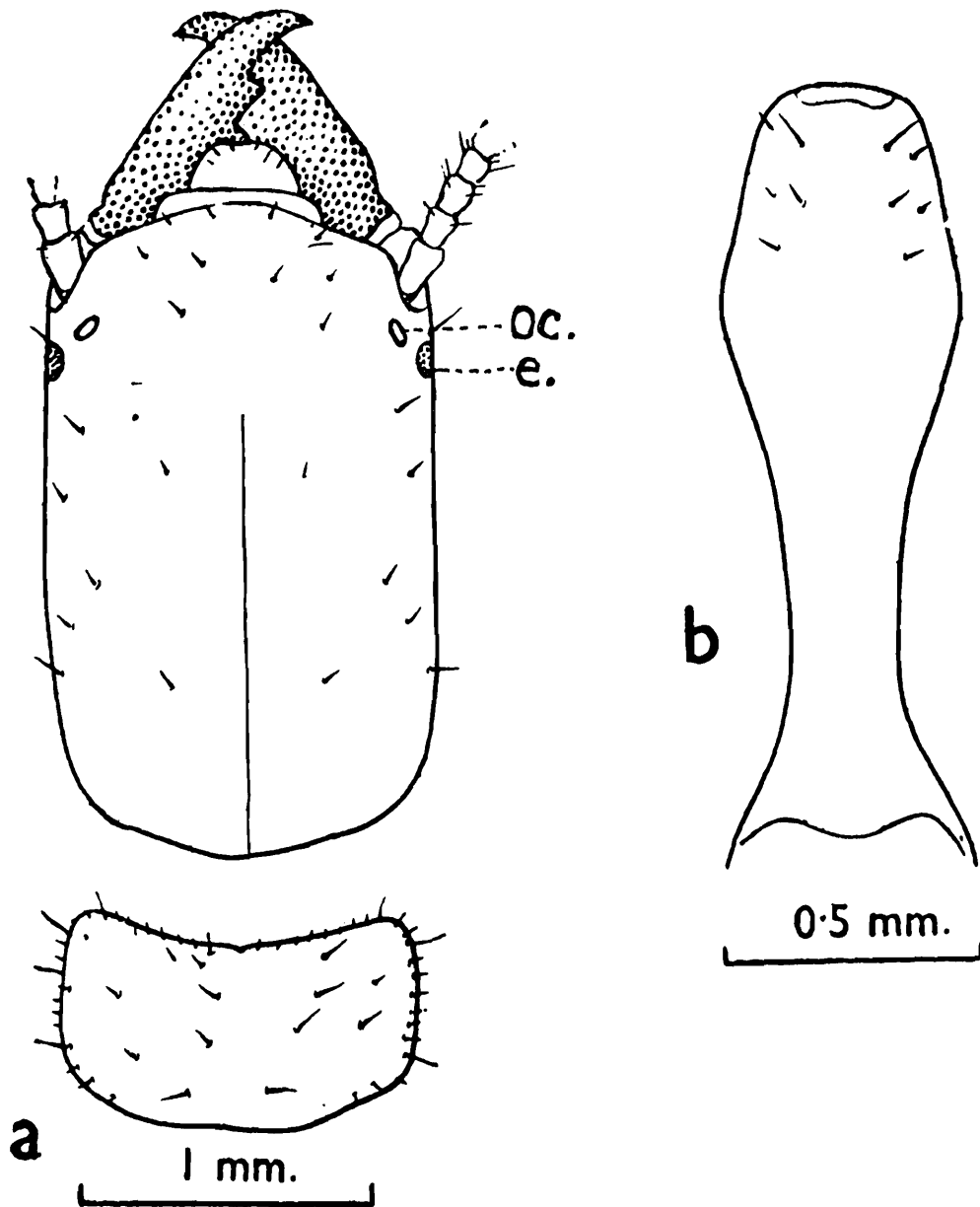


Fig. 5. *Glyptotermes chinpingensis* Tsai and Chen
 Soldier from Gailikhola Forest (Darjeeling Dist.), *P. K. Maiti coll.*, 4.xi.1966.
 a and b, Soldier. a, head and pronotum ; b, postmentum

Biology.—*Glyptotermes chinpingensis* Tsai and Chen has been collected from a moderately large colony around a fire-scar on the trunk of an unidentified tree in Gailikhola forest, Darjeeling Dist. The colony is found about 0.6 m. above the ground level and consisted of narrow tunnels which extended from the exposed sapwood into apparently sound heartwood. These tunnels are irregular and intercommunicated by small holes. The characteristic pellets are packed at some places of the tunnels. The number of soldiers are much less than pseudoworkers and imago-nymphs. No imago is available in the colony during the month of collection.

7. *Glyptotermes krishnai* Maiti and Chakraborty

(Fig. 6, Soldier, a)

1981. *Glyptotermes krishnai* P. K. Maiti and S. Chakraborty, *Bull. zoll. Surv. India*, 4 (1) : 76-80. S and PSW. Type-locality : India : Gt. Nicobar, Indian Ocean.

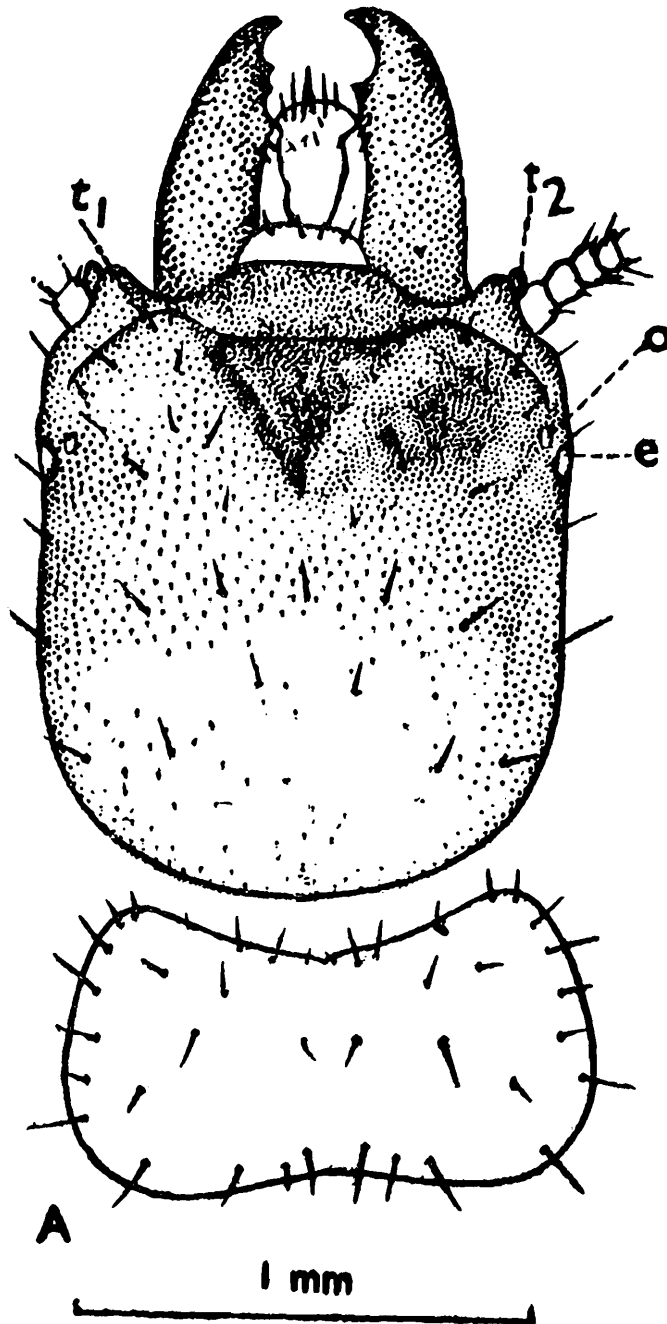


Fig. 6. *Glyptotermes krishnai* Maiti and Chakraborty
 Holotype Soldier from Khagribari (Cooch Behar Dist.), P. K. Maiti coll.,
 11.xi.1966.

Soldier. a, Head and pronotum ;

Material.—A vial (No. M7/11.11.66) with 9S. and sev. Psw. and Im.—Ny., Khagribari, Atiamochar Beat, Cooch Behar Forest Range, Cooch Behar Dist., P. K. Maiti coll., ii. xi. 1966, ex. “decaying log.”

Measurements (in mm.), etc.—(i) *Soldier*.—Length of head to lateral base of mandibles 1.15-1.23 ; Max. width of head 1.15-1.20 ; Max. length of labrum 0.25-0.27 ; Max. width of labrum 0.23-0.26 ; Max. length right mandible 0.62-0.67 ; Min. (median) length of postmentum 0.71-0.76 ; Max. width of postmentum 0.38-0.45 ; Min. width of postmentum (anteriorly) 0.25-0.28 ; Max. length of pronotum 0.67-0.75 ; Max. width of pronotum 1.13-1.22 ; No. of antennal segments 12.

Distribution.—*West Bengal* : Khagribari, Atiamochar Beat, Cooch Behar Forest Range, Cooch Behar Dist., *Elsewhere* : *India* : Great Nicobar Island, Indian Ocean.

Biology.—*Glyptotermes krishnai* is essentially a damp-wood infesting species. It has been collected from an unidentified, decaying log lying in a damp soil in the plain land miscellaneous forest at Atiamochar, Cooch Behar District. The attack is usually confined to the log mainly near the ground-level extending to irregular tunnels, the diameter of which is a little more than that of the head of the soldiers. No imagos are found in the colony in the month of November.

8. *Glyptotermes sensarmai* Maiti

(Fig. 7. Soldier, a-c, Pseudoworker, d-f)

1974. *Glyptotermes sensarmai* P. K. Maiti, *Proc. zool. Soc.*, 27 : 117-122. S. and W. *Type-locality* : *India* : West Bengal, Cooch Behar Dist., Khagribari Forest.

Material.—A vial (No. M₁/11.11.66) with sev. S. Psw. and Im.—Ny ; Khagribari, Atiamochar Beat, Cooch Behar Dist., P. K. Maiti coll. 11. xi. 1966, ex. 'live Sisso tree, *Dalbergia sisso*'.

Measurements (in mm.), etc.—(i) *Imago*.—Unknown (ii) *Soldier* (6 exs.).—Body-length including mandibles, ca. 5.00-7.00 ; Length of head to lateral base of mandibles 1.34-1.50 ; Max. width of head 0.94-1.13 ; Max. length of left mandible 0.65-0.70 ; Max. diameter of eye 0.10-0.13 ; Min. (median) length of postmentum 0.90-1.00 ; Max. width of postmentum 0.37-0.42 ; Max. length of pronotum 0.52-0.61 ; Max. width of pronotum 1.00-1.10 ; No. of antennal segments 12.

Distribution.—*West Bengal* : Cooch Behar Dist., Cooch Behar Forest Range, Atiamochar Beat, Khagribari (*Type-locality*), *Elsewhere* : None.

Biology.—The species has been found inhabiting the trunk of big standing *Dalbergia sissoo* tree at Atiamochar Forest (alt. 40 m.), Cooch

Behar Dist. The colony was confined around a big scar in dead and decaying wood, nearly 0.4 m. above the ground level. The nest is

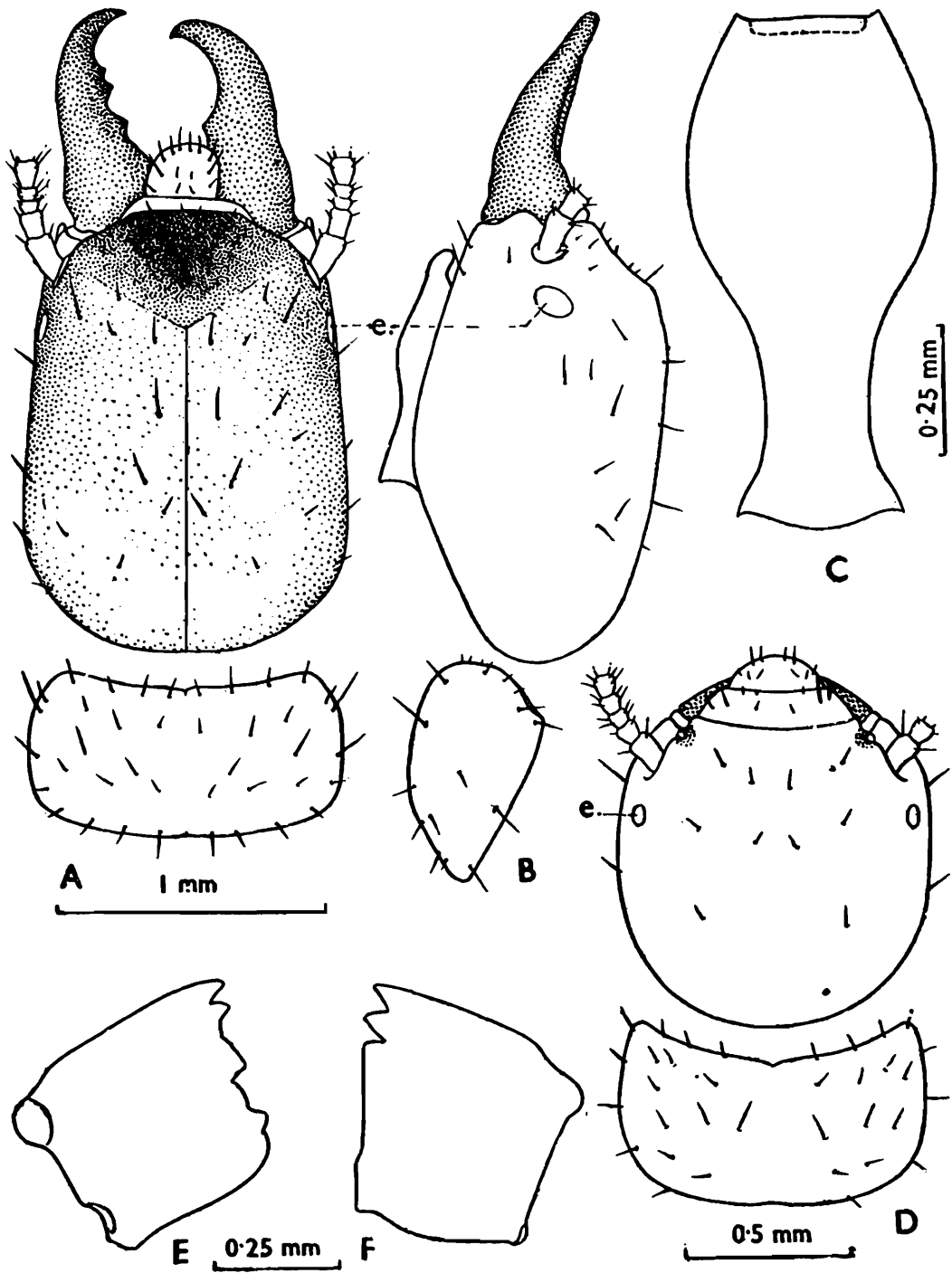


Fig. 7. *Glyptotermes sensarmai* Maiti

Holotype Soldier and paratype pseudoworker from Khagribari (Cooch Behar Dist.), P. K. Maiti coll., 11.xi.1966.

a-c, Soldier. a, Head and pronotum; b, same as in lateral view; c, post-mentum; d-f, Pseudoworker. d, Head and pronotum; e, left mandible; f, right mandible

formed of irregular tunnels inter-communicated by holes. The tunnels are mainly confined to the portion just below the bark of the tree but

some of these tunnels are extended up to healthy wood. In November, when the collection is made the imago-nymphs are plenty in the nest, but mature imagos are not found. A piece of infected wood has been brought and kept in the rearing chamber in the laboratory to note the emergence of reproductives. From November to mid January, though the colony survived, no emergence has been noticed. Economically, the species is important, as it causes damage through scars or wounds of live forest trees in north Bengal.

Genus (3) *Cryptotermes* Banks, 1906

9. *Cryptotermes dudleyi* Banks

(Fig. 8. Imago, a-c ; Soldier, d-f)

1918. *Cryptotermes dudleyi* N. Banks, *Bull. Amer. Mus. nat. Hist.*, **38** (17) : 660-661.

Im. and *S.* *Type-locality* : Central America : Panama.

1949. *Cryptotermes dudleyi*, T. E. Snyder, *Smith. misc. Coll.*, **112** : 41-42. Neotropical, Indo-Malaya, Papuan and Australian Regions.

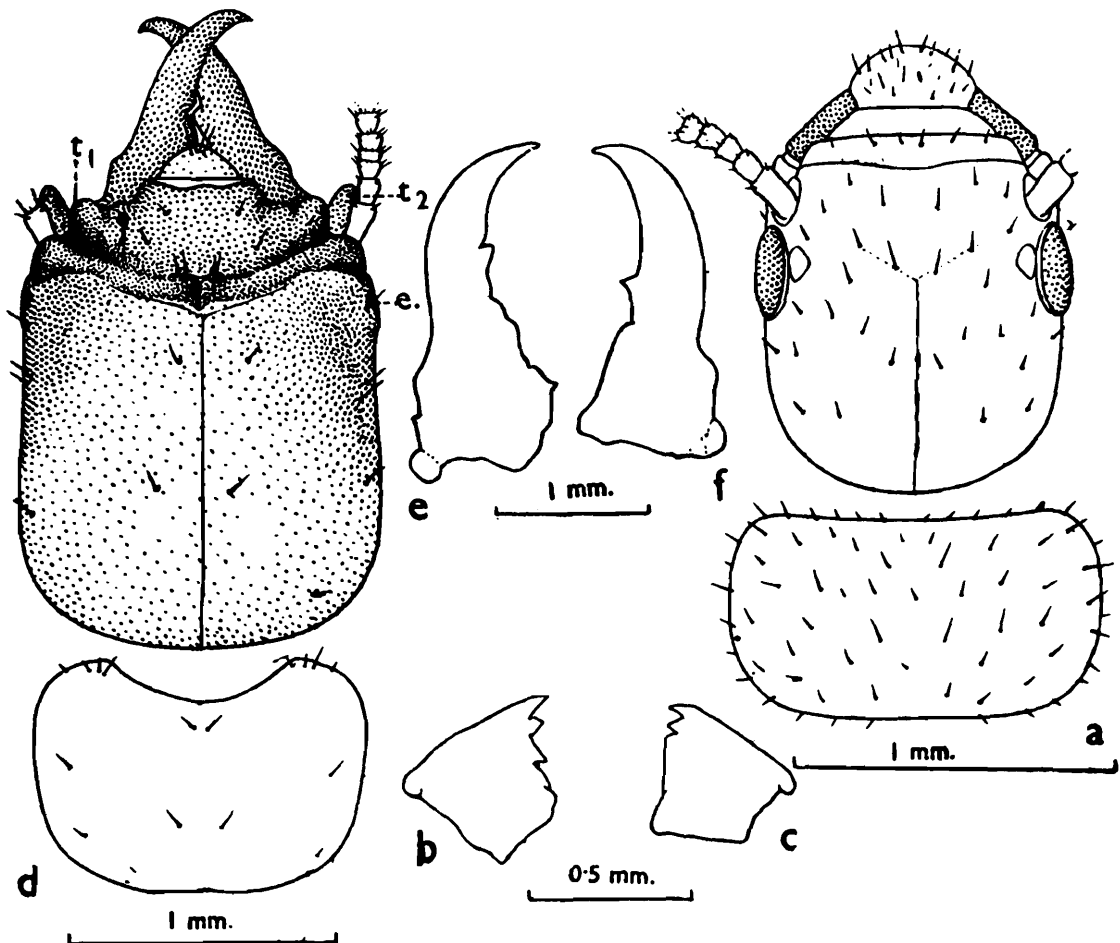


Fig. 8. *Cryptotermes dudleyi* Banks

Imago from Calcutta, O. B. Chhotani coll, 25.iv.1979

Soldier from Sundarban (24-Parganas Dist.), P. K. Sen-Sarma coll., 7.i.1954

a-c, Imago, a, Head and pronotum ; b, left mandible ; c, right mandible

d-f, Soldier. d, Head (t_1 -dorsal tubercle, t_2 -ventral tubercle) and pronotum ; e, left mandible ; f, right mandible

1957. *Cryptotermes dudleyi*, P. K. Sen-Sarma and R. N. Mathur, *Curr. Sci.*, 26 (12) : 399, India : West Bengal : 24-Parganas, Sundarbans.
1961. *Cryptotermes dudleyi*, K. Krishna, *Bull. Amer. Mus. nat. Hist.*, 122(4) : 382.
1970. *Cryptotermes dudleyi*, O. B. Chhotani, *Mem. zool. Surv. India*, 15 (1) : 34-42. Neotropical, Indo-Malayan, Ethiopian, Papuan and Australian Regions.
1975. *Cryptotermes dudleyi*, M. S Akhtar, *Bull. Dept. Zool. Univ. Panjab (N.S.)*, 7 : 28-31. Im., S. and Psw., Bangladesh : Chandpur and Teknaf.

Material.—LOT (A).—Three vials from Sundarbans, 24-Parganas Dist., P. K. Sen-Sarma coll., as follows : (i) S₅/7 1. 54, 1S and sev. Psw. J-Plot, 48 km. NE. of Namkhana Range H. Q., 7. 1. 1954, ex. “dry bamboo splints” (ii) No. S₁/11. 1. 54, with 3S. and sev. Psw., Sajnakhali, 40 km. S. of Rampur Range H. Q., 11. i. 1954, ex. “dry pole of *Heritiera minor*” (iii) No. S₁/14. 1. 54, with 1 Im. (deal.), 5S. and sev. Psw., Bagra, 25 km. S. of Rampur Range H. Q., 14. i. 1954, ex. “dry pole of *Carapa moluccensis* var. *gangetica*”

LOT (B).—2 vials from same colony in wooden frame of a door in Calcutta, as follows : (iv) a vial with 2 Im. (deal), O. B. Chhotani coll., 25.iv.1969, ex. “at light” at 10 P. M.” (v) a vial with 1 Im. (dealate), G. Chhotani coll., 26.iv.1970, ex. “at 5.30 p. m. at light”.

Measurements (in mm.), etc.—(i) *Imago* (3 exs.).—Body-length (with wings) 8.59-8.90 ; Body-length (without wings) 4.12-4.30 ; Length of head to lateral base of mandibles 1.12-1.25 ; Max. width of head with eyes 0.99-1.08 ; Max. diameter of compound eye (with ocular sclerite) 0.30-0.32 ; Max. diameter of lateral ocellus 0.09-0.11 ; Min. eye-ocellus distance Nil ; Max. length of pronotum 0.62-0.65 ; Max. width of pronotum 0.78-0.87 ; Length of forewing (with scale) 7.10-7.40. ; Length of hindwing (with scale) 6.23-6.30 ; No. of antennal segments 16-18. (ii) *Soldier* (10 exs.).—Body-length (excluding antennae) 5.00-5.60 ; Length of head to lateral base of mandibles 1.40-1.49 ; Max. width of head 1.23-1.30 ; Length of left mandible 0.68-0.76 ; Min. median length of postmentum 0.61-0.66 ; Max. width of postmentum 0.27-0.32 ; Max. length of pronotum 0.74-0.81 ; Max. width of pronotum 1.11-1.17 ; No. of antennal segments 11-14.

Distribution.—*West Bengal* : 24-Parganas Dist., Sundarbans : B-agra, J-plot, Jhingakhali, Sajnakhali and Calcutta. *Elsewhere* : *India* (vide, Chhotani, 1970) and all the Zoogeographical regions except the Palaearctic.

Biology.—This is a dry-wood infesting species and is commonly called as a powder-post termite. In West Bengal, this species is confined to the coastal area and attacks dead stubs, pillars, wooden poles and all

types of bamboo structures in mangrove forest in tidal zone of the state. It has also been recorded from wooden frame of a door in a building in Calcutta, causing considerable damage. The characteristic damage is easily detected by the presence of pellets of excreta usually found scattered below the infested wood.

Because of extensive damage done to wood work, this species is of considerable economic importance. In Sundarbans, all man-made structures near the creeks and rivers are found to be highly infested by this species (Sen-Sarma and Mathur, 1957).

Swarming has been observed in Calcutta in the months of April and May.

10. *Cryptotermes havilandi* (Sjöstedt)

(Fig. 9. Imago, a-c ; Soldier, d—e)

1900. *Calotermes havilandi* Y Sjöstedt, *K. Sv. Vet. Akad. Handl.*, 34 (4) : 37, 43-45, 218 and 220. *Type-locality* : Africa : Atlantic Ocean, Fernando Po.
1949. *Cryptotermes havilandi*, T. E. Snyder, *Smith. misc. Coll.*, 112 : 42. Ethiopian, Malagasy, and Neotropical (introduced) Regions.
1961. *Cryptotermes havilandi*, K. Krishna, *Bull. Amer. Mus. nat. Hist.*, 122 (4) : 382.

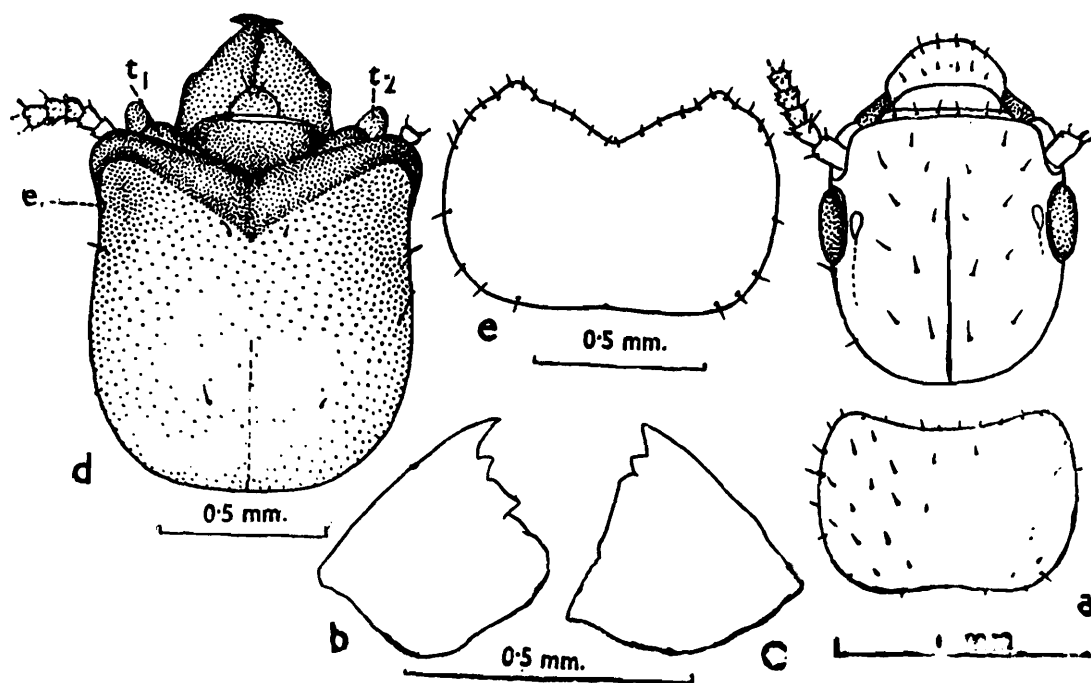


Fig. 9. *Cryptotermes havilandi* (Sjöstedt) Specimens from Sundarbans (24-Parganas Dist.), P. K. Sen-Sarma coll, 15.i.1954.
a-c, Imago. a, Head and pronotum ; b, left mandible ; c, right mandible. d and e, Soldier. d, Head (t_1 -dorsal tubercle, t_2 -ventral tubercle) ; e, pronotum

1970. *Cryptotermes havilandi*, O. B. Chhotani, *Mem. zool. Surv. India*, 15 (1) : 42-54. Im. S. and Psw. Oriental, Ethiopian, Neotropical and Malagasy Regions.
1975. *Cryptotermes havilandi*, M. S. Akhtar, *Bull. Dept. Zool. Univ. Panjab (NS)*, 7 : 33-35. Im. and S. Bangladesh (Chittagong and Sundarbans).

Material.—LOT (A).—(i) A vial (No. S1/15.1.54) with 2S., 1 Im. and sev. Psw. Jhingakhali, 32 km. SE. of Rampura H. Q., Sundarbans, 24-Parganas Dist., *P. K. Sen-Sarma coll.*, 15.1.1954, ex. "dry pole of *Carapa moluccensis* var. *gangetica*"

LOT (B).—(ii) A vial (No. D₂/8.3.59) with 3S. and Sev. W., Beliaghata, Calcutta, *P. C. Dhar coll.*, 8.iii. 1959, ex. "wooden pillar".

LOT (C).—Ten vials from different districts, *P. K. Maiti coll.*, as follows :—(iii) No. M₁/9.6.65, with sev. S. and W., Rajarchak, Krishnanagar City, Nadia Dist., 9.vi.1965, ex. "branch of Mango tree" (iv) No. M₁/26.12.65, with 2S., 1 deal. and sev. W., Vicinity of Robindra Sarobar, Ballygunge, Calcutta, 26.xii.1965. ex. "attacking trunk of *Ficus bengalensis*" (v) No. M₃/12.11.66, with sev. S., W. and Im.-nym., Paitkapara Tea Estate, 15 km. NE. of Alipurduar, Jalpaiguri Dist., 12.11.1966, ex. "wooden pillar of Sal in a Cowshed". (vi) No. M₅/12.11.66, with sev. S., W. and 2 deal., same as above in (v), ex. "pole" (vii). No. M₆/12.11.66, with 9S. and sev. W., same as above in (v), ex. "pillar in a house". (viii). No. M₈/13.11.66, with sev. S., W., 4 deal. and Im.-nym., New Town, Alipurduar, Jalpaiguri Dist., 13. xii. 1966, ex. "wooden pillar". (ix) No. M₁/12.7.69, with 2 deal. and 4 W., Vicinity of Rahindra Sarobar, Ballygunge, Calcutta, 12.vii.1969. ex. "nest in *Ficus bengalensis*". (x) No. M₄/17.8.69, with sev. S. and W., Rabindra Nagar, Midnapore, Midnapore Dist., 17. viii. 1969, ex. "branch of *Mangifera indica*". (xi) A vial with sev. S. and deal., Rabindra Sarobar, Ballygunge, 8.ix.1970, ex. "live liche tree". (xii) A vial with sev. S. and Psw., Ballygunge, 30.xii.1970, ex. "live Bakul tree".

Measurements (in mm.), etc.—(i) *Imago* (5 exs.).—Body-length (with wings) 8.40 ; Body-length (without wings) 4.43-5.50 ; Length of head to lateral base of mandibles 0.88-0.95 ; Max. width of head (with eyes) 0.88-0.92 ; Max. diameter of compound eye (with ocular sclerite) 0.26-0.30 ; Max. diameter of lateral ocellus 0.07-0.10 ; Min. eye-ocellus distance Nil ; Max. length of pronotum 0.57-0.65 ; Max. width of pronotum 0.88-0.91 ; Length of forewing (with scale) 7.20 ; Length of hindwing (with scale) 6.56 ; No. of antennal

segments 14. (ii) *Soldier* (10 exs.).—Body-length (excluding antennae) 3.43-4.10 ; Length of head to lateral base of mandibles 1.12-1.25 ; Max. width of head 1.03-1.25 ; Length of left mandible 0.52-0.58 ; Min. median length of postmentum 0.19-0.25. ; Max. width of postmentum 0.24-0.31 ; Max. length of pronotum 0.76-0.84 ; Max. width of pronotum 1.00-1.15 ; No. of antennal segments 11-15.

Distribution.—*West Bengal* : 24-Parganas, Sundarbans and Jhingakhali ; Midnapore Dist. Town ; Calcutta, Ballygunge and Beliaghata ; Nadia Dist., Krishnanagar ; Jalpaiguri Dist., Alipurduar and Paitakapara tea Estate. *Elsewhere* : Neotropical, Ethiopian, Malagasy, and Oriental regions. For detail vide, Chhotani (1970).

Biology.—The species has been recorded from pillars, poles, and living and dead branches of growing trees in different parts of West Bengal. In north Bengal, it has been observed to survive fully under extreme dry condition in pillars protected from moisture in houses and thereby, to cause enormous damage to wooden structures. The species usually makes irregular tunnels, the diameter of which is only slightly more than that of highly phrogmotic head of soldiers. These tunnels are filled up with characteristic tiny faecal pellets which measure about 0.30-0.40 mm. in length and 0.15-0.25 mm. in width.

Imagos with dealates have been collected from the colony in West Bengal in the months of July, November, December and January. Swarming occurs, of course, every month, but is very common in the dry months of January and February (Roonwal, 1970).

Economically, the species is very much important as it has been found to attack and damage the wooden pillars (mostly of sal) in houses in Jalpaiguri district, North Bengal. It also attacks many planted trees such as Banyan (*Ficus bengalensis*), Mango (*Mangifera indica*), Litchi (*Litchi chinensis*) and Bakul in West Bengal.

Family II. RHINOTERMITIDAE

Subfamily (i) HETEROTERMITINAE

Genus (4) *Heterotermes* Froggatt, 1896

11. *Heterotermes indicola* (Wasmann)

(Fig. 10. Imago, a-c ; Soldier, d-e)

1902. *Leucotermes indicola* E. Wasmann, *Zool. Jb. (Syst.)*, 17 (1) : 118-119. S. and W. *Type-locality* : India : Bombay.
1949. *Heterotermes indicola*, T. E. Snyder, *Smith. misc. Coll.*, 112 : 68.
1975. *Heterotermes indicola*, M. S. Akhtar, *Bull. Dept. Zool. Univ. Panjab (N.S.)*, Art. 7 : 43-45. S. Bangladesh, Khulna.

Material.—LOT (A).—4 vials from Calcutta, *O. B. Chhotani coll.* as follows : (i) No. $O_1/2.7.57$ with 1 Im., 2. vii. 1957, “at light” (ii) No. $O_1/6.8.57$ with sw. S. and W., 6. viii. 1957, ex. “galleries on wall of a house”. (iii) No. $O_8/13.8.57$ with sev. S. and W., 13. viii. 1957, ex. “galleries on wall” and (iv) No. $O_1/19.6.65$ with 1 Im., 19. vi. 1965, “at light” at 10 P.M. after 1st monsoon.

LOT (B).—12 vials from Calcutta as follows : (I) 3 vials sw. S. and W Indian Museum, Calcutta thus : (v) No. $A_1/5. ix. 60$, *S. M. Ali coll.*, 5. ix 1960, “feeding on wooden base and on caratineous structure

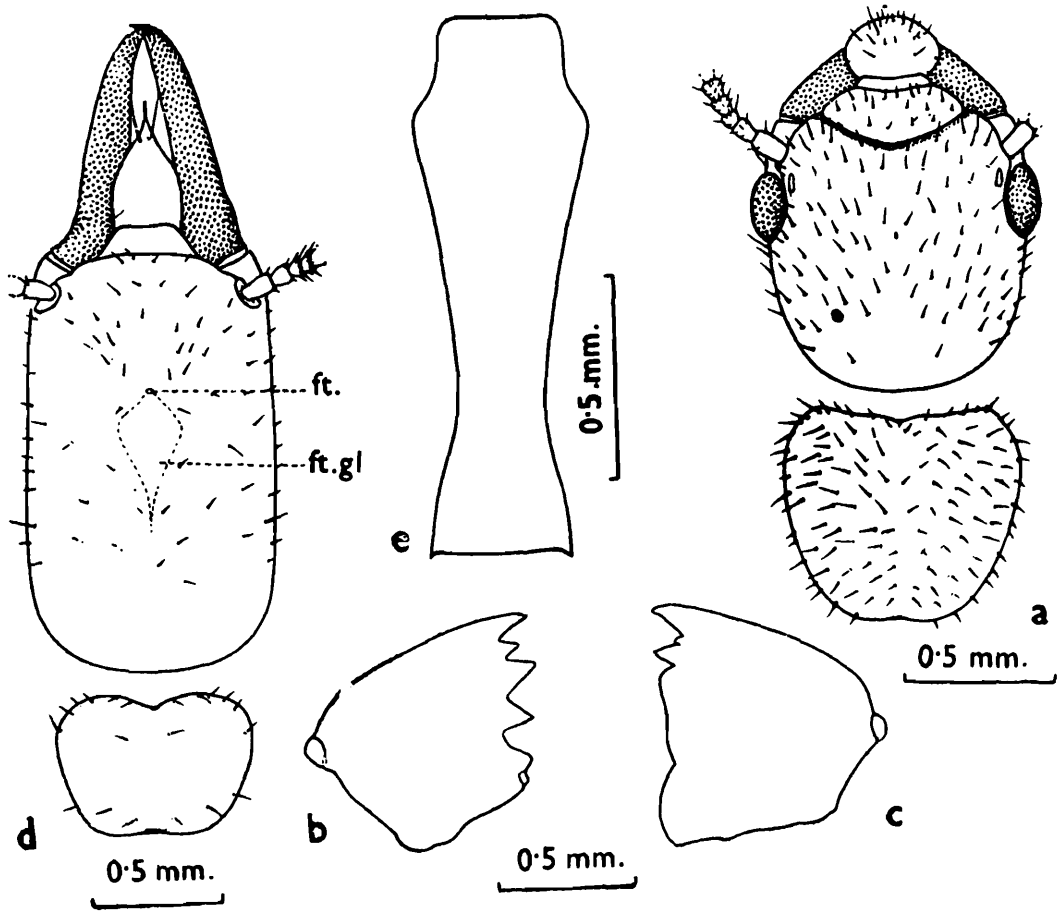


Fig. 10. *Heterotermes indicola* (Wasmann)

Imago from Calcutta, *P. K. Maiti coll.*, 30.vi.1966. Soldier from Sonarpur (24-Parganas Dist.), *P. K. Maiti coll.*, 21.xi.1965.

a-c, Imago. a, Head and pronotum ; b, left mandible ; c, right mandible
d-e, Soldier. d, Head and pronotum ; e, postmentum

of birds”. (vi) A vial with sw. S. and W., *ZSI Staff coll.*, 3. ix. 1960, “feeding skin and feather of birds”. (vii) A vial, *B. Sinha coll.*, 30. vii. 1966, “pipe closet door on floor” (II) 2 vials with sw. S. and W. from Jabakusum House, Calcutta, thus : (viii) A vial *P. C. Dhar coll.*, 11. v. 1961, ex. “under some waste paper”, and (ix) a vial, *S. Singh coll.*, 7. vii. 1962, ex. “galleries on wall”. (III) 3 vials, with S. and W. *P. K. Maiti coll.*, thus. (x) $M_1/2.9.63$, Ballygunge, 2. ix. 1963, ex.

“wooden pole”. (vi) M₁/29.8.65, Sealdah, 29. viii. 1965 ; and (xii) M₁/30.6.66 with 3 Ims., Nehru Road, 30. vi. 1966, “at light at 8 p.m.” (IV) 2 vials with S. & W., thus : (xiii) M₁/27.8.57, *M. L. Thakur coll.*, 27. viii. 1957, Bowbazar, ex. “wooden frame of a window”. (xiv) A vial, Kasba, *D. Chatterjee coll.*, 25. xi. 1965, ex. “galleries”. (V) 2 vials from Ultadanga, thus : (xv) S₁/21.7.65 with sev. S. and W., *G. N. Saha coll.*, 21. vii. 1965, ex. “gallery on wall” ; and (xvi) R₁/30.6.66 with 12 Ims., *K. Rui coll.*, 30. vi. 1966, “swarming after a heavy shower at 8 p.m.”.

LOT (C).—3 vials, with S. and W., *P. K. Maiti coll.*, thus : (xvii) M₂/21.11.65, Sonarpur, 15 Km. S. of Sealdah Rly. Stn., 24-Parganas, 21. xi. 1965, ex. “wooden frame of a window”. (xviii) A vial, Bose Para, Sreerampur, Hooghly Dist. 4. xii. 1965, and (xix) M₁/14.2.67, Saibari village, 10 Km. S. of Terapakhia Bazar, Midnapore Dist. 14. ii. 1967, ex. “gallery on wall of a house”.

Measurements (in mm.)—(i) *Imago* (10 exs.) : Total body-length (with wings) 9.50-10.00 ; Total body-length (without wings) 4.50-4.90 ; Length of head to lateral base of mandibles 0.81-0.85 ; Max. width of head (with eyes) 0.88-0.92 ; Max. diameter of compound eyes (with ocular sclerite) 0.21-0.25 ; Max. diameter of lateral ocellus 0.03-0.04 ; Min. eye-ocellus distance 0.03-0.05 ; Max. length of pronotum 0.53-0.57 ; Max. width of pronotum 0.73-0.76 ; Length of forewing (with scale) 7.80-8.30 ; Length of hindwing (with scale) 7.41-7.50 ; No. of antennal segments 17. (ii) *Soldier* (10 exs.) : Body-length 4.25-4.40 ; Length of head to lateral base of mandibles 1.40-1.61 ; Max. width of head 0.86-0.91 ; Length of left mandible 0.83-0.87 ; Min. (median) length of postmentum 1.00-1.08 ; Max. width of postmentum 0.35-0.39 ; Max length of pronotum 0.46-0.53 ; Max. width of pronotum 0.68-0.73 ; No. of antennal segments 15.

Distribution.—*West Bengal* : Calcutta and its vicinity ; Hooghly Dist. : Sreerampur ; 24-Parganas Dist. : Ultadanga ; and Midnapore Dist. : Saibari village (all present record). *Elsewhere* : Throughout Indian subcontinent except southern India, *Bangladesh* and *Afghanistan*.

Biology.—In West Bengal, all the collections made are mainly from residential buildings in Calcutta and southern Bengal. It causes severe damage to wooden structure in houses including house-hold articles like books, clothes, etc. The species makes long galleries on wall to reach the wooden structures. It is a real threat to the construction timbers throughout the State.

The biology of the species have been dealt by Roonwal (1955), Mathur and Sen-Sarma (1959), Arora and Gilotra (1960), Arora (1962), and Chatterjee and Thakur (1966). The species is observed to attack caratinised structure of mounted birds in the Indian Museum in Calcutta. Due to highly destructive nature, the species is of great economic importance.

In Calcutta, swarming is observed at dusk in the month of June and July.

Genus (5) *Reticulitermes* Holmgren, 1913

12. *Reticulitermes assamensis* Gardner

(Fig. 11. Imago, a ; Soldier, b-d)

1945. *Reticulitermes assamensis* J. C. M. Gardner, *Indian J. Ent.*, 6 (1-2) (1944) : 105-106. S. Type-locality : India : Assam, Sadiya.
 1977. *Reticulitermes assamensis*, M. L. Roonwal and O. B. Chhotani, *Ent. Basil*, 2 : 46-48. Im. (Deal.), S. Bhutan.

Material.—A vial (M_g/1.11.66) with 2 Im. and 2S., Chebbo Bosti, 3 km. S. of Kalimpong, Darjeeling Dist., P. K. Maiti coll., 1.xi.1966, ex. "gallery on dead stump"

Measurements (in mm.), etc.—(i) *Imago* (2 exs.) : Body-length (with wings) 9.21-9.40 ; Body-length (without wings) 5.50-5.61 ; Length of head to lateral base of mandibles 1.14-1.18 ; Max. width of

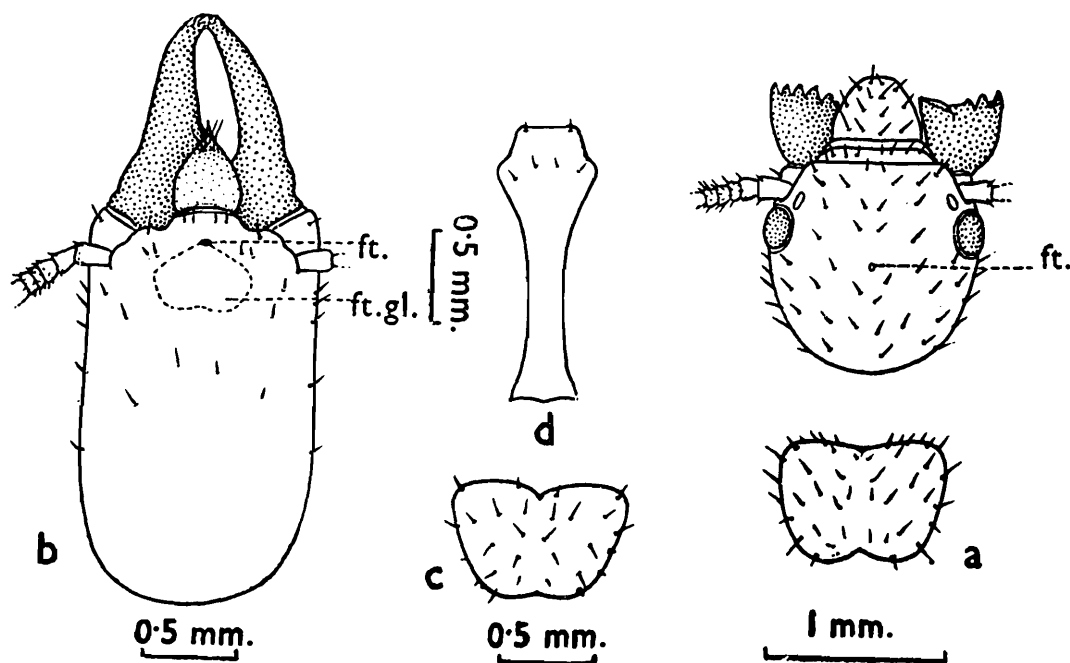


Fig. 11. *Reticulitermes assamensis* Gardner
 Specimens from Kalimpong (Darjeeling Dist.), P. K. Maiti coll., 1.xi.1966.
 a, Imago. a, Head and pronotum
 b-d, Soldier. b, Head ; c, pronotum ; d. postmentum

head (with eyes) 1.04-1.07 ; Max. diameter of compound eyes (with ocular sclerite) 0.22-0.25 ; Max. diameter of lateral ocellus 0.09-0.10 ; Min. eye-ocellus distance 0.07-0.09 ; Max. length of pronotum 0.57-0.60 ; Max. width of pronotum 0.88-0.90 ; Length of forewing (with scale) 8.00-8.10 ; Length of hindwing (with scale) 7.50-7.57 ; No. of antennal segments 18. (ii) *Soldier* (2 exs.) : Body-length 5.55-5.63 ; Length of head to lateral base of mandibles 1.84-2.00 ; Max. width of head 1.14-1.19 ; Length of left mandible 1.00-1.03 ; Min (median) length of postmentum 1.30-1.33 ; Max. width of postmentum 0.43-0.46 ; Max. length of pronotum 0.50-0.54 ; Max. width of pronotum 0.84-0.89 ; No. of antennal segments 13 (broken).

Distribution.—*West Bengal* : Darjeeling Dist., Samsing and Kalimpong. *Elsewhere : India* : Assam, Shillong and Sadiya (Type-locality). *Bhutan* : Sampa-Kothoka (1600-2600 m.).

Biology.—The species has been found making galleries on stump of a tree at Kalimpong, West Bengal. The galleries are measured about 5-9 mm. in diameter and run almost parallel to the fibre of the wood. The main colony was probably inside the ground at the base of the tree stump. However, the species is also known to cause damage to live roots of *Pinus logifolia* in Shillong. Though the period of swarming is not known, the imagos were collected from the galleries in the month of November.

Subfamily (ii) COPTOTERMITINAE

Genus (6) *Coptotermes* Wasmann, 1896

13. *Coptotermes heimi* (Wasmann)

(Fig. 12. Imago, a-c ; Soldier, d-e)

1902. *Arrhinotermes heimi* E. Wasmann, *Zool. J. (Syst.)*, 17(1) : 104. *Im. Type-locality* : India : Maharashtra, Ahmadnagar Dist., Wallon.
1913. *Coptotermes parvulus*, N. Holmgren, *J. Bombay nat. Hist. Soc.*, 22(1) : 102—104. S. and W. *Type-localities* : India : Gujarat, Anand and Vidtal.
- 1962a. *Coptotermes heimi*, M. L. Roonwal and O.B. Chhotani, *Indian Counc. agric. Res., Ent. Monogr.* No. 2, pp. 38-57, Im, S. and W. India and Pakistan.
1975. *Coptotermes heimi*, M. S. Akhtar, *Bull. Dept. Zool. Univ. Panjab (N.S.)*, Art. 7 : 36-42. Im. and S. Bangladesh.
1977. *Coptotermes heimi*, M. L. Roonwal and Chhotani, *Ent. Basil.*, 2 : 48-50. Im. Bhutan.

Material.—LOT (A).—5 vials from Sunderbans, 24-Parganas, *M. L. Roonwal coll.*, 1954, as follows : (i) No. R1/3.1.54, with sev. S. and W., Namkhana proper, 3.54, ex. “large pole of *Carapa moluccensis* var. *gangetica*”. (ii) No. R1/4.1.54, with 10S. and 3W., Narainpur

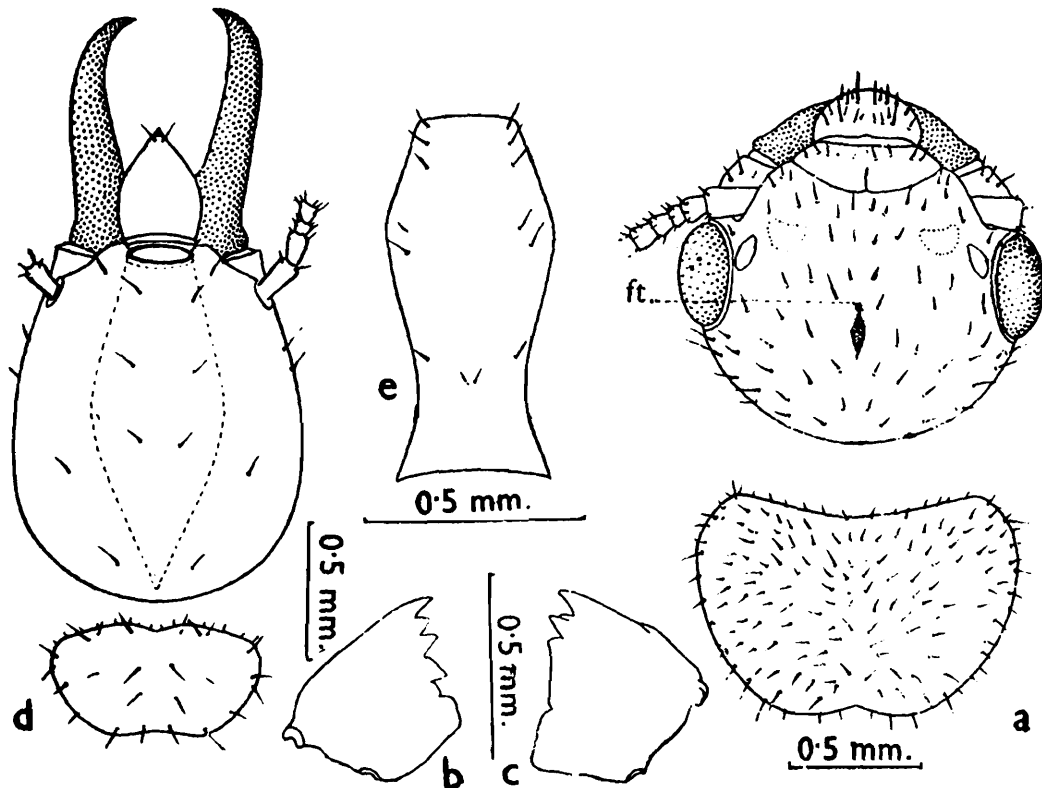


Fig. 12. *Coptotermes heimi* (Wasmann)

Imago from Calcutta, *C. Paiva coll.*, 6.xi.1960. Soldier from Calcutta, *O. B. Chhotani coll.*, 2.viii.1957

a-c, Imago. H, Head and pronotum ; b, left mandible, c, right mandible
d-e, Soldier. d, Head and pronotum ; e, postmentum

village,. 6 km. NE. of Namkhana Range H. Q., 4.1.54, ex. “bamboo pole”. (iii) No. R2/4.1.54, with sev. S. and W., ex. “*Albizzia lebek* log.”, other data same as in (ii). (iv) No. R3/4.1.54, with sev. S., 3W. and several Im.-nym., Narainpur village, 3rd coupe, 7 km. E. of Namkhana Range H. Q., 4.i.1954, ex. *Avicennia* sp. log”. (v) No. R5/4.1.54, with 9S. and 6W., Narainpur village, 2nd Coupe, 6 km. NE. of Namkhana Range, H. Q., 4.i.1954, ex. “bamboo pole”

LOT (B).—(I) 2 vials with sev. Im. from Calcutta, *C. paiva coll.*, 6.xi.1910, ex. flying at dusk” and *N. Annandale coll.*, 23.xii.1910. ex. “light” (II) 7 vials (vi-xii) with sev. S. and W from Calcutta, *O. B. Chhotani coll.*, 1957, Nos. 0₄, 0₅, 0₆, 0₇ and 0₈/2.8.57, Horticulture Farm, 2.viii.1957, ex. “under a log of *Behunia* sp.” (2 vials) ; ex. “an arm of cot lying on ground in a hut” (1 vial) ; ex. “a log lying on ground” (1 vial) ; ex. “a fallen mango tree” (1 vial). No. 0₁ and 0₃/27.9.57, Garia, 27.ix.1957, ex. “attacking the main trunk of *Ficus*

bengalensis" and ex. attacking trunk of an unknown tree", respectively. (III) 2 vials (xiii-xiv) with 2 Im. (No. 0₁/6.3.68) and 1 Im. (No. 0₁/7.3.68) from Park Circus, *O. B. Chhotani coll.*, 6.7. iii. 1968, ex. "at light". (IV) 9 vials (xv-xxiii) with sev. S. and W. from Calcutta, *M. L. Thakur coll.*, thus : No. M1/5.8.57, ex. "base of trunk of a living tree" Nos. M2, M5, M6 and M7/5.8.57, ex. "fence poles". No. M1/6.8.57, Eden Garden, 6. viii. 1957, ex. "a dead standing tree" No. M3/6.8.57, Eden Garden, ex. "gallery on a pole". No. M1/6.8.57, ex. "dead standing tree" and No. M3/6.8.57, ex. "trunk of a living tree". (V) (xxiv) No. D1/7.6.59, with sev. S. and W. from Calcutta, *P. C. Dhar coll.*, 7. vi. 1959, ex. "waste papers and clothes in a house". (xxv) No. S1/21.7.65 with sev. S. and Ny., Ultadanga, *G. N. Saha coll.*, 21. vii. 1965, ex. "wood". LOT (C).—vials with sev. S. and W. from different districts, as follows : (xxvi) vial from Krishnanagar, Nadia Dist., *Z. S. I. party coll.*, 13. viii. 1965, ex. "dead tree", (xxvii) No. M3/12.6.66, Near Baruipur Rly. Stn., 24-Parganas Dist., *P. K. Maiti coll.*, 12.vi.1966, ex. "under mud plaster in furrow of alive Litchi tree." (xxviii) No. M3/29.10.66, Subhasgram, 24-Parganas Dist., 29. x. 1966, ex. "galleries on a tree trunk". (xxix) No. M4/7.11.66, with sev. S. and W., Murti Beat, 10 km. W. of Nagrakata, Chalsa Forest Range, Jalpaiguri Dist., *P. K. Maiti coll.*, 7. xi. 1966, ex. "scar on a tree trunk". (xxx) No. d2/3.3.70, Guaberia, (near Haldia Port), Midnapore Dist., *A. K. Das coll.*, 3. iii. 1970, ex. "attacking wood inside mudwall in a house". (xxxi) No. 1, Sujapur (near Palta), 24-Parganas Dist., *A. K. Das coll.*, 16. iii. 1970, ex. "log lying on ground".

Measurements (in mm.) etc.—(i) *Imago* (3 exs.) : Body-length with wings 10.75-11.10 ; Body-length without wings 6.23-6.32 ; Length of head to lateral base of mandibles 1.08-1.13 ; Max. width of head (with eyes) 1.29-1.36 ; Max. diameter of compound eye (width ocular sclerite) 0.35-0.40 ; Max. diameter of lateral ocellus 0.15-0.18 ; Min. eye-ocellus distance. Nil ; Max. length of pronotum 0.71-0.78 ; Max. width of pronotum 1.10-1.25 ; Length of forewing (with scale) 9.56-9.62 ; Length of hindwing (with scale) 9.10-9.45 ; No. of antennal segments 21-22. (ii) *Soldier* (10 exs.) : Body-length 5.10-5.75 ; Length of head to lateral base of mandibles 1.18-1.30 ; Max. width of head 1.09-1.27 ; Length of left mandible 0.72-0.91 ; Min. (median) length of postmentum 0.78-0.89 ; Max. width of postmentum 0.35-0.43 ; Max. length of pronotum 0.42-0.48 ; max. width of pronotum 0.71-0.86 ; No. of antennal segments 14-16.

Distribution.—*West Bengal* : Calcutta : Eden Garden, Garia, Horticulture Farm (Alipur), Park Circus and Ultadanga. Jalpaiguri Dist. :

Murti Beat (Chalsa Forest Range). Midnapore Dist. : Guaberia (near Haldia Port). Nadia Dist. : Krishnanagar. 24-Parganas Dist. : Baruipur, Namkhana, Narainpur, Subhasgram and Sujapur (near Palta). *Elsewhere : India, Pakistan* (For details vide, Roonwal and Chhotani, 1962a), *Bangladesh and Indonesia* : Java, Semarang (introduced, Gay 1967).

Biology.—*Coptotermes heimi* (Wasman) is one of the most destructive, polyphagous species in India and West Pakistan. In West Bengal, it has been recorded from dead wood, under bark and in hollows of a number of plants, in wood work in houses, from paper, book, etc. The species is very common in the State and has been collected from many places in different habitats. At Murti Forest Beat in north Bengal, a large diffused nest of about 25cm. in length, 20 cm. in width and 10 cm. in height, was collected from decaying portion of a tree trunk. The nest consists of network of strands of semi-carton sponge-like fillings. However, other nests have also been observed to occur in soil and dead log. From the subterranean nest, the species usually extends its galleries (measuring about 6-8 mm. wide) to the exposed surface of wooden structure, tree trunk etc. It eats away the softer parts of the wood, while the harder parts like heart-wood and knots generally remain intact.

Beeson (1941) reported the species to swarm at sunset during the dry season, especially in January to March. Roonwal (1959 and 1970) referred to that the swarming took place 'in Spring and early Summer (March—May) in the warmer and more humid parts (West Bengal, Orissa, Bombay) and during the monsoon (June—August) in the drier parts (Punjab, Uttar Pradesh)'. However, the swarming has been observed in West Bengal in the month of March (Spring), and in November and December (Winter).

Economically, the species is of great importance as it destroys the wood in its many form throughout India.

14. *Coptotermes kishori* Roonwal and Chhotani

(Fig. 13. Soldier, a and b)

1962a. *Coptotermes kishori* M. L. Roonwal and O. B. Chhotani, *Indian Council, agric. Res., Ent. Monogr.*, No. 2, pp. 57-61, 77, 78. *S. and W. Type-locality* : India : West Bengal : Murshidabad Dist., Berhampur, ca. 185 km. N. of Calcutta.

1979. *Coptotermes kishori*, P. K. Sen-Sarma and M. L. Thakur, *Indian For. Rec.* 13(1) (N. S) : 13, S. Tripura.

Material.—A vial, No. M₈/8.9.65, with sev. S. and W., Kalyani (near University Science College), Nadia Dist., P. K. Maiti coll., 8. ix. 1965, ex. "*Ficus religiosus* tree".

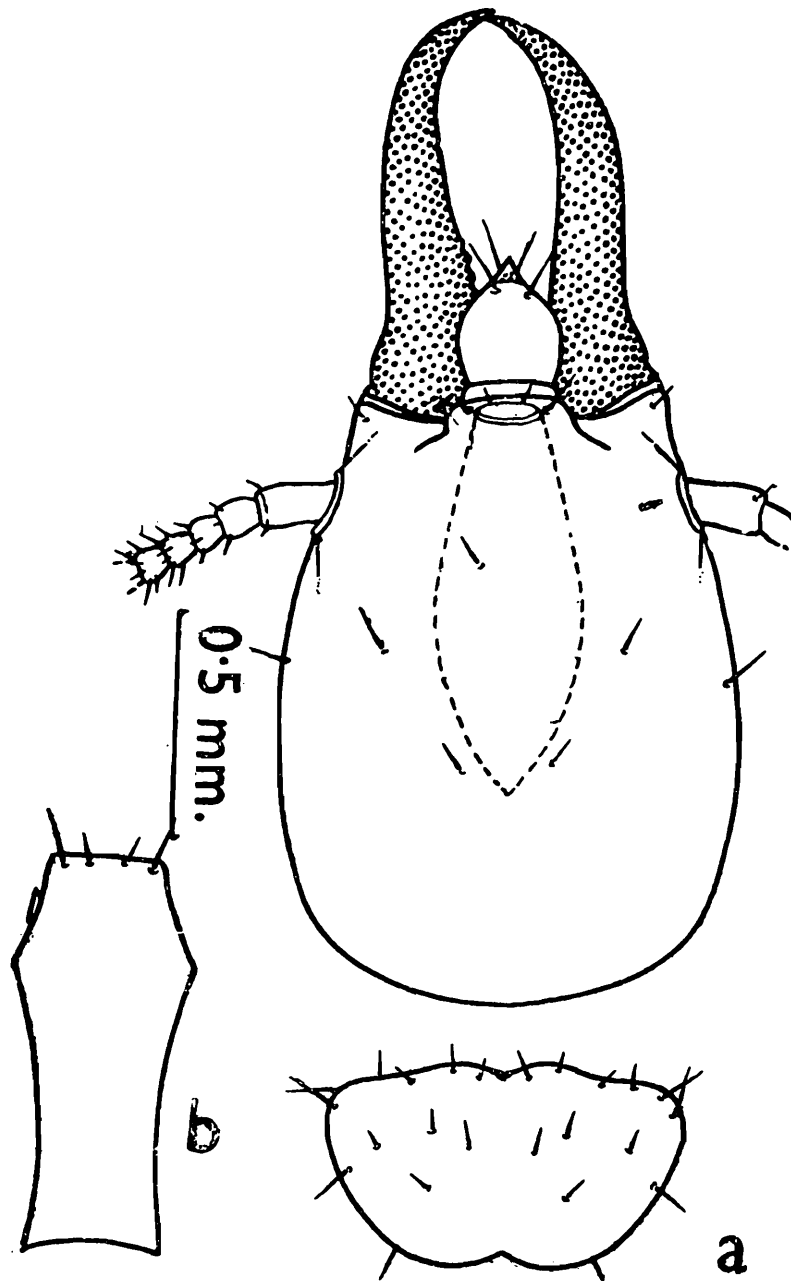


Fig. 13. *Coptotermes kishori* Roonwal and Chhotani
Soldier from Kalyani (Nadia Dist.), P. K. Maiti coll., 8. ix. 1965
a and b, Soldier. a. Head and pronotum ; b, postmentum

Measurements (in mm.) etc.—(i) *Imago* : Unknown. (ii) *Soldiers* (10 exs.) : Body-length 4.10-4.50 ; Length of head to lateral base of mandibles 1.15-1.19 ; Max. width of head 0.96-1.10 ; Length of left mandible 0.75-0.80 ; Min. (median) length of postmentum 0.73-0.84 ; Max. width of postmentum 0.34-0.40 ; Max. length of pronotum 0.34-0.39 ; Max. width of pronotum 0.67-0.74 ; No. of antennal segments 14.

Distribution.—West Bengal : Murshidabad Dist., Berhampur (type-locality) and Nadia Dist., Kalyani. *Elsewhere* : India : Tripura.

15. *Coptotermes travians* (Haviland)

(Fig. 14. Soldier, a and b)

1898. *Termes* (*Coptotermes*) *travians* G. D. Haviland, *J. Linn. Soc. Lond. (Zool.)*, 26(169) : 391-392, *Im., S. and W. Type-localities* : Malaya, Singapore and Borneo, Sarawak.

1949. *Coptotermes travians*, T. E. Snyder, *Smith. misc. coll.*, 112 : 83, Singapore, Indonesia and India.

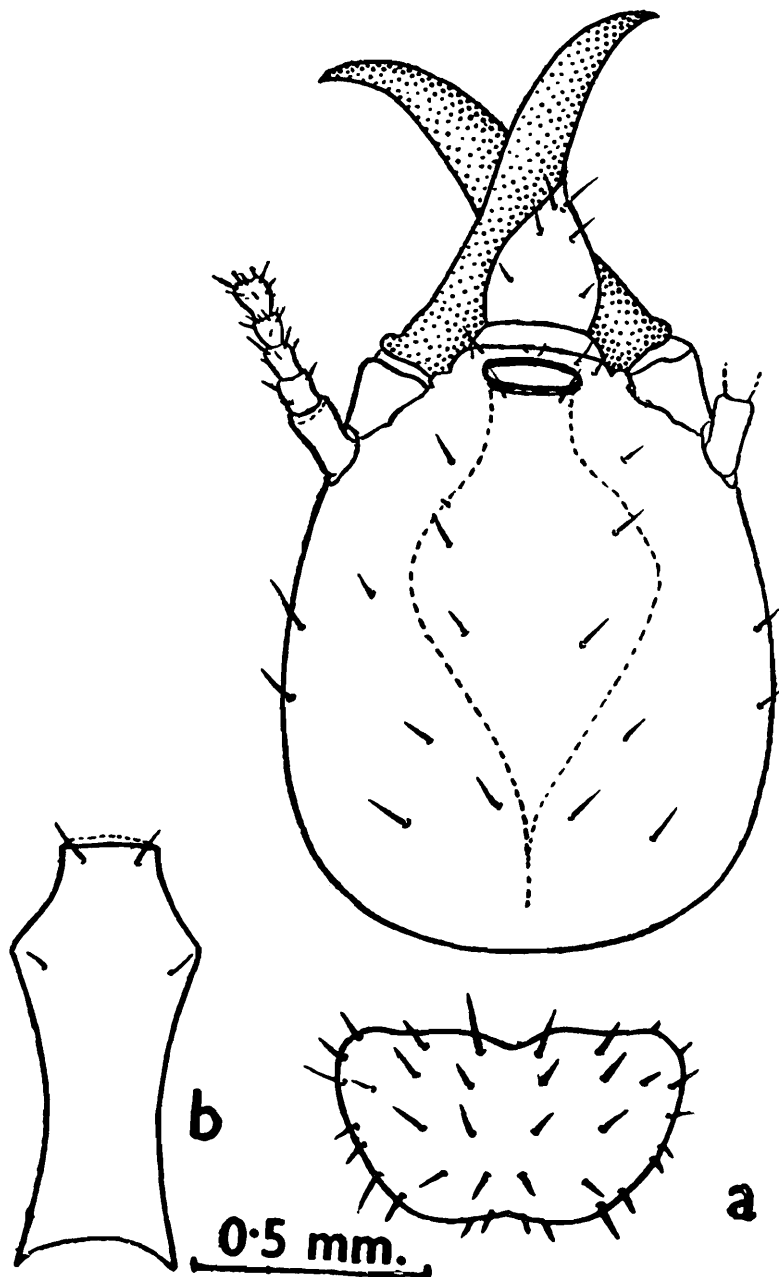


Fig. 14. *Coptotermes travians* (Haviland)
 Soldier from Calcutta, P. K. Maiti coll., 2.vi.1965.
 a, Head pronotum ; b, postmentum

1962. *Coptotermes travians*, M. L. Roonwal and O. B. Chhotani, *Indian Counc. agric. Res. Ent. Monogr.* No. 2, pp. 61-66, S. and W. India, Bangladesh, Burma, Malaya-Peninsula and Indonesia.
1975. *Coptotermes travians*, M. S. Akhtar, *Bull. Dept. Zool. Univ. Punjab* (N. S.), 7 : 42-43, S., Bangladesh : Sripur.
1979. *Coptotermes travians*, P. K. Sen-Sarma and M. L. Thakur, *Indian For. Rec.*, 13(1) : 13-14, S. Tripura.

Material.—A vial, No. M₂/2.6-65, with 4S., Calcutta (Ballygunge) ; P. K. Maiti coll., 2.vi.1965 ; ex. “decaying wood of a fence post”.

Measurements (in mm.), etc.—*Imago* (after, Holmgren, 1913) : Length with wings 11.50-12.00 ; Length without wings 6.50 ; length of forewing 9.50 ; Length of head 1.37 ; width of head 1.18 ; Width of pronotum 1.66 ; Length of pronotum 0.61. (ii) *Soldiers* (4 exs.) : Length of head to lateral base of mandibles 1.20-1.37 ; Max. width of head 1.00-1.14 ; Length of left mandible 0.71-0.76 ; Min. (median) length of postmentum 0.79-0.85 ; Max. width of postmentum 0.32-0.35 ; Max. length of pronotum 0.34-0.38 ; Max. width of pronotum 0.67-0.74 ; No. of antennal segments 14-15.

Distribution.—*West Bengal* : Calcutta (Ballygunge and Jairampur). *Elsewhere* : *India* (Assam, Orissa, West Bengal and Andaman and Nicobar Islands), *Burma, Bangladesh, Indonesia, Malay-Peninsula* and *Singapore* (type-locality).

Subfamily (iii) RHINOTERMITINAE

Genus (7) *Parrhinotermes* Holmgren, 1910

16. *Parrhinotermes khasii* Roonwal and Sen-Sarma

1956. *Parrhinotermes khasii* M. L. Roonwal and P. K. Sen-Sarma, *Indian J. agric. Sci.*, 26(1) : 6-11, S. and W., *Type-locality* : India : Meghalaya : Khasi Hills, Bank of the Nong-Priang stream.
1962. *Parrhinotermes khasii*, M. L. Roonwal and O. B. Chhotani, *Proc. nat. Inst. Sci.*, 28(B) : 310-312.

Material.—A vial (No. 21) with sev. S. and W., Kalimpong, Darjeeling Dist., G. K. Srivastava and P. K. Maiti coll., 2.xii.1973, ex. “log”.

Measurements (in mm.), etc.—*Imago* : Unknown (ii) *Soldier* (5 exs.) : Body-length 3.80-4.10 ; Length of head to lateral base of mandibles 1.11-1.23 ; Max. width of head 1.00-1.10 ; Length of left mandibles 0.67-0.69 ; Min. (median) length of postmentum 0.92-1.00 ; Max. width of postmentum 0.31-0.34 ; Max. length of pronotum

0.40-0.44 ; Max. width of pronotum 0.63-0.70 ; No. of antennal segments 13.

Distribution : *West Bengal* : Darjeeling Dist., Kalimpong. *Elsewhere* : *India* : Meghalaya : Khasi Hills (Type-locality).

Biology : Not known.

Family (III) STYLOTERMITIDAE

Genus (8) *Stylotermes* Holmgren and Holmgren, 1917

17. *Stylotermes bengalensis* Mathur and Chhotani
(Fig. 15. Soldier, a and b)

1959. *Stylotermes bengalensis* R. N. Mathur and O. B. Chhotani, *Zool. Anz.*, 163 (1-2) : 40-46. *S. and W. Type-locality* : India : West Bengal, Darjeeling Division.

1974. *Stylotermes bengalensis*, M. L. Thakur, *Indian For.*, 100(11) : 692-695. *Im. India* ; Uttar Pradesh, Bhawali.

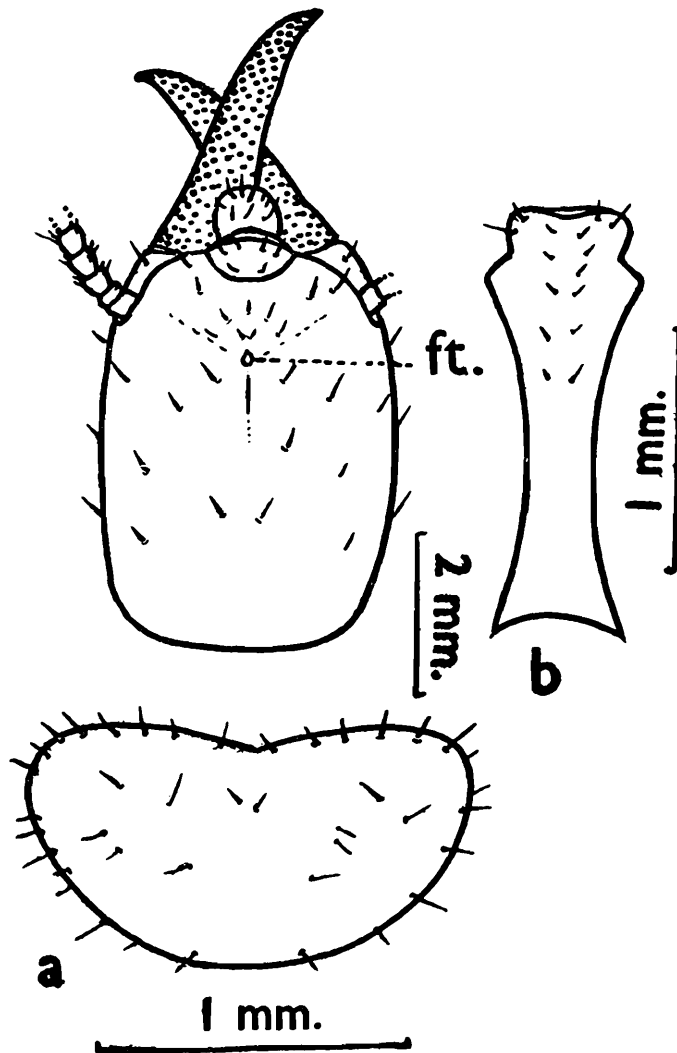


Fig. 15. *Stylotermes bengalensis* Mathur and Chhotani (After, Mathur and Chhotani 1959)
a and b, Soldier. a, Head and pronotum ; b, postmentum

Material.—Measurements are reproduced here from the literature, since the material of the species was not available for study.

Measurements (in mm.), etc. (i) *Imago*: Body-length (without wings) 6.25-8.35; Length of head to lateral base of mandibles 1.33-1.60; Max. width of head with eyes 1.68-1.80; Max. diameter of compound eye 0.45-0.50; Max. diameter of lateral ocellus 0.18-0.23; Min. eye-ocellus distance 0.10-1.12; Max. length of pronotum 0.85-0.90; Max. width of pronotum 1.35-1.50; Max. length of forewing scale 1.30-1.50; Max. length of hind wing scale 0.75-0.85. (ii) *Soldier* (3 exs.): Body-length 8.00-8.75; Length of head to lateral base of mandibles 2.60-2.70; Max. width of head 1.75-1.80; Length of left mandible 1.75-1.80; Min. (median) length of postmentum 1.80-2.00; Max. width of postmentum 0.70-0.75; Max. length of pronotum 0.80-0.90; Max. width of pronotum 1.45-1.55; No. of antennal segments 13-14.

Distribution.—*West Bengal*: Darjeeling Dist., Darjeeling Division (type-locality). *Elsewhere*: *India*: Uttar Pradesh, Garhwal.

Type-Host.—*Morus laevigata* Wall.

Biology.—Not known.

18. *Stylotermes parabengalensis* Maiti

1974. *Stylotermes parabengalensis* P. K. Maiti, *Orient Ins.*, 9(2): 143-148. S. *Type-locality*: *India*: West Bengal: Jalpaiguri Dist., near Nagrakata Rly. Stn.

Measurements (in mm.), etc.—(From the original description) (i) *Imago*: Unknown (ii) *Soldier* (7 exs.).—Length of head to lateral base of mandibles 1.92-2.23; max. width of head 1.19-1.34; Length of left mandible 1.14-1.26; Max. diameter of eye 0.10-0.14; Min. (median) length of postmentum 1.34-1.61; Max. width of postmentum 0.46-0.57; Max. length of pronotum 0.61-0.76; Max. width of pronotum 1.00-1.13; No. of antennal segments 12-13.

Family (IV) TERMITIDAE

Subfamily (i) APICOTERMITINAE

Genus (9) *Eurytermes* Wasmann, 1902

19. *Eurytermes buddha* Bose and Maiti (Fig. 16. Soldier, a and b)

1966. *Eurytermes buddha* G. Bose and P. K. Maiti, *Proc. Zool. Soc.*, 19: 115-120. S. and W. *Type-localities*: Coimbatore (Tamil Nadu) and Dharwar (Karnataka).

Material.—(i) No. M₆/16.8.69, with 1S. and sev. W., Forest on way to Women's College, Midnapore, Midnapore Dist., *P. K. Maiti coll.*, 16.viii.1969, ex. "soil under cowdung". (ii) No. M₉/16.8.69, with 3S. and sev. W., Jungle near Women's College, Midnapore Dist., *P. K. Maiti coll.*, 16.viii.1969, ex. "soil under cowdung".

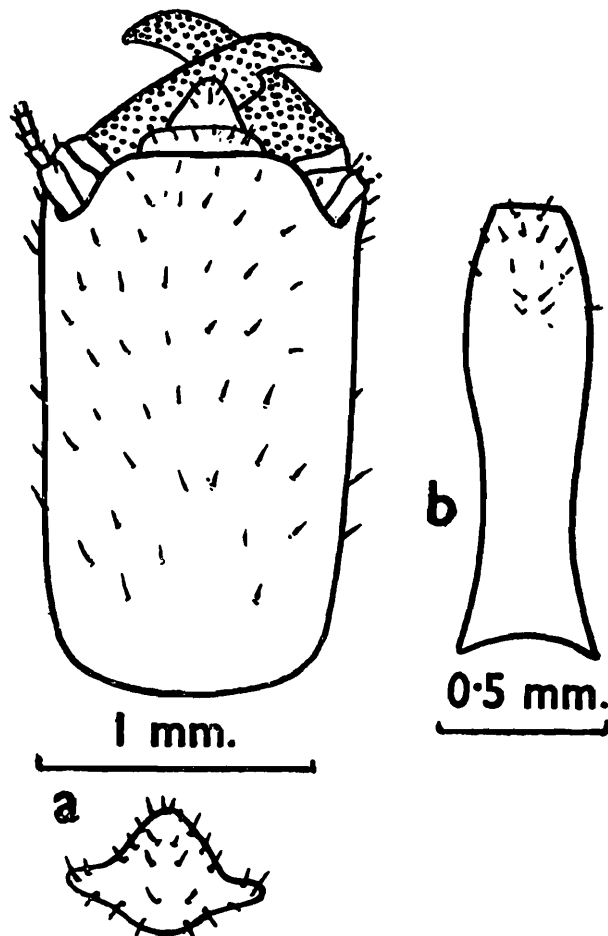


Fig. 16. *Eurytermes buddha* Bose and Maiti
Soldier from Midnapore, *P. K. Maiti coll.* 16.viii.1969.
a, Head and pronotum ; b, postmentum

Measurements (in mm.), etc.—(i) *Imago* : Unknown (ii) *Soldier* (4exs.).—Body-length 4.91-5.50 ; Length of head to lateral base of mandibles 1.70-1.79 ; Max. width of head 1.00-1.09 ; Length of left mandible 0.72-0.78 ; Length of right mandible 0.70-0.75 ; Left mandibular tooth distance 0.20-0.23 ; Right mandibular tooth distance 0.22-0.31 ; Min. (median) length of postmentum 1.07-1.16 ; Max. width of postmentum 0.31-0.34 ; Max. length of pronotum 0.37-0.43 ; Max. width of pronotum 0.61-0.67 ; No. of antennal segments 14.

Distribution.—*West Bengal* : Midnapore Dist., Midnapore: *Elsewhere* : *India* : Tamil Nadu ; Coimbatore and Karnataka ; Dharwar (type-locality).

While in Bandipur Forest in Karnataka, Prof. A. E. Emerson (U.S.A.) collected two soldiers of a species of *Eurytermes* that he had identified as *E. buddha* Bose and Maiti (Personal communication, 1967).

Remarks.—The soldiers from Midnapore conform very closely to the type soldiers of *Eurytermes buddha* Bose and Maiti, but for the postmentum at waist narrower [(width at waist/maximum width) 0.45-0.52, (0.59-0.71 in *E. buddha*)]. Out of three apical tibial spur of foreleg, one is very small and even sometimes not seen in some soldiers (all are quite distinct in *E. buddha*).

Biology.—*Eurytermes buddha* Bose and Maiti, is subterranean in habit and is confined to the deciduous forest in the laterite zone in West Bengal. It has been collected from soil under cowdung. No discrete soil-nest has been found. The percentage of soldiers in the colony is very low and no imagos are found in the colony during the time of collection in August.

Genus (10) *Speculitermes* Wasmann, 1902

20. *Speculitermes deccanensis paivai* Roonwal and Chhotani

(Fig. 17. Worker, a-c)

1962b. *Speculitermes deccanensis paivai* M. L. Roonwal and O. B. Chhotani, *Zool. Anz.*, 168 (1-4) : 62-63. *W. Type-locality* : India : Bihar, Madhupur.

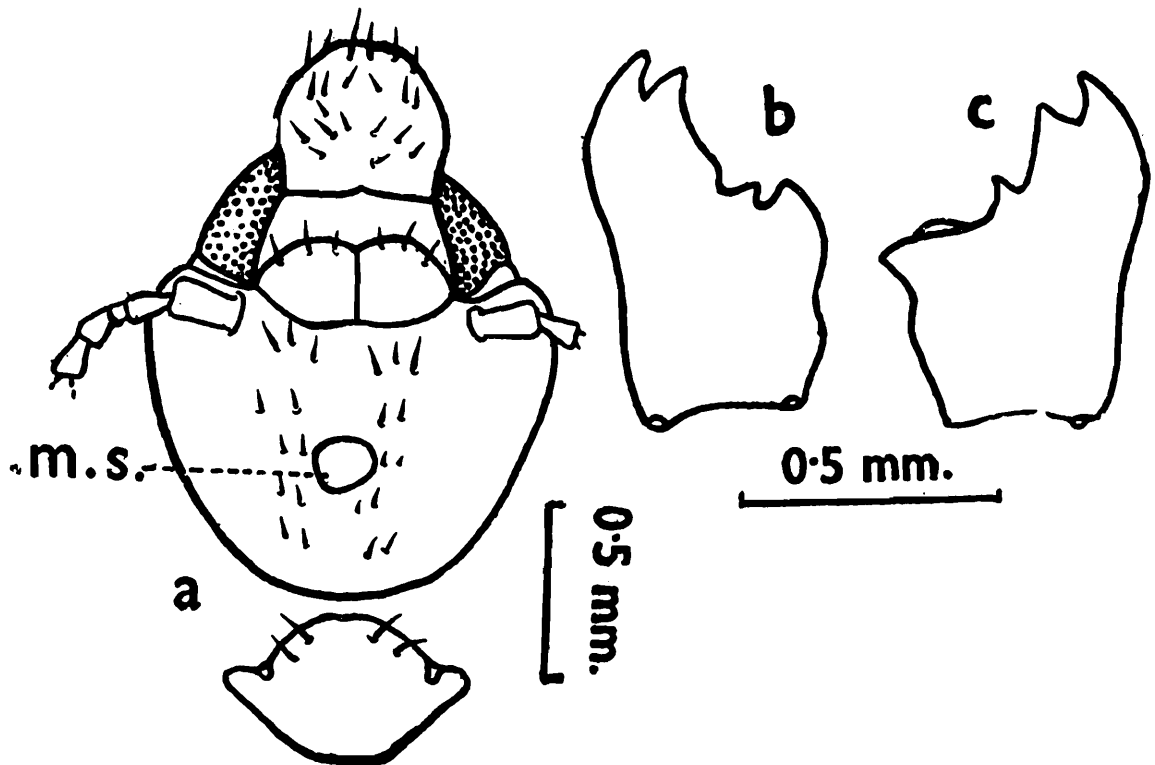


Fig. 17. *Speculitermes deccanensis paivai* Roonwal & Chhotani

(After, Roonwal and Chhotani, 1962)

a-c, Worker. a, Head and pronotum ; b, left mandible ; c, right mandible.

Material.—Holotype and Paratypes workers from Madhupur are examined.

Measurements (in mm.).—(i) *Imago* : Unknown (ii) *Soldier* : Unknown (iii) *Workers* (4 exs.) : Body-length 4.75-5.10 ; Length of head to lateral base of mandibles 1.00-1.06 ; Max. width of head 1.20-1.23 ; Max. length of postclypeus 0.23-0.25 ; Max. width of postmentum 0.53-0.57 ; Diameter of mid-dorsal spot 0.17 ; Max. length of pronotum 0.40 ; Max. width of pronotum 0.63-0.66 ; No. of antennal segments 14.

Distribution.—*West Bengal* : Calcutta, Tollygunj. *Elsewhere* : *India* : Bihar (Madhupur).

Biology.—Not known.

21. *Speculitermes roonwali* * sp. nov.

(Fig. 18. Imago, a-i)

Material.—(i) A vial (No. M3/26.6.66) with 21m. (female and male), Keranitolla, Midnapore, *P. K. Maiti coll.*, 26. vi. 1966, ex. "pairing on the ground while drizzling at 9 a.m." (ii) A vial (No. M2a/16.8.69) with 2 deal. (female and male), Judge's Court ground, Burge Town, Midnapore, *P. K. Maiti coll.*, 16. viii. 1969, ex. "soil, found mixed with *Dicuspiditermes incola* (Wasm.)".

Description.—1. *Imago* :

General : Head-capsule brownish black ; mid-dorsal spot and post-clypeus pale brown ; antennae yellowish, darker basally ; labrum yellowish brown ; mandibles yellowish brown with blackish brown denticular margins ; pronotum and abdominal tergites dark brown ; sternite paler ; wings somewhat brownish, paler distally ; legs yellowish white. Head, thorax and abdomen clothed with dense, short and long hairs. Total body-length with wings 13-14 mm., without wing 7.3-8.8 mm.

Head : Subcircular ; dorsum weakly depressed medially ; mid-dorsal spot large and round ; wider than long ; posterior margin round ; Y-suture indistinct. Eyes large, round, black and faceted, one on either side. *Ocelli* : Elongately oval, white ; separated from eye by almost half their long diameter. *Clypeus* : Divided into an ante- and postclypeus. Anteclypeus apilose hyaline ; a little shorter than

*The species is named in honour of Dr. M. L. Roonwal, an eminent Termitologist in India.

postclypeus; weakly narrowing in front and with a weak median projection. Postclypeus moderately swollen, pilose; twice as wide as long; divided into left and right halves by dark median line; posterior margin markedly differentiated from frons; anterior margin substraight. *Antennae*: With 15 segments, densely pilose; segment 1

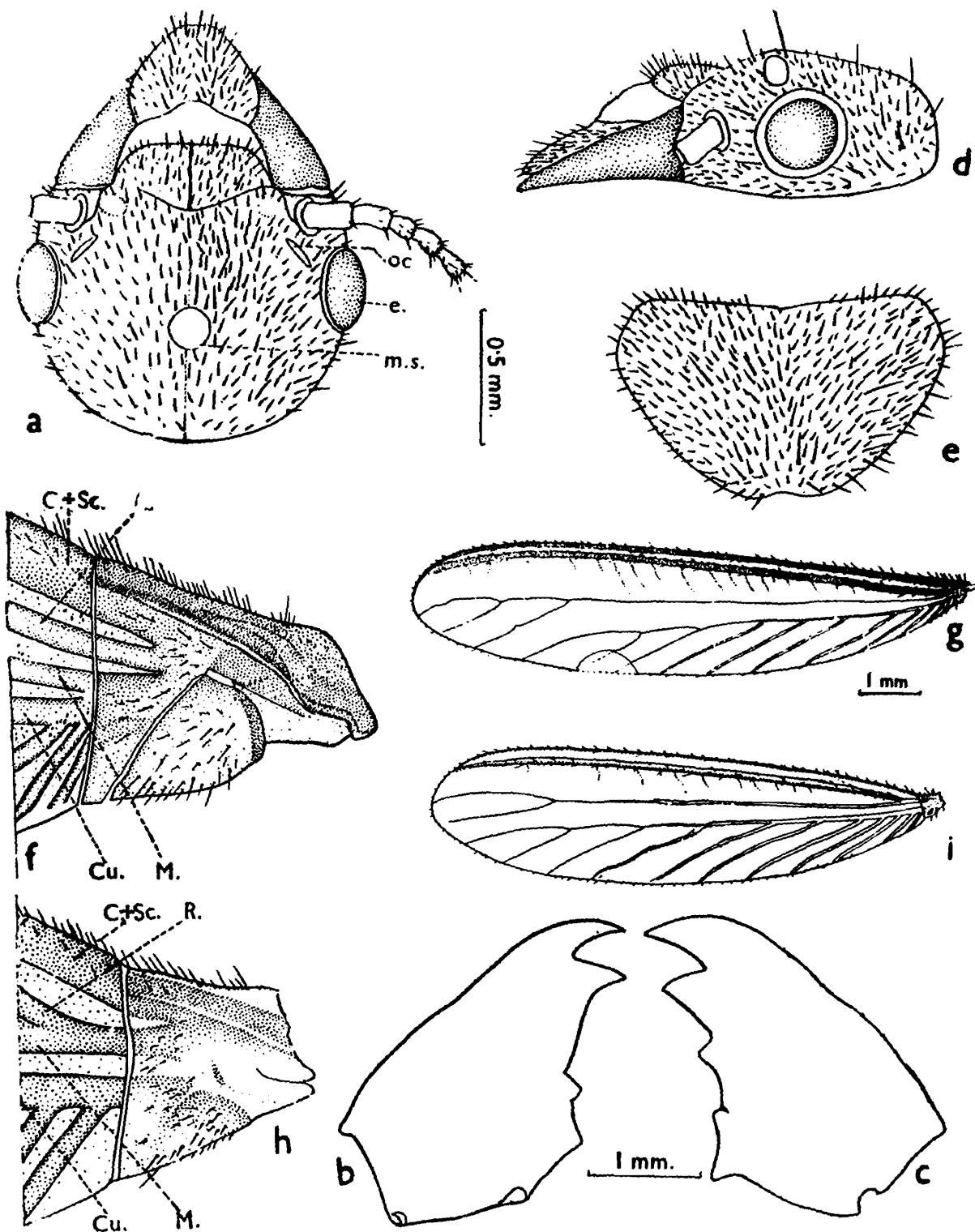


Fig. 18. *Speculitermes roonwali* sp. nov.

Holotype Imago (female) from Midnapore, P.K. Maiti coll., 26.vi.1966.

a, Head (e.-eye, m.s.-mid-dorsal spot, Oc.-ocellus); b, left mandible; c, right mandible; d, head in lateral view; e, pronotum; f, basal portion of forewing (C+Sc.-Costa and Subcosta, R.-radius; M.-Median; Cu.-cubitus); g, forewing; h, basal portion of hindwing; i, hindwing

longest, cylindrical, 2 almost half of 1, 3 a little shorter than 2, 4 subequal to or little longer and thicker than 3, 5-14 almost club-shaped and gradually increasing in length and width, last one (15) ovate, subequal to the penultimate one. *Labrum* : Much broader than long, narrowed at base ; anterior margin round, and fairly pilose. *Mandibles* : Of typically *Speculitermes*-type. Left mandible with an apical and 2 marginal teeth ; apical finely pointed ; 1st marginal subequal and close to apical, with long posterior margin ; 2nd small subtriangular ; molar plate broad. Right mandible also with an apical and 2 marginals ; apical sharply pointed ; 1st marginal smaller than apical and with a fairly long posterior margin ; 2nd short, a deep notch separating 2nd marginal from molar plate.

Thorax : Pronotum : Much broader than long ; broader anteriorly and narrowed posteriorly ; strongly hairy ; anterior margin feebly concave or substraight, without having median notch ; sides weakly convex ; posterior margin fairly emarginate.

Wings : Large, dirty brown, hairy at anterior and posterior margins. *Forewing* : Wing scale triangular and larger than that in hindwing. Costa and subcosta fused and bordering anterior margin of wing, rows of dense hairs marking its course. Radius arising independently from the scale, running close to and parallel with costa-subcosta, unbranched, strongly chitinised and with a few hairs on its course. Median comparatively weakly chitinised except in the basal portion and running throughout the entire length and with two branches from middle to the posterior margin of wing. Space between radius and median traversed by some feeble cross veins. Cubitus also weakly chitinised, with 10 branches to posterior margin, branches not subdivided, thickness of branches gradually decreasing distally. *Hindwing* : Smaller than forewing. Costa and subcosta as in forewing. Radius arising from the scale independently running close to and parallel with costa-subcosta, unbranched. Median arising from the radius, a little outside the scale, and running the entire length through the middle of wing, with branch to posterior margin. Cubitus with 10 branches.

Legs : Long and strongly pilose ; foreleg shortest ; tibial spur formule 3:2:2. Tarsi 4-segmented.

Abdomen : Elongate, strongly pilose ; 7th sternite shield-shaped in ♀ . Cerci pilose, 2-segmented, basal segment thick and broad.

<i>Measurements</i> (in mm.)—			<i>Range</i> (4 exs.)
1. Body-length with wings	...	...	12.95-14.00.
2. Body-length without wings	...	...	7.30- 8.00.
3. Length of head to lateral base of mandibles	...	...	0.96- 1.00.
4. Max. width of head (with eyes )	...	...	1.20- 1.25.
5. Max. height of head	...	...	0.50- 0.53.
6. Max. length of postclypeus	...	...	0.24- 0.26.
7. Max. width of postclypeus	...	...	0.53- 0.57.
8. Max. length of labrum	...	...	0.26- 0.28.
9. Max. width of labrum	...	...	0.46- 0.49.
10. Max. diameter of compound eye (with ocular sclerite )	...	...	0.30- 0.34.
11. Max. diameter of lateral ocellus	...	...	0.11- 0.13.
12. Min. diameter of lateral ocellus	...	...	0.08- 0.11.
13. Min. eye-ocellus distance	...	...	0.05- 0.06.
14. Min. eye-antennal distance	...	...	0.05- 0.07.
15. Diameter of mid-dorsal spot	...	...	0.17- 0.20.
16. Eye distance from lower margin of head	...	...	0.05- 0.06.
17. Max. length of pronotum	...	...	0.66- 0.70.
18. Max. width of pronotum	...	...	1.11- 1.15.
19. Length of forewing with scale	...	...	10.75(1)
20. Length of forewing scale	...	...	0.65- 0.75.
21. Length of hindwing with scale	...	...	9.90(1)
22. Length of hindwing scale	...	...	0.46- 0.52.

Comparison.—Out of the 10 species (excluding *S. roonwali* sp. nov.) under the genus in Indo-Malayan region, Imagos of only 5 species and subspecies are described so far. *Speculitermes roonwali* sp. nov. based on imagos only, is close to *S. cyclops cyclops* Wasmann and *S. dharwarensis* Roonwal and Chhotani from India and *S. macrodentatus* Ahmad from Thailand ; but differs from them as follows :—

1. From *S. cyclops* IMAGO (i) Smaller species, head-length 0.97-1.00 mm., head-width 1.25-1.27 mm. (vs. 1.20 mm., and 1.40 mm. respectively). (ii) Ocelli close to eyes, distance 0.05-0.07 mm. (vs. widely separated, distance 0.10-0.13 mm.). (iii) Eyes lying closer to antennal sockets, distance 0.05-0.07 mm. (vs. 0.10 mm.). (iv) Postclypeus weakly swollen (vs. greatly swollen). (v) Anterior margin of pronotum without median notch and lateral margin strongly converging

posteriorly (*vs.* anterior margin with a weak notch and not strongly converging).

2. From *S. dharwarensis* : IMAGO : (i) Head smaller, head-length 0.97-1.00, head-width 1.25-1.27 mm. (*vs.* 1.17 and 1.50 respectively). (ii) Mid-dorsal spot prominent, large and swollen, diameter 0.17-0.20 mm. (*vs.* small and depressed 0.17 mm.). (iii) Postclypeus moderately swollen, maximum width twice the median length (*vs.* greatly swollen, width much less than twice the length). (iv) Anterolateral corners of pronotum broadly round (*vs.* narrowly round). (v) Ocellus much smaller than max. diameter of mid-dorsal spot (*vs.* as big as mid-dorsal spot).

3. From *S. macrodentatus* : IMAGO : (i) Y-suture on head dorsum not visible (*vs.* visible). (ii) Ocelli closer to eyes, distance 0.05-0.07 mm. (*vs.* widely separated, distance 0.17). (iii) Eye distance from the lower margin of head, 0.05-0.07 mm. (*vs.* 0.13 mm.).

Type-specimens.—All specimens, in spirit and from two sources (vide, above under "Material") deposited in Z. S. I., Calcutta, in separate vials, as follows : *Holotype* : Imago (female), from "Material (i)" in Z. S. I., Calcutta (Reg. No. 1072/H₁₁) *Paratypes* : Imago (Male) from "Material (i)" ; and 2 Paratypes, a deal. (female) and one deal. (male) from "Material (ii)" in another vial (Reg. No 1073/H₁₁).

Type-locality and Distribution.—*Type-locality* : India : West Bengal, Midnapore (lat. 22°25' N., long. 87°15' E., alt 45 m). *Distribution* : Known only from the type-locality.

Biology.—At Midnapore, the imagos of *Speculitermes roonwali* were collected from ground at 9 a. m. in a cloudy morning in the month of June, while it was dizzying. Swarming took place along with *Odontotermes redemanni* (Wasmann). However, the former species staged the flight very sparsely, while the latter profusely. Two dealates were also collected from soil a few centimeters below the ground surface, very much close to a small colony of *Dicuspiditermes incola* (Wasmann).

Genus (11) *Euhamitermes* Holmgren, 1912

22. *Euhamitermes chhotanii* * sp. nov.

(Fig. 19. Soldier, a-e ; worker f-h)

Material—A vial (No. M1/10.11.66) with 2S. and sev. W., Atiamochar Forest Beat (near Forest Rest House), Cooch Behar Forest Range,

* The species is named in honour of Dr. O. B. Chhotani, a wellknown termitologist in India.

Cooch Behar Dist., *P. K. Maiti coll.*, 10.xi.1966, ex. "soil under cowdung, mixed with *Odontotermes parvidens* Holmgren and Holmgren",

Description—1. Imago.—Unknown,

2. Soldier,—

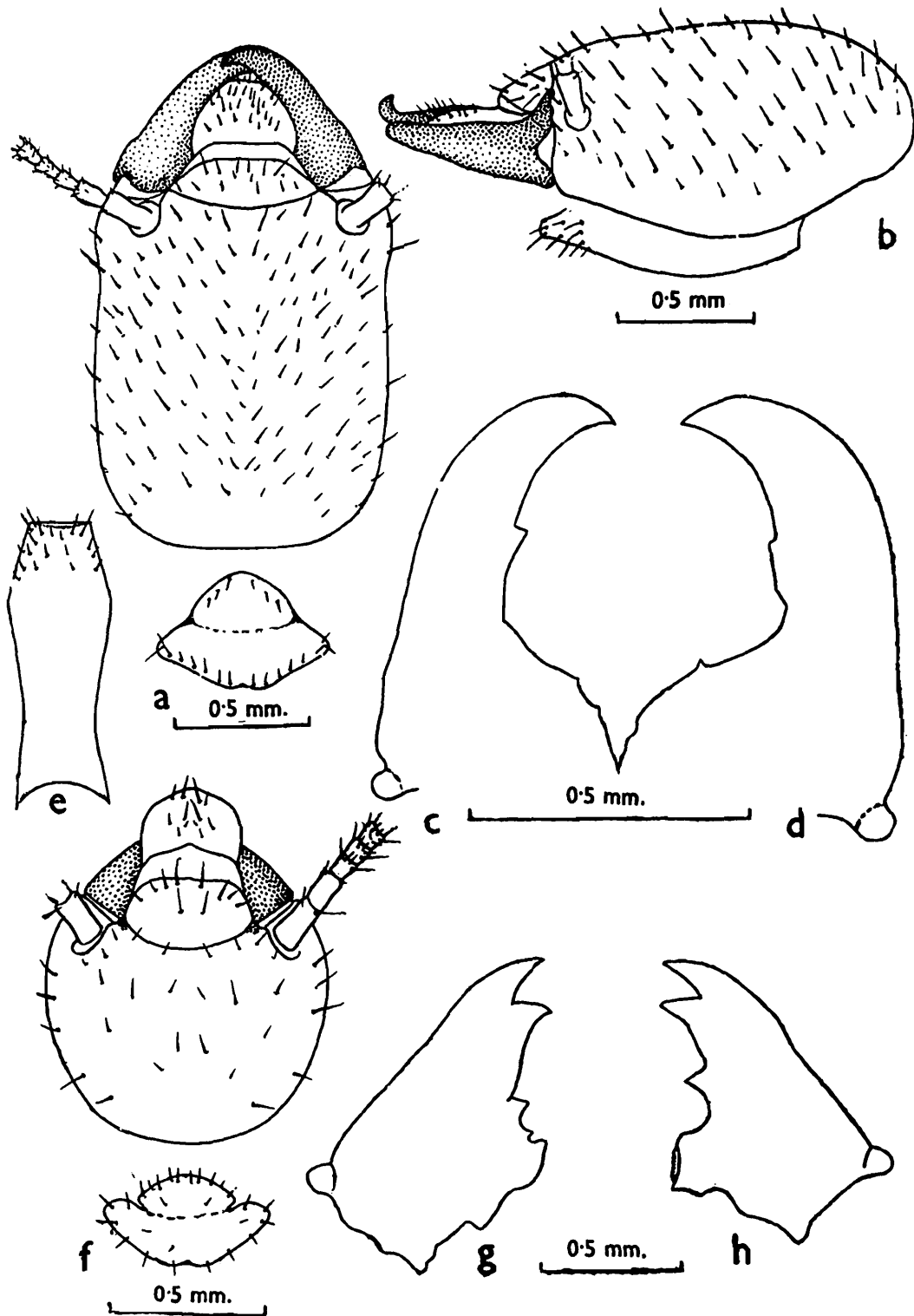


Fig. 19. *Euhamitermes chhotanii* sp. nov.

Holotype Soldier and paratype worker from Atiamochar Forest Beat (Cooch Behar Dist.), *P. K. Maiti coll.*, 10.xi.1966

a-e, Soldier. a, head and pronotum ; b, same in lateral view ; c, left mandible ; d, right mandible ; e, postmentum.

f-h, Worker. f, head and pronotum : g, left mandible ; h, right mandible

General : Head-capsule creamy yellow, somewhat darker posteriorly ; labrum, anteclypeus and antennae whitish ; postmentum and pronotum paler than head-capsule ; mandible dark brown, paler basally ; thorax, legs and abdomen whitish. Head, thorax and abdomen fairly densely pilose. Body-length (excluding antennae), 4.2.-4.6 mm.

Head : Head-capsule subrectangular, longer than broad ; lateral margins subparallel, very weakly diverging anteriorly ; posterior margin rounded. Fontanelle indistinct. *Eyes*, *ocelli* and *Y-suture* absent. *Antennae* : With 14 segments, fairly pilose ; segment 1 longest and cylindrical, 2 about half as long as 1, 3 shorter than 2, 4 subequal to 3, 5-9 club-shaped and gradually increasing in length, 10-13 subequal, the last (14) ovate and subequal to penultimate one. *Clypeus* divided into an ante- and a postclypeus. Anteclypeus yellowish white, apilose, convex at anterior margin. Postclypeus scanty hairy, much broader than long, a little darker than anteclypeus. *Labrum* : Transparent, with a scattered band of hairs, a little below the apex ; one and a half times as long as broad ; anterior margin broadly rounded. *Mandibles* : Thick, strongly built and sickle-shaped ; very broad basally and a little incurved at apex. Left mandible with a minute tooth, placed a little below apical one-third ; a deep concavity in between the straight posterior margin of tooth and molar plate ; molar plate with a minute but prominent denticle. Right mandible with a large prominent tooth having an incurved posterior margin and placed at apical one-third ; angular concavity in between tooth and molar plate ; molar plate with an indistinct denticle. *Postmentum* : Elongated and club-shaped, with a few long hairs anteriorly, widest a little below the anterior one-third whence the lateral margins weakly narrowing behind into a waist lying a little above the posterior margin, anterior margin substraight, posterior margin concave.

Thorax : *Pronotum* : Strongly saddle-shaped, with the anterior lobe strongly projecting, one and a half times as long as broad ; anterior margin narrowly rounded having without median notch ; posterior margin with a row of long hairs and medially emerginate. *Legs* : Pilose, hind-legs longest, tibial spur formule 3 : 2 : 2 (outer spur on foreleg very minute). Tarsi 4-segmented.

Abdomen : Oblong, moderately densely hairy. Cerci 2-segmented and hairy. Styli absent.

Measurements (in mm.), etc.—

Range (2 exs.)

1. Body-length

... .. 4.60

2.	Length of head to lateral base of mandibles	...	...	1.38
3.	Max. width of head	...	...	1.11
4.	Min. width of head (at base of mandible)	...	...	1.00
5.	Max. height of head	...	...	0.73
6.	Head Index I (width/length)	...	...	0.80
7.	Head Index II (height/width)	...	...	0.65
8.	Head Index III (height/length)	...	...	0.54
9.	Max. length of labrum	...	...	0.21
10.	Max. width of labrum	...	...	0.32
11.	Length of mandibles (a) Left mandible	...	...	0.69
	(b) Right mandible	...	...	0.69
12.	Width of left mandible at base	...	...	0.42
13.	Left mandible tooth distance from tip	...	...	0.24
14.	Right mandible tooth distance from tip	...	...	0.25
15.	Head-mandibular length Index (left mandible-length/head-length)	...	...	0.50
16.	Left mandibular tooth index (tooth distance/mandible length)	...	...	0.36
17.	Min. (median) length of postmentum	...	...	0.96
18.	Max. width of postmentum	...	...	0.38
19.	Width of postmentum at waist	...	...	0.30
20.	Postmentum contraction index (min. width/max. width)	...	...	0.78
21.	Max. length of pronotum	...	...	0.38
22.	Max. width of pronotum	...	...	0.61
23.	Pronotum head index (Pronotum width/head-width)	...	...	0.55
24.	Pronotum Index (length/width)	...	...	0.59

3. Worker.—

General: Head-capsule creamy yellow, much paler anteriorly; labrum, anteclypeus, antennae and pronotum yellowish white; mandibles along the toothed margin, dark-brown, paler basally; abdomen blackish because of intestinal contents showing through the highly transparent tergites and sternites. Head and body moderately densely pilose. Body-length (without antennae), 4.15-4.35 mm.

Head: Head-capsule subcircular, broader than long; posterior margin rounded. Fontanelle indistinct. Eyes and celli absent. Antennae with 14 segments, segment 1 longest and cylindrical, 2 about half of 1, 3 slightly shorter than 2, 4 subequal to or shorter or longer than 3; 5-9 gradually increasing in length; 10-13 subequal; the last

(14) ovate, subequal to 13. Anteclypeus apilose, transparent, somewhat projecting out medially. Postclypeus fairly swollen and pilose ; median length less than half the width ; median vertical suture indistinct. Labrum broadly tongue-shaped, broader than long, anterior margin rounded, with a few short and long hairs on the body. Mandibles of typical *Euhamitermes*-type.

Thorax : Pronotum saddle-shaped, anterior lobe strongly projecting out and without a median notch, much narrower than head ; median length less than half its width ; moderately pilose. Legs slender and hairy ; tibial spur formula 3:2:2, dorsal spur on fore-leg rudimentary.

Abdomen : Elongate and hairy. Cerci 2-segmented. Styli absent.

<i>Measurements</i> (in mm.)—			<i>Range</i> (10 exs.)
1. Body-length	...	...	4.20-4.35
2. Length of head to lateral base of mandibles	...	...	0.69-0.73
3. Maximum width of head	...	...	0.80-0.92
4. Max. height of head	...	...	0.33-0.38
5. Max. length of postclypeus	...	...	0.15-0.20
6. Max. width of postclypeus	...	...	0.30-0.40
7. Max. length of labrum	...	...	0.22-0.27
8. Max. width of labrum	...	...	0.31-0.39
9. Max. length of pronotum	...	...	0.25-0.28
10. Max. width of pronotum	...	...	0.48-0.53

Type-specimens.—*Holotype* : 1S. in a vial (Reg. No 615/H₁₁) in spirit, and *Paratype* and *Paramorphotypes* : 1S. and 15W., in another vial (Reg. No 616/H₁₁) other data same as under 'Material' above ; both deposited in Z.S.I., Calcutta.

Type-locality and Distribution.—*Type-locality* : Atiamochar Forest Beat (lat. 26°20' N., long. 89°35' E., alt. 40 m.), Cooch Behar Forest Range, Cooch Behar Dist., West Bengal, India. *Distribution* : Known only from the type-locality.

Comparison.—The soldier of *Euhamitermes chhotanii* sp. nov. can easily be separated from other Indian species, viz., *E. indicus* Holmgren and Holmgren from Shevaroy Hills and *E. lighti* Snyder from Dehra Dun, by its much smaller size. It is very close to *E. hamatus* Holmgren from Malaya Peninsula, *E. kanhaensis* Roonwal and Chhotani from Madhya Pradesh and *E. karnatakensis* Roonwal and Chhotani from Mysore State ; but differs from them as follows :—

1. From *E. hamatus* : (i) Left mandible with a minute and right with a prominent tooth (*vs.* with an obscure tooth on both the mandibles). (ii) Postmentum shape different, waist much broader (*vs.* much narrower). (iii) Head somewhat less densely pilose (*vs.* more densely pilose).

2. From *E. kanhaensis* : (i) Head-capsule shorter comparative to head-width, index (width/length) 0.79-0.80 and lateral margins weakly diverging anteriorly (*vs.* longer, head index 0.73 and lateral margin subparallel). (ii) Left mandibular tooth minute (*vs.* prominent). (iii) Postmentum much broader at waist, contraction index (min. width/max. width) 0.78 (*vs.* much narrower, index 0.60).

3. From *E. karnatakensis* : (i) Head-capsule a little longer than broad, head index (width/length) 0.79 ; lateral margins weakly diverging anteriorly (*vs.* much longer than broad, index 0.71 ; lateral margin subparallel). (ii) Left mandibular tooth minute (*vs.* large and pointed). (iii) Mandibles just half the head-length, head-mandibular index (left mandible-length/head-length) 0.50 (*vs.* mandibles shorter than half of head-length, index 0.43). (iv) Postmentum broader at waist, contraction index (min. width/max. width) 0.78 (*vs.* narrower, index 0.62).

Biology.—Not known.

Genus (12) *Synhamitermes* Holmgren, 1912

23. *Synhamitermes quadriceps* (Wasmann)

(Fig. 20. Imago, a-c ; Soldier, d and e)

1902. *Amitermes quadriceps* E. Wasmann, *zool. Jb. (Syst.)*, 17 (1) : 123-124. S. W. and Nv. *Type-locality* : India : Maharashtra, Khandala (near Bombay).
1960. *Synhamitermes quadriceps*, M. L. Roonwal and P. K. Sen-Sarma, *Indian Counc. Agric. Res., Ent. Monogr.* No. 1, pp. 7-14, Im. India : Maharashtra and Rajasthan.
1975. *Synhamitermes quadriceps*, M. S. Akhtar, *Bull. Dept. zool. Univ. Panjab (N.S.)*, 7 : 159-162. Im. and S. Bangladesh.

Material.—(i) A vial (No. 0_{13a}/24.9.57) with 2S., 1 Queen and 10W., Barrackpur (near Water Works), 24-Parganas Dist., O. B. Chhotani coll., 24. ix. 1957, ex. "mound of *Odontotermes redemanni* (Wasm.)". (ii) A vial, (No. D₁/22.2.59) with 6S. and 8W., Barisha, Calcutta, P. C. Dhar coll., 22. ii. 1959, found mixed with *Odontotermes* sp. collected at base of a bamboo pole". (iii) A vial, (No. M₄/26.vi.1966) with 4 Im. Midnapore P. K. Maiti coll., 26.vi.1966, ex.

“swarming while drizzling at 9 a.m.”. (iv) A vial (No. M₂/17.8.69) with 9S. and 2 Im. (immature) and sev. W., Midnapore, P. K. Maiti coll., 17.viii.1969, ex. “soil”.

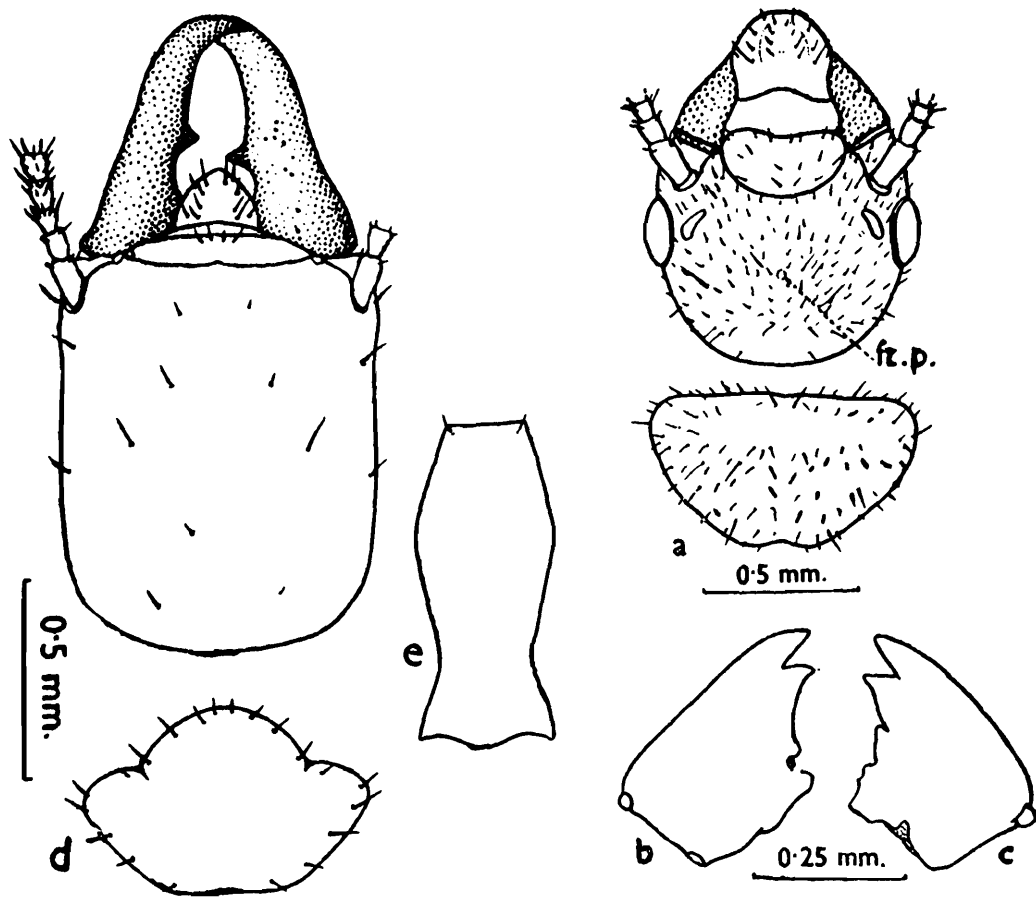


Fig. 20. *Synhamitermes quadriceps* (Wasmann)

Specimens from Midnapore, P. K. Maiti coll.

a-c, Imago. a, Head and pronotum ; b, left mandible ; c, right mandible
d and e, Soldier. d, Head and pronotum ; e, postmentum

Measurements (in mm.), etc.—(i) *Imago* (5exs.): Body-length with wings 8.84-9.10 ; Body-length without wings 5.53-5.72 ; Length of head to lateral base of mandibles 0.64-0.75 ; Max. width of head (with eyes) 0.83-0.94 ; Max. diameter of compound eye (with ocular sclerite) 0.24-0.27 ; Max. diameter of lateral ocellus 0.10-0.14 ; Min. eye-ocellus distance 0.03-0.07 ; Max. length of pronotum 0.56-0.61 ; Max. width of pronotum 0.73-0.76 ; Length of forewing (with scale) 7.62-7.76 ; Length of hindwing (with scale) 7.15-7.29 ; No. of antennal segments 15. (ii) *Soldier* (10 exs.): Body-length 4.00-4.30 ; Length of head to lateral base of mandibles 0.84-0.95 ; Max. width of head 0.69-0.78 ; Length of left mandibles 0.59-0.63 ; Min. (median) length of postmentum 0.55-0.58 ; Max. width of postmentum 0.23-0.29 ; Max. length of pronotum 0.24-0.29 ; Max. width of pronotum 0.48-0.53 ; No. of antennal segments 13.

Distribution.—*West Bengal* : 24-Parganas Dist., Barrackpore and Barisa ; Midnapore Dist., Midnapore. *Elsewhere* : *India* : Assam (Kamrup Dist., Gotanagar), Maharashtra [Khandala (type locality) ; Kusgaon Forest and Vardhangad Forest, Koregaon], Rajasthan (Chitenpura, near Kotah).

Remarks.—The imagos from Midnapore generally agree with the description given by Roonwal and Sen-Sarma (1960), except that the wing-scales are paler than the wing-membrane (wing-membrane paler than wing-scale, Roonwal and Sen-Sarma, 1960) and that the median vein in both fore- and hindwings does not show much variations (highly variable, Roonwal and Sen-Sarma, 1960). In soldiers from Barrackpore and Barisa (both 24-Parganas), the outer margin of mandible is either substraight or very weakly incurved at the middle (appreciable median concavity at outer margin in specimens from other places). This is probably the colonial variation.

Biology.—*Synhamitermes quadriceps* (Wasm.) is essentially subterranean in habit and the only representative of this small but interesting genus known to occur all over the main land of India. The species has been found nesting in some close association with other species, such as in the outer walls of the mound of *Odontotermes redemanni* at Barrackpore, in the vicinity of subterranean nests of *Speculitermes* at Midnapore and in association with some species of *Odontotermes* in Calcutta. At Midnapore, a fairly large colony has been detected at a depth of about 40 cm. below the ground surface. The nest usually comprises of a series of small irregular cell connected by short and narrow passages. The cells are measured from 5-10 mm. from floor to ceiling and about 2-5 cm. across and are found scattered around the root of a shrub. Nothing particular is known as regards the economic importance of the species. However, it usually causes minor damage to the roots of the shrubs around which the nest was found. The swarming at Midnapore, has been observed in the month of June while it was drizzling at 9 a.m. The imagos were also collected from the soil nest in August, 1969 from the same locality.

Subfamily (ii) Termitinae

Genus (13) *Microcerotermes* Silvestri, 1901

24. *Microcerotermes beelsoni* Snyder

(Fig. 21. Imago, a-c ; Soldier, d-f)

1933. *Microcerotermes beelsoni* T. E. Snyder, *Proc. U. S. nat. Mus.*, 82(16) : 12-14.
Im. Type-locality : India : Uttar Pradesh, Chakrata Range, Haldwani.

1949. *Microcerotermes beesoni*, T. E. Snyder, *Smith. misc. Coll.*, 112 : 133, India.
1967. *Microcerotermes beesoni*, B. Prashad, R. S. Thapa and P. K. Sen-Sarma, *Indian For. Bull. (N. S. Ent.)*, No. 246, pp. 14-18. Im. S. and W. India : Uttar Pradesh and Delhi.
1977. *Microcerotermes beesoni*, M. L. Roonwal and O. B. Chhotani, *Ent. Basil.*, 2 : 58-59. S. and W. Bhutan.

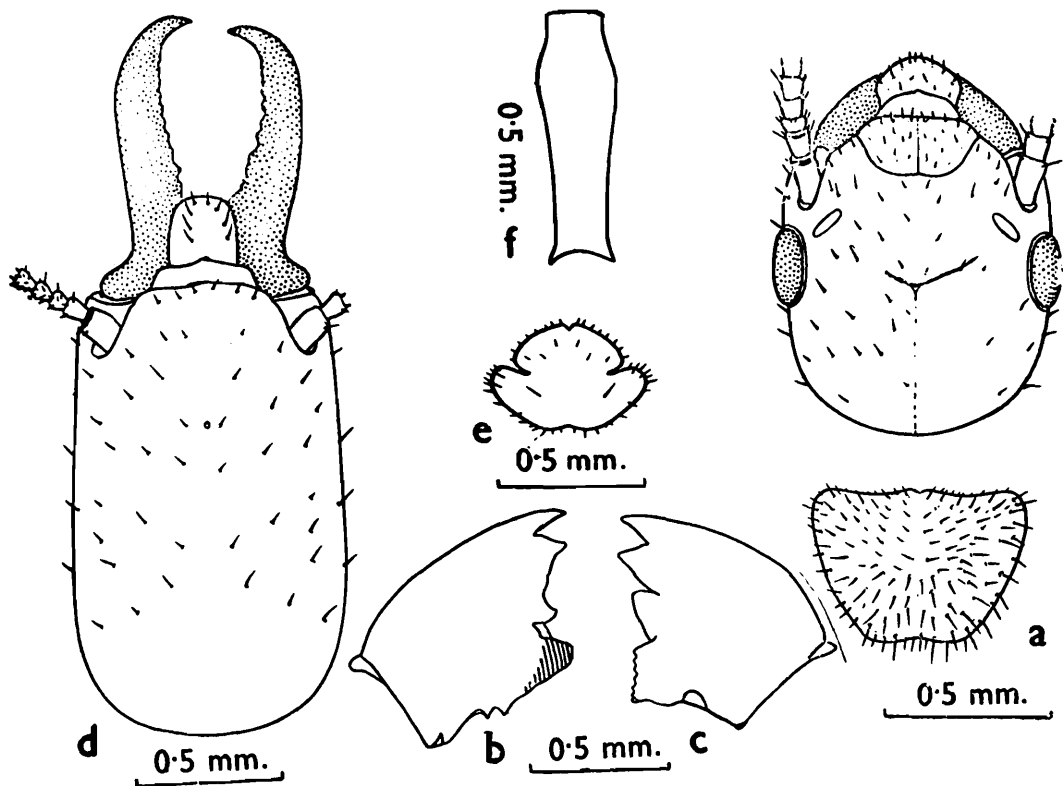


Fig. 21. *Microcerotermes beesoni* Snyder Specimens from Sundarbans (24-Parganas Dist.), *M.L. Roonwal coll.*, 4.i.1954.

a-c, Imago. a. Head and pronotum ; b, left mandible ; c, right mandible
d-f, Soldier. d, Head ; e, pronotum ; f, postmentum

Material—LOT (A).—Five vials from Sundarbans, 24-Parganas Dist., *P. K. Sen-Sarma coll.*, 1954, as follows : (i)—(iii) Nos. $S_2/5.1.54$, $S_3/5.1.54$ and $S_5/5.1.54$; with sev. S. and W. Kakdwip, 100 km. S. of Calcutta, 5.i.1954, “Carton nest encircling a dead stump of *Acacia arabica*” (3 vials). (iv) No. $S_4/6.1.54$, with sev. S. and W., Pathar Pratima, 25 km. E. Namkhana Range H. Q., 6.i.1954, ex. “very small wood-carton nest” (v) No. $S_5/11.1.54$, Sajnakhali, 40 km. S. of Rampura Range H. Q., 11.i.1954 ; ex. “wood-carton nest”.

LOT (B).—Five vials from Murshidabad Dist., *P. K. Sen-Sarma coll.*, 1954, as follows : (vi) No. $S_5/19.1.54$, with sev. S. and W., Berhampur, 19.i.1954, ex. “under a lump of earth” (vii) No. $S_1/20.1.54$, with sev. S. and W., Lalbag, 10 km. N. of Berhampur, 20.i.1954,

ex. "wood-carton nest at the base of *Phoenix silvestris*". (viii) No. S₅/21.1.54, with 1 Queen, sev. S. and W., Gocorn, 15 km. W., of Berhampur, 21.1.1954, ex. "carton nest". (ix-x) No. S₂/22.1.54, with 1 Queen, sev. S. and W., ex. "wood-carton nest at the base of *Phoenix silvestris*" and No. S₃/22.1.54, with sev. S. and W., ex. "Wood-carton nest" ; both from Berhampur on 22.i.1954.

LOT (C).—(xi) One vial (No. R₇/4.1.54) with King, Queen, sev. S. and W. from Narainpur village, 1st camp, 4 km. E. of Namkhana Range H. Q., Sundarbans, 24-Parganas Dist., *M. L. Roonwal coll.*, 4.i.1954, ex. "wood-carton nest".

LOT (D).—Two vials from Subhasgram, 20. km. S. of Sealdah Rly. Stn., 24-Parganas Dist., *M. L. Roonwal coll.*, as follows : (xii-xiii) No. R₉/33.12.53, with 5S. and sev. W., ex. "broken part of wood-carton nest found at the base of *Borassus flabellifer*" and No. R₁₀/30.12.53, with 1 Queen, sev. S. and W., ex. "wood-carton nest" ; both on 30.xii.1953.

LOT (E).—Three vials (xiv-xvi) Nos. O₁/13.8.57, O₅/13.8.57, O₆/13.8.57 ; with sev. S. and W., from Horticulture Farm, Calcutta, *O. B. Chhotani coll.*, 13. viii. 1957, all ex. "galleries on tree".

LOT (F).—Two vials from Jaynagar, 24-Parganas Dist., *P. K. Maiti coll.*, 13.xi.1965, as follows : (xvii) No. M₁/13.ii.65, with sev. S., ex. "carton nest", (xviii) No. M₂/13.11.65, with sev. S. and W., ex. "attacking the stem of a shrub".

LOT (G).—Two vials (xix-xx) Nos. N₁ and M₂/26.2.66, with sev. S. and W., from Santineeketan, Birbhum Dist., *P. K. Maiti coll.*, 26.ii.1966, ex. "attacking stem of Casuarina plant".

LOT (H).—Three vials (xxi-xxiii) Nos. S₄, S₁₁, S₁₄/27.1.66, (with sev. S. and W., from Kamarhati, 1 km. E. of Muragacha Rly. Stn., Nadia Dist., *S. C. Mitra coll.*, 27.i.1966, ex. "fallen wood".

LOT (I).—One vial (xxiv) No. M₂/29.10.66, with sev. S. and W., Subhasgram, 24-Parganas Dist., *P. K. Maiti coll.*, 29.x.1966, ex. "attacking a young plant".

Measurements (in mm.), etc.—(i) *Imago* (3 exs.) : Body-length (with wings) 6.50-7.80 ; Body-length (without wings) 3.10-5.00 ; Length of head to lateral base of mandibles 0.76-0.80 ; Max. width of head (with eyes) 0.80-0.87 ; Max. diameter of compound eye (with ocular sclerite) 0.19-0.22 (2) ; Max. diameter of lateral ocellus 0.05-0.07 ; Min. eye-ocellus distance 0.05-0.07 ; Max. length of pronotum

0.40-0.46 ; Max. width of pronotum 0.58-0.67 ; Length of forewing (with scale) 6.00-6.50 ; Length of hindwing (with scale) 5.70-6.00 ; No. of antennal segments 14. (ii) *Soldier* (20 exs.) : Body-length 4.50-5.50 ; Length of head to lateral base of mandibles 1.30-1.60 ; Max. width of head 0.70-0.90 ; Length of left mandible 0.78-0.89 ; Min. (median) length of postmentum 0.70-0.90 ; Max. width of postmentum 0.28-0.32 ; Max. length of pronotum 0.21-0.28 ; Max. width of pronotum 0.45-0.57 ; No. of antennal segments 13.

Distribution.—*West Bengal* : 24 Parganas District : Jaynagar Subhasgram, and Sundarbans (Kakdwip, Narainpur, Pathar Pratima and Sajnakhali) ; Murshidabad District : Berhampur, Gocorn and Lalbag ; Birbhum District : Santineeketan ; Nadia District : Kamarhati (near Muragacha village) ; Calcutta. *Elsewhere : India* : Uttar Pradesh : Dehra Dun, Jhajra, New Forest, Haldwani and Chakata Range (Type-locality). Delhi : Vijaya Nagar.

Remarks.—*Microcerotermes beelsoni* is a highly variable species. The soldier shows great variation in size, (head-length 1.30-1.60 mm. and head-width 0.70-0.90 mm.), shape (subrectangular to much elongated) of head, postmentum (much narrow at waist) and pronotum (anterior margin indistinctly to distinctly notched medially). Due to such extreme variations, the identity of the species creates some confusion, but as the present study is based on large series of collections it has been possible to detect the 'normal' type and the varinats with intermediates.

Biology.—The species *Microcerotermes beelsoni* Snyder, a member of the subterranean group of termites, is widely distributed in the Gangetic and Coastal aluvial plains, and sparsely in the laterite zone of West Bengal. In this area, it usually builds carton nest, either buried partly in the soil or encircling the trunk of live and dead trees. It has also been collected frequently from cracks and hollows of both live and dead plants, decaying logs, fence posts. The subterranean nests are of common occurrence, situated generally either a few centimeter below the ground level in contact with burried timber or encircling the trunk of living and dead trees. It is observed that these nests occur mainly in well drained area where water logging is not possible. The carton nests collected from the area vary generally in shape and size. These are spherical, sub-oval or cone-shaped in shape and are constructed of semidigested woody material and lignin. Internally, the honey combed structure of these nests is tough and can not be conveniently differentiated into outer and inner zones. The nest sometimes usually

accommodates more than one royal chambers at the bottom of the nests or a little above.

Mathur and Sen-Sarma (1960) have reported the presence of more than one royal chambers to accommodate substitute queens in some nests at Dehra Dun.

The species is recorded to reproduce parthenogenetically. Vishnoi (1954) has reported the occurrence of 45 brachypterous females with egg masses in nearly 20 chambers in a nest located around the base of pear tree at Delhi.

The winged adults have been recorded from the colony in West Bengal in April. Emergence of imagos is reported during May to July in Dehra Dun (Mathur and Sen-Sarma, 1960).

In West Bengal, the species causes considerable damage to several species of plants namely, Guava (*Psidium guayava*), Casurina (*Casurina* sp.), Date palm (*Phoenix silvestris*), Babul (*Acacia* sp.) etc. and many shrubs.

25. *Microcerotermes cameroni* Snyder

(Fig. 22. Imago, a ; Soldier, b-d)

1934. *Microcerotermes cameroni* T. E. Snyder, *Indian For. Rec.*, 20 (11) : 21-22. *Im.* and *S.* *Type-locality* : India : Tamil Nadu, North Vellore.
1949. *Microcerotermes cameroni*, T. E. Snyder, *Smith. misc. Coll.*, 112 : 135.
1967. *Microcerotermes cameroni*, B. Prashad, R. S. Thapa and P. K. Sen-Sarma, *India For. Bull. (N. S. Ent.)*, No. 246, pp. 27-31.

Material.—LOT (A).—Ten vials from Sundarbans, P. K. Sen-Sarma coll., 1954, as follows : (i) No. S₄/5.1.54, with sev. S. and W., ex. "carton nest encircling on *Acacia* stump" and (ii) No. S₆/5.1.54, with 1 Queen, sev. S. and W., ex. "wood carton nest" from Kakdwip on 5.i.1954. (iii-iv) No. S₁/6.1.54 and No. S₂/6.1.54, each, with 1 Queen, sev. S. and W., Pathar Pratima, 25 km. E. of Namkhana Range H. Q., 6.i.54 ; ex. "carton nest". (v) No. S₆/7.1.54, with sev. S. and W. ; and (vi) No. S₇/7.1.54, with 5S. and sev. W., from J. Plot, 46 km. NE. of Namkhana Range H. Q., 7.i.1954, ex. "carton nest." (vii) No. S₆/11.1.54, with sev. S. and W. ; (viii) No. S₇/11.1.54, with 1 Queen, sev. S. and W. ; and (ix) No. S₈/11.1.54, with sev. S. and W. ; all from Satjalia village, Sajnakhali, 40 k. S. of Rampura Range H. Q., 11.i.1954, ex. "wood-carton nest" (x) No. S₄/13.1.54, with 1 Queen, 3 reproductives, 5S. and sev. W., Gosaba village, 6 km. N. of Sajnakhali, 13.i.1954, ex. "wood-carton nest".

LOT (B).—2 vials from Berhampur, Murshidabad Dist., *P. K. Sen-Sarma coll.*, 1954, as follows : (xi) No. S₁/19.1.54, with 2S. and 5W., ex. “wood-carton nest”. (xii) No. S₂/19.1.54, with 1 Queen, sev. S. and W., ex. “wood carton-nest”

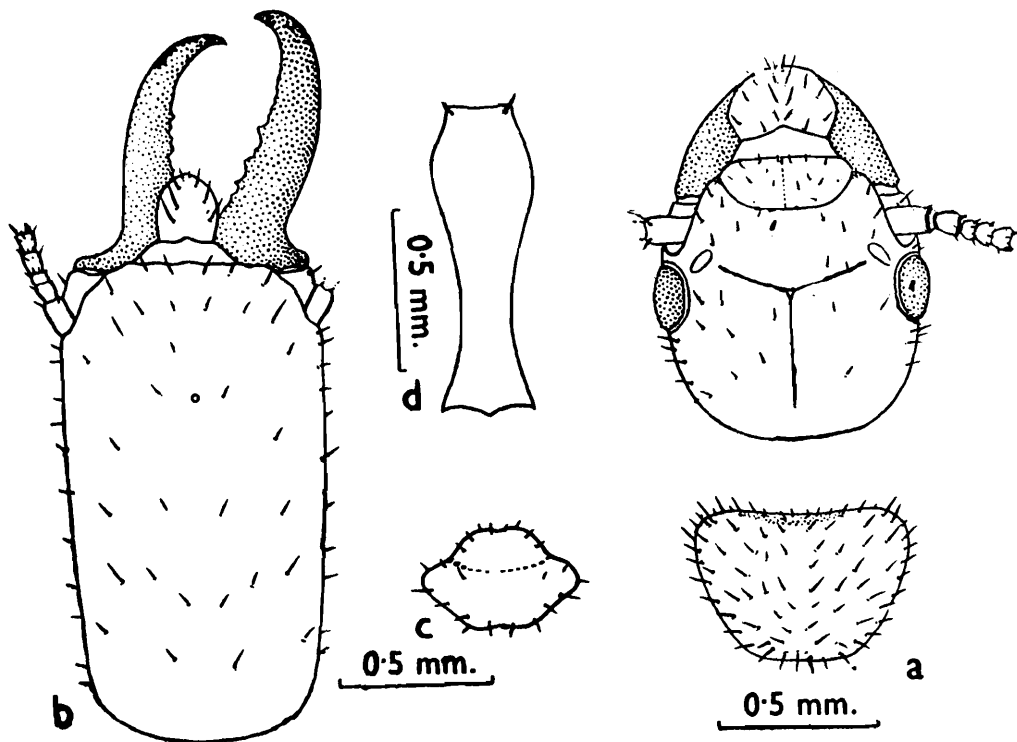


Fig. 22. *Microcerotermes cameroni* Synder ; Specimens from Midnapore, *P. K. Maiti coll.*, 8.iv.1966.

a, Imago. a, head and pronotum

b-d, Soldier. b, Head ; c, pronotum ; d, postmentum

LOT (C).—2 vials from Sundarbans, *M. L. Roonwal coll.*, 4.i.1954 as follows : (xiii) No. R₄/4.1.54, with 2 deal., sev. S. and W., Narainpur village, 3rd Camp, 8 km. E. of Namkhana Range H. Q., ex. “*Phoenix silvestris*” (xiv) No. R₆/4.1.54, with 4S. and W., Narainpur village, 2nd Camp, 4 km. E. of Namkhana Range H. Q., ex. “living date palm, *Phoenix silvestris*”

LOT (D).—(xv) A vial No. O₁₀/27.9.57, with sev. S. and W. Garia, 24-Parganas, *O. B. Chhotani coll.*, 27.9.1957, ex. “citrus log lying on ground”.

LOT (E).—Two vials from Jaynagar, 24-Parganas, *P. K. Maiti coll.*, 13.11.1965, as follows : (xvi) No. M₁/13.11.1965, with sev. S. and W., ex. “carton nest”. (xvii) No. M₂/13.11.1965, with 2S. and sev. W., ex. “attacking date palm *Phoenix silvestris* tree”.

LOT (F).—(xviii) A vial (No. M₁/29.10.1966) with sev. S., Subhasgram, 24-Parganas Dist., *P. K. Maiti coll.*, 29.x.1966, ex. “branch of live guava tree”.

LOT (G).-(xix) A vial No, M₁/8.4.66) with 1 Queen, 3 Im., sev. S. and W., Midnapore, P. K. Maiti coll., 8.iv.1966, ex. "carton nest on ground" ; and (xx) A vial with 8 Im. only, 26.vi.1965, ex. "swarming at 9 A. M."

LOT (H).-Four vials from Nadia District, S. C. Mitra coll., 1966 as follows : (xxi) No. S₁/28.1.66, with 5S. and sev. W., Muragacha vill., 2 km. NW. of Muragacha Rly. Stn., 28.1.1966, ex. "log." (xxii) No. S₅/27.1.66, with sev. S. and W., Kamarhati, 1 km. E. of Muragacha Rly. Stn., 27.i.1966, ex. "fallen wood". (xxiii) No. S₈/27.1.66, with 4S. and sev. W., Dharmadah, 2 km. W. of Muragacha Rly. Stn., 29.i.1977, ex. "Gallery on wood". (xxiv) No. S₉/30.1.66, with 5S. and sev. W., Sadhanpara, 3 km. SW. of Muragacha Rly. Stn., 30.i.1966, ex. "attacking a log"

Measurements (in mm.), etc.—

(i) *Imagos* (3 exs.) : Body-length (with wings) 8.50-9.12 ; Body-length (without wings) 4.75-5.14 ; Length of head to lateral base of mandibles 0.83-0.89 ; Max. width of head (with eyes) 0.83-0.90 ; Max. diameter of compound eye (with ocular sclerite) 0.21-0.25 ; Max. diameter of lateral ocellus 0.07-0.08 ; Min. eye-ocellus distance 0.04-0.07 ; Max. length of pronotum 0.42-0.51 ; Max. width of pronotum 0.65-0.71 ; Length of forewing (with scale) 7.45-8.00 ; Length of hindwing (with scale) 7.00-7.65 ; No. of antennal segments 14. (ii) *Soldiers* (20 exs.) : Body-length 4.30-5.20 ; Length of head to lateral base of mandibles 1.40-1.67 ; Max. width of head 0.90-1.00 ; Length of left mandible 0.86-0.96 ; Min. (median) length of postmentum 0.85-1.00 ; Max. width of postmentum 0.29-0.35 ; Max. length of Pronotum 0.27-0.35 ; Max. width of pronotum 0.53-0.65 ; No. of antennal segments 13.

Distribution.—*West Bengal* : 24-Parganas Dist., Garia, Jaynagar, Subhasgram, Sunderbans (Gosaba, J-Plot, Kakdwip Bazar, Narainpur, Pathar Pratima and Satjalia) ; Midnapore Dist., Midnapore ; Murshidabad Dist., Berhampur ; Nadia Dist., Muragacha village and its vicinity. *Elsewhere* : *India* : Andhra Pradesh : Waltair. Kerala State : Cochin. Tamil Nadu : North Vellore (type-locality).

Remarks.—The species, *Microcerotermes cameroni* Snyder occurs widely in the Gangetic and Coastal alluvial zones and sparsely in the Laterite zone of West Bengal. The extreme intra-specific variations in shape, size and colouration of head of both imagos and soldiers create some confusion in the identity of the species. Long series of detailed

collections, available from West Bengal, have helped to note the variations as follows. *Imago* : Eye-ocellus distance varies from nearly half the Diameter to about maximum diameter of ocellus. Y-suture either indistinct or distinct. *Soldier* : Lateral margins of head are generally parallel, but in some cases margins are either diverging or converging anteriorly. Head-length in relation to width is very variable, index (width/length) 0.55-0.66. The mandibles are weakly to strongly incurved at apex, and are variable in length in relation to head, head-mandibular length index (mandible-length/head-length) varies from 0.50-0.59. The postmentum is generally narrow, the waist varies from narrow to broad (0.16-0.22 mm.). The pronotum weakly to deeply notched at anterior margin medially.

Biology.—*Microcerotermes cameroni* Snyder is also a subterranean termite and is very close to *M. beesoni* Snyder in habit and distributional pattern in West Bengal. The species was so far known from southern India, while *M. beesoni* from northern India only. However, both the species have been found side by side at several occasions in this area. *M. cameroni* also builds carton nest ; the shape, size, structure etc. are very similar to that of *M. beesoni*. The species has been observed swarming at Midnapore in the month of June 1966, at 9 A. M.

Genus (14) *Angulitermes* Sjöstedt, 1924

26. *Angulitermes longifrons* sp. nov.

(Fig. 23. Soldier, a-e ; Worker, f-h)

Material.—LOT (A).—Two vials from Gidhni, 50 km. W. of Kharagpur, Midnapore Dist., *P. K. Maiti coll.*, 9.iv.1966, as follows : (i) No. M₁/9.4.66, with 8S. and sev. W., ex. “under cowdung in woil”. (ii) No. M₂/9.4.66, with 9S. and sev. W., ex. “under cowdung”.

LOT (B).—Two vials from Forest near Gope Palace (Women’s College), Midnapore, Midnapore Dist., *P. K. Maiti coll.*, 16.viii.1969, as follows : (iii) No. M₃/16.8.69, with 4S. and sev. W., “under cowdung”. (iv) No. M₇/16.8.69, with 2S. and 5W., ex. “soil”

Description—1. *Imago*.—Unknown.

2. *Soldier*.—

General : Head-capsule bright yellow ; antennae darker and labrum paler than head-capsule ; mandibles dark reddish brown ; body and

legs whitish yellow. Head-capsule moderately and body fairly densely pilose. Body-length, 3.80-4.10 mm.

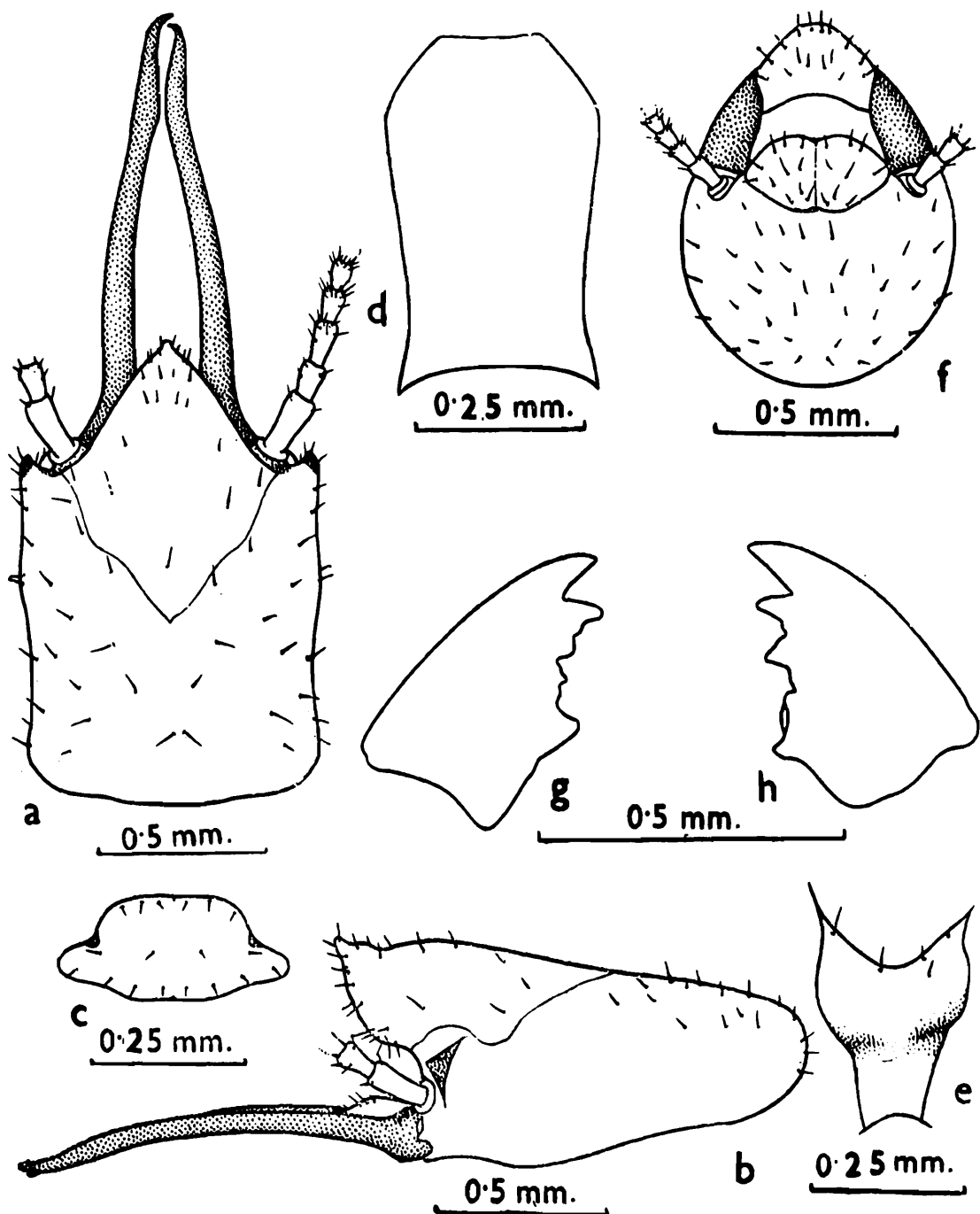


Fig. 23. *Angulitermes longifrons* sp. nov. Holotype Soldier and paratype worker from Gidhni (Minapore Dist.), P. K. Maiti coll., 9.iv.1966.

a-e, Soldier. a, Head ; b, same in lateral view ; c, pronotum ; d, postmentum ; e, labrum

f-h, Worker. f, head ; g, left mandible ; h, right mandible

Head : Head-capsule subrectangular ; broadest just behind anterolateral corners, whence gradually converging behind and somewhat incurved a little above posterior margin ; posterior margin convex weakly depressed medially ; anterolateral corners prominently projecting out like horns and strongly chitinised ; frontal projection large, prominent and conical ; apex pilose, somewhat pointed and turned

upwards, reaching upto or sometimes beyond median depression of labrum. Fontanelle : Lying below frontal projection, prominent and less hairy than head ; fontanelle gland large and prominent. *Eyes* and *Ocelli* : Absent. *Antennae* : With 14 segments ; segment 1 and 2 sparsely, and remainder fairly densely pilose ; segment 1 longest, 2 slightly and 4 much smaller than 3, 5-8 club-shaped and increasing gradually in length, 9 to the penultimate one subequal to or shorter than 8, the last ovate and a little longer than the penultimate one. *Clypeus* : Postclypeus weakly swollen and pilose. Anteclypeus whitish and apilose. *Labrum* : A little longer than broad ; anterolateral corners with horn-like projections ; anterior margin deeply concave and with hairs ; lateral margins narrowing posteriorly. *Mandibles* : Of snapping-type ; long and slender ; pointed and weakly incurved at distal end ; fairly longer than head-length. *Postmentum* : Short, club-shaped ; widest a little below anterior margin, with transverse weak striations and apilose ; lateral margin weakly incurved basally ; anterior margin substraight and posterior margin weakly incurved.

Thorax : Pronotum : Strongly saddle-shaped, anterior margin considerably raised ; broader than long and much narrower than head-capsule ; anterior margin without median notch ; fairly pilose. *Legs* : Thin, short and pilose. Tibial spur formula 3 : 2 : 2 ; tarsi 4-segmented ; claws weak.

Abdomen : Oblong, short ; fairly densely pilose. Cerci short, 2-segmented and hairy. Styli absent.

<i>Measurements</i> (in mm.), etc. :—	<i>Range</i> (10 exs.)	<i>Holotype</i>
1. Body-length	3.80-4.10	4.00
2. Length of head to lateral base of mandibles	1.10-1.14	1.10
3. Length of head to tip of frontal projection	1.34-1.44	1.38
4. Max. width of head	0.85-0.88	0.88
5. Max. height of head	0.61-0.73	0.65
6. Max. height of frontal projection	0.28-0.34	0.30
7. Head Index I (width/length)	0.77-0.99	0.78
8. Head Index II (height/width)	0.69-0.82	0.76
9. Head Index III (height/length)	0.54-0.65	0.59
10. Max. length of labrum	0.23-0.27	0.26
11. Max. length of labrum (without tip)	0.14-0.21	0.20
12. Max. width of labrum	0.21-0.23	0.23

<i>Measurements</i> (in mm.), etc. :—	<i>Range</i> (10 exs.)	<i>Holotype</i>
13. Max. length of mandibles		
(a) Left	... 1.24-1.38	1.26
(b) Right	... 1.24-1.36	1.24
14. Head mandibular Index (Left mandible-length/head-length)	1.10-1.21	1.14
15. Min (median) length of postmentum	0.36-0.40	0.40
16. Max. width of postmentum	... 0.28-0.34	0.30
17. Min. width of postmentum	... 0.20-0.24	0.23
18. Postmentum contraction Index (min. width/max. width)	... 0.70-0.85	0.76
19. Max. length of pronotum	... 0.11-0.15	0.14
20. Max. width of pronotum	... 0.38-0.44	0.38
21. Pronotum Index (length/width)	0.28-0.36	0.36
22. Head-pronotum width Index (pronotum-width/head-width)	... 0.41-0.45	0.43
23. No. of antennal segments	... 14	14

3. Worker.—

Head-capsule pale yellow, thorax whitish, abdomen appearing dark gray because of intestinal content ; head and body fairly pilose. Body-length 3.90-4.10 mm.

Head-capsule suboval, a little longer than broad. Fontanelle, eyes and ocelli absent. Antennae with 14 segments, pilose ; segments 3 and 4 subequal and shorter than 2, 5-13 increasing in length, last one conical and much longer. Postclypeus brownish, much swollen and pilose, twice as wide as long, posterior margin strongly convex. Anteclypeus hyaline, apilose, projecting in front medially. Labrum broadly tongue-shaped, pilose. Mandibles straw coloured, deep brown on toothed margin. Left mandible with an apical and two marginal teeth and a blunt projection at base ; apical finger-like, 1st marginal bluntly pointed out, 2nd marginal small with isolateral margins. Right mandible with an apical, two marginal teeth and a molar plate ; apical stout and finger-like, 1st and 2nd marginals subequal, 2nd somewhat directed posteriorly, molar margin concave.

Pronotum : Strongly saddle-shaped, pilose ; twice as wide as long and half as wide as head. Legs as in soldier. Abdomen oblong, fairly densely pilose. Cerci 2-segmented. Styli absent,

<i>Measurements</i> (in mm.).—	<i>Range</i> (10 exs.)
1. Body-length	3.9-4.1
2. Length of head to lateral base of mandibles	0.84-0.90
3. Length of head to tip of labrum	0.95-0.10
4. Length of postclypeus	0.18-0.24
5. Width of postclypeus	0.36-0.42
6. Max. length of pronotum	0.18-0.24
7. Max. width of pronotum	0.36-0.24

Type-specimens : All specimens, in spirit and from a single source (*vide*, above under 'Material-i'), in separate vials, deposited as follows : *Holotype* : S., in Z.S.I., Calcutta (Reg. No. 1070/H₁₁). *Paratypes & Paramorphotypes* : (i) 4S. and 5W., in Z.S.I., Calcutta (Reg. No. 1071/H₁₁) ; (ii) 1S. and 2W., in F.R.I., Dehra Dun ; (iii) 1S. and 2W., in Emerson's Collection, A.M.N.H., New York.

Type-locality and distribution : *Type-locality* : Gidhni (lat. 22°25' N., long, 86°53' E.), Midnapore Dist., West Bengal, India. *Distribution* : Gidhni (*type-locality*) and Midnapore.

Comparison : Though *Angulitermes longifrons* sp. nov. can easily be separated from all Indian species for its soldier having very prominent projection of anterolateral corners below the antennal socket on head, and stout and large frontal projection ; the species is close to *A. fletcheri* (Holmgren and Holmgren) and *A. acutus* Mathur and Sen-Sarma, both from South India, and *A. resimus* Krishna from Burma ; but differs as follows :

From *A. fletcheri* : SOLDIER : (i) Antero-lateral corners below antennal sockets prominently projected out like horns (*vs.* not prominent). (ii) Frontal projections large, stout and thickly cone-shaped (*vs.* comparatively small and less thickly cone-shaped). (iii) Lateral margins of head weakly converging posteriorly with considerable depression above the posterior margin (*vs.* parallel sided with a very slight depression in the posterior third). (iv) Postmentum wider at waist, index (max. width/min. median) 0.74-0.83 (*vs.* index 0.62*).

From *A. acutus*.—SOLDIER : (i) Anterolateral corners of head prominently projected out like horns (*vs.* no such horns). (ii) Frontal projection large (*vs.* small). (iii) Anterior margin of labrum deeply concave (*vs.* weakly concave).

* Index calculated from syntype Soldier, present in Z.S.I., Calcutta.

From *A. resimus*.—SOLDIER : (i) Anterolateral corners of head prominently projected out like horns (*vs.* distinctly angular, but not horn-like). (ii) Small species, head-length 1.10-1.14 mm., head-width 0.85-0.88 mm. (*vs.* 1.38-1.45 mm., 1.02-1.05 mm. respectively). (iii) Anterior lower margin of frontal projection sloping downwards at a very prominent angle overhanging on clypeus (*vs.* flat).

Biology : The species *Angulitermes longifrons* (sp. nov.) is described from soldiers and workers collected from four colonies in Sāl forest of laterite zone in the western part of Midnapore District. The occurrence of the nests can be detected by the characteristic mud plaster on the dried up cowdung lying on ground in the vicinity of the subterranean nests. It is essentially a soil inhabiting termite and was collected either independently or associated with species of the genera like *Speculitermes* and *Odontotermes* which also had their nests in the adjacent area. The nest of the species is mainly consisting of a few round chambers or cells of 25-45 mm. in diameter and numerous irregular tunnels of about 5-7 mm. in diameter which extend down into soil upto about 30 cm. The subterranean nest communicates with soil surface by means of external openings of 5-6 mm. in diameter which are temporarily plugged up, perhaps, to prevent the entry of enemies or to regulate the humidity and temperature at the required level.

The percentage of soldiers in a colony is quite high. The soldiers, if touched by a forcep, jump to a short distance with the aid of their mandibles and they produce a ticking sound by rubbing the mandibles against each other, when dropped into alcohol. No imago was found in the colonies at the time of collection in the months of April and August.

Genus (15) *Dicuspiditermes* Krishna, 1965

27. *Dicuspiditermes incola* (Wasmann)

(Fig. 24. Soldier, a and b)

1893. *Eutermes incola* E. Wasmann, *Ent. Zeitg.*, 12 (7) : 242. Im. Type-locality : Sri Lanka, Colombo.
1949. *Capritermes incola*, T. E. Synder, *Smith. misc. Coll.*, 112 : 194. Im., S. and W. Sri Lanka and India.
1965. *Dicuspiditermes incola*, K. Krishna, *Amer. Mus. Novit.*, No. 2210, p. 18.
1968. *Dicuspiditermes incola*, K. Krishna, *Bull. Amer. Mus. nat. Hist.*, 138(5) : 290.

Material.—Three vials from Midnapore, Midnapore Dist., P. K. Maiti coll., 16.viii.1969, as follows : (i) No. M₂/16.8.69, with sev. S. and W., Judge's Court ground, Burge Town, ex. "soil under a stone". (ii) No. M_g/16.8.69, with sev. S. and W., Jungle adjacent to Gope Palace (Women's College), ex. "soil nest, with *Odontotermes redemanni*

(Wasmann)". (iii) No. M₉/16.8.69, with 1S. and sev. W., ex. "mixed with *Synhamitermes quadriceps* (Wasmann) and *Speculitermes* sp."

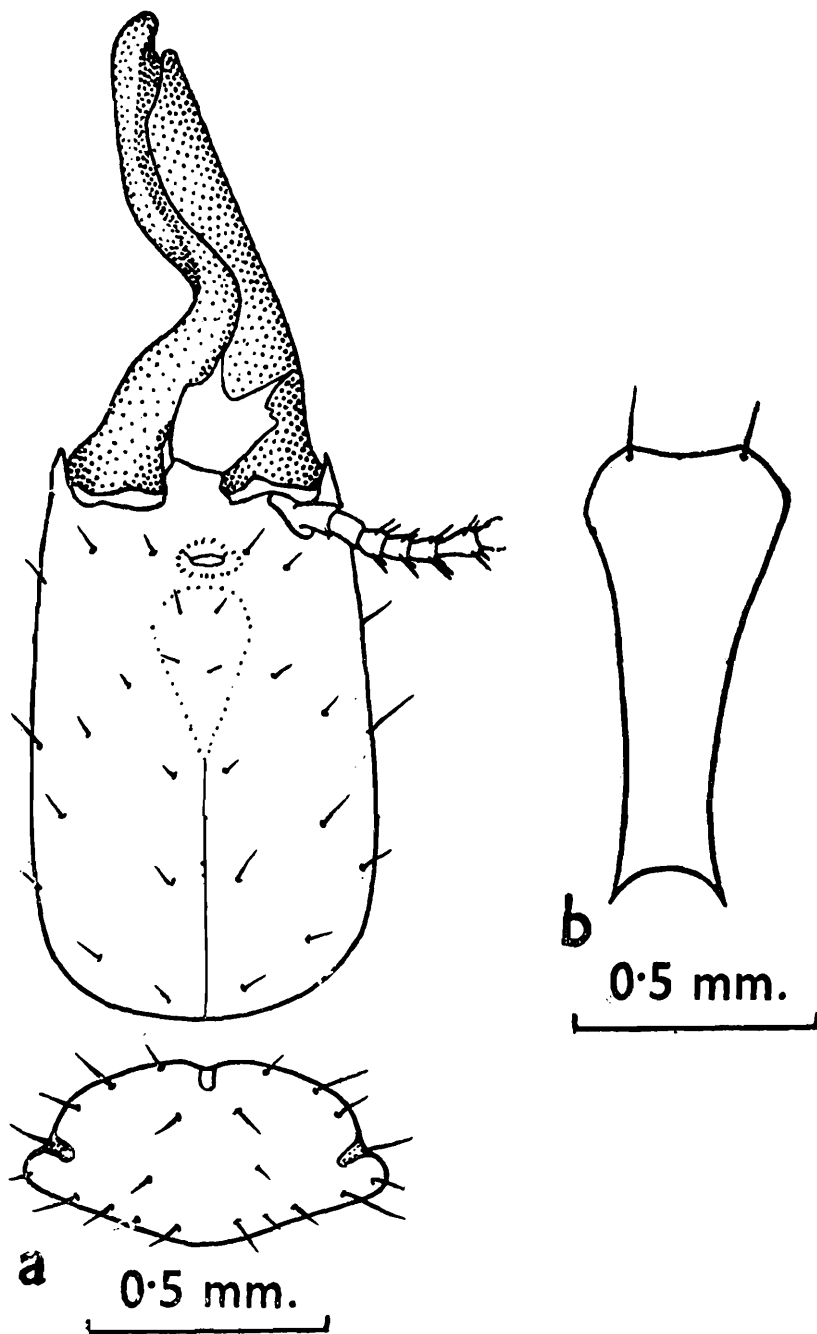


Fig. 24. *Dicuspiditermes incola* (Wasmann) Soldier from Midnapore, P. K. Maiti coll., 16.viii.1969.

a, Head and pronotum ; b, postmentum

Measurements (in mm.), etc.— (i) *Imago* (after Holmgren, 1913) : Length with wings 11.50-13.00 ; Length without wings 6.00-7.00 ; Length of forewings 10.00-10.50 ; Head-length 1.33 ; Head-width 1.22-1.29 ; Length of pronotum 0.57 ; Width of pronotum 0.95-10.06 ; No. of antennal segments 14. (ii) *Soldier* (10 exs.) : Body-length 5.10-6.00 ; Length of head to lateral base of mandibles 2.07-2.19 ; Max. width of head 1.30-1.38 ; Length of left mandible 1.80-1.87 ; Length of right man-

dible 1.75-1.79 ; Min. (median) length of postmentum 0.99-1.10 ; Max. width of postmentum 0.48-0.54 ; Max. length of pronotum 0.33-0.39 ; Max. width of pronotum 0.81-0.86 ; No. of antennal segments 14.

Distribution.—*West Bengal* : Midnapore and its vicinity. *Elsewhere* : *India* : Tamil Nadu : Nilgiri Hills. Maharashtra : Bombay and Khandala (near Bombay), Karnataka : Bababudin Hills and Mercara. *Sri Lanka* : Anuradhapura, Bandarawella, Colombo (type-locality) and Peradeniya.

Biology.—The species is so far known from the Peninsular India and Sri Lanka. In the present study, it has been recorded from eastern India occurring in laterite unit of West Bengal. Only three small colonies have been found nesting in soil in association with other species of termites, namely *Speculitermes* sp., *Synhamitermes quadriceps* (Wasmann) and *Odontotermes redemanni* (Wasmann) in this State.

Genus (16) *Pericapritermes* Silvestri, 1914

28. *Pericapritermes ceylonicus* (Holmgren)

(Syn : *Capritermes distinctus* Holmgren)

(Fig. 25. Soldier, a and b)

1911. *Capritermes ceylonicus* N. Holmgren, In Escherich's, *Termitenleben auf Ceylon*, Jean, pp. 204-205, S. and W. *Type-locality* : Sri Lanka : Paradeniya.
 1913. *Capritermes distinctus*, N. Holmgren, *K. Sv. Vet. Akad. Handl.*, 50(2) : 246. Im. S. and W, *Type-locality* : Sri Lanka.
 1949. *Capritermes ceylonicus*, T. E. Snyder, *Smith. misc. coll.*, 112 : 193, Sri Lanka.
 1968. *Pericapritermes ceylonicus*, K. Krishna, *Bull. Amer. Mus. nat. Hist.*, 138(5) : 294.

Material.—(i) A vial (No M₄/4.11.66) with 2S. and sev. W., Gailikhola Forest, 4 km. SW. of Teesta Bridge, Darjeeling District, P. K. Maiti coll., 4.xi.1966, ex. "soil under a log".

Measurements (in mm.), etc.— (i) *Imago* (after, Holmgren 1913) : Length with wings 10.00 ; Length without wings 4.50 ; Length of fore-wing 8.00 ; Head-length to tip of labrum 1.14-1.18 ; Head-width 0.14-1.18 ; Length of pronotum 0.57 ; Width of pronotum 0.95-1.03 ; No. of antennal segments 15. (ii) *Soldier* (2 exs.) : Body-length 5.84-6.00 ; Length of head to lateral base of mandibles 2.00-2.26 ; Max. width of head 1.19-1.32 ; Length of left mandible 1.42-1.53 ; Length of right mandible 1.34-1.45 ; Min. (median) length of postmentum 1.20-1.23 ; Max. width of postmentum 0.39-0.44 ; Max. length of pronotum 0.31-0.34 ; Max. width of pronotum 0.60-0.65 ; No. of antennal segments 14.

Distribution.—The species is reported here for the first time from India, occurring in North Bengal as follows : *West Bengal* : Darjeeling District, Gailikhola Forest and Ghumti (alt. 550 m.).

Elsewhere : Sri Lanka : Bandarawella, Heneratogoda, Kandy (alt. 915 m.), Haputale (alt. 1525 m.) and Paradeniya (type-locality).

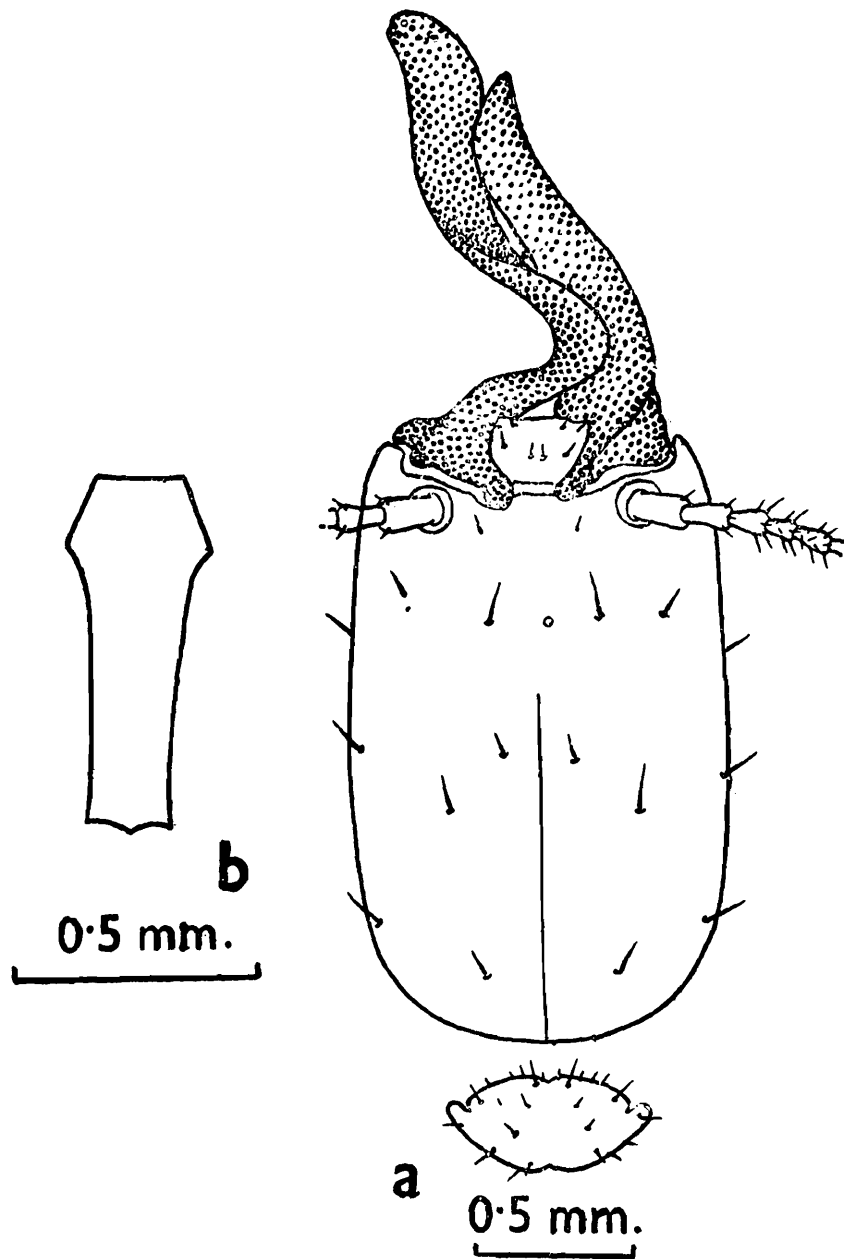


Fig. 25. *Pericapritermes ceylonicus* (Holmgren) Soldier from Gailikhola Forest (Darjeeling Dist.), P. K. Maiti coll., 4.xi.1966.

a, Head and pronotum ; b, postmentum

Remarks.—Out of the two soldiers collected from Gailikhola Forest, one is fairly larger than the other, and even exceeds the known range of measurements. In this specimen the antennal segment 2 is distinctly shorter than 3 and the latter twice the 4 (as against 2 and 3 subequal and the latter slightly longer than 4).

Biology.—The species is essentially a subterranean termite occurring in moist hill-soil under log lying in Gailikhola Forest (alt. 300 m.) and Ghumti, Darjeeling District. In Ceylon, the species occurs under logs,

stones and also often in the mounds of *Odontotermes redemanni* (Wasmann) and *Hypotermes obscuriceps* (Wasmann) [Roonwal 1970].

29. ***Pericapritermes dunensis*** (Roonwal and Sen-Sarma)

(Fig. 26. Soldier, a and b)

1960. *Capritermes dunensis* M. L. Roonwal and P. K. Sen-Sarma, *Indian Counc. agric. Res. (Ent. Monogr.)* No. 1, pp. 28-33, S. and W. Type-locality : India : Uttar Pradesh, Dehra-Dun.

1968. *Pericapritermes dunensis*, K. Krishna, *Bull. Amer. Mus. nat. Hist.*, 138(5) : 294.

1977. *Pericapritermes dunensis*, M. L. Roonwal and O. B. Chhotani, *Ent. Basil*, 2 : 64-66. Im. S. and W. Bhutan.

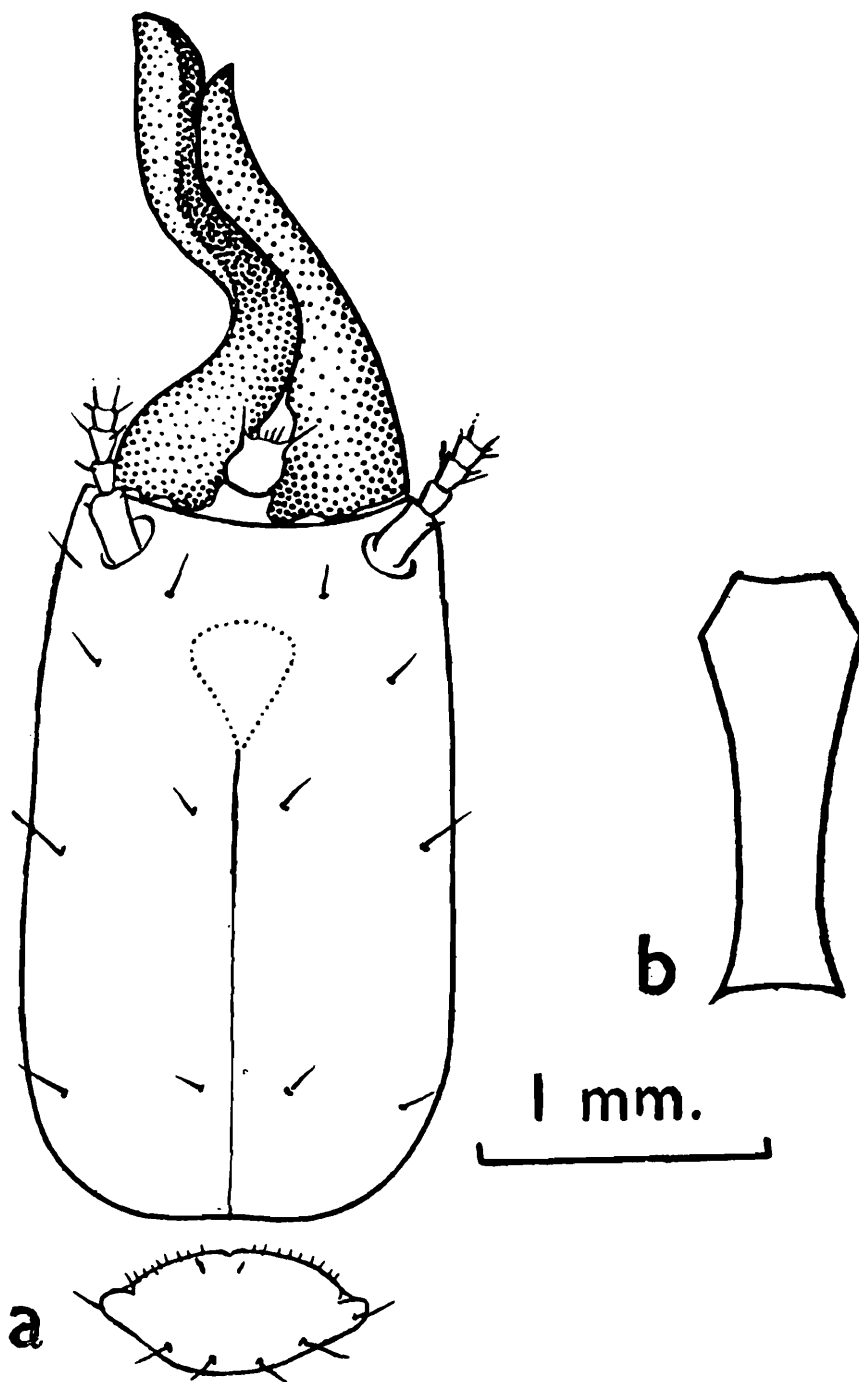


Fig. 26. *Pericapritermes dunensis* Roonwal and Chhotani Soldier from Gailikhola Forest (Darjeeling Dist.), P. K. Maiti coll., 4.xi.1966.
a, Head and pronotum ; b, postmentum

Material.—A vial (No. M₁/4.11.77) with sev. S. and W., Gailikhola Forest (alt. 300 m.), 4 km. SW. of Teesta Bridge, Darjeeling Dist., P. K. Maiti coll., 4.xi.1966, ex. "soil".

Measurements (in mm.) etc.— (i) *Imago*.—Unknown. (ii) *Soldiers* (10 exs.) : Body-length 5.46-6.10 ; Length of head to lateral base of mandibles 2.32-2.55 ; Max. width of head 1.32-1.40 ; Max. length of left mandible 1.63-1.66 ; Max. length of right mandible 1.45-1.53 ; Min. (median) length of postmentum 1.44-1.51 ; Max. width of postmentum 0.47-0.53 ; Max. length of pronotum 0.41-0.44 ; Max. width of pronotum 0.79-0.84 ; No. of antennal segments 14.

Distribution.—*West Bengal* : Darjeeling District, Gailikhola Forest (near Teesta Bridge).

Elsewhere : *India* : Meghalaya : Khasi-Jaintia Hill District, Shillong. Uttar Pradesh : Dehra Dun (type-locality).

Biology.—The distributional records show that the species is confined to the hilly tracts of northern and eastern India. It is essentially a subterranean species.

30. *Pericapritermes tetraphilus* (Silvestri)

(Syn : *Capritermes orientalis* Mathur and Sen-Sarma)

(Fig. 27, Soldier, a and b)

1922. *Capritermes tetraphilus* F. Silvestri, *Rec. Indian Mus.*, 24(4) : 543-545. S. Type-locality : Bangladesh : Chittagong Hill, Rangamati.
- 1961a. *Capritermes orientalis* R. N. Mathur and P. K. Sen-Sarma, *Bull. Ent.*, No. 22, pp. 1-4, Type-locality : Burma.
1965. *Pericapritermes tetraphilus*, K. Krishna, *Amer. Mus. Novit.*, No. 2210, pp. 15-16.
1968. *Pericapritermes tetraphilus*, K. Krishna, *Bull. Amer. Mus. nat. Hist.*, 138(5) : 294.
1975. *Pericapritermes tetraphilus*, M. S. Akhtar, *Bull. Dept. Zool. Univ. Panjab (N.S.)*, 7 : 172-175. Im. and S. Bangladesh.

Material.—A vial, No. M₁/2.11.66) with 5S. and sev. W., Tashiding Forest, 5 km. NE. of Teesta Bridge, Darjeeling Dist., P. K. Maiti coll., 2.xi.1966, ex. "under a log".

Measurements (in mm.) etc.— (i) *Imago*.—Unknown (ii) *Soldiers* (5 exs.) : Body-length 6.10-6.90 ; Length of head to lateral base of mandibles 2.42-2.53 ; Max. width of head 1.32-1.50 ; Length of left mandible 1.53-1.69 ; Length of right mandible 1.46-1.56 ; Min (median) length of postmentum 1.46-1.53 ; Max. width of postmentum

0.46-0.52 ; Max. length of pronotum 0.38-0.42 ; Max. width of pronotum 0.80-0.86 ; No of antennal segments 14.

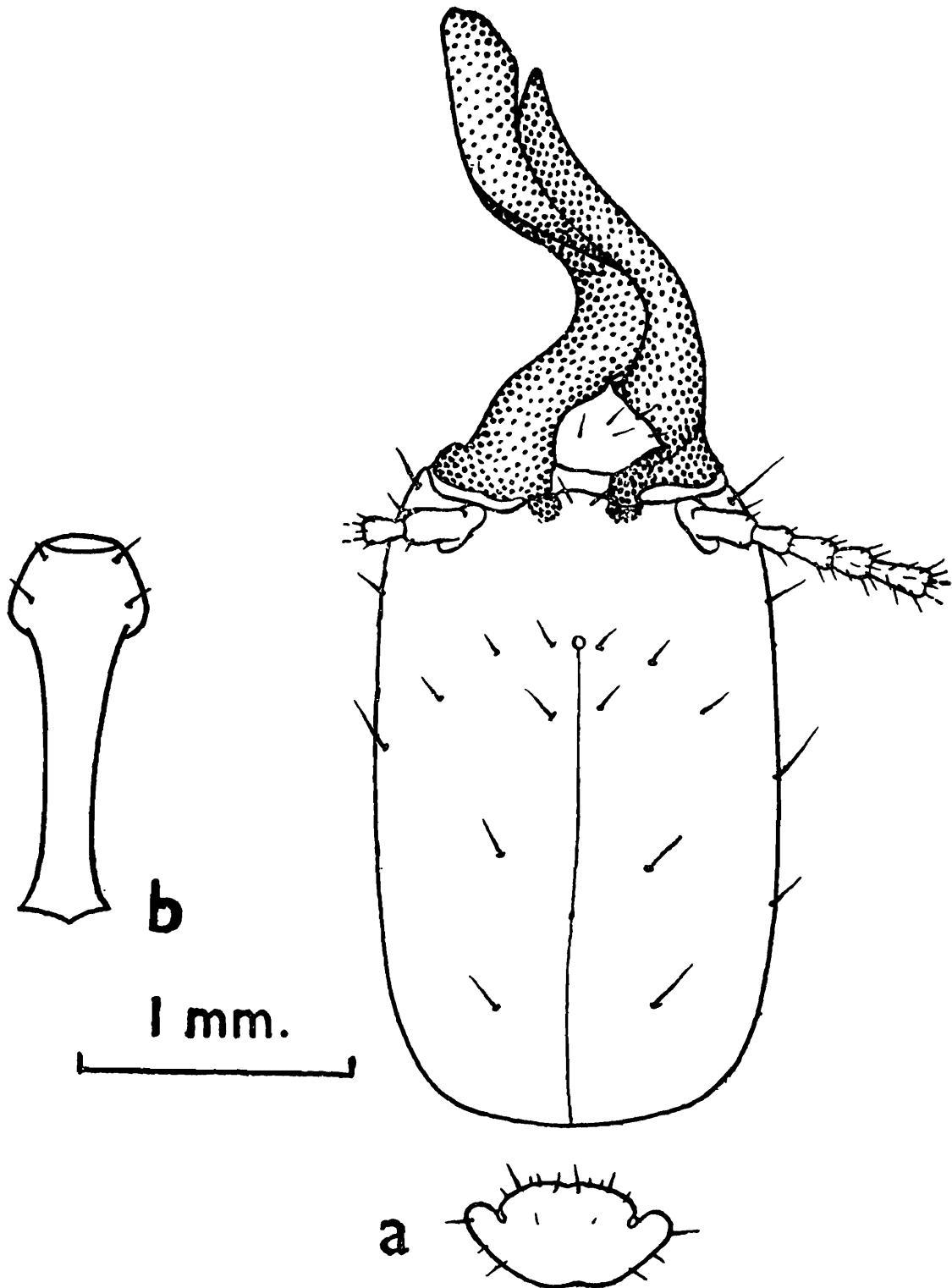


Fig. 27. *Pericapritermes tetraphilus* (Silvestri) Soldier from Tashiding Forest (Darjeeling Dist.), P.K. Maiti coll., 2.xi.1966.

a, Head and pronotum ; b, postmentum

Distribution.—The species is recorded for the first time from India, occurring in north Bengal as follows : *West Bengal* : Darjeeling Dist., Tashiding forest. *Elsewhere* : *Bangladesh* ; Chittagong Hill (type-

locality). *Burma* : Maymo (type-locality of *Capritermes orientalis* Mathur and Sen-Sarma) and Paan Yegaw.

Biology.—*Pericapritermes tetraphilus* (Silvestri) is essentially a subterranean termite, inhabiting in the hilly tracks of eastern India, Bangladesh and Burma. In north Bengal, a single colony was detected in the Tashiding forest (alt. 300 m.). It was found in association with some other species of termites in moist hill-soil in cool and shady pockets of the forest. The nest consists of a few small cells confined to the superficial soil. However, the colony is composed of a few soldiers and large number of workers, without having any imago.

Subfamily (iii) MACROTERMITINAE

Genus (17) *Macrotermes* Holmgren, 1909

31. *Macrotermes estherae* (Desneux)

(Fig. 28, Soldier (maj.), a-c ; Soldier (min.), d-f)

1908. *Termes estherae* J. Desneux, *Ann. Soc. Ent. Belg.*, 51 (12) : 390. *Im.*, *S.* (maj. and min.) and *W.* *Type-localities* : Karnataka : Bijapur district and Bombay (Kaladji).
1917. *Termes estherae*, K. and N. Holmgren, *Mem. Dept. Agric. India* (Ent.), 5(3) : 146, *Im. S.* and *W.* Madras : Ballary District.
1949. *Macrotermes estherae*, T. E. Snyder, *Smith. misc. Coll.*, 112, : 211. India and Sri Lanka.

Material.—Two vials from Tashiding Forest, 5 Km. NE. of Teesta bridge, Darjeeling Dist., *P. K. Maiti coll.*, 2.xi.1966, "soil under decaying log" as follows : (i) Vial (No. $M_9/2.11.66$) with 1S. (maj.), 11S. (min.) and 2W. (ii) Vial (No. $M_{10}/2.11.66$) with 1S. (maj.), 5S. (min.) and 5W.

Measurements (in mm.), etc.—(i) *Imago* (after Holmgren 1913) : Length with wings 32.00-33.00 ; Length without wings 15.00-16.00 ; Length of forewing 27.00-27.70 ; Head-length to tip of labrum 3.27 ; Head-width 2.93 ; Length of pronotum 1.44 ; Width of pronotum 2.81 ; No. of antennal segments 19. (ii) *Soldier* (maj. and min. respectively) : Body-length 14.00-14.10 ; 7.80-8.10 ; Length of head to lateral base of mandibles 4.45-4.51 ; 3.68-3.76 ; Max. width of head 3.90-4.06 ; 2.15-2.26 ; Length of left mandible 2.25-2.31, 1.67-1.73 ; Min. length of postmentum 2.95-3.00, 1.76-1.82 ; Max. width of postmentum 1.08-1.12, 0.80-0.87 ; Max. length of pronotum 1.49-1.53, 0.95-1.10 ; Max. width of pronotum 2.83-2.90, 1.72-1.80 ; No. of antennal segments 17.

Distribution.—*West Bengal* : Darjeeling Dist., Tashiding forest and Ghumit. *Elsewhere* : *India* : Maharashtra (Bombay) and Tamil Nadu ; Coimbatore. *Karnataka* : Hadagalli, Harpanahalli, Malaga and Hospet. *Sri Lanka*.

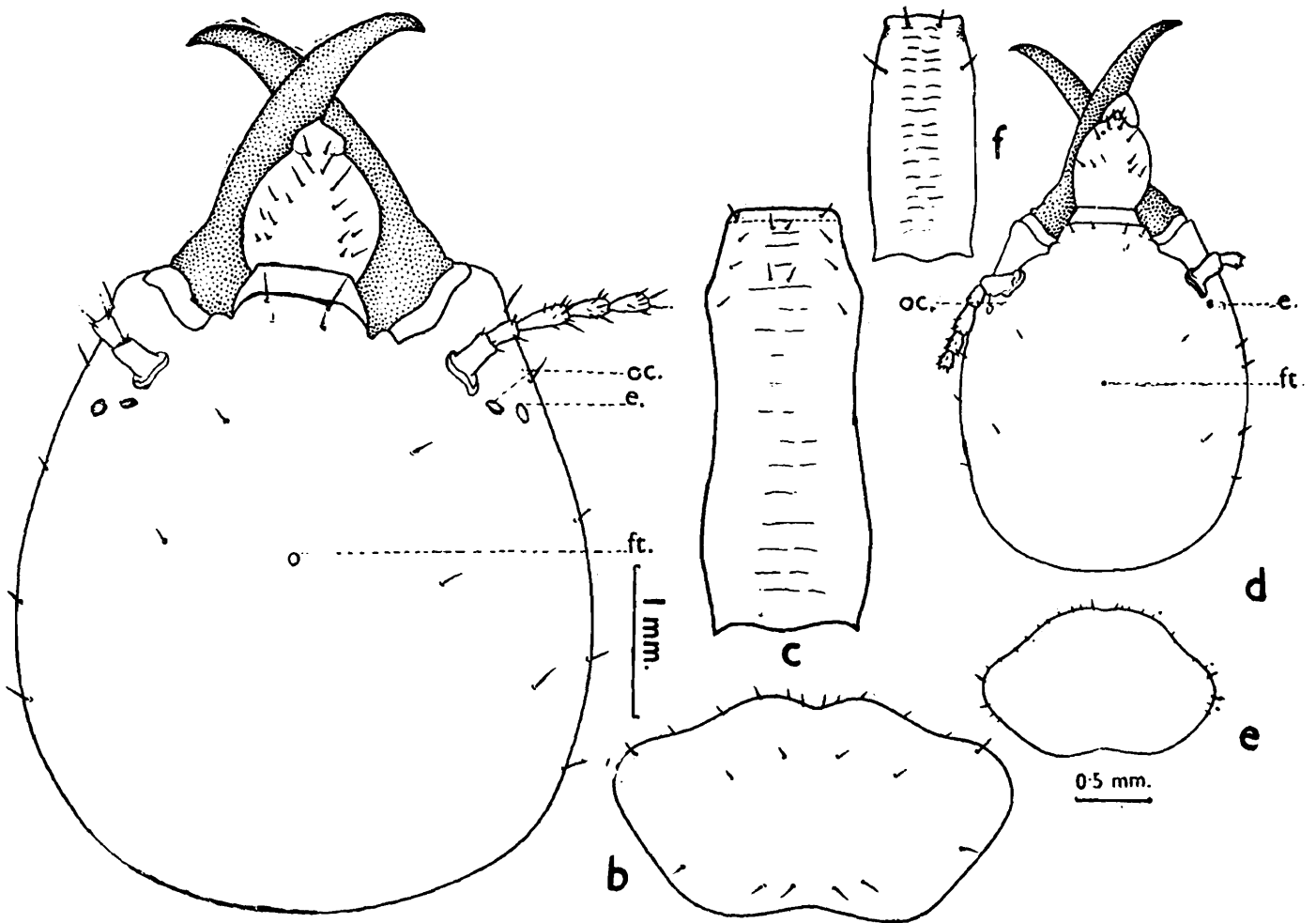


Fig. 28. *Macrotermes estherae* (Desneux) Soldiers (major and minor) from Tashiding Forest (Darjeeling Dist.), P.K. Maiti coll., 2.xi.1966.

a-c, Soldier (major). a, Head ; b, pronotum ; c, postmentum
d-f, Soldier (minor), d, Head ; e, pronotum

Biology.—The species is fairly well distributed in Sri Lanka and peninsular India. It occurs sparsely in the sub-Himalayan tracts of Darjeeling district in West Bengal. Two small colonies were collected in Tashiding Hills Forest (alt. 300 m.) in the Teesta Valley. The colonies were found in soil nest under decaying log lying in well drained area. The species makes intercommunicating tunnels spreading horizontally in different direction to a quite long distance. At places, the underground tunnels are packed up with dried up leaves and grass blades.

No imago was available in the colony during the time of collection in the month of November. In south India, however, swarming occurs

in July after rains and the workers and soldiers are reported to move in the rows under the leaves for foraging (Holmgren and Holmgren, 1917).

The species does not build mounds, but sometimes the subterranean nest is indicated by the presence of small earthen hillocks of 2-8 cm. height (Roonwal, 1970).

32. *Macrotermes gilvus* (Hagen)

(Syn : *Macrotermes azarellii* (Wasmann)

(Fig. 29. Soldier (min.), a)

1858. *Termes gilvus* H. A. Hagen, *Linn. Ent. Stettin. Ent. Ver. Berlin*, 12 : 148-151. Im. (Queen) S. (maj. and min.) and W. Type-locality : Indonesia ; Java.
1896. *Termes azarellii*, E. Wasmann, *Ann. Mus. Stor. Nat. Genova*, (2) 16 (36) : 626-628. S. (maj. and min.) and W. Type-locality : Burma : Palon (Pegu).
1865. *Macrotermes gilvus*, K. Krishna, *Amer. Mus. Novit.* ; No. 2210, pp. 20-21, King, Queen and S. (maj. and min.). Burma.
1966. *Macrotermes gilvus*, M. L. Roonwal and P. K. Maiti, *Treubia*, 27 (1) : 102-105. Im. and S. (maj. and min.) Indonesia.

Material.—Two vials from Samsing, Darjeeling Dist., *Balwant Singh coll.*, x.1933, ex. "rotten wood", as follows : (i) A vial with 1S. (min.) ; (ii) A vial with 2W.

Measurements (in mm.) etc.—(i) *Imago* (after, Holmgren 1913) : Length with wings 23.00-30.00 ; Length without wing 14.00 : Length of forewing 20.00-25.00 ; Head-length to tip of labrum 2.66 ; Head-width 2.28 : Length of pronotum 1.33 ; Width of pronotum 2.36 ; No. of antennal segments 19. (ii) *Soldier* (min.) : Body-length 5.90 ; Length of head to lateral base of mandibles 1.76 ; Max. width of head 1.57 ; Length of left mandibles 1.15 ; Min. length of postmentum 1.23 ; Max. width of postmentum 0.42 ; Max. length of pronotum 0.65 ; Max. width of pronotum 1.00 ; No. of antennal segments 17.

Distribution.—*West Bengal* : So far the species was known from West Bengal by the name *Macrotermes azarellii* (Wasmann) until Krishna (1965), synonymised it to *M. gilvus* (Hagen). It was known from only Samsing, Darjeeling District. *Elsewhere* : *Burma, Cochin-China, Cambodia, Indonesia, Philippines, Thailand and Vietnam.*

Remarks.—*Macrotermes gilvus* (Hagen) is a very variable species. Because of this fact, numerous infra-specific categories had been created

in the past. Snyder (1949) has catalogued some 8 forms, varieties and subspecies. Krishna (1965) has, however, synonymised all these and also *M. azarellii* which is described from Burma by Wasmann (1896).

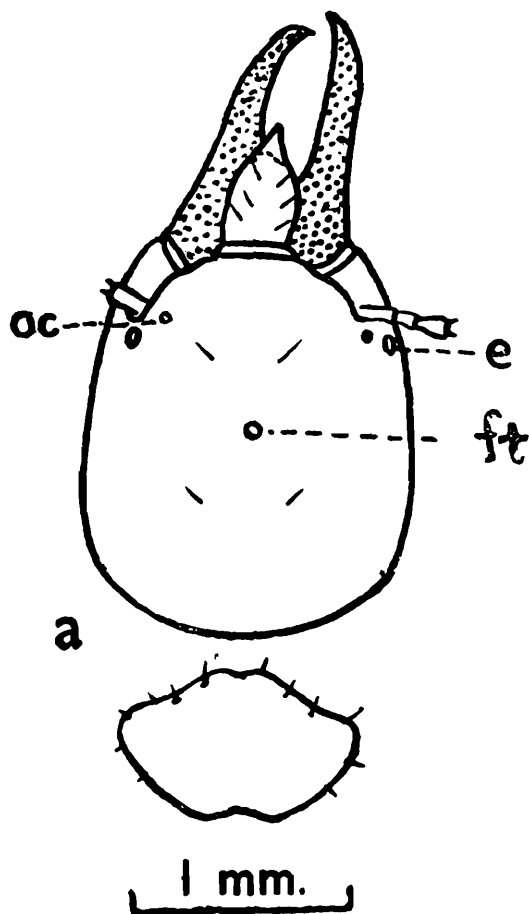


Fig. 29. *Macrotermes gilvus* (Hagen) Soldier (minor) from Samsing, Balwant Singh coll., x.1938.
a, Head and pronotum

Biology.—The species has a restricted distribution in moist hill forest in the Duars area in Darjeeling district. It is recorded from a rotten wood at Samsing (alt. 300 m.). However, the biology of the species has been studied by various authors (*vide*, Roonwal, 1970).

33. *Macrotermes khajuriae* Roonwal and Chhotani

(Fig. 30. Soldier (maj.), a-c ; Soldier (min.), d-f)

1962. *Macrotermes khajuriae* M. L. Roonwal and O. B. Chhotani, *Proc. nat. Inst. Sci. India*, B, 28 (4) : 329-334, S. (maj. and min.) and *W. Type-locality* : India : Meghalaya, Khasi-Jaintia Hills Dist., Umsa and Nongkharai.

1977. *Macrotermes khajuriae*, M. L. Roonwal and O. B. Chhotani, *Ent. Basil.*, 2 : 68, S. (min.), Bhutan.

Material.—Three vials from Darjeeling Dist., P. K. Maiti coll., as

follows : (i) No. $M_2/4.11.66$, with 1S. (min.), Teesta Valley Forest, 2 Km. W. of Teesta Bridge, 4.xi.1966, ex. "soil". (ii) No. $M_7/4.xi.66$, with 1S. (maj.), 3S. (min.) and 3W., Gailikhola Forest, 4 Km. SW. of Teesta Bridge, 4.xi.1966, ex. "mud plaster in hollow of the trunk of a standing tree, *Odontotermes parvidens* also collected from the same source". (iii) No. $M_8/2.11.66$, 5S. (min.) and sev. W., Tashiding Forest, 5 km. NW. of Teesta Bridge, 8.xi.1966, ex. "gallery on a tree trunk".

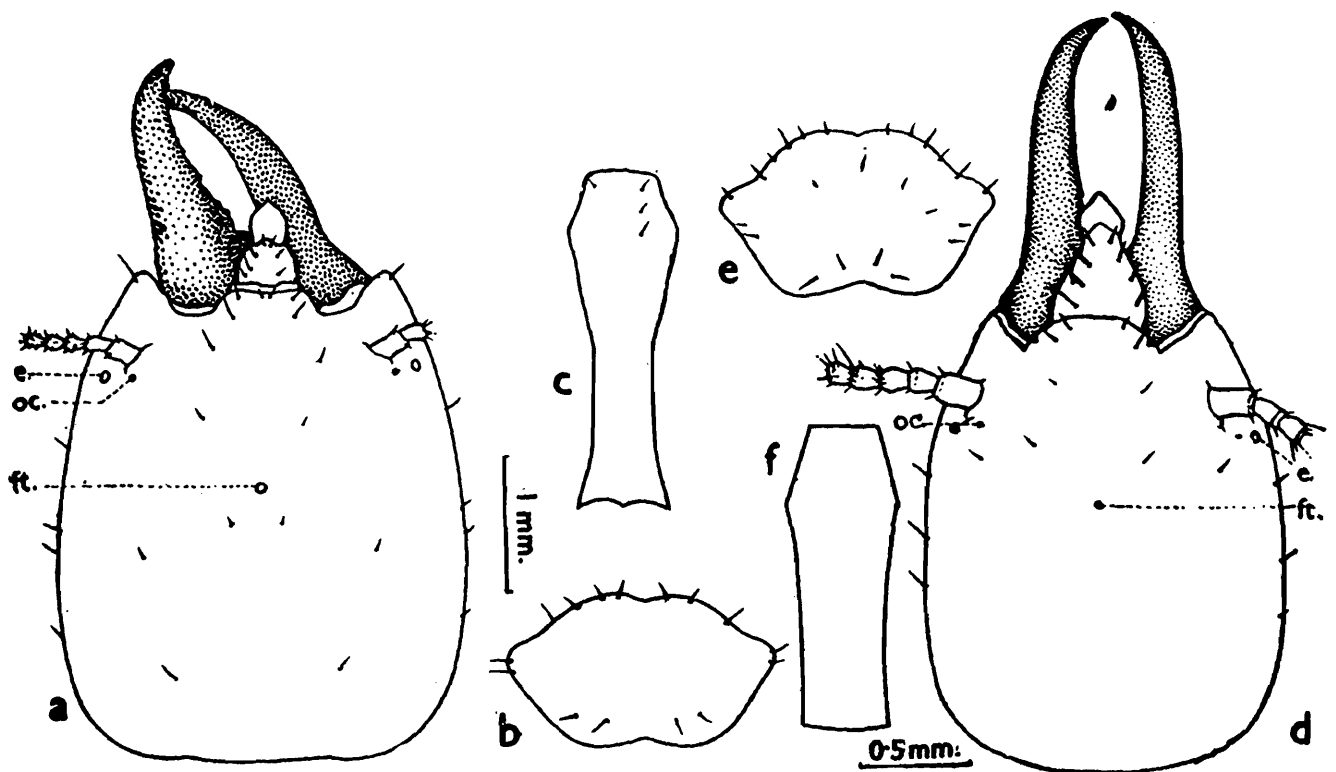


Fig. 30. *Macrotermes khajuriai* Roonwal and Chhotani Soldier (major and minor) from Teesta Valley Forest (Darjeeling Dist.), P.K. Maiti coll., 4.xi.1966.

a-c, Soldier (major). a, Head ; b, pronotum ; c, postmentum
d-f, Soldier (minor). d, Head ; e, pronotum ; f, postmentum

Measurements (in mm.) etc.—(i) *Imago*.—Unknown. (ii) *Soldier* (1 maj. and 9 min. respectively).—Body-length 10.50, 5.00-5.30 ; Length of head to lateral base of mandibles 3.70, 1.85-2.00 ; Max. width of head 3.00, 1.55-1.62 ; Length of left mandibles 1.70, 1.26-1.30 ; Min. length of postmentum 2.50, 1.20-1.25 ; Max. width of postmentum 0.82, 0.49-0.53 ; Max. length of pronotum 1.10, 0.65-0.73 ; Max. width of pronotum 2.00, 0.98-1.12 ; No. of antennal segments 17, 16.

Distribution.—*West Bengal* : Darjeeling Dist : Gailikhola Forest (alt. 300 m.), Teesta Valley Forest (alt. 300 m.) and Tashiding Forest (alt. 300 m.). *Elsewhere* : *India* : Meghalaya : Khasi-Jaintia Hills Dist. Umsa, Nongkarai (type-locality).

Remarks.—In measurements, both major and minor soldiers from Darjeeling District quite agree with the types, but differ morphologically, *Soldier (major)*: In specimens from Darjeeling district, the left mandible has no basal projection, the 3rd antennal segment is subequal to or slightly longer than 2nd, and pronotum with a very weak median emargination at the anterior margin. On the other hand, in the type-specimens, the left mandible is with a prominent basal projection directed upwards, the 3rd antennal segment is much longer than 2nd, and the pronotum with a prominent median notch. *Soldier (minor)*: In specimens from Darjeeling, the pronotum is without a median notch, but in type-specimens, the pronotum is having a prominent median notch on the anterior margin.

On the basis of these differentiating characters, the specimens from West Bengal could have been named as a separate species. But due to lack of sufficient number of examples, tentatively, these have been put under *M. khajuriai* Roonwal and Chhotani.

Biology.—The species is restricted to the hilly areas of Assam and West Bengal. In West Bengal, it occurs only in the hill forests growing in the Teesta Valley where the weather is humid with heavy rainfall. Three colonies were observed, of which one was inside the hollow of a standing tree at Gailikhola Forest. The hollow space was filled up with earthen material, the superficial layer of earth was occupied by *Odontotermes parvidens*. The specimens were collected from galleries on tree trunk and from the soil in other occasions.

Genus (18) *Odontotermes* Holmgren, 1910

34. *Odontotermes assmuthi* Holmgren

(Fig. 31. Soldier, a)

- 1913a. *Odontotermes (O) assmuthi* N. Holmgren, *J. Bombay nat. Hist. Soc.*, 22 (1) : 112-113, S. and W. *Type-locality*: India: Borivili Jungle (Maharashtra).
1949. *Odontotermes (O) assmuthi*, T. E. Snyder, *Smith. misc. Coll.*, 112 : 220. India (Wrongly stated that imago is unknown.)
1958. *Odontotermes assmuthi*, M. Ahmad, *Biologia*, 4 (1&2) : 103.
1962. *Odontotermes assmuthi*, R. N. Mathur and P. K. Sen-Sarma *Bull. Ent.* No. 3, pp. 7-12, *Im.* India: Uttar Pradesh (Dehra Dun) and Maharashtra (Karwar, near Bombay).
1975. *Odontotermes assmuthi*, M. S. Akhtar, *Bull. Dept. Zool. Univ. Panjab (N. S.)*, 7 : 73-75, S. Bangladesh: Rajsahi and Nator.

Material.—LOT (A).—Two vials with sev. S. and W. *M. L. Roonwal*

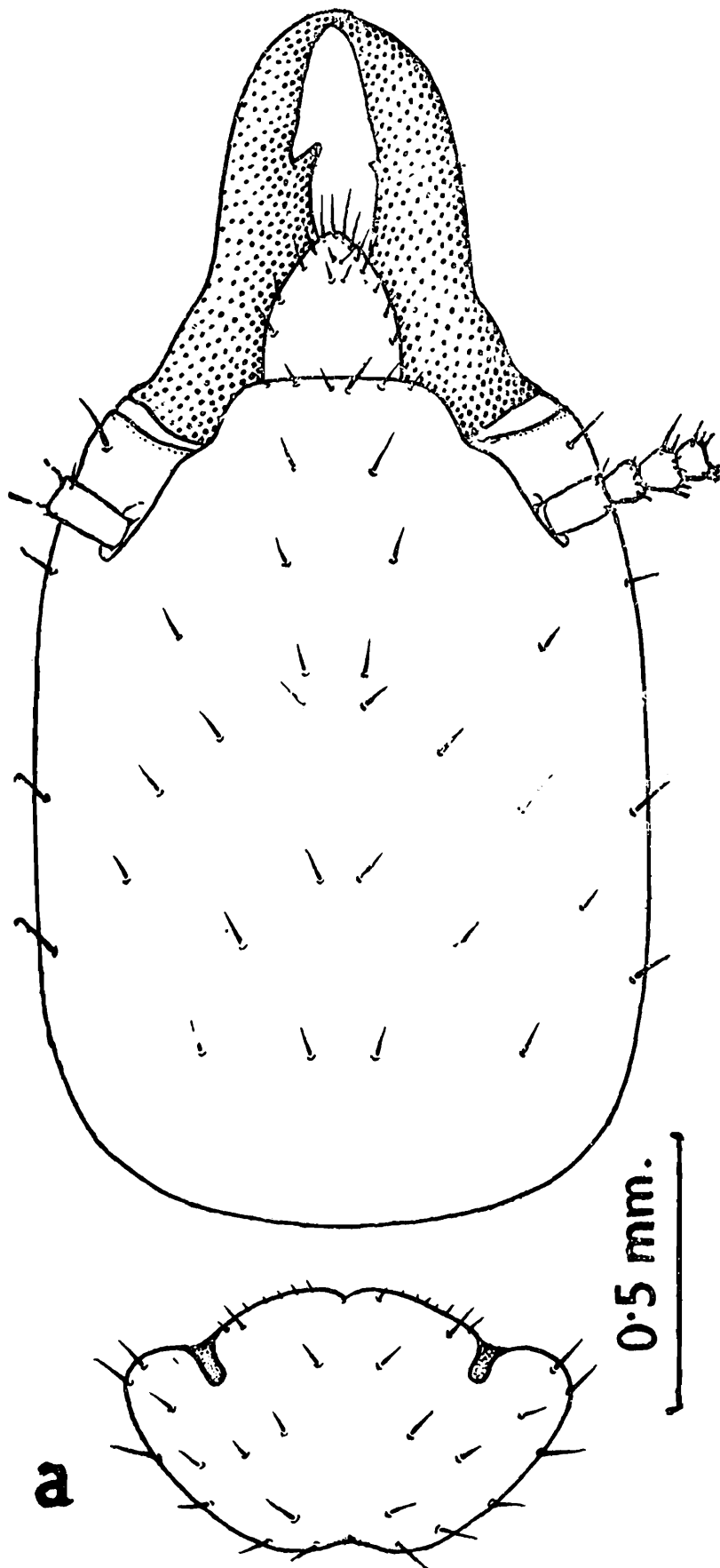


Fig. 31. *Odontotermes assmuthi* Holmgren Soldier from Rabindra Sarobar (Calcutta), P. K. Maiti coll., 25.x.1965.
a, Head and pronotum

coll., 1952, as follows : (i) No. R₁/26.11.52, Calcutta, 26.xi.1952, ex. "mud gallery on tree trunk". (ii) No. R₁/27.11.52, Palta, (24-Parganas Dist.), 21 Km. S. of Calcutta, 27.xi.1952, ex. "soil".

LOT (B).—Four vials with sev. S. and W., from Murshidabad Dist. *P. K. Sen-Sarma coll.*, 1954, as follows : (iii) No. S₃/19.1.54, Berhampur, 19.i.1954, ex. "*Mangifera indica* tree". (iv) No. S₆/20.1.54, Lalbag, 11 Km. N. of Berhampur, 20.i.1954, ex. "under lump of earth". (v) No. S₈/20.i.54, Lalbag, 20.1.54, ex. "nearby dried up grass roots". (vi) No. S₁/12.1.54, Gocorn, 16 Km. W. of Berhampur, 21.i.1954, ex. "gallery on tree trunk".

LOT (C).—Ten vials from Calcutta and its vicinity, *O. B. Chhotani coll.*, 1957, as follows : (vii) No. O₁/2.8.57 with sev. S. and W., Horticulture Farm, Alipur, 2. viii. 1957, ex. "under dry leaves lying on ground". (viii) No. O₄/13.8.57 with sev. S. and W., Agriculture Farm, 13.viii.1957, ex. "under a fallen log". 5 vials from Kidderpore on 18.ix. 1957, thus, (ix) No. O₁/18.9.57. with sev. S. and W., ex. "fallen bamboo cut pieces" ; (x) No. O₄/18.9.56 with sev. S. and W., ex. "attacking bamboo" ; (xi) No. O₅/18.9.57 with 5S. and sev. W., ex. "attacking a wooden pole" ; (xii) No. O₇/18.9.57 with 3S. and sev. W., ex. "attacking a bamboo pole" ; (xiii) No. O₁₀/18.9.57 with 3S. and sev. W., ex. "attacking wooden frame." 3 vials from Barrackpur on 24.ix.1957, thus (xiv) No. O₈/24.9.57 with sev. S. and W., ex. "twigs of Sunflower" ; (xv) No. O₁₁/24.9.57 with 5S. and sev. W., ex. "under log" ; (xvi) No. O₁₈/24.9.57 with 1S. and 5W., ex. "pole of unknown wood" ; (xvii) No. O₇/27.9.57 with sev. S. and W., Garia, 27.ix.1957, ex. "trunk of Mehudi tree".

LOT (D).—One vial, (xviii) No. M₂/6.8.57 with sev. S. and W., Eden Garden, *M. L. Thakur coll.*, 6.viii.1957, ex. "under log".

LOT (E).—Two vials *P. K. Maiti coll.*, as follows. (xix) No. M₁/25.10.65 with 2S. and 2W., Rabindra Sarobar, 25.x.1965, ex. "gallery in tree trunk" ; (xx) No. M₅/19.1.65 with 3S. 5W from Plassey, Nadia Dist.

Measurements (in mm.) etc.—(i) *Imago* (after, Mathur and Sen-Sarma, 1962) : Body-length (with wings) 24.50-26.30 ; Body-length (without wings) 12.50-13.70 ; Length of head to lateral base of mandibles 1.60-1.90 ; Max. width of head with eyes 2.20-2.30 ; Max. diameter of eye (with ocular sclerite) 0.55-0.58 ; Max. diameter of ocellus 0.21-0.25 ; Min. eye-ocellus distance 0.25-0.30 ; Max. length of pronotum 1.10-1.25 ; Max. width of pronotum 2.10-2.20 ; Min. length of forewing

19.00-21.00 ; Min. length of hindwing 18.50-19.00 ; No. of antennal segments 19. (ii) *Soldier* (10 exs.) : Body-length 5.20-5.60 ; Length of head to lateral base of mandibles 1.60-1.75 ; Max. width of head 1.17-1.30 ; Length of left mandibles 0.72-0.88 ; Left mandibular tooth distance from tip 0.28-0.35 ; Min. (median) length of postmentum 1.00-1.17 ; Max. width of postmentum 0.49-0.53 ; Max. length of pronotum 0.50-0.56 ; Max. width of pronotum 0.88-1.00 ; No. of antennal segments 16.

Distribution.—*West Bengal* : Calcutta (Alipur, Eden Garden, Kidderpore and around Rabindra Sarobar) ; 24-Parganas Dist. : Barrackpore, Garia and Palta. Murshidabad Dist. : Berhampur, Gocorn and Lalbag ; Nadia Dist. : Plassey (near monument).

Elsewhere : *India* : Bihar, Tamil Nadu, Maharashtra, Karnataka, Panjab and Uttar Pradesh, Singapore ? (John, 1925) ; *Bangladesh*.

Biology.—The species occurs in the different habitats in West Bengal, such as, in galleries on tree trunks, feeding on bark of trees, attacking wooden frame of houses, poles, bamboo pieces, logs lying on ground, etc. and from under dried up leaves and debries. The nest of the species is subterranean and of defused type.

The swarming has been reported in day time in the months of June and July at Bombay and Dehra Dun from holes in soil (Mathur and Sen-Sarma, 1962 ; Roonwal, 1970). The species has been reported as a serious pest of sugarcane setts (Pruthi and Narayanan, 1939).

35. *Odontotermes feae* (Wasmann)

(Fig. 32. Soldier, a and b)

1896. *Termes feae* E. Wasmann, *Ann. Mus. Stor. nat. Genova*, (2) 16 : 625-626. S. and W. *Type-locality* : Burma : Carin Cheba and Cobapo.
1949. *Odontotermes* (*O.*) *feae*, T. E. Snyder, *Smith. misc. Coll.* 112 : 226-227, Im., S. and W. Burma and India (including Bengal).
1965. *Odontotermes feae*, K. Krishna, *Amer. Mus. Novit.*, No. 2210, pp. 22-23. Im., S. and W. Burma.
1968. *Odontotermes feae*, W. V. Harris, *Opusc. Ent.* 33 (1-2) : 149, S. and W. Vietnam.
1975. *Odontotermes feae*, M. S. Akhtar, *Bull. Dept. Zool. Univ. Panjab* (N. S.), 7 : 75-79. Im. and S. Bangladesh.
1977. *Odontotermes feae*, M. L. Roonwal and O. B. Chhotani, *Ent. Basil*, 2 : 69-70, S. and W. Bhutan.

Material.—LOT (A).—Three vials from Murshidabad Dist., P. K. Sen-Sarma coll., 1954, as follows : (i) No. S₃/20.1.54 with 8S. and sev.

W. and (ii) No. S₅/20.1.54 with sev. S. and W., Lalbag, 10 Km. N. of Berhampur, 20.i.1954, ex. "*Mangifera indica* tree". (iii) No. S₃/21.1.54 with 5S. and 3W., Gocorn, 16 Km. W of Berhampur, 21.i.1954, ex. "bark of living *Mangifera indica* tree."

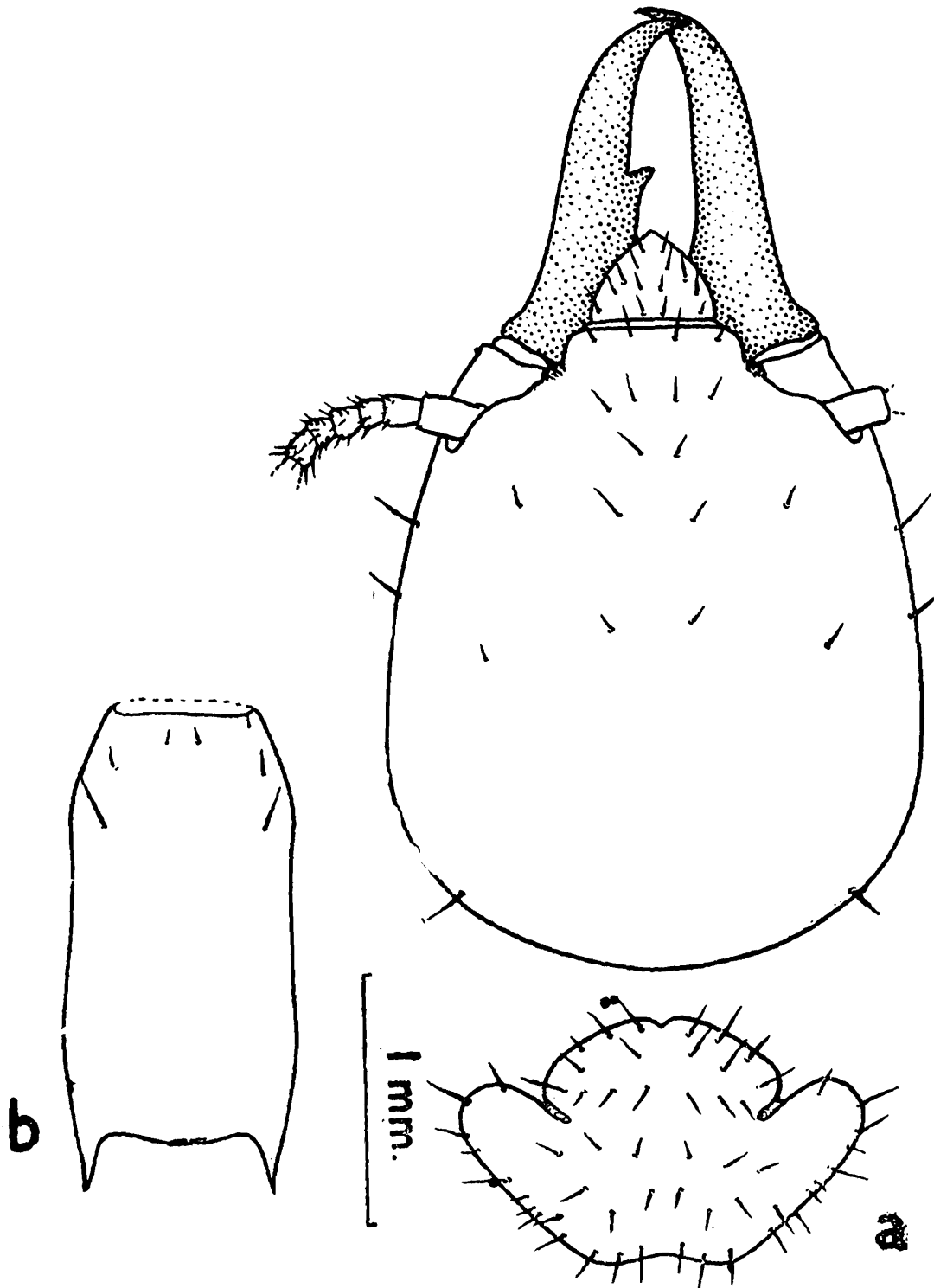


Fig. 32. *Odontotermes feae* (Wasmann) Soldier from Kalyani (Nadia Dist.), P. K. Maiti coll., 10.ix.1965.

a, Head and pronotum ; b, postmentum

LOT (B).—One vial (iv) No. S₄/25.1.54, with 1S. and 5W. Purandarpur, 19 km. N. of Bankura, Bankura Dist., P. K. Sen-Sarma coll., 25.i.1954, ex. "rotten stump of *Shorea robusta*."

LOT (C).—Six vials from 24-Parganas Dist., as follows (v) No. G₁/8.7.65 with sev. S. and W., Bira, 20 km. N. of Sealdah Stn., *L. K. Ghosh coll.*, 8. vii. 1965, ex. "log". (vi) No. 12 with 3S. and sev. W., Barrackpore, *O. B. Chhotani coll.*, 29. ix. 1965, ex. "soil" (vii) No. 1 with sev. S. and W., Lakshmikantapore, *Z. S. I. party coll.*, 15.x.1965. (viii) No. 8 with 1S. and 3W., Barasat, *A. K. Das coll.*, 6. xii. 1965, ex. "under bricks". (ix) No. B₃/2.3.66 with 2S. and sev. W., Ranaghat, *K. N. Baidya coll.*, ex. "gallery on tree" (x) No. M₂/29.10.66, with 1S. and Sev. W., Subhasgram, *P. K. Maiti coll.*, 29. x. 1966, ex. "gallery on a pole".

LOT (D).—One vial (xi) No. M₁/10.9.65 with 1S. and 5W., near University Lake Hall, Kalyani, Nadia Dist., *P. K. Maiti coll.*, 10. ix. 1965, ex. "earthen cover on grass"

LOT (E).—Three vials with sev. S. and W from Midnapore Dist., *P. K. Maiti coll.*, as follows : (xii) No. M₁/1. 10. 65, Terapakhia Bazar, Tamruk Subdivision, ex. "soil" ; (xiii) No. M₁/2.10.65, Saibari Vill., 10 km. S. of Terapakhia Bazar, 2. x. 1965, ex. "underground nest in the floor of a house" (xiv) No. M₁/7. 9. 66, Bamumia Vill., 10 km. W. of Haria Bazar, 7. ix. 1966, ex. "soil". (xv) One vial, Gope Forest, Midnapore, ex. "*Eucalyptus sp.*".

LOT (F).—One vial (xvi) No. 1 with 1S. and sev. W., Burdwan, *A. K. Das coll.*, 14. ii. 1966, ex. "in soil under a log"

LOT (G).—Two vials from Calcutta, as follows : (xvii) No. 1 with 2S. and sev. W., Calcutta, *M. M. Ghosh coll.*, 6. 12. 65, ex. "soil". (xviii) No. R₁/27. 12. 53 with 3S. and sev. W.. Alipur, *M. L. Roonwal coll.*, 27. xii. 1953, ex. "eating green bark of *Albizzia sp.*".

Measurement (in mm.) etc.—(i) *Imago* (after, Holmgren, 1913 and Ahmad, 1958) Length of head to tip of labrum 2.96-3.08 ; Length of head without mandibles 1.92-2.18 ; Width of head 2.70-2.85 ; Long diameter of eye 0.64-0.70 ; Length of ocellus 0.29-0.34 ; Eye-ocellus distance 0.23-0.27 ; Length of pronotum 1.19-1.41 ; Width of pronotum 2.31-2.66. (ii) *Soldier* (10 exs.) Body-length 6.25-7.50 ; Length of head to lateral base of mandibles 2.38-2.62 ; Max. width of head 2.00-2.20 ; Length of left mandible 1.20-1.38 ; Left mandibular tooth distance from tip 0.60-0.75 ; Min. (median) length of postmentum 1.72-1.80 ; Max. width of postmentum 0.80-0.96 ; Max. length of pronotum 0.75-0.88 ; Max. width of pronotum 1.60-1.75 ; No. of antennal segments 17.

Distribution.—*West Bengal* : Calcutta (Alipur), 24-Parganas Dist. : Barasat, Barrackpore, Bira, Lakshmikantapur and Subhasgram. Midnapore Dist., Bamunia Village, Midnapore (Gope Forest), Terapakhia Bazar and Saibari: Village. Bankura Dist. : Puranderpur, and Harra. Nadia Dist. : Kalyani and Ranaghat. Murshidabad Dist. : Gocorn and Lalbag. Burdwan Dist. : Burdwan. *Elsewhere* : *India, Bangladesh, Burma, Thailand and Vietnam.*

Biology.—*Odontotermes feae* (Wasmann) occurs widely in the Gangetic plains and in the Laterite zone of West Bengal. It has so far never been recorded from the sub-Himalayan tract of this State. The species usually makes galleries or mud plaster on living plants, grasses, decaying wood, fence posts, etc. It has also been collected from under logs, bricks, cowdung, rubbish and refuse, and sometimes found to feed on the bark of several plants.

The species is a common soil inhabiting termite usually living in underground nest. A large colony has been found nesting in the earthen floor of a house at Saibari village in the southern part of Midnapore district. The underground nest has occupied an area of 1.50-2.00 m. in diameter, and is comprised of numerous large irregular, vertical chambers separated by thick mud wall and connected by fairly large tunnels. Fungus combs are found in some chambers lying much below the ground level. No royal chamber could be traced out. Large amount of dried up leaves, straw, etc. has been noticed in some chambers, on which the species perhaps feeds in adverse conditions.

The species does not construct termitarium in West Bengal, although it has been recorded to do so at Barkuda Island (Roonwal and Chhotani, 1966b) and in Thailand (Ahmad, 1965).

Swarming has not yet been recorded in this area. However, the species swarms after sunset in the months of June, September and November in different parts of India, usually during or after rain (Roonwal, 1970).

The species is one of the most important termites as it causes a lot of damage to bark of young and also of old plantations, wood in its many forms and timbers in buildings and new plantations. In Gope forest (near Midnapore Town) it has been observed to attack seedlings of *Eucalyptus* and teak being cultivated for afforestation.

36. *Odontotermes gurdaspurensis* Holmgren and Holmgren
(Fig. 33. Soldier, a and b)

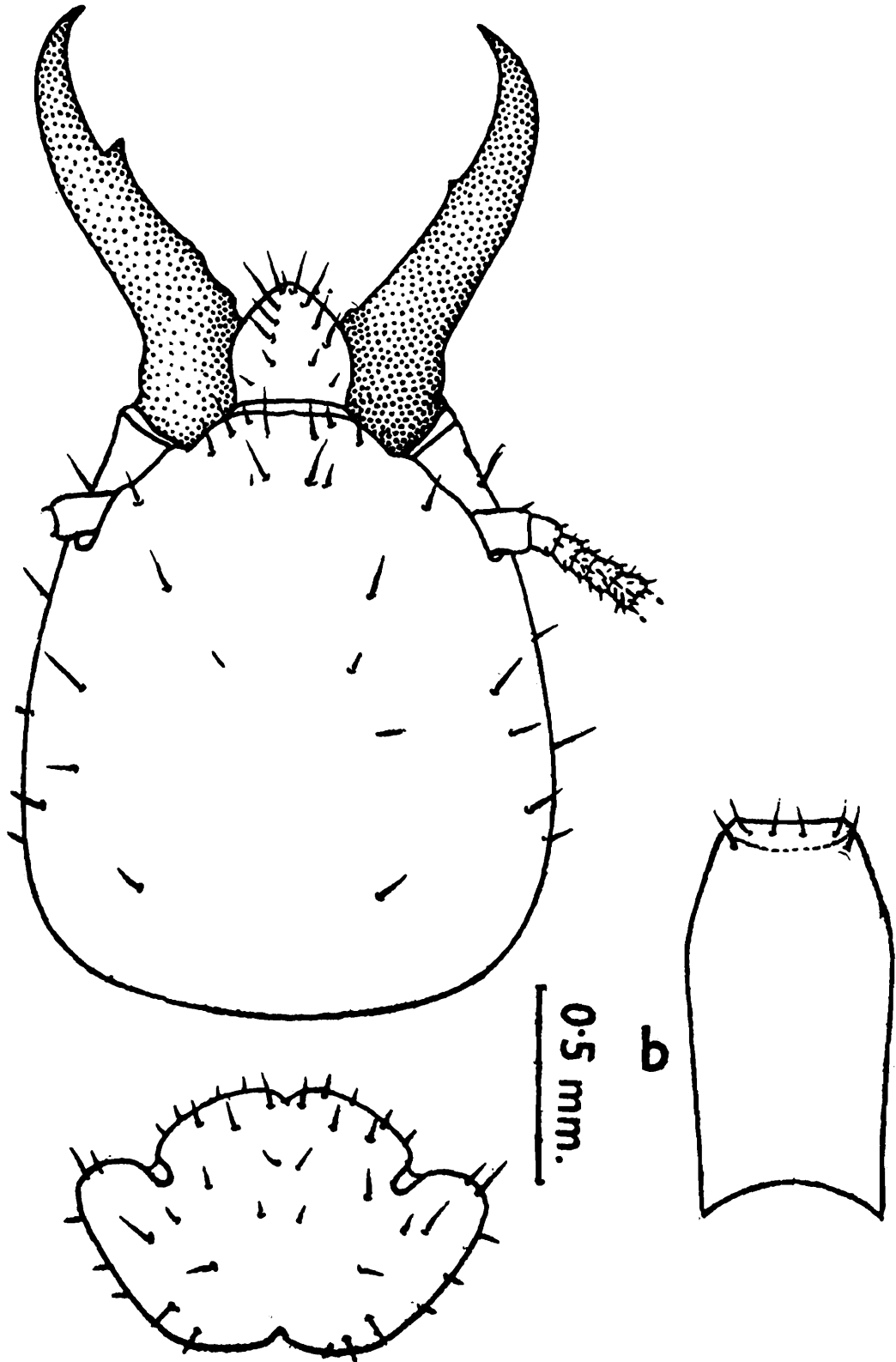


Fig. 33. *Odontotermes gurdaspurensis* Holmgren and Holmgren
Soldier from Bankura, P. K. Sen-Sarma coll., 25.i.1954.
a, Head ; b, postmentum

1917. *Odontotermes obesus* f. *gurdaspurensis* K. Holmgren and N. Holmgren, *Mem. Dept. Agric. India*, 5 (3) : 149. *Im.* and *S.* Type-locality : India : Panjab.
1949. *Odontotermes obesus* f. *gurdaspurensis*, T. E. Snyder, *Smith. misc. Coll.*, 112 : 235.
1955. *Odontotermes gurdaspurensis*, M. Ahmad, *Biologia*, 1 (2) : 222-224, S. Pakistan.

Material.—Four vials with sev. S. and W., Bankura, Bankura Dist., P. K. Sen-Sarma coll., 1954 as follows : (i) No. S₈/25.1.54, ex. "under morrum block" ; No. S₁₀/25.1.54, ex. "under dried up grass" ; Nos. S₃ and S₄/27.1.54, ex. "soil".

Measurements (in mm.), etc.—(i) *Imago* (after, Holmgren and Holmgren, 1917) : "Ocelli separated from the eye by almost their diameter" Length of body with wings 27.00 m. ; Breadth of head 2.47-2.66 mm. ; Breadth of pronotum 2.39-2.51 mm." (ii) *Soldier* (10 exs.) : Body-length 5.20-5.90 ; Length of head to lateral base of mandibles 1.52-1.63 ; Max. width of head 1.30-1.42 ; Length of left mandible 0.90-1.04 ; Left mandibular tooth distance from tip 0.34-0.40 ; Min. (median) length of postmentum 0.95-1.00 ; Max. width of postmentum 0.47-0.50 ; Max. length of pronotum 0.60-0.67 ; Max. width of pronotum 0.98-1.10 ; No. of antennal segments 16.

Distribution.—*West Bengal* : Bankura Dist. : Bankura. *Elsewhere* : *India* : Punjab : Gurdaspur (type-locality), Rajasthan : Udaipur. Kashmir : Bharakow : *Pakistan* : Lahore.

Biology.—The species occurs in most dried area in the district of Bankura, West Bengal. It builds mounds or lives in soil in the dry deciduous Sāl forest where the weather is very dry. No detailed structure of the mound is known.

Swarming usually takes place after rain at 9 a. m. from holes in ground (Holmgren and Holmgren, 1917). In Rajasthan, the species causes damage to fruit plants at Udaipur (Kushwaha, 1960).

37. *Odontotermes horni* (Wasmann)

(Fig. 34. Imago, a-c ; Soldier, d and e)

1902. *Termes horni* E. Wasmann, *Zool. Jb. (Syst.)*, 17(1) : 111-112. *S.* Type-locality : Sri Lanka.
1949. *Odontotermes (O.) horni*, T. E. Snyder, *Smith. misc. Coll.*, 112 : 229. Ceylon.
1962. *Odontotermes horni*, M. L. Roonwal and O. B. Chhotani, *Proc. nat. Inst. Sci. India*, (B) 28 (4) : 349-352. *Im.* and *S.* Manipur.

Material.—LOT (A).—23 Vials with S. and W. from Calcutta and its vicinity, O. B. Chhotani coll., 1957 as follows : Nos. 0₈, 4, 9, 10, 11,

12/31.7.57, from Zoological Garden, 31.vii.1957. $0_3/2.8.57$, Horticulture Farm, 2.viii.1957, ex. "under a log". Nos. $0_2, 5, 7/13.8.57$, Agriculture Farm, 13.viii.1957, ex. "under logs". Kidderpore, 18.ix.1957, No. $0_3/$

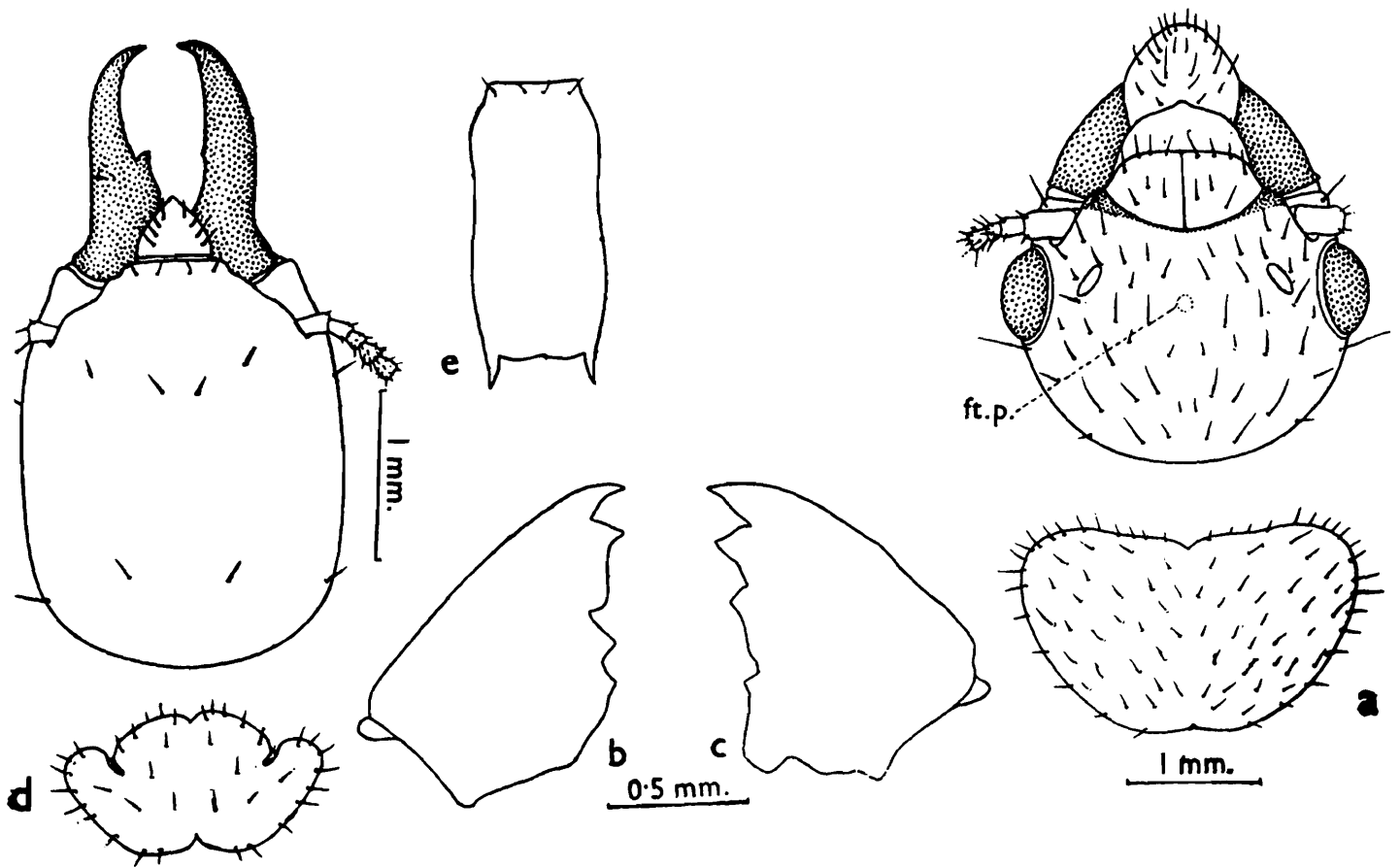


Fig. 34. *Odontotermes horni* (Wasmann) Specimens from Calcutta, Gravelly coll., 17-18.ii.1910.

a-c, Imago. a, Head and pronotum ; b, left mandible ; c, right mandible
d and e, Soldier. d, Head and pronotum ; e, postmentum

18.9.57, ex. "attacking palm tree" ; No. $0_6/18.9.57$, ex. "attacking bamboo pole" ; No. $0_{11}/18.9.57$, ex. "khajur tree" ; No. $0_{12}/18.9.57$, ex. "under cowdung" ; No. $0_{13}/18.9.57$, ex. "dead standing palm tree". Brarrackpore, 24-Parganas Dist., 24.ix.1957 : No. $0_1/24.9.57$, ex. "under fallen cocoanut and shisham log" ; No. $0_5/24.9.57$, ex. "attacking bamboo lying on ground" ; No. $0_7/24.9.57$, ex. "attacking Tagar tree" ; No. $0_9/24.9.57$, ex. "twigs of Sun flower" ; No. $0_{12}/24.9.57$, ex. "under log of unknown tree" ; No. $0_{17}/24.9.57$, ex. "under a khajur log lying on ground" Garia, 27.ix.1957 : No. $0_3/27.9.57$, ex. "root of the living *Ficus bengalensis*" ; No. $0_8/27.9.57$, ex. "attacking a dead cocoanut tree".

LOT (C).—Four vials with sev. S. and W., from Calcutta, M. L. Thakur coll., 6.viii.1957 : Nos. $M_5, 6, 7, 8/6.8.57$, all ex. "railway sleeper".

LOT (D).—Two vials with S. and W., from Park Circus, Calcutta,

A. P. Kapur coll., as follows : No. K₁/7. 4. 50, 7.iv.1950, ex. "wooden post" ; No. K₁/8.7.58, 8.vii.1958, ex. "gallery in a garage".

LOT (E).—Three vials with S. and W., from Balvedere, Calcutta, *M. L. Roonwal coll.*, 1959 as follows : No. R₁/10.2. 59, 10.ii.1959, ex. "tree trunk" ; No. R₂/10.2.59, ex. "trunk of tree" ; No. R₃/23.ii.59, ex. "nest inside a living tree".

LOT (F).—Two vials with S. and W. from Barisha, Calcutta, *P. C. Dhar coll.*, 19.ii.1959 as follows : No. D₁/19.2.59, ex. "bamboo base" ; D₂/19.2.59. ex. "under bamboo in soil".

LOT (G).—Two vials with S. and W. from Dhakuria, Calcutta, *P. K. Maiti coll.*, 12. xii. 1965, ex. "gallery on tree trunk", Nos. M₁, M₃/12.12.65.

LOT (H).—Two vials Nos. S₁, 2/16.3.66 with S. and W., Behala, Calcutta, *S. K. Saha coll.*, 16.iii. 1966, ex. "dead young plants"

LOT (I).—Seven vials with S. and W., from Subhasgram, 24-Parganas Dist., *M. L. Roonwal coll.*, 30. xii. 1953, as follows : No. R₁/30. 12. 53, ex. "*Acacia arabica* log lying on moist soil" ; No. R₂/30.12.53, ex. "living palm stem" ; No. R₄/30.12.53, ex. "dead log" ; No. R₅/30.12.53, ex. "*Borassus flabelifer* log, lying on ground" ; No. R₇/30.12.53, ex. "dead palm" ; No. R₈/30.12.53, ex. "dead rotten *Mangifera indica* stem" ; No. R₁₁/30.12.53, ex. "under log".

LOT (K).—Seven vials with sev. S. and W., from different districts, as follows : No. 1, Gocharan, 24-Parganas Dist., *H. L. Paul coll.*, 28. viii. 1954, ex. "mango tree". No. 1, Barasat, 24-Parganas Dist., *A.K. Das coll.*, 1967, ex. "soil". No. M₁/19.6.66, Phulia (near Rly. Stn.), Nadia Dist., *G. K. Mondal coll.*, 19. vi. 1966, ex. "gallery on dead standing tree". No. G₁/6.6.66, Barasat, *L. K. Ghosh coll.*, 6. vi. 1966, ex. "soil". No. 1735, Chandannagar, Hooghly Dist., *V. D. Srivastava coll.*, 24. xi. 1965. One vial, Muragacha, Nadia Dist., *S. C. Mitra coll.*, 28. i. 1966, ex. "fallen wood" No. S₉/20. 1. 54, Lalbag, Murshidabad Dist., *P. K. Sen-Sarma coll.*, 20. i. 1954, ex. "under dung".

LOT (L).—Five vials with S. and W. from different districts, *P. K. Maiti coll.*, as follows : No. M₂/10.11.66, Kamyakhyaguri, Jalpaiguri Dist., ex. "gallery on tree trunk". No. M₂/9.11.66, Cooch Behar, ex. "gallery on a sal tree". No. M₁/7.1.66, Bamunia vill., 10 km. W. of Haria Bazar, Midnapore Dist., ex. "soil". No. M₃/8.4.66, Rabindranagar, Midnapore, ex. "under a log". No. M₂/24.1.67, Sree Pally, Asansol, Burdwan Dist., ex. "gallery on tree trunk".

Measurements (in mm.), etc.—(i) *Imago* (5 exs.) : Body-length with wings 18.00-19.00 ; Body-length without wings 13.78-14.10 ; Length of head to lateral base of mandibles 1.93-2.00 ; Max. width of head 2.61-2.75 ; Max. length of postclypeus 0.52-0.54 ; Max. width of postclypeus 1.07-1.14 ; Max. diameter of compound eye (with ocular sclerite) 0.70-0.74 ; Max. diameter of lateral ocellus 0.29-0.32 ; Min. eye-ocellus distance 0.18-0.22 ; Max. length of pronotum 1.40-1.45 ; Max. width of pronotum 2.52-2.58 ; No. of antennal segments 19-20. (ii) *Soldier* (10 exs.) : Body-length (excluding antennae) 7.20-7.70 ; Length of head to lateral base of mandibles 2.30-2.45 ; Max. width of head 1.82-1.93 ; Length of left mandible 1.30-1.45 ; Left mandibular tooth distance from tip 0.73-0.80 ; Min. (median) length of postmentum 1.50-1.60 ; Max. width of postmentum 0.75-0.87 ; Max. length of pronotum 0.80-0.90 ; Max. width of pronotum 1.40-1.52 ; No. of antennal segments 17.

Distribution.—*West Bengal* : Calcutta and its vicinity. 24-Parganas Dist., Barrackpore, Barasat and Gocharan. Midnapore Dist., Bamunia village and Midnapore. Nadia Dist., Muragacha and Phulia. Burdwan Dist., Asansol. Murshidabad Dist., Lalbag. Hooghly Dist., Chandanagar. Cooch Behar Dist., Cooch Behar. Jalpaiguri Dist., Kamyakhya-guri. *Elsewhere* : *India* : Assam, Borjuli Tea Estate, Manipur : Imphal Valley, Karnataka : Bangalore, Uttar Pradesh : Dehra Dun ; *Sri Lanka*, *Cambodia* and *Vietnam*.

Remarks.—The eye-ocellus distance in imago varies from less than half to half of maximum diameter of ocellus.

Biology.—The species occurs throughout West Bengal, except in the hilly tracts of north Bengal. It is common in the Gangetic plains. The collection data shows that the species attacks all sorts of fallen wood as well as bark or dead tissues of live trees and shrubs. At numerous occasions, it has been collected from galleries or mud plasters, on transmission poles, fence posts, bamboo poles, railway sleeper and other timbers in direct contact with the soil. The interior of dead stump or logs, etc., that it attacks, is often completely destroyed and filled with earthy material traversed by galleries. The stems of both live and dead plants are sometimes completely covered with a thick earthen sheath, under cover of which the wood may be severely damaged. It has never been reported to attack the live tissues in plant.

The species is reported as a pest of tea in Sri Lanka (Harris, 1961) and of rubber plants in Vietnam (Roonwal, 1970). It rarely establishes

itself in buildings (Beeson, 1941), though it has been recorded here in a single instance in a garage in Calcutta.

In Calcutta, swarming has been reported in October usually in the evening from small holes on the ground (From the ZSI Cards).

38. *Odontotermes parvidens* Holmgren and Holmgren

(Fig. 35. Soldier, a-e)

1917. *Odontotermes (O.) parvidens* K. Holmgren and N. Holmgren, *Mem. Dept. Agric. India (Ext.)*, 5(3) : 154. *S. and W. Type-localities : India. On road from Mysore to Mercara (Karnataka) ; Dhar, Gurdaspur Dist. (Punjab) ; Kamakhya Hill (553 m.) and Gauhati (Assam). Bangladesh : Chaumahani, Noakhali Dist.*

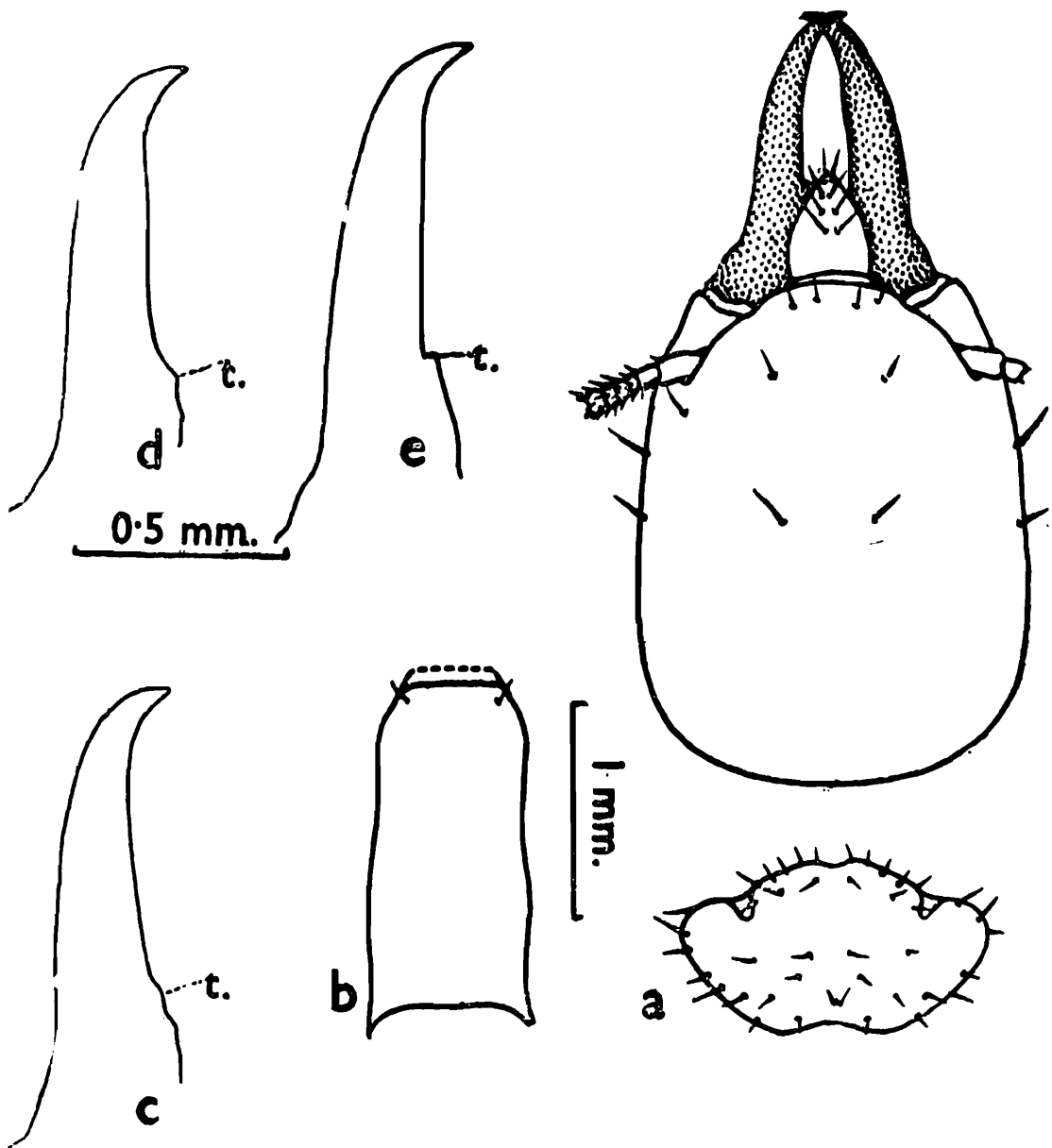


Fig. 35. *Odontotermes parvidens* Holmgren and Holmgren Soldier from Pesok Tea Estate (Darjeeling Dist.), P. K. Maiti coll., 29.x 1966.

a, Head and pronotum ; b, postmentum ;

c-e showing the variation in size of left mandibular tooth (t.)

1949. *Odontotermes (O.) parvidens*, T. E. Snyder, *Smith. misc. Coll.*, **112** : 236. India and Bangladesh.
1958. *Odontotermes parvidens*, R. N. Mathur and P. K. Sen-Sarma, *Indian For. Bull.* (N. S.), *Ent.*, No. 219, pp. 6-9, Im. West Bengal and Uttar Pradesh.
1975. *Odontotermes parvidens*, M. S. Akhtar, *Bull. Dept. Zool. Univ. Panjab* (N. S.), **7**, 87-90, S. & W. Bangladesh.
1977. *Odontotermes parvidens*, M. L. Roonwal and O. B. Chhotani, *Ent. Basil*, **2** : 73-74. S. and W. Bhutan.

Material.—LOT (A).—One vial with 4 Im., 4S and 4W., Samsing, Darjeeling Dist., *B. Singh coll.*, ii. 1934.

LOT (B).—Twenty vials with S. and W from Darjeeling Dist., *P. K. Maiti coll.*, 1966, as follows : (i) No. $M_3/29.10.66$, Pesok Tea Estate (near Forest Office), 7 km. W of Teesta Bridge, 29.x.1966, ex. "gallery on a wooden post." (ii) No. $M_2/31.10.66$, Kalimpong (near Forest Bungalow), 31.x.1966, ex. "attacking young plant" (iii) No. $M_2/1.11.66$, Chebbo Bosti (1209 m.), 3 km. S. of Kalimpong, 1.xi.1966, ex. "soil under dried up leaves". (iv) No. $M_1/2.11.66$, Tashiding Forest, 5 km. NE. of Teesta Bridge, 2.xi.1966, ex. "soil under a log" and (v) No. $M_4/2.11.66$, ex. "gallery on a tree" (vi) No. $M_4/3.11.66$, Bong Bosti, 5 km. E. of Kalimpong, 3.xi.1966, ex. "attacking a dead branch of a live tree" (vii) No. $M_1/4.11.66$, Gailikhola Forest, Teesta Valley Forest, 2 km. W. of Teesta Bridge, 4.xi.1966, ex. "gallery on a pole" and (viii) No. $M_7/4.11.66$, ex. "gallery inside a dead tree trunk, with *Macrotermes khajuriae*". (ix) No. $M_4/5.11.66$, near Coronation Bridge, 5.xi.1966, ex. "earthen cover on a big stone" (x) No. 31, Nazeok, *G. K. Srivastava and P. K. Maiti coll.*, 7.i.1974, ex. "soil"

LOT (C).—Eighteen vials with S. and W. from Jalpaiguri Dist., *P. K. Maiti coll.*, 1966, as follows : (xi) No. $M_3/21.10.66$, Kadamtalla, Jalpaiguri, 21.x.1966, ex. "fence post" and (xii) No. $M_4/21.10.66$, ex. "bamboo pole" (xiii) No. $M_6/22.10.66$, near Court at the West bank of the river Teesta, Jalpaiguri, 22.x.1966, ex. "base of a stump". (xiv) No. $M_3/24.10.66$, Patkata Colony, Jalpaiguri, 24.10.1966, ex. "earthen cover on a timber" and (xv) No. $M_4/24.10.66$, ex. "under stone in soil". (xvi) No. $M_1/5.11.66$, Bagra Coat, 5.xi.1966, ex. "wooden pole on road side". (xvii) No. $M_3/5.11.66$, Mal Bazar, 5.xi.1966, ex. "dead log" and (xviii) No. $M_5/5.11.66$, ex. "soil" (xix) No. $M_2/6.11.66$, Bhagatpore Tea Estate (near Nagrakata Rly. Stn.), 6.xi.1966, ex. "gallery inside a hollow trunk" (xx) No. $M_3/6.11.66$, Champaguri, 5 km. NW. of Nagrakata Rly. Stn., ex. "under cowdung" (xxi) No. $M_5/6.11.66$, Thaljhorahat, 10 km. NW of Nagrakata Rly. Stn., 6.xi.1966, ex. "gallery on a log" (xxi) No. $M_1/7.11.66$, Khunia

Junction, West bank of the Jaldhaka river, 8 km. W. of Nagrakata Rly. Stn., ex. "feeding on bark of a big standing tree". (xxiii) No. M₅/7.11.66, Murti Beat, Chalsa Forest Range, 12 km. W. of Nagrakata Rly. Stn., 7.xi.1966, ex. "under cowdung" and (xxiv) No. M₆/7.11.66. (xxv) No. M₂/12.11.66, near Estate quarters, Paitkapara Tea Estate, 14 km. NE. of Alipurduar, 12.xi.1966. ex. "nest in floor of a deserted house" and (xxvi) No. M₄/12.11.66, ex. "soil under a stone". (xxvii) No. M₂/13.11.66, New Town, Alipurduar, 13.xi.1966, ex. "mud plaster on a Sisso tree". (xxviii) No. M₄/13.11.66, New Alipurduar Rly. Stn., 13.xi.1966, ex. "attacking railway sleeper".

LOT (D).— Four vials with S. and W. from Cooch Behar Dist., P. K. Maiti coll., 1966, as follows : (xxix) No. M₆/10.11.66 and (xxx) No. M₇/10.11.66, near Rest House, Atiamochar Forest Beat, Cooch Behar Range, 10.xi.1966, ex. "damaging the bark of young plant". (xxxi) No. M₇/11.11.66, Khagribari, Atiamochar Beat, Cooch Behar Forest Range, 11.xi.1966, ex. "scar mark on a Khair tree" and (xxxii) No. M₈/11.11.66. ex., "forest litter".

Measurements (in mm.), etc.— (i) *Imago* (4 exs.) : Body-length (with wings) 29.10-29.50 ; Body-length (without wings) 12.12-12.60 ; Length of head to lateral base of mandibles 1.52-1.67 ; Max. width of head (with eyes) 2.56-2.62 ; Max. diameter of compound eye (with ocular sclerite) 0.61-0.65 ; Max. diameter of lateral ocellus 0.20-0.25 ; Min. eye-ocellus distance 0.26-0.30 ; Max. length of pronotum 1.10-1.20 ; Max. width of pronotum 2.12-2.37 ; Length of forewing (with scale) 25.40-26.00 ; Length of hindwing (with scale) 23.50-23.80 ; No. of antennal segments 19.

(ii) *Soldier* (20 exs.) : Body-length 5.50-6.45 ; Length of head to lateral base of mandibles 1.80-2.70 ; Max. width of head 1.50-2.10 ; Length of left mandibles 1.30-1.46 ; Left mandibular tooth distance from the tip 0.84-0.96 ; Min. (median) length of postmentum 1.38-1.50 ; Max. width of postmentum 0.70-0.76 ; Max. length of pronotum 0.72-0.79 ; Max. width of pronotum 1.32-1.45 ; No. of antennal segments 17.

Distribution.—*West Bengal* : The species is found distributed only in the Sub-Himalayan zone as follows : Darjeeling Dist., Gailikhola Forest (near Teesta Bridge), Kalimpong (Bong Bosti and Chhobo Bosti), Tashiding Forest and Samsing. Jalpaiguri Dist., Alipurduar, Bagracoat, Bhagatpur Tea Estate, Champaguri, Jalpaiguri (Kadamtalla, New Town and Patkata colony), Khunia Junction, Mal Bazar, Murti Forest Beat, New Alipurduar, Paitkapara Tea Estate and Thaljhorahat. Cooch Behar

Dist., Atiamochar Forest Beat (Khagribari). The species in West Bengal was so far known only from Samsing. *Elsewhere : India : Assam, Karnataka, Punjab and Uttar Pradesh ; Pakistan and Bangladesh.*

Remarks.—*Odontotermes parvidens* Holmgren and Holmgren is a highly variable species. The soldier shows great variation in the shape (suboval to rectangularly oval) and size (head-length 1.80-2.7 mm., head-width 1.50-2.00 mm.) of the head capsule and left mandibular tooth (indistinct to very prominent.). The median notch on anterior margin of pronotum is also either weak or prominent. The study of long series of collections from North Bengal and the valuable contribution of Roonwal and Chhotani (1962) on variations of the species from Assam, have proved that the variations are colonial.

Biology.—The species is well represented in the Sub-Himalayan zone of West Bengal and has never been recorded from the other zones in southern part of the State. The species occurs in numerous habitats, such as, in hollows and scars of forest trees, in galleries and mud plaster on tree trunks, railway sleepers, fence posts, bamboo poles ; and in sub-terranean nests in soil and under cowdung, stones, logs, etc. In some cases, the species has been found in association with other termites of the species *Macrotermes khajuriae*, *Microtermes obesi* and *Nasutitermes fletcheri*. In Gailikhola forest, *O. parvidens* and *M. khajuriae* have been collected from the large hollowed portion inside the trunk of a almost dead tree. The hollowed part has been packed up with soil collected by these termites, the former species has been found in the superficial layer and the latter in the deeper layer.

Elsewhere in India, the species is found in association with other species of termites, namely, *Neotermes* sp., *Coptotermes* sp., *Odontotermes obesus*, *O. feae*, *Microtermes* sp., *Nasutitermes* sp., etc. (Beeson, 1941 ; Roonwal, 1954a and 1970 ; Roonwal and Chhotani, 1962 ; Mathur and Sen-Sarma, 1958, 1962a).

A subterranean nest has been found in the floor of a deserted house in Paitkapara Tea Estate, Jalpaiguri district which consisted of series of chambers interconnected by fairly large tunnels. Some of the chambers are packed up with fungus combs of moderate size.

The swarming takes place in the month of February in North Bengal (Mathur and Sen-Sarma, 1958 ; Roonwal, 1970).

The species usually causes considerable damage to bark of both young and old trees in North Bengal.

39. *Odontotermes redemanni* (Wasmann)

(Fig. 36. Imago, a-c ; Soldier, d and e)

1893. *Termes redemanni* E. Wasmann, *Wien. Ent. Zeitg.*, 12 (7), : 239-242, *Im.*, Queen, S. and W. Type-locality : Sri Lanka.1949. *Odontotermes* (O.) *redemanni*, T. E. Snyder, *Smith. misc. Coll.* 112 : 238. Sri Lanka.1975. *Odontotermes obesus*, M. S. Akhtar, *Bull. Dept. Zool. Univ. Panjab (N. S.)*, 7 : 86-87, S. Bangladesh.

Material.—LOT (A).—Ten vials from 24-Parganas Dist. as follows : 5 vials with sev. S. and W., Naihati, M. L. Roonwal coll., 29.xii.1953, thus, R₁/29.12.53, ex. "under dried up dung" ; Nos. R₃ /29.12.53, ex.

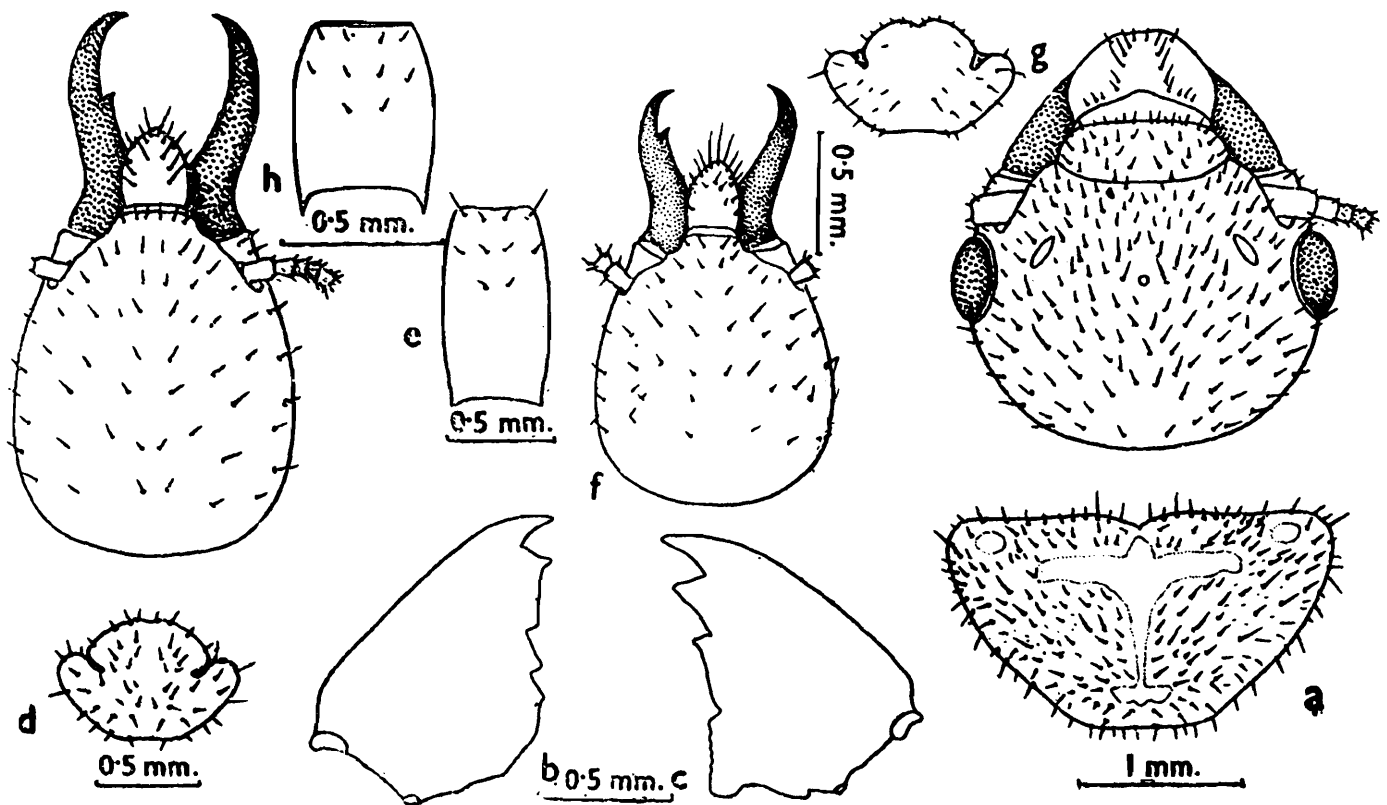


Fig. 36. *Odontotermes redemanni* (Wasmann) Specimens from Midnapore, P. K. Maiti coll., 26.vi.1966.

a-c, Imago. a, Head and pronotum ; b, left mandible ; c, right mandible
d and e, Soldier. d, Head and pronotum ; e, postmentum ;
f-h, Soldier (Dwarf). f, Head ; g, pronotum ; h, postmentum

"mound" ; and No. R₆/29.12.53, with 1 king., sev. S. and W., ex. "mound". 2 vials (No. O₃/24.9.57 and O₁₅/24.9.57) with 1 K., 1Q., and sev. S. and W. each, Barrackpore (near Water Works), O. B. Chhotani coll., 24.xi.1957, ex. "mounds". A vial (No. M₁/19.7.65) with sev. S. and W., Titagarh, P. K. Maiti coll., 19. vii. 1965, ex. "mound". 3 vials (Nos. S₂, S₃ and S₇/10.1.54) with King, sev. S. and W., each, Tushkhali, Rampura proper, Sundarbans, P. K. Sen-Sarma coll., 10.i.1954, ex. "mounds".

LOT (B).—One vial (No. R₁/20.8.59) with 1S. and sev. W., Calcutta (Eden Garden), *M. L. Roonwal coll.*, 20.viii.1959, ex. "soil".

LOT (C).—One vial with sev. S. and W., Baishnab Nagar, Maldah, *P. C. Ghosh coll.*, 15.iii.1967, ex. "soil".

LOT (D).—One vial (No. S₇/25.1.54) with 2S. and sev. W., Bankura, Bankura Dist., *P. K. Sen-Sarma coll.*, 25.i.1954, ex. "*Ficus bengalensis* mixed with *Microtermes obesi*".

LOT (E).—Five vials with sev. S. and W from Hooghly Dist. as follows : 4 vials (Nos. M₁₋₄/8.11.65). Chandannagar, *P. K. Maiti coll.*, 18.xi.1965, ex. "mounds" ; and 1 vial with 5S. and sev. W., Singur, *S. R. Bose coll.*, x.1952.

LOT (F).—Six vials with sev. S. and W from Midnapore Dist. as follows : : 5 vials, Midnapore, *P. K. Maiti coll.*, April-June, 1966 ; thus, No. M₅/8.4.66 with 2S. and 2W., Rabindra Nagar, ex. "earthen cover on ground" ; No. M₆/8.4.66, Burge Town, ex. "soil nest, mixed with *Microtermes obesi*" ; No. M₄/9.4.66, Gope Forest, ex. "soil" ; No. M₈/9.4.66, Gope Forest, ex. "soil" ; No. M₁/26.6.66, Keranitolla, ex. "soil" ; No. M₂/26.6.66 with 2 Im. and 5S., Keranitolla, ex. "emerging from hole on ground" ; a vial (No. 3) with 1S. and sev. W., Kharagpur, *K. S. Pradhan coll.*, 1.xii.1947, ex. "trunk of a palas tree".

LOT (G).—Three vials with sev. S. and W. from Santineeketan and Bolpur, Birbhum Dist., *P. K. Maiti coll.*, 1966, ex. "soil".

LOT (H).—One vial with 4S. and sev. W., Sree Pally, Asansol, Burdwan Dist., *P. K. Maiti coll.*, 12.vi.1966, ex. "mud plaster on ground".

LOT (I).—Four vials with S. and W., from Nadia Dist., as follows : three vials from Phulia, *R. K. Ghosh coll.*, 4.xi.1964 and *G. K. Mondal coll.*, 3.vii.1966, all ex. "soil". One vial (No. B₂/2.3.66) Ranaghat, *K. N. Baidya coll.*, 2.iii.1966, ex. "mound". One vial (No. S₁/28.1.66) Muragacha, *S. C. Mitra coll.*, 28.i.1966, ex. "soil"

LOT (J).—Two vials with sev. S. and W. from Jalpaiguri Dist., *P. K. Maiti coll.*, as follows : M₂/5.11.66, Mal Bazar (near Bus Stand), ex. "galleries on tree trunk" ; M₆/6.11.66, Thaljhorahat, 10 km. NW of Nagrakata Rly. Stn., ex. "gallery on dead log".

LOT (K).—One vial with sev. S. and W. from Darjeeling Dist. as

follows : No. M₂/4.11.66, Teesta Valley Forest (alt. 300 m.), 2 km. W. of Teesta Bridge, *P. K. Maiti coll.*, 4.xi.1966, ex. "soil".

LOT (L).—One vial with sev. S. and W. from Purulia (near Central Bus Stand), *P. K. Maiti coll.*, xi.1968, "soil".

Measurements (in mm.), etc.—(i) *Imago* (2 exs.) : Body-length with wings 25.00-25.50 ; Body-length without wings 13.30-13.50 ; Length of head to lateral base of mandibles 1.65-1.71 ; Max. width of head (with eyes) 2.38-2.45 ; Max. diameter of compound eye (with ocular sclerite) 0.58-0.65 ; Max. diameter of lateral ocellus 0.25-0.65 ; Min. eye-ocellus distance 0.16-0.22 ; Max. length of pronotum 1.30-1.34 ; Max. width of pronotum 2.23-2.27 ; Length of forewing with scale 23.46-23.52 ; Length of hindwing with scale 22.00-22.10 ; No. of antennal segments 19. (ii) *Soldier* (20 exs.) : Body-length 3.92-5.20 ; Length of head to lateral base of mandibles 1.25-1.57 ; Max. width of head 1.05-1.30 ; Length of left mandibles 0.75-1.00 ; Left mandibular tooth distance from tip 0.25-0.38 ; Min. (median) length of postmentum 0.62-0.75 ; Max. width of postmentum 0.45-0.53 ; Max. length of pronotum 0.40-0.52 ; Max. width of pronotum 0.75-1.00 ; No. of antennal segments 16-17.

Distribution.—*West Bengal* : 24-Parganas Dist., Barrackpore, Naihati, Titagarh and Tushkhali. Calcutta. Bankura Dist., Bankura. Purulia Dist., Purulia. Hooghly Dist., Chandannagar and Singur. Midnapore Dist., Midnapore (Rabindranagar, Keranitolla) and Kharagpur. Burdwan Dist., Birbhum Dist., Santineeketan and Bolpur. Nadia Dist., Muragacha, Phulia and Ranaghat. Maldah Dist., Baishnabnagar. Jalpaiguri Dist., Mal Bazar and Thaljhorahat. Darjeeling Dist., Teesta Valley Forest. *Elsewhere* : *India* : Bihar and Maharashtra. *Sri Lanka* (throughout the island) and *Bangladesh*.

Remarks.—*Odontotermes redemanni* (Wasmann) is a highly variable species. The intercolonial variations in the soldiers, as far as the shape and size of head, and left mandibular-tooth distance from the tip, have been a source of confusion in the correct identity of the species. Long series of collections made from West Bengal are studied. The following variations are noted.

Imago : The eye-ocellus distance varies from 0.16-0.22 mm. as against 0.08-0.09 mm. given by Ahmad (1958).

Soldier : The shape of head-capsule varies from suboval to oval, and weakly to strongly converging in front. The left mandibular tooth

is placed above the middle and its distance from the tip varies from 0.25-0.38 mm. The median notch at the anterior margin of pronotum is weakly to strongly notched.

The species is very close to *O. obesus* (Rambur) which has already been reported from the State. However, the occurrence of *O. obesus* in this State is doubtful as the mound it builds, are similar to those of *O. redemanni* found in South India and Sri Lanka. However, in the present study, the species has been considered tentatively as *O. redemanni*.

Biology.—The species is a common mound building termite in Sri Lanka and South India. In West Bengal, the species occurs widely in the Laterite and Gangetic faunal units and less so in the coastal and the sub-Himalayan units. The mounds are of common occurrence in well drained soil of jungles and pasture lands, on embankments of river, tanks and ponds ; and along the railway tracts and roads. The highest concentration of mounds are found in the dry deciduous Sāl forest in the laterite unit in the districts of Bankura, Purulia and western Midnapore. The colour of the mounds depend upon the colour of the adjoining soil. The internal structure of the mounds and the ecology of the species in this State, are studied in details by Mukherji and Mitra (1949). Apart from mounds, the species has also been recorded frequently from galleries and mud plaster on tree trunks, logs, fence posts, transmission poles, grasses ; under stone, refuse and rubbish, in dried up animal dung, manured soil, etc. From the nest, the galleries or covered runways extend to a quite long distance through which the workers go out for foraging.

The mounds are flat, rarely exceeding the height of about 1.5 m. with many peaks ; the diameter at base is generally quite large, measuring 2-3 m. The chambers inside the nest are packed up with numerous fungus combs. In the low rainfall areas of laterite unit, the mounds are of still shorter in height and broader at base, in high rainfall areas of sub-Himalayan zone they are taller with narrower base.

The species usually swarms in the months of June to August in West Bengal. At Midnapore, heavy swarming has been observed on a humid and cloudy morning at 9 A.M., while it has been dizzying in the last week of June, 1966. On the same day the swarming took place once again just before sunset. The imagos emerge from a hole in the ground under a bush. The individual generally flies from the hole at the angle of about 45 degrees and attains a height of about 15 m. in

the air. Having attained height, they fly in different directions to a considerable distance. After alighting on the ground, the reproductives run in search of the opposite sex. During the course of this crawling, the wings are shed off by jarking movements. Sometimes a single female is followed by more than one male, ultimately only one gains the pairing partnership. The male then follows the female touching his mouth parts to her abdomen. Both these pairing individuals then try to find out suitable place in the soil *i.e.*, under stones or bricks, etc. for their future nesting site. As soon as they gain entrance they close up the opening. As a rule, then the copulation starts.

The species is of great importance in the State as regards its economic importance as well as modifying the soil texture. It causes damage to growing trees, bark of many a plants, timbers in human use, fence posts and several other articles. The species has also been recorded from tea plantation in North Bengal, but the extent of damage is yet to be estimated. However, the species is known to damage tea and coconut in Sri Lanka.

Genus (19) *Hypotermes* Holmgren, 1913

40. *Hypotermes obscuriceps* (Wasmann)

(Fig. 37. Soldier, a)

1902. *Termes obscuriceps* E. Wasmann, *Zool. Jb. (Syst.)*, 17 (1) : 113-114. S. and W.
Type-localities : Sri Lanka : Trincomali and Bandrawella.
1913. *Odontotermes (Hypotermes) obscuriceps*, N. Holmgren, *K. Sv. Vet. Akad. Handl.*, 50 (2) : 141-143. Im., S. and W.
1962. *Hypotermes obscuriceps*, M. L. Roonwal and O. B. Chhotani, *Proc. nat. Inst. Sci. India*, 28 (4) : 360-362. S. Assam.

Material.—One vial with 3S. and 5W. from Ghumti, Darjeeling Dist., *F. H. Gravely coll.*, 27.iii.1910. *det.* F. Silvestri.

Measurements (in mm.), etc.—(i) *Imago* (after, Holmgren, 1913) : Length with wings 26.00-27.00 ; Length without wings 10.00-12.00 ; Length of forewing 22.00-24.00 ; Head-length 2.47 ; Head-width 2.28 ; Length of pronotum 1.06 ; Width of pronotum 2.13. (ii) *Soldier* (3 exs.) : Body-length 3.50-3.77 ; Length of head to lateral base of mandibles 1.15-1.20 ; Max. width of head 0.95-1.05 ; Length of left mandibles 0.55-0.69 ; Max. length of pronotum 0.45-0.50 ; Max. width of pronotum 0.63-0.69 ; No. of antennal segments 16.

Distribution.—*West Bengal* : Darjeeling Dist. : Ghumti ; Calcutta.
Elsewhere : *India* : Meghalaya : Rongrengiri, Shillong, Umsa and Nong
 Kharai. *Sri Lanka* and *South Vietnam*.

Biology.—Unknown.

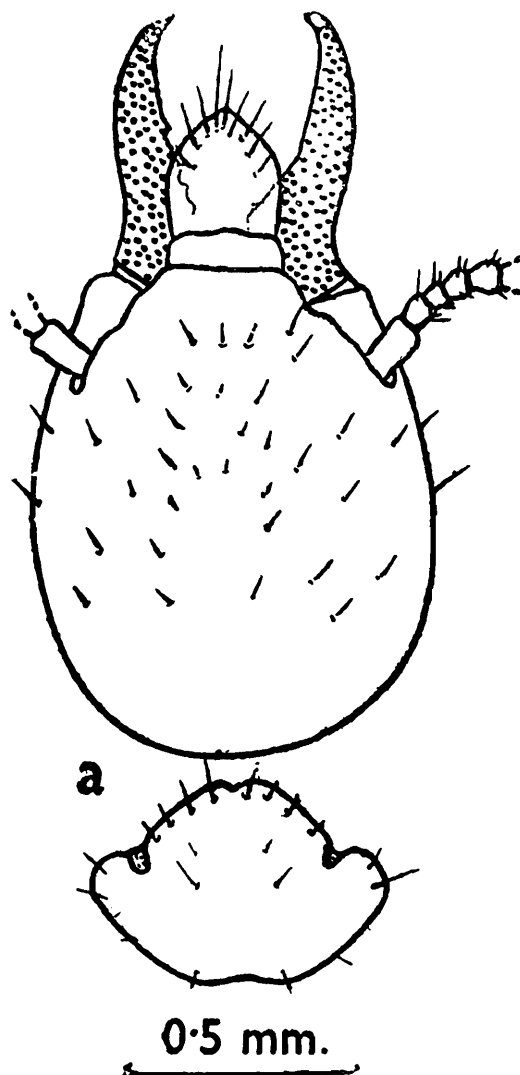


Fig. 37. *Hypotermes obscuriceps* (Wasmann) Soldier from Ghumti (Darjeeling Dist.),
 F. H. Gravely coll., 27.iii.1910.
 a, Head and pronotum

41. *Hypotermes xenotermis* (Wasmann)

(Syn : *Hypotermes nongpriangi* Roonwal and Sen-Sarma)

(Fig. 38. Soldier, a and b)

1896. *Termes xenotermis* E. Wasmann, *Ann. Mus. Stor. nat. Genova*, (2) 16 : 628 S.
 and *W. Type-locality* : Burma : Palon Pegu.
1949. *Odontotermes (Hypotermes) xenotermis*, T. E. Snyder, *Smith. misc. col.*, 112 :
 244.

1956. *Hypotermes nongpriangi* M. L. Roonwal and P. K. Sen-Sarma, *Indian J. agric. Sci.*, 26 (1): 21-26. Assam. (Synonymised, vide, Krishna, 1965).
1965. *Hypotermes xenotermitis*, K. Krishna, *Amer. Mus. Novit.*, No. 2210 p. 25. Burma.
1975. *Hypotermes xenotermitis*, M. S. Akhtar, *Bull. Dept. Zool. Univ. Punjab* (NS), 7: 97-101, Im. and S. Bangladesh.
1977. *Hypotermes xenotermitis*, M. L. Roonwal and O. B. Chhotani, *Ent. Basil.*, 2: 74-75. Im. and S. Bhutan.

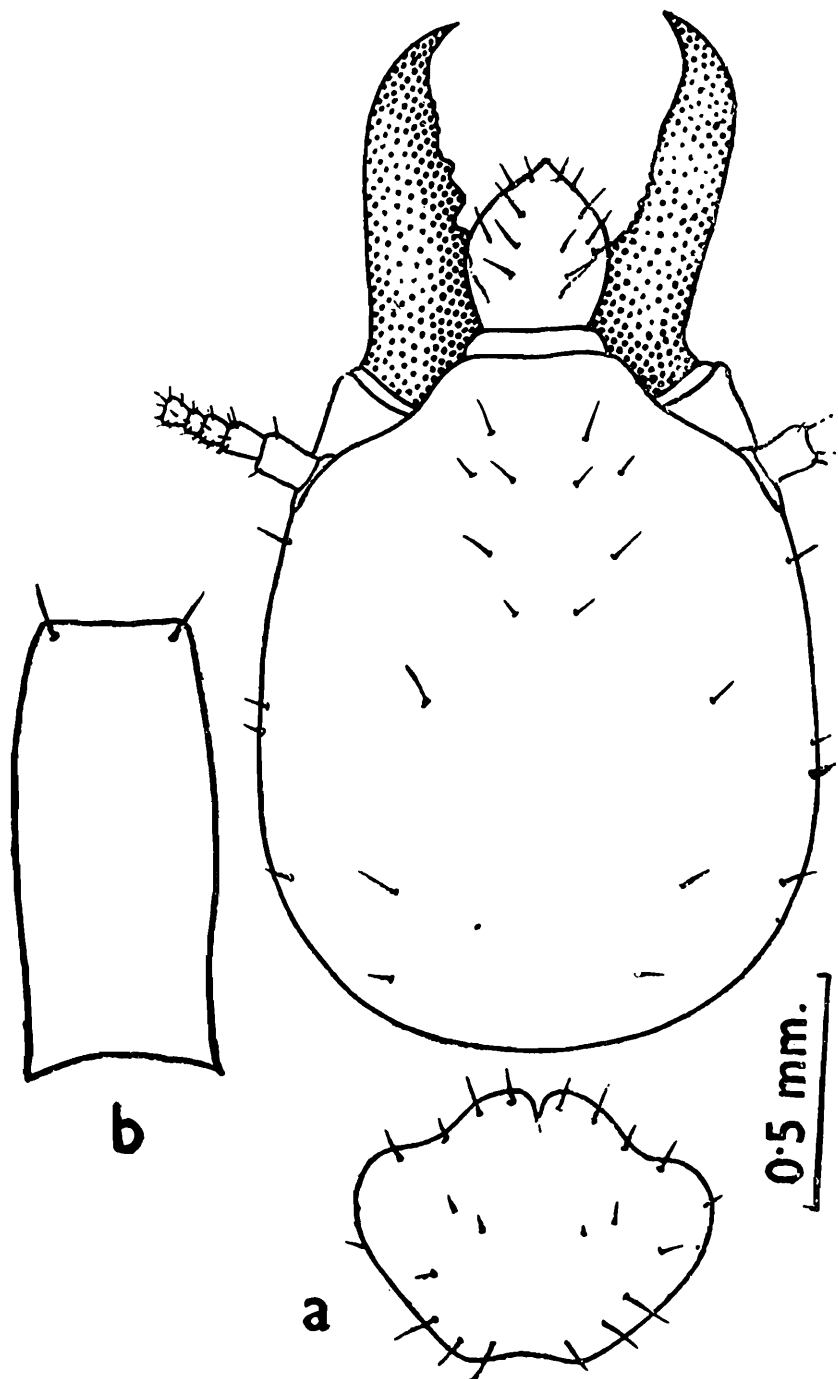


Fig. 38. *Hypotermes xenotermitis* (Wasmann) Soldier from Pangar Air Port (Jalpaiguri Dist.), P. K. Maiti coll., 20.x.1966.
a, Head and pronotum ; b, postmentum

Material.—A vial (No. M₂/20.10.66) with 2S. and sev. W., Pangar Air Port, 7 km. W of Jalpaiguri, Jalpaiguri Dist., P. K. Maiti coll. 20.x.1966, ex. "log lying on ground"

Measurements (in mm.), etc.— (i) *Imago* (after, Holmgren, 1913) : Head-length 2.15 ; Head-width 1.89-1.90 ; Length of pronotum 0.87 ; Width of pronotum 1.71-1.79. (ii) *Soldier* (3 exs.) : Body-length 4.00-4.20 ; Length of head to lateral base of mandibles 1.38-1.42 ; Max. width of head 1.20-1.23 ; Length of left mandible 0.72-0.74 ; Min. (median) length of postmentum 0.80-0.84 ; Max. width of postmentum 0.42-0.46 ; Max. length of pronotum 0.55-0.57 ; Max. width of pronotum 0.80-0.84 ; No. of antennal segments 16.

Distribution.—*West Bengal* : Jalpaiguri Dist. : Pangar Air Port. *Elsewhere* : *India* : Assam ; *Burma* : Palon Pegu (type-locality) ; *Thailand* and *Bangladesh*.

Remarks.— The soldiers from West Bengal have more elongately oval head and incurved mandibles.

Biology.— *Hypoterme xenotermitis* (Wasmann) is poorly represented in West Bengal. Only a single small colony has been found in the plains of Jalpaiguri district. A few soldiers and workers have been collected from under the bark of a log. No discrete nest structure is observed and no imagoes are found in the colony in the month of October.

Genus (20) *Microtermes* Wasmann 1902.

42. *Microtermes obesi* Holmgren

(Syn : *Microtermes anandi* Holmgren)

(Fig. 39. Imago, a-c ; Soldier, d and e)

1913. *Microtermes obesi* N. Holmgren, *K. Sv. Vet. Akad. Handl.*, 50 (2) : 150. *Im.*
Type-locality : India : Khandala (near Bombay).

1913a. *Microtermes anandi*, N. Holmgren, *J. Bombay nat. Hist. Soc.*, 22 (1) : 114.

1949. *Microtermes obesi*, T. E. Snyder, *Smith. misc. Coll.*, 112 : 252.

1964. *Microtermes obesi*, P. N. Chatterjee and M. L. Thakur, *Indian For. Rec. (NS), Ent.*, 10 (11) : 234-239. *Im.*, S. and W. India, North Sri Lanka and Pakistan.

1975. *Microtermes obesi*, M. S. Akhtar, *Bull. Dept. Zool. Univ. Panjab (NS)*, 7 : 101-105. *Im.* and S. Bangladesh.

Material.— LOT (A).— Three vials with sev. S. and W., from Murshidabad Dist., P. K. Sen-Sarma coll., as follows : No. S₈/19.1.54,

Berhampur, ex. "rotten stump". No. S₇/20.1.54, Lalbag, "under lump of earth" and No. S₁/22.1.54, Lalbag, ex. "dried up leaves on soil".

LOT (B).— One vial (No. S₇/25.1.54) with sev. S. and W., Bankura, Bankura Dist., P. K. Sen-Sarma coll., 25.i.1954, ex. "soil".

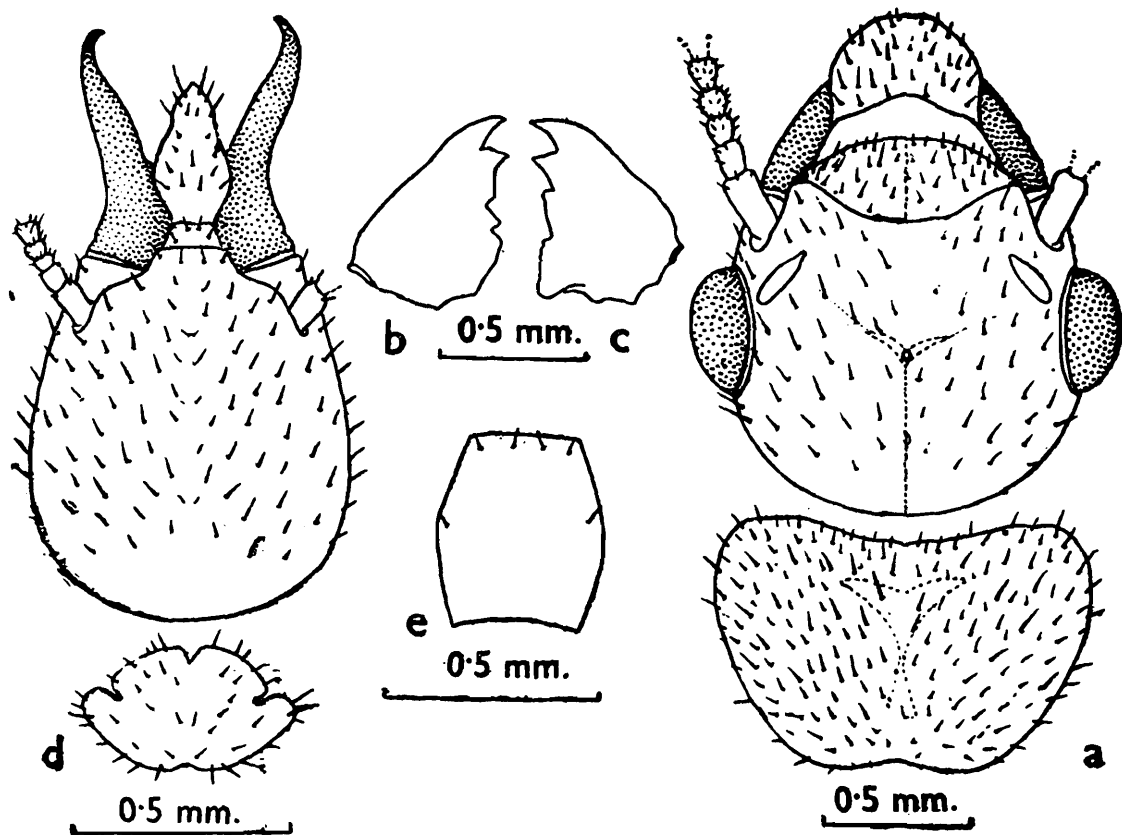


Fig. 39. *Microtermes obesi* Holmgren

Imago from Alipur (Calcutta), M. L. Roonwal coll., 20.vi.1958 ; Soldier from Berhampur (Murshidabad Dist.), P. K. Sen-Sarma coll., 19.i.1954.

a-c, Imago. a, Head and pronotum ; b, left mandible ; c, right mandible
d and e, Soldier. d, Head and pronotum ; e, postmentum

LOT (C).— Four vials with sev. S. and W. from Calcutta and its vicinity, O. B. Chhotani coll., as follows : No. O₅/31.7.57, Zoological Garden, 31.vii.1957, ex. "under rubber pipe". No. O₈/2.8.57, Horticulture Farm, 2.viii.1957, ex. "young plant". No. O₈/18.9.57, ex. "fallen log of wood" and No. O₉/18.9.57, ex. "twigs lying in a room" both from Kidderpore, 18.ix.1957, No. O₁₁/27.9.57, Garia, 27.ix.1957, ex. "piece of wood". No. O₁/4.5.61, with 5 Im., Ballygunge, 4.v.1960, ex. "at light at about 6.30 P. M."

LOT (D).— Three vials with sev. Im. from Alipur, Calcutta, M. L. Roonwal coll., on 27.vi.1957, ex. "at light at 8 P. M." ; on 20.vi.1958, ex. "swarming at light at 7 P. M." ; on 25.vi.1958, ex. "swarming at light at 7 P. M."

LOT (E).—Fifteen vials with sev. S. and W., from different districts *P. K. Maiti coll.*, as follows : 5 vials from Midnapore Dist., thus : No. $M_1/2.3.67$, Saibari vill., 10 km. S. of Terapakhia Bazar, 2.iii.1967, ex. "bamboo pole" ; No. $M_1/1.3.67$, Terapakhia Bazar, Tamluk Subdivision, 1.iii.1967, ex. "attacking log" ; No. $M_6/8.4.66$, Rabindranagar, Midnapore, 8.iv.1966, ex. "attacking log under soil" ; No. $M_7/9.4.66$, Gope Forest, Midnapore, 9.iv.1966, ex. "soil" and No. $M_6/16.8.69$, 16.viii.1969, ex. "mixed with *Eurytermes buddha*". 24-Parganas Dist., No. $M_8/12.6.65$, Baruipur, 12.vi.1966, ex. "attacking a dead branch of pear tree" ; No. $M_1/29.10.66$, Subhasgram, 29.x.1966, ex. "under log". No. $M_1/1.11.66$, Chebbo Bosti, 3 km. S. of Kalimpong, Darjeeling Dist., 1.xi.1966, ex. "fence post". 3 vials from Jalpaiguri Dist., thus : No. $M_2/7.11.66$, Khunia Junction, Nagrakata Forest, 7.xi.1966, ex. "gallery on a standing tree" ; No. $M_7/7.11.66$, Murti Beat, Chalsa Beat, Chalsa Forest Range, 7.xi.1966, ex. "damaging a log fallen on ground" ; No. $M_4/12.11.66$, Paitkapara Tea Estate, 12.xi.1966, ex. "dead branch of tea plantation". One vial No. $M_3/10.11.66$, Atiamochar Forest Beat, Cooch Behar Dist., ex. "attacking a dead stump". One vial from Santineeketan, Birbhum Dist., 1966, ex. "log". Two vials from Andul and Sibpur (Botanical Garden), Howrah Dist., 10.xi.1968, all ex. "attacking log". One vial (No. 4) from Gorubathan (Bhuttabari), *G. K. Srivastava and P. K. Maiti coll.*, 19. xii. 1973, ex. "under bark".

LOT (F).—One vial with 2 Im. Santragachi (near Rly. Stn.), Howrah Dist., *R. N. Tiwari coll.*, 27.v.1970, ex. "light".

Measurements (in mm.), etc.—(i) *Imago* (10 exs.) : Body-length (with wings) 14.90-15.30 ; Body-length (without wings) 8.20-8.50 ; Length of head to lateral base of mandibles 1.05-1.13 ; Max. width of head (with eyes) 1.06-1.14 ; Max. diameter of compound eye (with ocular sclerite) 0.42-0.48 ; Max. diameter of lateral ocellus 0.21-0.26 ; Min. eye-ocellus distance 0.04-0.09 ; Max. length of pronotum 0.84-0.92 ; Max. width of pronotum 1.23-1.32 ; Length of forewing (with scale) 12.00-12.25 ; Length of hindwing (with scale) 10.70-10.83 ; No. of antennal segments 15-16. (ii) *Soldier* (20 exs.) : Body-length 4.10-4.55 ; Length of head to lateral base of mandibles 0.74-0.88 ; Max. width of head 0.70-0.80 ; Length of left mandible 0.45-0.54 ; Min. (median) length of postmentum 0.42-0.48 ; Max. width of postmentum 0.32-0.39 ; Max. length of pronotum 0.25-0.31 ; Max. width of pronotum 0.47-0.54 ; No. of antennal segments 14.

Distribution.—In West Bengal, it is a very common species

occurring from plains to quite high elevation (upto 1209 m. alt.) and recorded as follows : *West Bengal* : 24-Parganas Dist., Barrackpore, Baruipur and Subhasgram. Midnapore Dist. : Midnapore, Saibari and Terapakhia Bazar. Hooghly Dist. : Chandannagar. Howrah Dist., Andul, Sibpur and Santragachi. Burdwan Dist., Asansol. Birbhum Dist., Santineeketan. Calcutta (Alipur, Ballygunge, Garia, Horticulture Farm, Kidderpore, Zoological Garden). Nadia Dist., Kalyani and Plassey. Maldah Dist., Kaliachack. Cooch Behar Dist., Cooch Behar Forest Range, Atiamochar Beat. Jalpaiguri Dist., Murti Forest, Nagrakata Forest (Khunia Junction) and Paitkapara Tea Estate. Darjeeling Dist., Kalimpong (Chebbo Bosti).

Elsewhere : *India, Sri Lanka, Pakistan, Burma, Thailand, Cambodia and Vietnam* (For detailed distribution in India *vide*, Chatterjee and Thakur, 1964).

Remarks.—The imagos from West Bengal have narrower head (head-width including eyes 1.06-1.14 mm.) and larger eye (diameter 0.42-0.48 mm.) as compared to those from other places (known range, head-width 1.32-1.60 mm., diameter of eyes 0.34-0.40 mm.).

Biology.—The species is subterranean in habit and a member of the fungus growing termites. In West Bengal, it is of considerable economic importance and has been found to attack logs, poles, bamboos, fence posts, dead portion of both young and old plantations, roots of agricultural crops, vegetable and flowering plants, etc.

The underground nest consists of a number of small chambers which are inter-connected by narrow channels. The species cultivates fungi in small, rounded fungus combs which are found in the nest chambers. To reach the source of food, it constructs thin, delicate earthen galleries or sheathing on the exposed surface. Sometimes it has been found nesting in the outer wall of the mounds of *Odontotermes redemanni* (Wasmann). In numerous occasions the species occurs in close association with other species of termites *viz.*, *Odontotermes redemanni* (Wasm.), *Pericapritermes ceylonicus* (Holmg.), *Angulitermes longifrons* (sp. nov.), *Nasutitermes* sp. and others.

The species swarms in the months of May and June in Calcutta, immediately after rain.

It has been noticed to attack the roots of young sugarcane plantations in Plassey, Murshidabad district resulting in wilting the leaves. Dutt (1962) reported the species causing damage to mature standing crop of two species of Jute cultivated at Barrackpore. Ghosh (1964)

referred to that "*Microtermes* sp. (probably *M. obesi*) is a regular menace in the cultivation of wheat and autumn paddy at Kaliachak in the district of Maldah.

Subfamily (iv) NASUTITERMITINAE

Genus (21) *Nasutitermes* Dudley, 1890

43. *Nasutitermes gardneri* Snyder

(Fig. 40. Soldier, a)

1933. *Nasutitermes (Subulitermes) gardneri* T. E. Snyder, *Proc. U. S. nat. Mus.*, **82** (16) : 12. S. Type-locality : India : West Bengal, Darjeeling Dist., Rangirum (alt. 1825 m.).
1949. *Nasutitermes gardneri*, T. E. Snyder, *Smiths. misc. Coll.*, **112** : 278, India.
1959. *Nasutitermes gardneri*, B. Prashad and P. K. Sen-Sarma, *Indian Counc. agric. Res., Ent. Monogr.*, Code No. 10.23, pp. 31-34. S. and W. Rangirum and Darjeeling, Darjeeling Dist., West Bengal.
1977. *Nasutitermes gardneri*, M. L. Roonwal and O. B. Chhotani, *Ent. Basil*, **2** : 76-77. S. Bhutan.

Material.— Five vials with sev. S. and W from Darjeeling Dist., as follows : (i) A vial (No. 12), Tarkhola (alt. 325 m.), *H. Khajuria coll.*, 13.vii.1958, ex. "decaying wood" (ii and iii) Two vials (Nos. 2 and 6), Barbatia Bosti, 3 km. N. W of Ghoom Bhanjang Youth Hostel (alt. 1900 m.), *P. K. Maiti coll.*, 18.iii.1973, (iv. and v) Two vials (Nos. 68 and 72) Forest, 3 km. N. of Takdah F. R. H. (1500 m.), *H. S. Sharma coll.*, 26.iii.1973, ex. "both rotten wood".

Measurements (in mm.), etc.— (i) *Imago* : Unknown. (ii) *Soldier* (10 exs.) : Body-length 4.00-4.90 ; Length of head with rostrum 1.53-1.76 ; Length of head without rostrum 0.96-1.11 ; Length of rostrum 0.57-0.65 ; Max. width of head 0.88-1.07 ; Max. height of head 0.55-0.69 ; Posterior bulge of head 0.25-0.34 ; Max. length of pronotum 0.20-0.25 ; Max. width of pronotum 0.42-0.25 ; No. of antennal segments 13.

Distribution.— *Nasutitermes gardneri* is restricted only to the high hills in the Darjeeling district and is known as follows : *West Bengal* : Darjeeling Dist. : Darjeeling, Rangirum (type-locality). and Tarkhola. *Elsewhere* : None.

Remarks.— The species exhibits considerable variations in shape and size of head and rostrum in soldier caste. These variations are intra colonial. In the specimens from Tarkhola, Darjeeling District, length

of head with rostrum in soldier varies from 1.55—1.75 mm. and without rostrum from 0.96-1.11 mm. The shape of head also is narrowly pearshaped to broadly pear-shaped. The rostrum is subcylindrical to conical and the basal hump is weakly to fairly prominent.

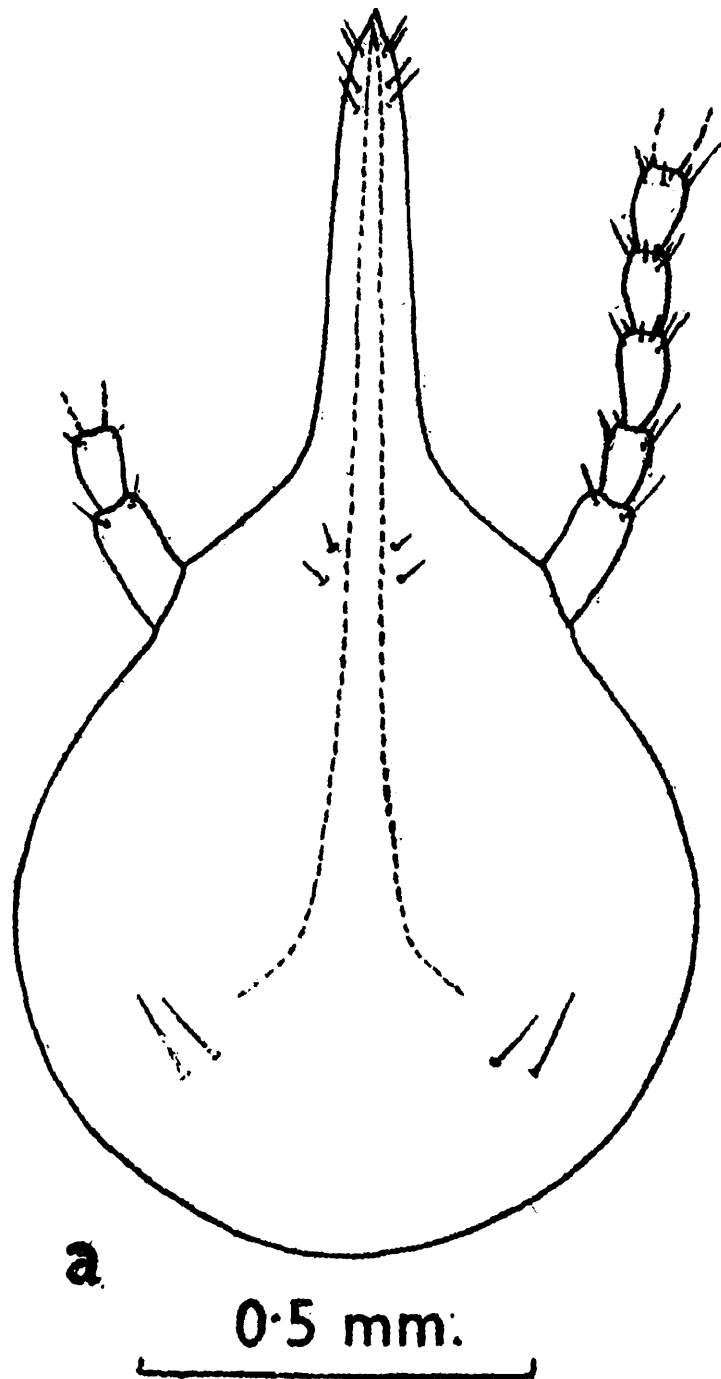


Fig. 40. *Nasutitermes gardneri* Snyder
 Soldier from Rangirum (Darjeeling Dist.), J. C. M. Gardner coll.,
 6 xi. 1929.
 a, Head

Biology.— The species is so far known to occur in hilly forests in the district of Darjeeling. It has been collected from decaying wood lying on soil. Nothing particular is known of its biology.

44. *Nasutitermes garoensis* Roonwal and Chhotani
(Fig. 41. Soldier, a)

1962. *Nasutitermes garoensis* M. L. Roonwal and O. B. Chhotani, *Proc. nat. Inst. Sci. India*, B. 28 (4) : 379-384. S. and W. Type-locality : India : Meghalaya : Garo Hills District, Rongrengiri.

1977. *Nasutitermes garoensis*, M. L. Roonwal and O. B. Chhotani, *Ent. Basil.*, 2 : 77-78. Im. and S. Bhutan.

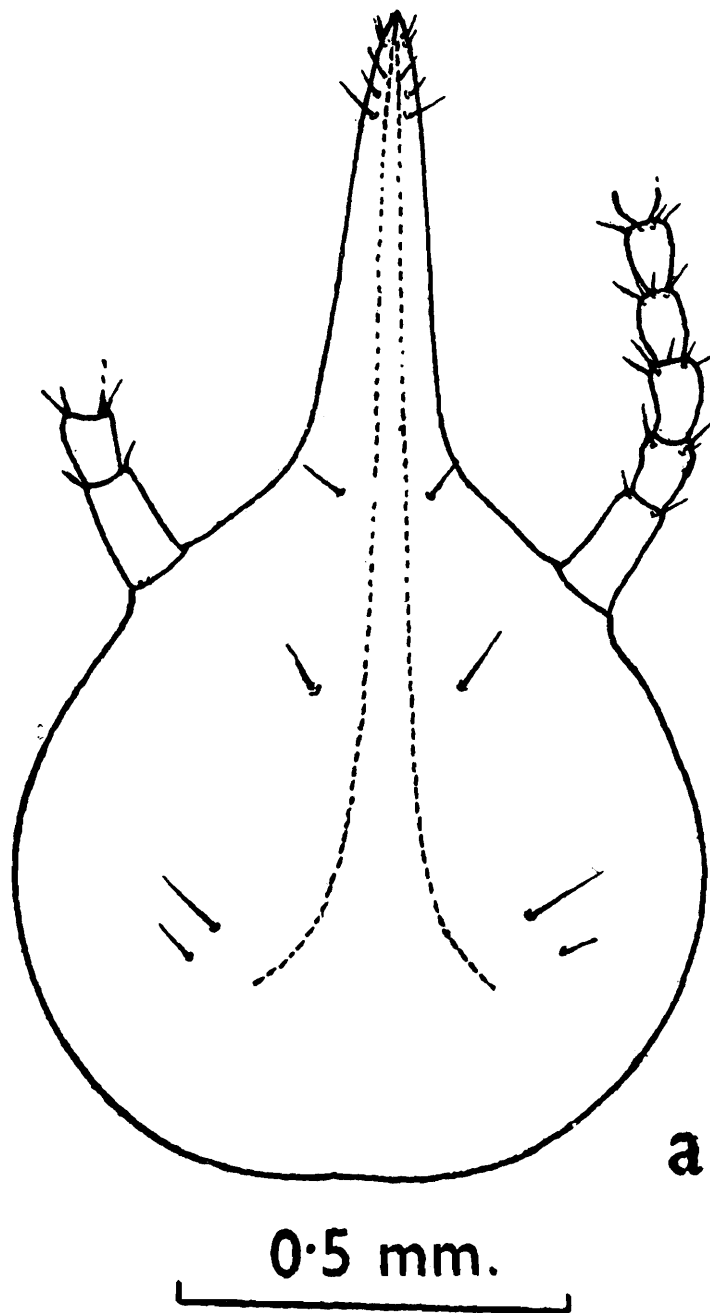


Fig. 41. *Nasutitermes garoensis* Roonwal and Chhotani
Soldier from Atiamochar Forest Beat (Cooch Behar Dist.), *P. K. Maiti coll.*, 10.xi.1966.

a, Head

Material.— Four vials as follows : (i) A vial, (No. M₅/10.11.66) with 5S. and sev. W., Atiamochar Forest Beat (near Forest Rest House), Cooch Behar Forest Range, Cooch Behar Dist., *P. K. Maiti*

coll., 10.xi.1966, ex. "decaying log". (ii) A vial (No. 89) with sev. S. and W., Village, 5 km. W. of Goke F. R. H., Singla (450 m.), Darjeeling Dist., *H. S. Sharma coll.*, 19.iv.1973, ex. "rotten log". (iii) A vial (No. 1) with sev. S. and W., Forest, 3 km. E. or Rangpo (600 m.) F. R. H., Darjeeling Dist., *H. S. Sharma coll.*, 5.iv.1973, ex. "rotten log." (iv) A vial (No.10) with sev. S. and W., Mal Forest, 2 km. S. W. of Gorubathan (400 m.), Darjeeling Dist., *G. K. Srivastava and P. K. Maiti coll.*, 18.xii.1973, ex. "understone".

Measurements (in mm.), etc.— (i) *Imago* (after, Roonwal and Chhotani, 1977): Total Length with wings 13.5-14.7; Total length without wings 6.8; Head length to base of mandibles 1.03; Max. width of head with eyes 1.23-1.30; Eye (L) 0.47; Ocelli (L) 0.17; Min. eye-ocellus distance 0.03; Pronotum (LXW) 0.63-0.70 x 1.00-1.07; Length of forewing (including scale) 11.3-12.0; Ditto, hindwing 10.60-11.40. (ii) *Soldier* (5 exs.): Body-length 3.40-3.90; Length of head with rostrum 1.53-1.58; Length of head without rostrum 0.88-0.92; Length of rostrum 0.62-0.66; Max. width of head 0.86-0.91; Max. height of head 0.54-0.57; Posterior bulge of head 0.27-0.32; Max. length of pronotum 0.12-0.16; Max. width of pronotum 0.42-0.47; No. of antennal segments 12.

Distribution.— The species is recorded for the first time from West Bengal and is distributed as follows: *West Bengal*: Cooch Behar Dist.: Cooch Behar Forest Range, Atiamochar Beat (near Forest Rest House). *Elsewhere*: *India*: Assam: Goalpara District: Raimona; Meghalaya: Garo Hills District: Rongrengiri (type-locality). *Bhutan*.

Biology.—The species is so far known in the high rainfall areas in Assam and West Bengal. In Cooch Behar the species is found attacking a decaying wood lying in moist soil in the forest.

45. *Nasutitermes jalpaiguriensis* Prashad and Sen-Sarma

(Fig. 42. Soldier, a)

1959. *Nasutitermes jalpaiguriensis* B. Prashad and P. K. Sen-Sarma, *Indian Counc. agric. Res. (Ent. Monogr.)*, Code No. 10-23, pp. 39-43, S. and W. *Type-locality*: India: West Bengal: Jalpaiguri, Teesta Division. Prashad and Sen-Sarma (1959) described this species from material from Jalpaiguri which was referred to as *N. fletcheri* (Holmgren and Holmgren) by Roonwal and Pant (1953).

1975. *Nasutitermes jalpaiguriensis*, M. S. Akhtar, *Bull. Dept. Zool. Univ. Panjab (N. S.)*, 7: 136-137. S. Bangladesh.

Material.—Twelve vials from Darjeeling Dist., as follows ; 3 vials with S. and W., Tarkhola, *H. Khajuria coll.*, ex. “decaying wood”, thus : No. 3 on 13.viii.1958 ; Nos. 6 and 7 on 4.viii.1958. 3 vials with S. and

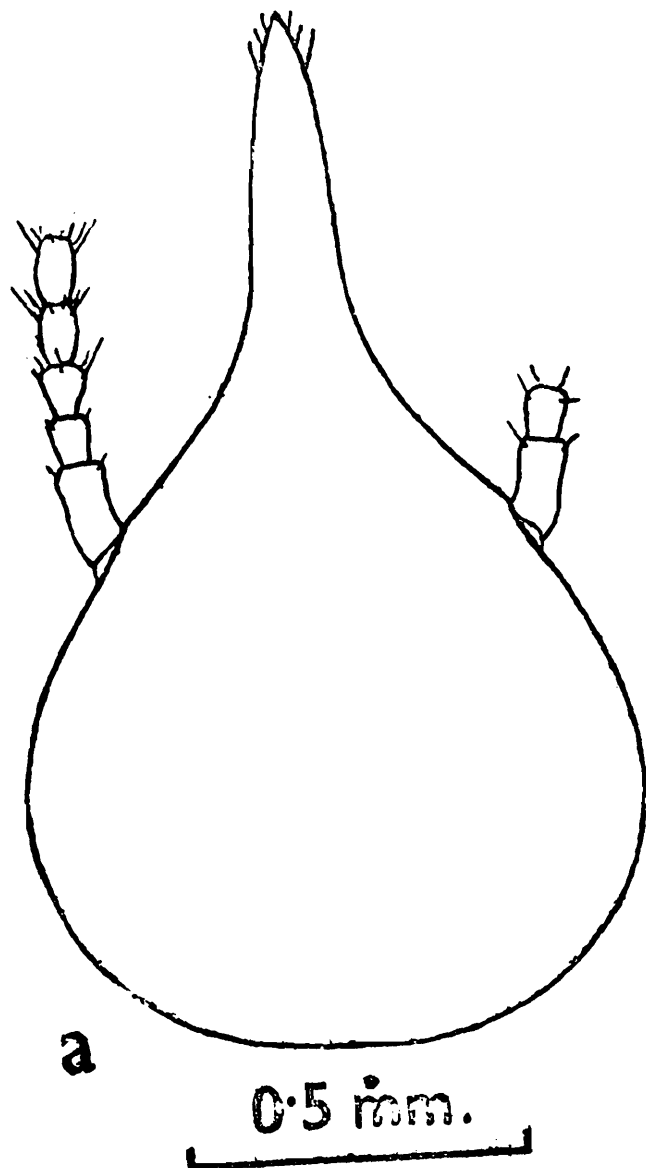


Fig. 42. *Nasutitermes jalpaiguriensis* Prasad and Sen-Sarma
Soldier from Pesok Tea Estate (Darjeeling Dist.), *P. K. Maiti coll.*,
29.xi.1966.
a, Head

W., Tashiding Forest, 5 km. NE. of Teesta Bridge, *P. K. Maiti coll.*, 2.xi.1966, thus : No. $M_1/2.11.66$, ex. “gallery on bark of a standing tree” ; No. $M_6/2.11.66$, ex. “under a stone in soil”. 2 vials with S. and W., Gailikhola Forest, 4 km. SW. of Teesta Bridge, Teesta Valley Forest (near Teesta Bridge), *P. K. Maiti coll.*, 4.xi.1966, thus : No. $M_3/4.11.66$, ex. “under log in soil” ; and $M_5/4.11.66$, ex. “attacking a dead log”. 2 vials, Nos. M_1 and $M_2/29.11.66$, with S. and W., Pesok Tea Estate (near Forest Office), 7 km. W. of Teesta Bridge, *P. K. Maiti coll.*, 29.xi.1966, ex. “decaying wood”. A vial (No. $M_3/3.11.66$) with

S. and W., Bong Bosti, 5 km. E. of Kalimpong, *P. K. Maiti coll.*, 3.xi. 1966, ex. "dead branch of a standing tree". A vial (No. 31) with S. and W. Reyang (275 m.), *H. S. Sharma coll.*, 29.iii.1973, ex. "gallery on bark of tree".

Measurements (in mm.), etc.—(i) *Imago* : Unknown (ii) *Soldier* (20 exs.) : Body-length 3.60-4.10 ; Length of head with rostrum 1.40-1.62 ; Length of head without rostrum 0.91-1.00 ; Length of rostrum 0.50-0.62 ; Max. height of head 0.57-0.69 ; Max. width of head 0.88-1.03 ; Posterior bulge of head 0.27-0.33 ; Length of pronotum 0.15-0.21 ; Max. width of pronotum 0.38-0.47 ; No. of antennal segments 12.

Distribution.—*West Bengal* : Darjeeling Dist., Gailikhola Forest, Kalimpong (Bong Bosti), Pesok Tea Estate, Tarkhola and Tashiding Forest. *Elsewhere* : None.

Remarks.—The species shows wide variations in shape and size of head-capsule and rostrum. Head-capsule without rostrum varies from pear-shaped to broadly rounded and rostrum conical to subconical. Projection on either side of base of rostrum is generally indistinct, sometimes fairly prominent. Rostral hump is generally weak, but sometimes becomes fairly prominent.

Biology.—The species is widely distributed in the hilly tracts of Darjeeling district and generally attacks dead branches of live plants and decaying rotten logs. The species also occurs in galleries on tree trunks, poles, fence posts etc. ; in soil under stones and rubbish ; and even covered runways on the outer wall of the mounds of *Odontotermes redemanni* (Wasmann). From the subterranean nest, it does extend its galleries on exposed surface of tree trunks reaching considerable height. These galleries on the trees measure 2-4 mm. in diameter and are having blackish inner wall.

The species is very common in the natural hill forest at Tashiding, Darjeeling district and almost at every steps, nests of the species can be observed. This forest with its characteristic vegetations and high precipitation offers an ideal ecological condition for better survival of this species.

46. *Nasutitermes suknensis* Prasad and Sen-Sarma

(Fig. 43. Soldier, a)

1959. *Nasutitermes suknensis* B. Prasad and P. K. Sen-Sarma, *Indian Counc. agric. Res. (Ent. Monogr.)*, Code No. 10.23, pp. 64-66. *S. Type-locality* : India : West Bengal : Darjeeling Dist., Sukna.

Material.—As the material (including types) are not available for study, the measurements are reproduced here from the original description.

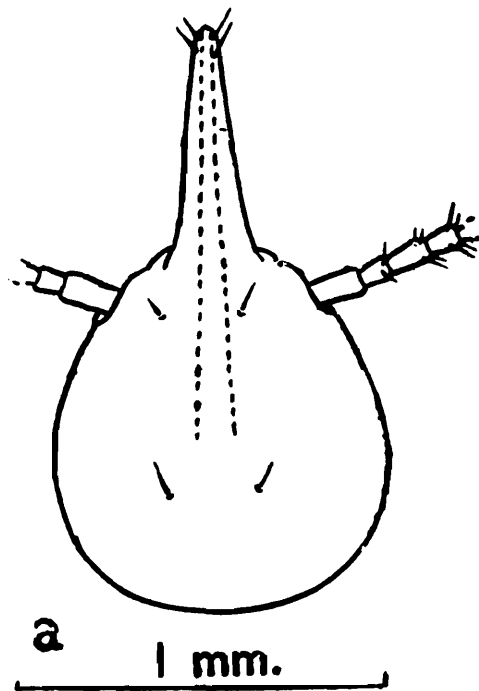


Fig. 43. *Nasutitermes suknesis* Prasad and Sen-Sarma (After Prasad and Sen-Sarma, 1959)
a, Soldier (Head)

Measurements (in mm.), etc.—(i) *Imago* : Unknown : (ii) *Soldier* (2 exs.) : Body-length 3.3-3.4 ; Length of head with rostrum 1.55-1.60 ; Length of head without rostrum 0.90-1.00 ; Length of rostrum 0.60-0.65 ; Max. width of head 0.90-0.95 ; Posterior bulge of head 0.25-0.30 ; Length of pronotum 0.15 ; Max. width of Pronotum 0.40 ; No. of antennal segments 13.

Distribution.—*West Bengal* : Darjeeling Dist., Sukna (type-locality).
Elsewhere : None.

Biology.—Nothing is known.

Genus (22) **Bulbitermes** Emerson, 1949

47. **Bulbitermes emersoni** Maiti

(Fig. 44. Soldier, a-d, Worker, e-g)

1977. *Bulbitermes emersoni* Maiti, in M. L. Roonwal and O. B. Chhotani, *Ent. Basil*, 2 : 78-79. S. Bhutan.

1979. *Bulbitermes emersoni* P. K. Maiti, *Proc. zool. Soc.*, 30 : 135-139. *S. Type-locality* : Tashiding Forest, Darjeeling Dist., West Bengal, India.

Material :—Holotype and Paratypes Soldiers, Tashiding Forest, Darjeeling Dist., West Bengal, P. K. Maiti coll., 2.xi.1966, ex. 'decaying log' det. P. K. Maiti.

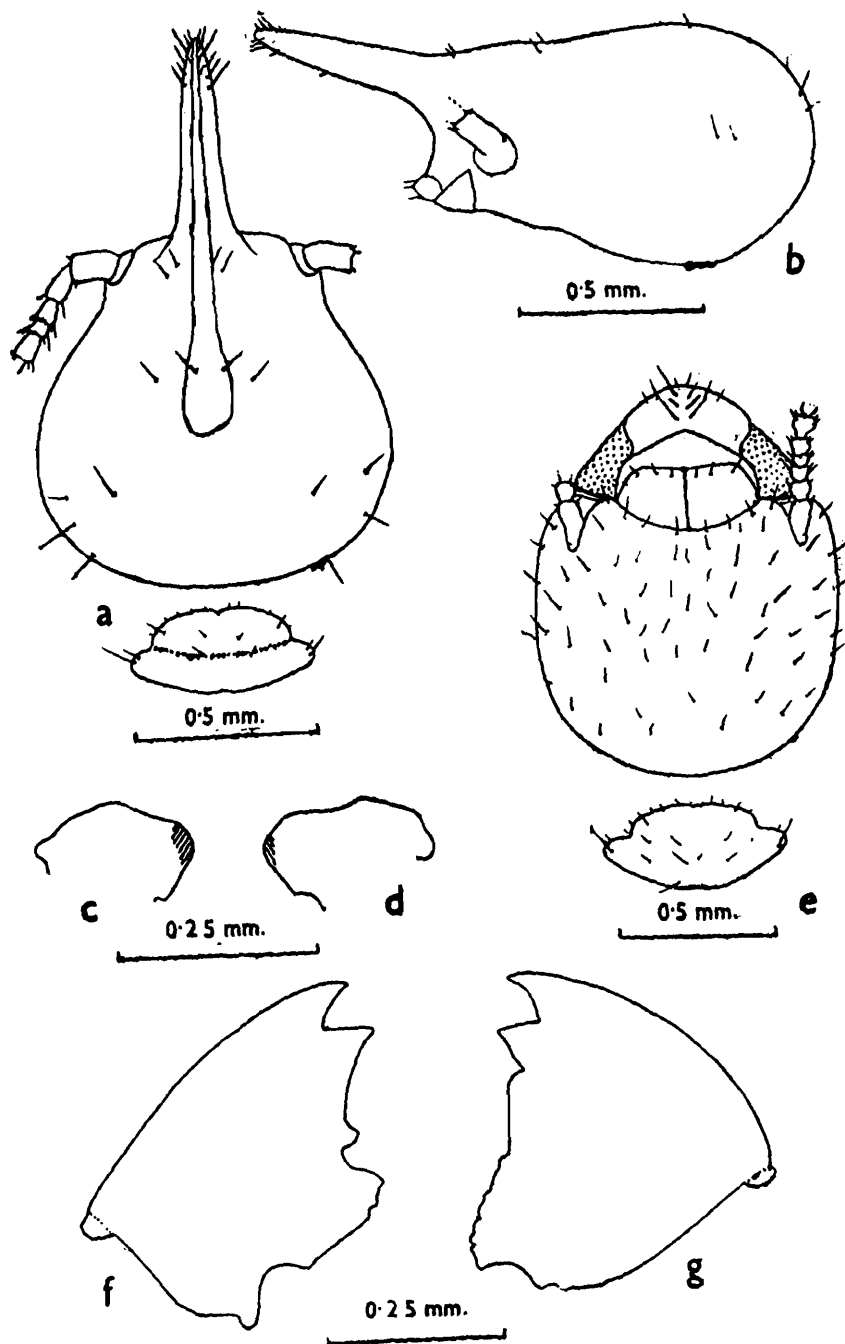


Fig. 44. *Bulbitermes emersoni* Maiti.

Holotype Soldier and paramorphotype worker from Tashiding Forest (Darjeeling Dist.), P. K. Maiti coll., 2.xi 1966.

a-d Soldier a, Head and pronotum; b, head in lateral view; c, left mandible; d, right mandible

e-g, Worker e, Head and pronotum; f, left mandible; g, right mandible

Measurements (in mm.), etc.—(i) *Imago* : Unknown : (ii) *Soldier* (7 exs.) : Body-length 3.50-3.60; Length of head with rostrum 1.39-1.45; Length of head without rostrum 0.90-0.95; Max. width of head 0.88-0.92; Min. width (constriction behind the antennae) of head 0.57-0.61;

Posterior bulge of head 0.34-0.38 ; Length of pronotum 0.14-0.17 ;
Max. width of pronotum 0.37-0.42 ; No. of antennal segments 13.

Distribution.—*West Bengal* : Darjeeling Dist. ; Tashiding Forest (type-locality). *Elsewhere* : Bhutan.

Biology.—Not known.

Genus (23) *Trinervitermes* Holmgren, 1912

48. *Trinervitermes biformis* (Wasmann)

(Fig. 45. Soldier (maj.) a and Soldier (min.) b)

1902. *Eutermes biformis* E. Wasmann, *Zool. Jb. (Syst.)*, 17(1) : 133-135. *Im.*, S. (maj. and min.) and *W. Type-localities* : Sri Lanka : Bandarawella ; India : Khandala (near Bombay).
1949. *Trinervitermes biformis*, T. E. Snyder, *Smith. misc. Coll.*, 112 : 323-324. Sri Lanka and India.
1966. *Trinervitermes biformis*, B. Prashad and P. K. Sen-Sarma, *Indian For. Bull. (N. S.)*, No. 247, pp. 7-26. Sri Lanka and India.

Material.— Three vials with sev. S. (maj. and min.) and W. as follows : A vial (No. S₁/27.1.54) Bankura, Bankura Dist., P. K. Sen-Sarma coll., 27.i.1954, ex. "sandy soil". Two vials (Nos. M₁ and M₂/9.4.66) Gope Forest (near Women's College), Midnapore, P. K. Maiti coll., 9.iv.1966, ex. "nest in laterite soil under a stone"

Measurements (in mm.), etc.—(i) *Imago*(after, Prashad and Sen-Sarma, 1966) : Body-length 8.92-12.42 ; Length of head to lateral base of mandibles 1.20-1.42 ; Max. width of head (with eyes) 1.52-1.87 ; Max. diameter of eye 0.50-0.57 ; Max. diameter of ocellus 0.20-0.27 ; Min. eye-ocellus distance 0.05-0.07 ; Max. length of pronotum 0.90-1.12 ; Max. width of pronotum 1.50-1.82 ; Min. length of forewing (without scale) 15.80-18.00 ; Min. length of hindwing (without scale) 15.10-17.00. (ii) *Soldier* (10 exs.) : Body-length 4.85-5.12 ; Length of head with rostrum 2.25-2.32 ; Length of head without rostrum 1.40-1.52 ; Max. width of head 1.29-1.36 ; Posterior bulge of head 0.65-0.72 ; Max. height of head 0.96-1.09 ; Max. length of pronotum 0.23-0.29 ; Max. width of pronotum 0.67-0.73 ; No. of antennal segments 12-14.

Distribution.—*West Bengal* : Midnapore Dist. ; Midnapore. Bankura Dist ; Bankura and Puranderpur, and Murshidabad Dist. ; Berhampur. *Elsewhere* : *India* : Maharashtra, Madhya Pradesh, Tamil Nadu, Karnataka and Rajasthan. Sri Lanka : Bandarawella (one of the type-localities) and Colombo.

Remarks.— The species exhibits considerable variations as regards its colour, shape and size of head and rostrum, and in number of antennal segments in soldier castes as follows: *Soldier (major)*: The

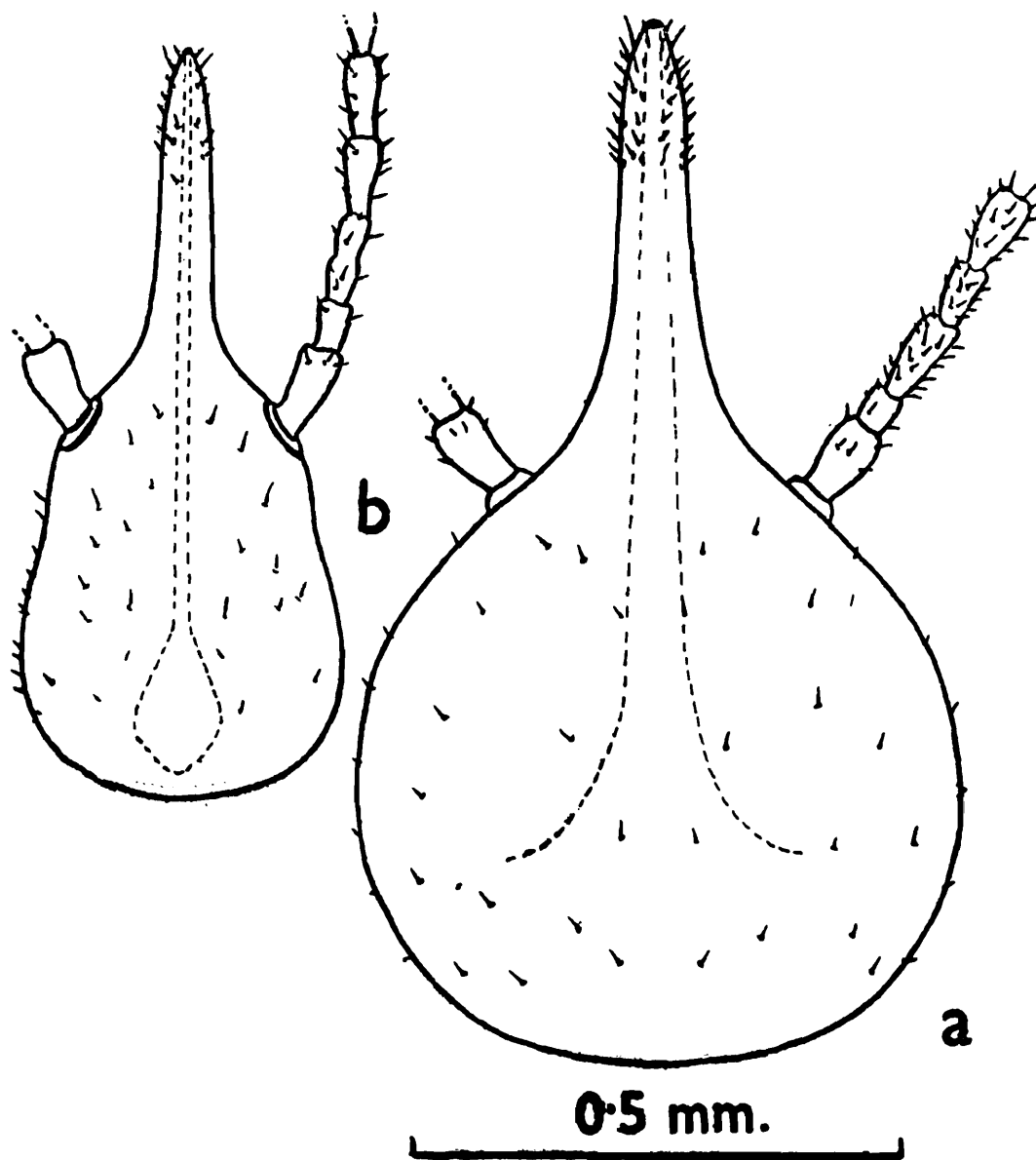


Fig. 45. *Trinervitermes biformis* (Wasmann) Specimens from Midnapore, P. K. Mätti coll., 9.iv.1966.

a, Head of Soldier (major) ; b, Head of Soldier (minor)

shape of the head-capsule varies from subround to pear-shaped which are represented by intermediate forms. The colour of rostrum varies from reddish brown to dark brown with having reddish brown colour at apex. Rostrum varies in length in relation to head-length to base of rostrum and shape from conical to subconical. Antennae may be 12 to 14 segmented, with 13 segments in most of the cases. Abdominal tergites is usually smoky-brown, sometime changing from pale-brown to smoky-brown. *Soldier (minor)*: Variations occur mostly in colouration and in antennal segments (12-14).

However, variations noted in the present study are mainly inter-colonial rather than intracolony.

Biology.— The species has been recorded here from soil nests in the most dried parts of Midnapore, Bankura and Murshidabad districts. A few observations on the structure of nests made at Midnapore, are worth recording here.

The subterranean nest opens to the exterior by an external opening measuring 2-3 cm. The opening leads to numerous irregular tunnels which are traced down to a depth of about 0.50 metres. The inner walls of the tunnels are blackish due to faecal coating inside. Some round cells or chambers measuring 3-6 cm. from ceiling to floor and 5-8 cm. across, are scattered throughout the nest. Some of which are packed with dried up leaves and grass blades. Both major and minor soldiers are predominantly found in the colony.

It is a well known foraging termite in India. Some of the species of the genus build earthen mounds (Coaton, 1948) in South Africa, but in India the only species, *T. biformis* has been reported to build small mounds in the dense grassy field or on embankment of the agricultural fields in the States of Karnataka and Tamil Nadu (Sen-Sarma and Mathur, 1961).

Economically the species is important in India. It has been referred to cause damage fruit trees like mango, guava, citrus, chiku and many vegetable crops in different parts of India (Patel and Patel, 1952 ; Kushwaha, 1960 ; Chhotani, 1980).

C. *Zoogeography and speciation :*

As already mentioned, 48 species and subspecies belonging to 23 genera under 3 families occur in the State. The most primitive living termite of the family Mastotermitidae known from Australia are not found in West Bengal, nor are the most highly evolved types, such as, those found in Africa are met with.

For a zoogeographical analysis, the species and subspecies are arranged below under the following categories.

<i>CATEGORY</i>	<i>NO. OF SPECIES</i>
(i) Species confined to West Bengal	15
(ii) Species common with whole of India	28
(iii) Species common with Bangladesh	13
(iv) Species common with Burma	5
(v) Species common with Sri Lanka	7
(vi) Species common with Indo-Malayan Region (excluding India, Bangladesh, Burma and Sri Lanka)	6

(i) *Species confined to West Bengal*

1. *Neotermes buxensis* 2. *N. kalimpongensis* 3. *N. mangiferae*
4. *Glyptotermes krishnai* 5. *G. sensarmai* 6. *Coptotermes kishori*
7. *Stylotermes parabengalensis* 8. *Speculitermes deccanensis paivai*
9. *Speculitermes roonwali* sp. nov. 10. *Euhamitermes chhotanii* sp. nov.
11. *Angulitermes longifrons* sp. nov. 12. *Nasutitermes gardneri* 13. *N. jalpaiguriensis*
14. *N. sukensis* 15. *Bulbitermes emersoni*

(ii) *Species common with whole of India*

1. *Neotermes bosei* 2. *Cryptotermes dudleyi* 3. *C. havilandi*
4. *Heterotermes indicola* 5. *Reticulitermes assamensis* 6. *Coptotermes heimi*
7. *C. travians* 8. *Stylotermes bengalensis* 9. *Eurytermes buddha*
10. *Synhamitermes quadriiceps* 11. *Microcerotermes beelsoni*
12. *M. cameroni* 13. *Dicuspiditermes incola* 14. *Pericapritermes dunensis*
15. *Pericapritermes tetraphilus* 16. *Macrotermes estherae*
17. *M. khajuriai* 18. *O. assmuthi* 19. *O. feae* 20. *O. gurdaspurensis*
21. *O. horni* 22. *O. parvidens* 23. *O. redemanni* 24. *Hypotermes obscuriceps*
25. *H. xenotermitis* 26. *Microtermes obesi*
27. *Nasutitermes garoensis* 28. *Trinervitermes biformis*

(iii) *Species common with Bangladesh*

1. *Cryptotermes havilandi* 2. *C. dudleyi* 3. *Coptotermes heimi*
4. *C. travians* 5. *Heterotermes indicola* 6. *Synhamitermes quadriiceps*
7. *Pericapritermes tetraphilus* 8. *Odontotermes assmuthi* 9. *O. feae*
10. *O. parvidens* 11. *Hypotermes xenotermitis* 12. *Microtermes obesi*
13. *Nasutitermes jalpaiguriensis*

(iv) *Species common with Burma*

1. *Pericapritermes tetraphilus* 2. *Macrotermes gilvus* 3. *Odontotermes feae*
4. *Hypotermes xenotermitis* 5. *Microtermes obesi*

(v) *Species common with Sri Lanka*

1. *Cryptotermes dudleyi* 2. *Pericapritermes ceylonicus* 3. *Macrotermes estherae*
4. *Odontotermes horni* 5. *O. redemanni* 6. *Hypotermes obscuriceps*
7. *Microtermes obesi*

(vi) *Species common with Indo-Malayan Region (excluding India, Bangladesh, Burma and Sri Lanka)*

1. *Glyptotermes caudomunitus* 2. *G. chinpingensis* 3. *Coptotermes travians*
4. *Macrotermes gilvus* 5. *Odontotermes feae* 6. *Microtermes obesi*

The above analysis indicates that the termite fauna of West Bengal is as a rule that of Indian sub region of the Indo-Malayan Zoogeographical Region. *Glyptotermes chinpingensis*, a species known from South China and *G. caudomunitus* known from Java are recorded for the first time from India, occurring in Teesta valley forest in Darjeeling district. *Pericapritermes ceylonicus* so far known from Sri Lanka only, is reported here from the State with its first record from India. *Bulbitermes*, a purely Oriental genus and mostly known from South-east Asia, has been recorded for the first time from the Indian union.

A large proportion of species, 15 out of 48 or 31.25% are endemic to West Bengal. Some 28 species share their distribution with whole of India and another 4 occurring in this State are new record from Indian Union. It is interesting to note that most of the endemic species (10 out of 15) are confined to the Himalayan and Sub-Himalayan zone of the State. Moreover, 25 species of the whole population (including 10 endemic species) occur in this natural unit (*vide*, Table 2). Because of the fact that this zone is ecologically characterised in having varieties of dense forests in the mighty labyrinth of ridges and valleys which usually restrict the easy dispersion of termites ; the termites are restricted into small or medium-sized populations confined into valleys or patches of dense forests. The migration pressure is low and there are less opportunities of inter-population mixing. Thus, the variation-intensity is increased as a result of well known "population effects" and thereby the process of speciation speeded up (Roonwal and Chhotani, 1965). So, the above hypothesis explains the cause of high speciation rate in the area.

ECOLOGY

A. Faunal Zones :

The State of West Bengal has been divided broadly into four natural units (*vide*, Table 1) with regard to its physiography, climate and vegetation (Map No. 1). The state can, however, be divided into 3 rather distinct faunal zones (*vide*, Table 2) corresponding to the natural units in respect of distribution and relative abundance of termites. The termite fauna of the Gangetic and Coastal alluvial plains is very similar. Due to faunal resemblance, the above two units are considered here under the Gangetic faunal zone only. It is very interesting to note the correlation between the termites from those faunal zones and natural units. Some species are restricted to a particular zone, some overlap from one to another and some are present in all the zones.

TABLE—2. Showing the distribution of species of termites in each faunal zone

SPECIES RESTRICTED		SPECIES COMMON		
Himalayan and Sub-Himalayan Faunal Zone	Gangetic Faunal Zone	Laterite Faunal Zone	Gangetic and Laterite Faunal Zones	All Faunal Zones
<i>Neotermes bosei</i> , <i>N. buxensis</i> , <i>N. kalimpongensis</i> , <i>Glyptotermes caudomunitus</i> , <i>G. chinpingensis</i> , <i>G. krishnai</i> , <i>G. sensarmai</i> , <i>Reticulitermes assamensis</i> , <i>Stylotermes bengalensis</i> , <i>S. parabengalensis</i> , <i>Parrhinotermes khasii</i>	<i>Neotermes mangiferae</i> <i>Cryptotermes dudleyi</i> <i>Coptotermes kishori</i> <i>C. travians</i> <i>Speculitermes deccanensis paivai</i> <i>Odontotermes assmuthi</i> (<i>Hypotermes obscuriceps</i> —also in the Himalayan and Sub-Himalayan Zone)	<i>Eurytermes buddha</i> <i>Speculitermes roonwali</i> <i>Anqulitermes longifrons</i> <i>Dicuspiditermes incola</i> <i>Odontotermes qurdaspurensis</i>	<i>Synhamitermes quadriceps</i> <i>Microcerotermes beesoni</i> <i>M. cameroni</i> <i>Odontotermes feae</i> <i>Trinervitermes biformis</i>	<i>Cryptotermes havilandi</i> <i>Heterotermes indicola</i> <i>Coptotermes heimi</i> <i>Odontotermes horni</i> <i>Odontotermes redemanni</i> <i>Microtermes obesi</i>
<i>Euhamitermes chhotanii</i> , <i>Pericapritermes ceylonicus</i> , <i>P. dunensis</i> , <i>P. tetraphilus</i> , <i>Macrotermes estherae</i> , <i>M. gilvus</i> , <i>M. khajurii</i> , <i>Odontotermes parvidens</i> , <i>Hypotermes xenotermitis</i> , <i>Nasutitermes gardneri</i> , <i>N. garoensis</i> , <i>N. jalpaiguriensis</i> <i>N. suknensis</i> and <i>Bulbitermes emersoni</i>				

The fauna of the northern portion of the Gangetic plains (the plains of Darjeeling, Jalpaiguri and Cooch Behar Districts) shows great affinities to that of Himalayan and Sub-Himalayan Unit, as such this area is included under the Himalayan and Sub-Himalayan faunistic zone in the present account.

1. *Himalayan and Sub-Himalayan Faunal Zone* : The species are found in abundance in this zone, particularly in the fairly heavy precipitation tracts of swampy Terai and Duars and in riverain forest areas. A rapid reduction of species takes place in the high altitude of the Himalayas where temperate climate prevails. Thus it appears that vegetational and altitudinal variations have certainly enriched the fauna and offered varieties of habitats and ecosystems to these insects in the swampy sub-Himalayan part. The dense forests of the ridges and valleys still preserve the natural condition which favours the termite to flourish well in the area. As many as 11 genera and 25 species (about 50% of the total fauna) are restricted to this zone.

The primitive kalotermitid damp-wood genera, *Neotermes* and *Glyptotermes* are well represented in this zone occurring in different localities in the plains as well as at higher altitude. As a rule, these genera are found in dead and live tissues of tree stumps. The three species of *Neotermes* extend from plains to higher altitude of Kalimpong (alt. 1209 m.), and are confined to varying altitude in their respective ecological niches. *N. bosei* occurs in the riverain forests of Jalpaiguri and Cooch Behar District, *N. buxensis* in low forested hills and *N. kalimpongensis* in the subtemperate altitude of Kalimpong. Out of four species of *Glyptotermes*, *G. sensarmai* and *G. krishnai* are restricted to the plain-land miscellaneous forest of Cooch Behar, while both the exotic species viz., *G. caudomunitus* and *G. chinpingensis* are confined to medium altitude (350 m.) in Gailikhola forest in the Teesta Valley.

Reticulitermes assamensis and *Parrhinotermes khasii* are fairly well represented in the Sub-Himalayan tracts of Kalimpong. *Stylotermes bengalensis* occurs in the Sub-Himalayan tracts of India from Garhwal to Darjeeling, while its closest ally *S. parabengalensis* is found only in the plains of Nagrakata and Cooch Behar, attacking trees in plantation.

The exclusively Oriental genus, *Euhamitermes* is represented by a single species, *E. chhotanii* (sp. nov.) in the moist soil of the plain-land forest of Cooch Behar. All the three species of the genus *Pericapritermes* are restricted to forest areas on both sides of the river Teesta at low altitude (about 300 m.) in the Darjeeling district, occurring in

their individual specific niches. The genus *Macrotermes* with its three species, is also restricted to the same zone, but totally absent in the southern Gangetic plain and occurs at varying altitude and vegetational types. *Hypotermes*, a closely allied genus to *Odontotermes*, is represented in this zone by two species. *H. xenotermitis* occurs in the Savanna-like formations of the plains of Jalpaiguri and *H. obscuriceps* in the Darjeeling hill range (also in the Gangetic zone). *Nasutitermes*, a genus having cosmotropical distribution, has perhaps most successfully established itself in this zone, being present through hot and humid plains to cool temperate altitudes. *N. jalpaiguriensis* is the most common species occurring widely from the plains to the high altitude up to Kalimpong; *N. garoensis* is found in the plains and *N. sukhnensis* in the slightly elevated localities. But, *N. gardneri* is restricted to only the subtemperate altitude of Darjeeling district, where the other species of termites are very rare. *Bulbitermes* has been recorded for the first time from the Indian Union, with a single species, *B. emersoni* occurring in the riverain forest of Tashiding in Darjeeling District.

2. *Gangetic Faunal Zone*: As compared to the vastness of this zone, the termite population is not at all rich. Only 11 species occur in this area, of which 6 are endemic and 5 share distribution with laterite zone (*vide*, Table 2). There is not a single genus completely restricted to this zone. As a rule, the termite fauna of this zone should have been rich because of its hot and humid climate. But due to very fertile alluvial soil and moderately high precipitation, this area is very suitable for cultivation, thereby, the human population pressure is very high. The natural vegetation has almost completely disappeared due to human encroachment. Moreover, the industrial development has also modified the natural conditions. Thus, numerous factors have influenced considerably to reduce the number of species in the area.

As stated above, all the species of the genus *Neotermes* are confined to the Himalayan and sub-Himalayan zone, but the single species, *N. mangiferae* found in a log in a timber depot in Calcutta, probably came in transport from North Bengal or some other parts of eastern India, where the genus is well represented. *Cryptotermes dudleyi* believed to be an introduced species, has successfully established itself in man-made structures in the natural mangrove forest of Sundarbans as well as in some buildings at Calcutta.

The family Rhinotermitidae is represented by two species viz., *Coptotermes kishori* and *C. travians* which occur sparsely in isolated localities around human habitations in the area.

Speculitermes deccanensis paivai, the only representative of the genus *Speculitermes*, is only known from Tollygunge, Calcutta. *Odontotermes assmuthi* is fairly well distributed in this zone.

3. *Laterite Faunal Zone* : The western part of West Bengal is arid or semi-arid, as such its termite fauna is not at all rich. Due to poor type of soil and dry nature of climate, this area is quite unsuitable for cultivation and perhaps for this reason the human population pressure is less. The limited expanse of dry deciduous forests and barren undulating tracts still preserve their own natural condition. As compared to the Gangetic plains, the galleries and nests of termites are more frequently found in this zone. Probably due to very hot weather, even for a short foraging activity, these insects build extensive runways or mud plasters on exposed surface as otherwise they are liable to undergo desiccation.

Out of 10 species recorded from this zone, 5 are having restricted distribution and 5 are also known from the Gangetic zone (*vide* Table 2).

Eurytermes budda known so far from the peninsular India has been found to occur in soil under forest cover at Midnapore. The most interesting genus *Speculitermes*, is represented by *S. roonwali* (sp. nov.) and is collected at Midnapore while swarming. The termitid genera with snapping type of soldier mandibles, distributed in the area, are *Dicuspiditermes* and *Angulitermes*. The former genus known by *D. incola* is restricted to the relatively moist pockets and the latter genus by *A. longifrons* (sp. nov.) is rather widespread in the most dried areas of Midnapore district. *Odontotermes gurdaspurensis* predominantly found in the western India and Pakistan is also collected from the area. *Trinervitermes biformis* occurs sparsely in the non-forested area under very hard lateritic soil.

Species common to the Gangetic and Laterite faunal Zones :

The species mentioned above have been found restricted to some particular faunal zones. There are 5 species belonging to the family Termitidae which share their distribution both in the Gangetic and Laterite faunal zones (*vide*, Table 2).

Synhamitermes quadriceps is a very rare species found in these zones. The genus *Microcerotermes* is represented by two identical species, namely, *M. beelsoni* and *M. cameroni* which are very common in these zones. Both these species make carton nests and widely occur in almost identical ecological habitats in the well-drained areas of the State.

The large species, *Odontotermes feae* is also common in the area. The nasute genus *Trinervitermes* represented by a single species. *T. biformis* is abundant in the peninsular and western India. It is fairly well represented in the most dried laterite soil in the non-forested areas of Midnapore and Bankura districts. However, it is also recorded from the Gangetic alluvial unit.

Species common to all the zones :

There are six species which are widely spread throughout the State (*vide*, Table 2) indicating their strong adaptability to various ecological niches. The powder-post termite *Cryptotermes havilandi*, a native to East Africa and the Congo, is found in the coastal and interior areas of India and is fairly widely distributed in West Bengal, inhabiting in planted economic trees around human habitations and in swamp mangrove forests of the Gangetic delta.

Two rhinotermitid species viz., *Heterotermes indicola* and *Coptotermes heimi* which are most notorious wood-destroying termites of India, are widely distributed in the State. The former is predominantly found in buildings mainly in the Gangetic plain, while the latter occurs widely in both wild habitats and in man-made wooden structures.

The most common genus *Odontotermes* is represented throughout the State by two species, namely, *O. redemanni* and *O. horni*. The former is the only mound-building termite species in the State, occurring widely in the laterite zone, and sparsely so in the Gangetic plains and Sub-Himalayan tracts of West Bengal. But the latter species is widespread in the Gangetic plain and is less commonly found in the laterite zone and northern plains of the Sub-Himalayan zone. It is absent in subtemperate altitude of North Bengal where *Odontotermes parvidens* is very common. The fungus-growing subterranean species, *Microtermes obesi* is the most ubiquitous species and can adapt to numerous ecological habitats.

B. Habitat Group :

As a rule, the termites lead a cryptobiotic mode of life being shut out from light and environmental hazards, inhabiting either wood or soil. In respect of the mode of dwelling, the termites of West Bengal may easily be classified into two broad groups, viz., 1. *Wood-dwellers* which include (i) damp-wood termites, and (ii) dry-wood termites; and 2. *soil-dwellers* which comprise (i) subterranean termites, (ii) carton-nest-building termites, and (iii) mound-building termites.

1. *Wood-dwellers* : The termites belonging to this group, spend their entire life in either dead or living woods, which provide both food and shelter. The members of the families, Kalotermitidae and Stylotermitidae belong to this group. They can be further subdivided into two subgroups : (i) Damp-wood dwellers : the termites falling in this sub group prefer wood with high moisture content as found in dead and decaying timbers and in branches of live trees in moist and cool pockets of the Himalayan and sub-Himalayan zones of the State. All the eight species of the genera *Neotermes* and *Glyptotermes* and two belonging to *Stylotermes* come under this category. (ii) *Dry-wood dwellers* : The termites belonging to this sub group can flourish in dry and seasoned wood. The two species of *Cryptotermes* occurring in this State fall in this category. They are commonly known as powder-post termites, as they extrude fine dust-like piles of pellets from their wood nest. The soldiers of these two species are characterised in having short, truncated head with weak mandibles. The function of such type of head is believed to plug up the outlets of their tunnels against the enemies.

2. *Soil-dwellers* : The majority of the species occurring in this State nest in the soil spending most part of their lives in soil. The species of the families Rhinotermitidae (except the genus *Stylotermes*) and Termitidae belong to this group and can be divided into three subgroups. (i) *Carton-nest builders* : Termites of only two species of *Microcerotermes* are found widely spread in the Gangetic and Laterite zones of this State, fall in this category. Their carton nests are made up of a mixture of termite faecal matter, woody particles, earth, etc. and vary widely in shape and size. These are usually found adpest against tree bases, pillar etc. and are buried partly or wholly in the soil. On the basis of the nests, the two species i.e., *M. beesoni* and *M. cameroni* can hardly be separated. (ii) *Mound-builders* : Some termites are known to build extensive mounds of accumulated earth cemented with salivary secretions and faecal matters. The only species *Odontotermes redemanni*, belonging to this group, is well represented in the State. It constructs mounds of variable shape and size. Some of the species like *Microtermes obesi* and *Hypotermes obscuriceps* are found inhabiting on the outer walls of the mounds of the species as secondary tenants. (iii) *Subterranean* : All the other termites of the families Rhinotermitidae and Termitidae fall in this category. They are either purely or partly ground dwellers and usually extend runways and galleries on the exposed surface of substratum to reach their source of

food. They generally build nests under the ground and sometimes extend to the wooden structure above the ground as in the species of *Coptotermes* and *Heterotermes* which can be called partly subterranean and the remaining ones are purely subterranean, such as those belonging to the genera, *Eurytermes*, *Speculitermes*, *Euhamitermes*, *Synhamitermes*, *Angulitermes*, *Dicuspiditermes*, *Pericapritermes* and others.

C. *Swarming period* :

The annual reproductive cycle of termites is indicated by emergence of alates or swarming which is essentially a seasonal phenomenon. The data regarding the presence of alates or dealates in the nest and the swarming periods of alates from the nests in case of the species found in West Bengal have been compiled in the Table 3. The data reveals that the swarming mainly occurs at the beginning of the rainy season *i.e.*, in the month of May to July at the time when there is high atmospheric humidity. However, in some cases, it extends throughout the entire period of rains from May to October. Rarely, swarming occurs in the dry and cold seasons when there are practically no rains from November to February. But the species, *Coptotermes heimi* has been observed swarming twice a year, once in May and the other in November and December. The swarming of the termites has been recorded mostly at dusk or early evening after rains. In case of *Speculitermes roonwali*, *Microcerotermes cameroni*, *Synhamitermes quadriceps* and *Odontotermes redemanni*, the swarming has been noticed at about 9 O'clock in the morning during rains at Midnapore. However, the developing reproductives or the nymphs are mostly encountered in the colony in the winter season during the months of November to February. It has also been noticed that there is very little uniformity in the swarming habits of different species ; even there are differences in respect of time of emergence within the species.

D. *Predator* :

The cryptobiotic mode of life in termites, in fact, secures them from their enemies. But, when the colonies are exposed or the imagos are in flight, many insects and varieties of animals prey upon them as their food. In India, very little is known about the enemies of termites, except the report of Lefroy (1909) and Mathur (1962). However, there is no record on this aspect from West Bengal. Some observations made on predacious animals on termites in the State, have been dealt herewith briefly.

Ants : Among the insects, the black ants are the most merciless

TABLE—3. Swarming periods of Termites in West Bengal
 X=Months when alates were encountered in the nest or in flight. alat, alates; deal, dealates

Species	Name of localities	Alates observed		Months											
		In nest	In flight	J	F	M	A	M	J	J	A	S	O	N	D
1	2	3	4	5											
1. <i>Neotermes boseli</i>	Calcutta (reared colony)...	—	alat.	—	X	—	—	—	—	—	—	—	—	—	—
	Murti forest ...	{ alat. deal.	—	—	—	—	—	—	—	—	—	—	—	X	—
2. <i>N. buxensis</i>	Samsing ...	deal.	—	—	—	—	—	—	—	—	—	—	—	X	—
3. <i>Glyptotermes caudomunitus</i>	Bagdogra ...	alat.	—	—	—	—	—	—	X	—	—	—	—	—	—
4. <i>Cryptotermes dudleyi</i>	{ Gailikhola Forest ...	alat.	—	—	—	—	—	—	—	—	—	—	—	X	—
	Bagra ...	deal.	—	X	—	—	—	—	—	—	—	—	—	—	—
	Calcutta ...	—	alat.	—	—	—	X	X	—	—	—	—	—	—	—
	J-Plot ...	deal.	—	X	—	—	—	—	—	—	—	—	—	—	—
5. <i>C. havilandi</i>	Alipurduar ...	deal.	—	—	—	—	—	—	—	—	—	—	—	X	—
	Calcutta ...	deal.	—	X	—	—	—	—	—	X	—	X	—	X	X
	Jhingakhali ...	deal.	—	X	—	—	—	—	—	—	—	—	—	—	—
	Paitkapara Tea Estate ...	deal.	—	—	—	—	—	—	—	—	—	—	—	—	—
6. <i>Heterotermes indicola</i>	Calcutta, Ultadanga ...	—	alat.	—	—	—	—	—	X	X	—	—	—	—	—
7. <i>Reticulitermes assamensis</i>	Kalimpong ...	alat.	—	—	—	—	—	—	—	—	—	—	—	—	—
8. <i>Coptotermes heimi</i>	Calcutta ...	—	alat.	—	—	X	—	—	—	—	—	—	—	X	X
9. <i>Speculitermes roonwali</i>	Midnapore ...	{ — deal.	alat.	—	—	—	—	—	X	—	—	—	—	—	—
10. <i>Synhamitermes quadricaps</i>	Midnapore ...	{ — deal.	alat.	—	—	—	—	—	X	—	X	—	—	—	—
11. <i>Microcerotermes beelsoni</i>	... ..	alat.	—	—	—	—	X	—	—	—	—	—	—	—	—
12. <i>M. cameroni</i>	Gosaba ...	alat.	—	X	—	—	—	—	—	—	—	—	—	—	—
	Narainpur ...	deal.	—	—	—	—	—	—	—	—	—	—	—	—	—
	Midnapore ...	alat.	alat.	—	—	—	—	—	X	—	—	—	—	—	—
13. <i>Odontotermes horni</i>	Calcutta ...	—	alat.	—	—	—	—	—	—	—	—	—	X	—	—
14. <i>O. parvidens</i>	Samsing ...	alat.	—	—	X	—	—	—	—	—	—	—	—	—	—
15. <i>O. redemanni</i>	Midnapore ...	—	alat.	—	—	—	—	—	X	—	—	—	—	—	—
16. <i>Microtermes obesi</i>	Calcutta ...	—	alat.	—	—	—	—	X	X	—	—	—	—	—	—
	Santragachi ...	—	alat.	—	—	—	—	X	—	—	—	—	—	—	—

enemies of termites. When the mounds or nests are excavated, the ants gather in huge numbers to attack and carry off the sluggishly moving termites. Even after the swarming, the parading couple become the easy prey to various species of ants. The following species of ants have been observed to attack them in West Bengal.

- (i) *Camponotus compressus* Fabr. attacks the species of *Heterotermes indicola*, *Coptotermes heimi*, *Microcerotermes beelsoni*, *Odontotermes assmuthi*, *O. horni*, *O. parvidens*, *O. redemanni*, *Microtermes obesi* in different localities in West Bengal.
- (ii) *Lobopelta diminuta* Smith is predacious on *Coptotermes heimi* and *Odontotermes parvidens* in North Bengal.
- (iii) *Solenopsis geminata* Fabr. predaes *Angulitermes longifrons*, *Odontotermes redemanni* and *Microtermes obesi* at Midnapore.
- (iv) *Cremastogaster rothneyi* Mayr attacks the species of *Cryptotermes havilandi* and *Coptotermes heimi* as soon as the wood nest of these termites are excavated. These ants usually live in the same wood, where the termites are in their own territory.

If the ant colony is disturbed, the inmates spread out rapidly and attack the termites immediately when they are met with. This has been observed in some nests in Calcutta.

Dragon fly : One species of dragon fly, *Crocothemis servilia servilia* (Drury) has been noticed to attack the imagos of *Odontotermes redemanni* while swarming in the late morning at Midnapore. The predators usually after catching the imago in air fall on the ground, due to weight of the prey and bit it mutilating the body parts completely.

Cockroach : The most common cockroach, *Periplaneta americana* Linn. is noticed at Calcutta to catch hold of the wingless imagos of *Microtermes obesi* being attracted to the light at the time of swarming.

Frog and Toad : The common frog, *Rana tigrina* Daudin is usually observed to engulf the parading couple after they have shed their wings. Similarly, toad, *Bufo melanostictus* Schneider devours greedily on termites as they emerge from their nests. These amphibians are generally observed waiting near the tanks and under the lamp posts just after the rain, to predate these insects. The species observed being eaten are *Coptotermes heimi*, *Odontotermes horni*, *O. redemanni* and *Microtermes obesi* in Calcutta and at Midnapore.

Lizards : The house lizard, the gecko, *Hemidactylus brocki* Gray is the most relentless enemy of termites. The species is usually found on

wall and ceiling near the electric lamps in houses and avails of the opportunity to devour these insects voraciously which are attracted to light. The termite species recorded are *Coptotermes heimi*, *Microtermes obesi* in Calcutta.

Birds : Termites constitute the favourite food of birds. Many birds are found sitting on convenient branches to snap these swarming insects and to devour them. Some of the birds namely, common house crow (*Corvus splendens* Vieillot), the Indian jungle crow (*Corvus macrorhynchos* Wagler), the common myna (*Acridotheres tristis tristis* Linnaeus), the bank myna (*A. ginginians* Latham), the common swallow (*Hirundo rustica* Linnaeus), the common pariah kite (*Mitrus migrans*) and house swift (*Apus affinis*) have been seen to assemble in great number at places where termites stage their flight and to feed upon them in air. The domestic fowls (*Gallus gallus* Linnaeus) is often found to enjoy the soil-inhabiting species by digging the soil by their bills or claws. These observations have been made in Calcutta and at Midnapore.

Mammals : Among the mammals, some insectivorous bats are observed in Midnapore to feed upon swarming species of *Odontotermes redemanni* at dusk. The field rat (*Rattus* sp.) feeds on soil-inhabiting termites as evidenced by examining its stomach contents.

Thus, the large population of termites provides food for many animals and these enemies certainly play an important role in controlling termites population to some extent. It has also been observed that the animals preying on termites do not show any selective feeding.

ECONOMIC IMPORTANCE

The termite fauna of West Bengal, as revealed by the present study, is no doubt rich, probably because of the favourable physical and climatological features of the area. The fauna exhibits widely different habits and has considerable local economic importance. In seeking food and shelter, some of the termites cause enormous damage to wood-works and structures in buildings, to agricultural and forest crops, to timber in storage and in different use, to books, clothes and other house-hold cellulosic material in West Bengal. However, the amount of damage done to growing agricultural crops is comparatively small, perhaps, because they are never true primary pests, as damage with which they are associated is secondary in nature. Nearly one-third of total number of species can be distinctly marked as noxious to human economy. The species listed below are very important as they cause

economic loss in this State. Though the richest termite fauna occurs in the Himalayan and Sub-Himalayan zone, the most destructive wood-destroying species are those belonging to the genera *Heterotermes*, *Coptotermes*, *Odontotermes* and *Microtermes* which are common in the southern hot and humid plains. The destructive propensities have been discussed in connection with biological notes dealt with under "Systematic Account"

Following are the species of economic importance

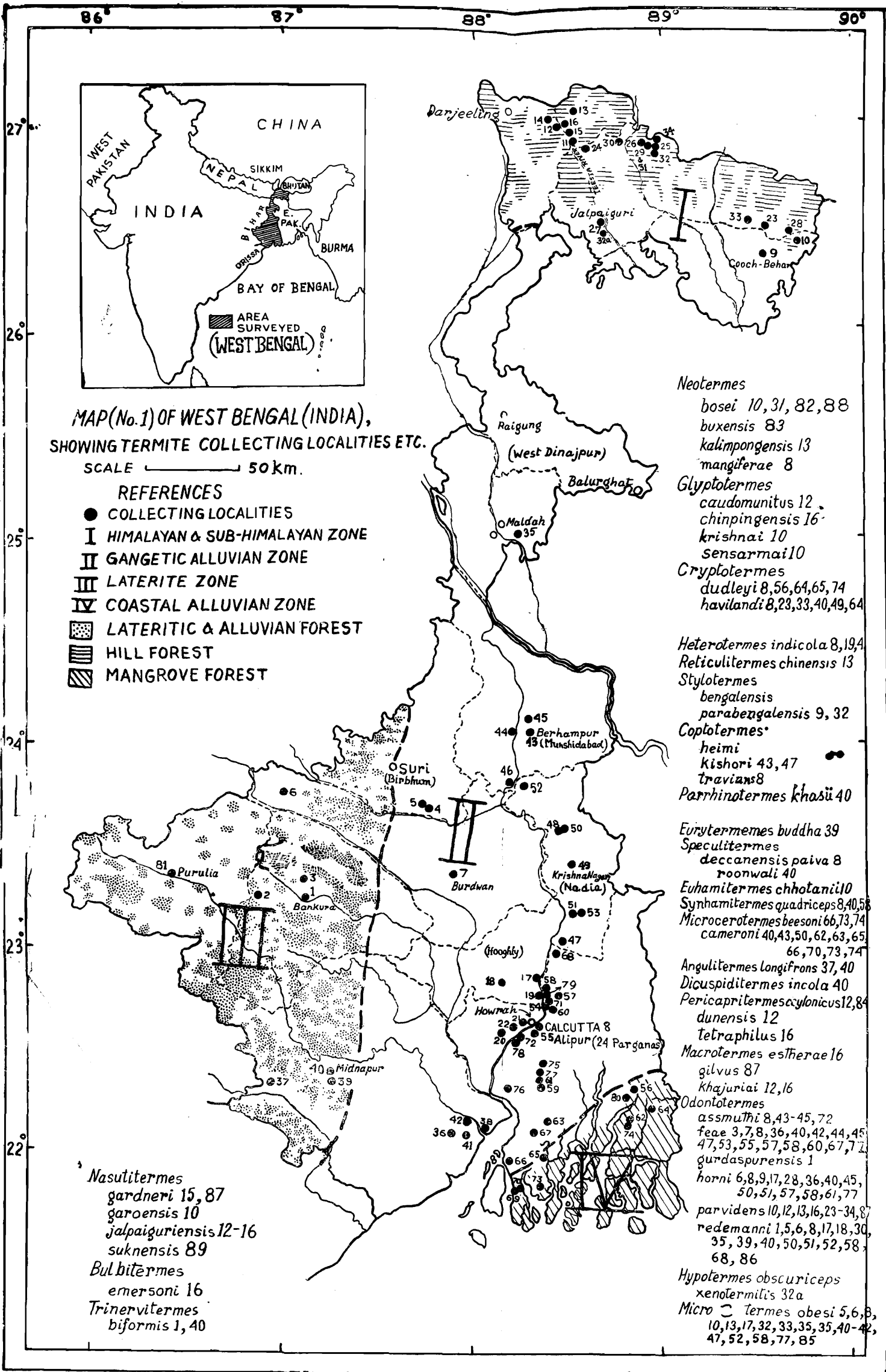
- | | |
|---|---|
| (i) <i>Species which usually inhabit wood</i> | (ii) <i>Species which do not usually inhabit wood, but destroy wood</i> |
| <i>Neotermes bosei</i> | <i>Microcerotermes beesoni</i> |
| <i>N. kalimpongensis</i> | <i>M. cameroni</i> |
| <i>Glyptotermes chinpingensis</i> | <i>Odontotermes feae</i> |
| <i>G. sensarmai</i> | <i>O. horni</i> |
| <i>Cryptotermes dudleyi</i> | <i>O. parvidens</i> |
| <i>C. havilandi</i> | <i>O. redemanni</i> |
| <i>Heterotermes indicola</i> | <i>Microtermes obesi</i> |
| <i>Coptotermes heimi</i> | |
| <i>Stylotermes parabengalensis</i> | |

ACKNOWLEDGEMENTS

The author is grateful to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta, for providing facilities for the work ; to Dr. M. L. Roonwal and Dr. T. N. Ananthakrishnan, ex-Directors, Zoological Survey of India, for valuable advice ; to Dr. Kumar Krishna, American Museum of Natural History, New York ; to Dr. O. B. Chhotani, Deputy Director and to Dr. (Mrs) G. Chhotani, Zoologist, Zoological Survey of India, for confirmation of some of the species ; to Dr. B. Biswas, Deputy Director, Zoological Survey of India, for discussing the aspect of zoogeography ; and to Dr. P. K. Sen-Sarma, Director, Biological Research, F. R. I., for encouragements. Grateful acknowledgement is made to Late Prof. D. N. RayChaudhuri, Professor of Zoology, University of Calcutta, for critically going through the manuscript.

SUMMARY

The monograph deals with the termite fauna of West Bengal, India, with regard to their taxonomy, variations, field biology, distribution, zoogeography, economic importance, swarming period and predators.



MAP (No. 1) OF WEST BENGAL (INDIA),
SHOWING TERMITE COLLECTING LOCALITIES ETC.

SCALE 50 km.

REFERENCES

- COLLECTING LOCALITIES
- I HIMALAYAN & SUB-HIMALAYAN ZONE
- II GANGETIC ALLUVIAN ZONE
- III LATERITE ZONE
- IV COASTAL ALLUVIAN ZONE
- LATERITIC & ALLUVIAN FOREST
- HILL FOREST
- MANGROVE FOREST

- Nasutitermes gardneri* 15, 87
- gaoensis* 10
- jalpaiguriensis* 12-16
- suknensis* 89
- Bulbitermes emersoni* 16
- Trinervitermes biformis* 1, 40

- Neotermes bosei* 10, 31, 82, 88
- buxensis* 83
- kalimpongensis* 13
- mangiferae* 8
- Glyptotermes caudomunitus* 12
- chinpingensis* 16
- krishnai* 10
- sensarmai* 10
- Cryptotermes dudleyi* 8, 56, 64, 65, 74
- havilandi* 8, 23, 33, 40, 49, 64
- Heterotermes indicola* 8, 19, 4
- Reticulitermes chinensis* 13
- Stylotermes bengalensis*
- parabengalensis* 9, 32
- Coptotermes heimi*
- kishori* 43, 47
- travians* 8
- Parrhinotermes khasu* 40
- Eurytermes buddha* 39
- Speculitermes deccanensis paiva* 8
- roonwali* 40
- Euhamitermes chatani* 10
- Synhamitermes quadriceps* 8, 40, 58
- Microcerotermes beesoni* 66, 73, 74
- cameroni* 40, 43, 50, 62, 63, 65, 66, 70, 73, 74
- Angulitermes longifrons* 37, 40
- Dicuspiditermes incola* 40
- Pericapritermes acylonicus* 12, 84
- dunensis* 12
- tetraphilus* 16
- Macrotermes estherae* 16
- gilvus* 87
- Khajuriai* 12, 16
- Odontotermes assmuthi* 8, 43-45, 72
- faeae* 3, 7, 8, 36, 40, 42, 44, 45, 47, 53, 55, 57, 58, 60, 67, 72
- gurdaspurensis* 1
- horni* 6, 8, 9, 17, 28, 36, 40, 45, 50, 51, 57, 58, 61, 77
- parvidens* 10, 12, 13, 16, 23-34, 87
- redemanni* 1, 5, 6, 8, 17, 18, 30, 35, 39, 40, 50, 51, 52, 58, 68, 86
- Hypotermes obscuriceps xenotermilis* 32a
- Microtermes obesi* 5, 6, 8, 10, 13, 17, 32, 33, 35, 35, 40-42, 47, 52, 58, 77, 85

86°

87°

88°

89°

MAP (No. 2) OF WEST BENGAL (INDIA),
SHOWING DISTRIBUTION OF SPECIES OF TERMITES.

Family: KALOTERMITIDAE

- *Neotermes bosei*
- *Neotermes buxensis*
- ⊕ *Neotermes kalimpongensis*
- ⊕ *Neotermes mangiferae*
- ⊖ *Glyptotermes caudomunitus*
- ⊖ *Glyptotermes chinpingensis*
- ⊕ *Glyptotermes krishnai*
- ⊗ *Glyptotermes sensarmai*
- *Cryptotermes dudleyi*
- *Cryptotermes havilandi*

Family: RHINOTERMITIDAE

- ⊙ *Heterotermes indicola*
- ⊕ *Reticulitermes chinensis*
- *Stylotermes bengalensis* *
- *Stylotermes parabengalensis* *
- *Coptotermes heimi*
- *Coptotermes kishori*
- *Coptotermes travians*
- ⊙ *Parrhinotermes khasii*

* Family: Stylotermitidae

27°

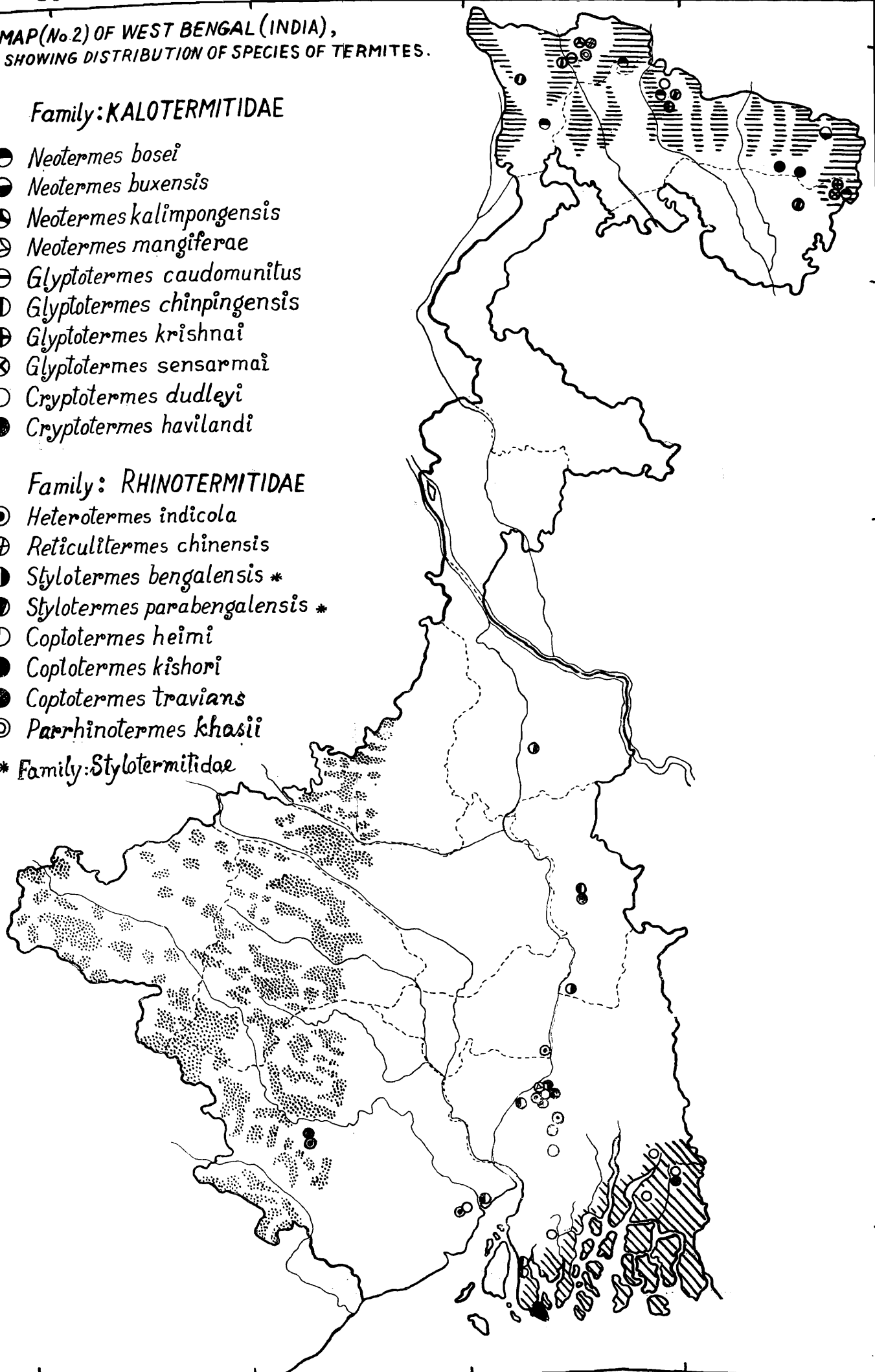
26°

25°

24°

23°

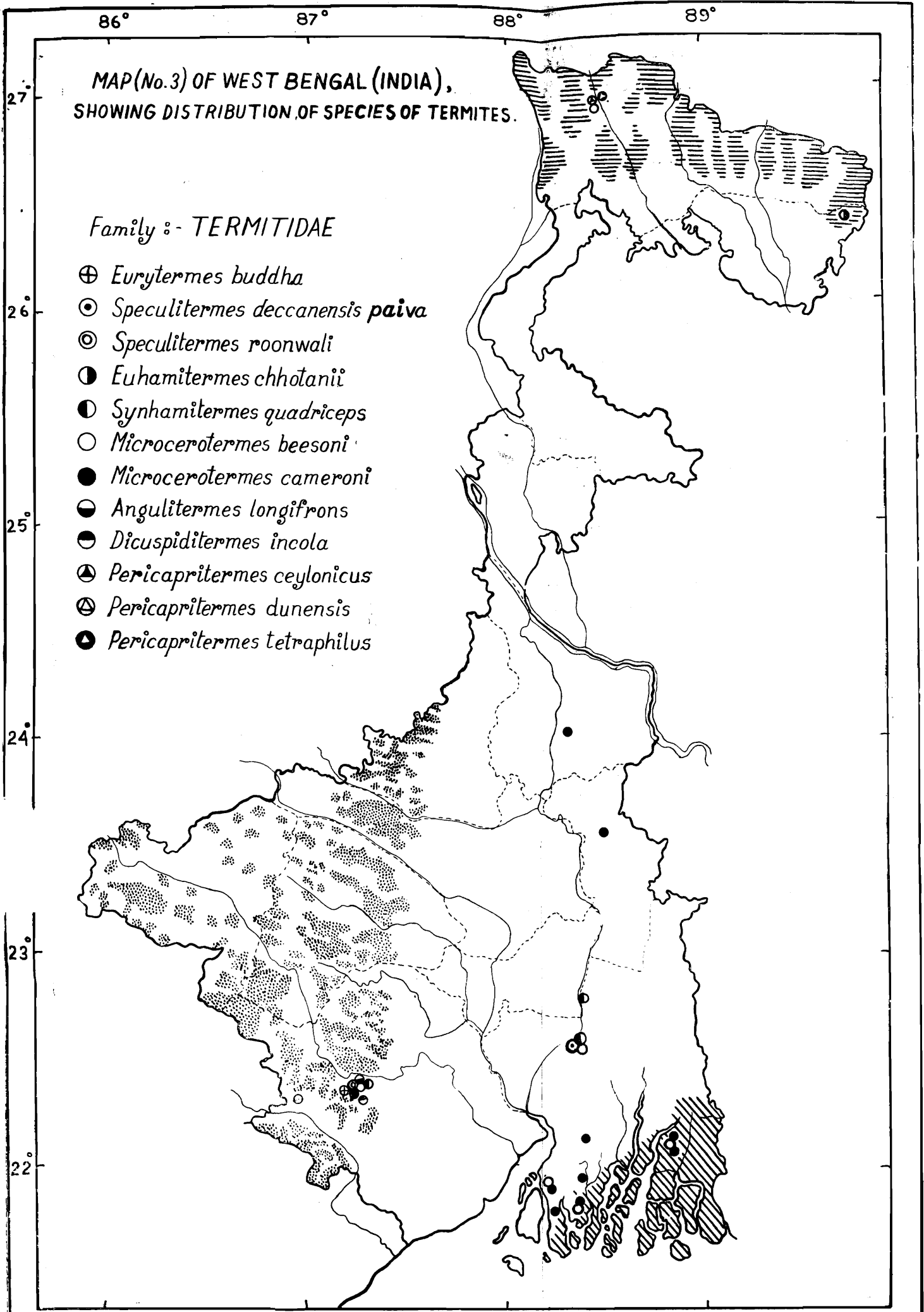
22°



MAP (No. 3) OF WEST BENGAL (INDIA),
SHOWING DISTRIBUTION OF SPECIES OF TERMITES.

Family :- TERMITIDAE

- ⊕ *Eurytermes buddha*
- ⊙ *Speculitermes deccanensis paiva*
- ⊙ *Speculitermes roonwali*
- *Euhamitermes chhotanii*
- *Synhamitermes quadriceps*
- *Microcerotermes beelsoni*
- *Microcerotermes cameroni*
- *Angulitermes longifrons*
- *Dicuspiditermes incola*
- ▲ *Pericapritermes ceylonicus*
- ▲ *Pericapritermes dunensis*
- ▲ *Pericapritermes tetraphilus*

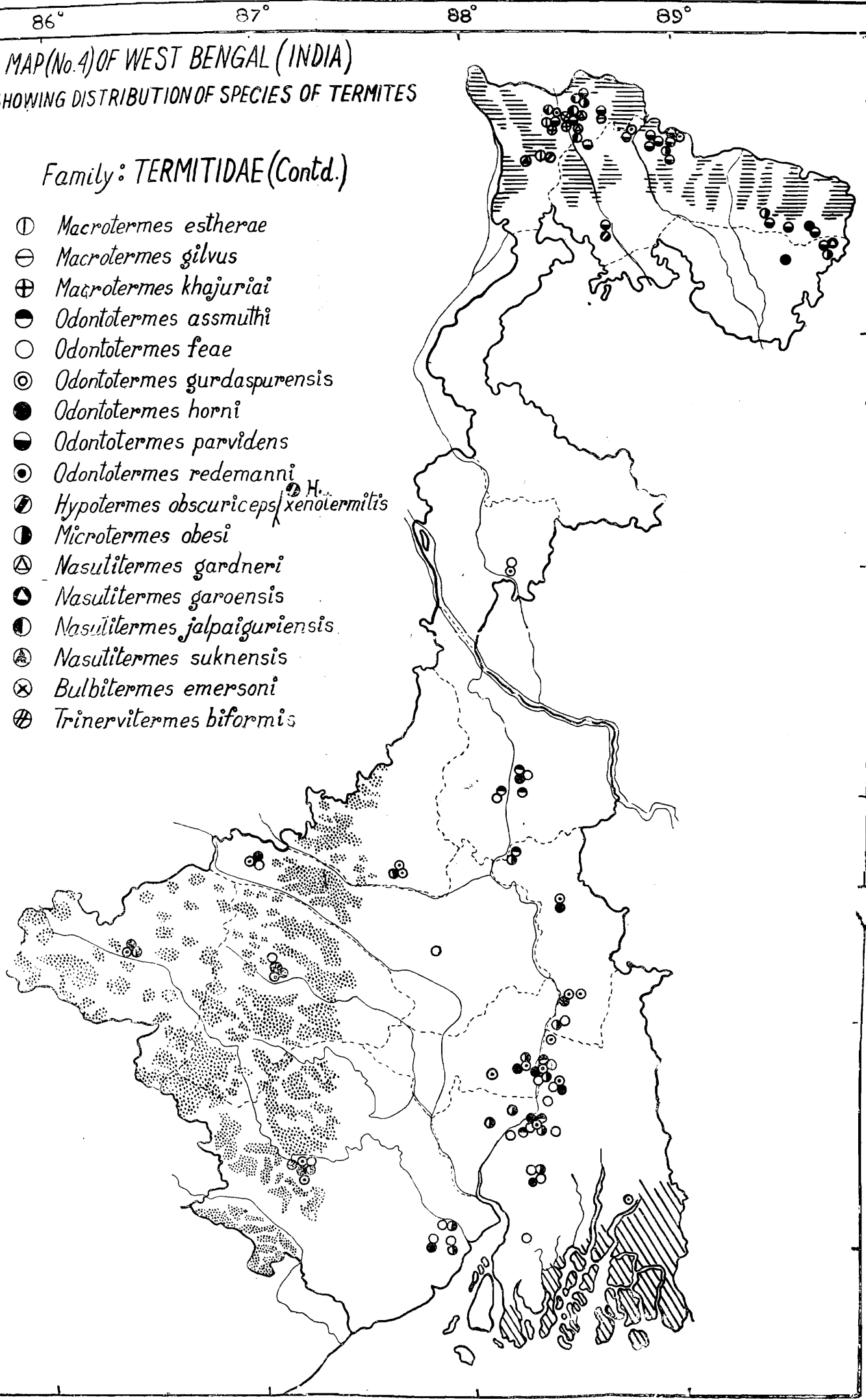


MAP (No. 4) OF WEST BENGAL (INDIA)
SHOWING DISTRIBUTION OF SPECIES OF TERMITES

Family: TERMITIDAE (Contd.)

- ① *Macrotermes estherae*
- ⊖ *Macrotermes gilvus*
- ⊕ *Macrotermes khajuriae*
- *Odontotermes assmuthi*
- *Odontotermes feae*
- ⊙ *Odontotermes gurdaspurensis*
- *Odontotermes horni*
- ◐ *Odontotermes parvidens*
- ⊙ *Odontotermes redemanni*
- ⦿ *Hypotermes obscuriceps* ^{H.} *xenotermis*
- *Microtermes obesi*
- △ *Nasutitermes gardneri*
- ▲ *Nasutitermes garoensis*
- *Nasutitermes jalpaiguriensis*
- ⊙ *Nasutitermes suknesis*
- ⊗ *Bulbitermes emersoni*
- ⊕ *Trinervitermes biformis*

27
26
25
24
23
22



1. West Bengal, a politically defined State of eastern India, stretches over an area of 87, 072 square kilometres (2.45 per cent of total area of India), presents varied topographical and ecological regions. For diversities in physiography, climate, vegetations, etc., this State is perhaps unparalleled in the whole of India, specially because of its contrasting land elevations *i. e.*, from sea level upto 3600 m. Accordingly, the State has been divided here into four Natural units, namely, (i) Himalayan and Sub-Himalayan, (ii) Gangetic alluvial, (iii) Laterite, and (iv) Coastal alluvial units (Map 1).

2. The termite fauna of West Bengal was studied so far in a desultory manner. Before undertaking the present study as many as 28 species and subspecies based on only stray collections from only about 20 localities had been reported by the different authorities. For the first time, an attempt has been made to survey the fauna thoroughly and to bring out a concise monograph on these insects. As many as 48 species and subspecies (3 new to science) belonging to 23 genera in 8 subfamilies under 4 families are recorded so far from the area.

3. The present study is mainly based on extensive collection made by the author and it is also augmented by incorporating a good collection present in Zoological Survey of India, Calcutta and Forest Research Institute, Dehra Dun. Out of more than 100 collection localities, 77 places are new localities of collections.

4. Four families are represented in the State, *viz.*, the Kalo-termitidae, Rhinotermitidae, Stylo-termitidae and Termitidae, the last being most richly represented and consisting of 4 subfamilies, 15 genera and 30 species and subspecies. Some 20 species and 10 genera are reported here for the first time and of these the genus *Bulbitermes* is recorded for the first time from the Indian Union. The most common genus *Odontotermes* is represented by 6 species, some of these are widespread in the State.

5. Running keys based on imagos and soldiers have been provided for easy identification of the termites of the State.

6. The species have been dealt with in details with regard to their synonymy, distribution (Maps. 2-4), variations, field biology, economic importance, etc.

7. In accordance with the distribution pattern of termites, the State has been divided into three distinct faunal zones, corresponding to the physiographic units of the State. The fauna of the Gangetic and Coastal ecological zones are hardly separable for which these are broadly

considered together as the Gangetic faunal zone. These are (i) Himalayan and Sub-Himalayan, (ii) Gangetic, and (iii) Lateritic faunal zones. Faunistically, the Himalayan and Sub-Himalayan zone has proved to be richest in having 25 endemic species (about 50% of the total fauna). Some 6 species are found restricted in the Gangetic faunal zone and 5 species in the Laterite. However, 6 species are found common in all these zones (*vide* Table 2). The probable causes of richness or paucity of fauna under respective zone and their pattern of ecological distribution have been critically discussed as far as practicable in the light of major environmental variables in the different zones.

8. With regard to the mode of dwelling, the termites of West Bengal have been classified into two broad groups, namely, 1. *Wood-dwellers* which include (i) Damp-wood termites and (ii) dry-wood termites ; and 2. *Soil-dwellers* which include (i) subterranean termites (ii) carton-nest-building termites, and (iii) mound-building termites.

9. The period of occurrence of imagos in the colony and their swarming in the State in case of as many as 16 species have been tabulated (Table 3). Most of the species swarm from the beginning of the rainy season from May to July, when the atmospheric humidity is quite high. But, *Coptotermes heimi* stages their flight both in the rainy season as well as dry winter months of November and December. The majority of the species emerge at dusk or early evening just after shower, while some have been observed to swarm even in the morning during rain.

10. The zoogeography and probable causes of high rate of speciation in some species occurring in North Bengal have been briefly discussed.

11. The most noxious species are distinctly marked and their destructive propensities are taken into consideration.

12. Lastly, a number of insects and other animals like frogs, toads, lizards, birds and mammals have been observed predaceous on different species of termites in the State.

It is quite clear that the State of West Bengal is faunistically rich, as about one-fifth of termite species of Indian Union occur in such a limited area of the State.

REFERENCES

- AHMAD, M. 1950. The Phylogeny of termite genera based on imago-worker mandibles,—*Bull. Am. Mus. nat. Hist.*, New York, **95** (2), pp. 37-86.

- AHMAD, M. 1952. The genus *Cryptotermes* (Isoptera : Kalotermitidae) in India and Pakistan.—*Proc. 4th Pakistan Sci. Cong.*, Peshawar, 1952, pt. 3, p. 71 (abs.).
- AHMAD, M. 1955. Termites of West Pakistan.—*Biologia*, Lahore, **1** (2), pp. 202-264.
- AHMAD, M. 1958. Key to the Indo-Malayan termites.—*Biologia*, Lahore, **4** (1-2), pp. 33-198.
- AHMAD, M. 1965. Termites (Isoptera) of Thailand.—*Bull. Am. Mus. nat. Hist.*, New York, **131** (1), pp. 1-113.
- AKHTAR, M. S. 1975. Taxonomy and Zoogeography of the termites (Isoptera) of Bangladesh.—*Bull. Dep. Zool. Panjab Univ. (N.S.)*, Lahore, **7**, pp. 1-199.
- ARORA, G. L. 1962. Biological observation on some termites from Hoshiarpur, Punjab.—*Proc. New Delhi Symp.*, 1960, pp. 111-113, UNESCO, Paris.
- ARORA, G. L. and GILOTRA, S. K. 1960. The biology of *Odontotermes obesus* (Rambur).—*Res. Bull. Punjab Univ. (Sci.) [N. S.]*, Chandigarh, **10** (3-4), pp. 247-255.
- ASSMUTH, J. 1915. Indian wood-destroying white ants (Second contribution).—*J. Bombay nat. Hist. Soc.*, Bombay, **23**, pp. 690-694.
- BANERJEE, B. 1956. Some common termites of Calcutta.—*J. Bombay nat. Hist. Soc.*, Bombay, **54** (1), pp. 204-206.
- BEESON, C. F. C. 1941. *The Ecology and Control of Forest Insects of India and Neighbouring Countries*, Vasant Press, Dehra Dun, 1007 pp. (Isoptera, pp. 524-553).
- BOSE, G. and MAITI, P. K. 1966. A new species of *Eurytermes* Wasmann (Insecta : Isoptera).—*Proc. zool. Soc.*, Calcutta, **19**, pp. 115-120.
- CHATTERJEE, P. N. and THAKUR, M. L. 1964. A new species of *Angulitermes* from North India (Isoptera : Termitidae).—*J. Bombay nat. Hist. Soc.*, Bombay, **61** (2), pp. 348-353.
- CHATTERJEE, P. N. and THAKUR, M. L. 1964a. Revision of the Termite genus *Microtermes* Wasmann (Isoptera : Termitidae).—*Indian Forest. Rec. (Ent.)*, (N. S.), Dehra Dun, **10** (11), pp. 219-260.

- CHATTERJEE, P. N. and THAKUR, M. L. 1966. Biology and ecology of Oriental termites (Isoptera) : Observations on the habits and biology of some termites of the Doon Valley.—*Indian Forester*, Dehra Dun, **92** (2), pp. 139-142.
- CHHOTANI, O. B. 1970. Taxonomy, zoogeography and phylogeny of the genus *Cryptotermes* (Isoptera : Kalotermitidae) from the Oriental Region.—*Mem. zool. Surv. India.*, Delhi, **15** (1), pp. 1-81.
- CHHOTANI, O. B. 1980. Termite pests of agriculture in the Indian region and their control.—*Tech. Mongr. No. 4, Zoological Survey of India*, Calcutta, pp. 1-94.
- DOVER, C. and MATHUR, R. N. 1934. Methods of testing the susceptibility of timbers to termite attack.—*Indian Forest Rec.*, Dehra Dun, **20** (7), pp. 1-20.
- DUTT, N. 1962. Preliminary observations on the incidence of termite attacking jute.—*Proc. New Delhi Symp.*, 1960, pp. 217-218, UNESCO, Paris.
- EMERSON, A. E. 1949. In : Snyder, T. E. 1949. Catalogue of the termites (Isoptera) of the world.—*Smith. misc. coll.*, Washington, **112**, p. 377
- GAY, F. J. 1967. A world review of introduced species of termites,—*CSIRO*, Melbourne, Bull. No. 286, pp. 1-88.
- GHOSH, S. K. 1964. Insecticidal control of termite, *Microtermes* sp. (Isoptera : Termitidae), damaging wheat crop.—*Indian Agric.*, **8** (2), pp. 87-91.
- HARRIS, W. V. 1961. *Termites, Their Recognition and Control*, Longmans, Green and Co. Ltd., London, i-x + 1-187 pp.
- HOLMGREN, K. and N. 1917. Report on a collection of termites from India.—*Mem. Dept. agric. India*, Calcutta, **5** (3), pp. 138-171.
- JOHN, O. 1925. Termiten von Ceylon, der Malayischen Halbinsel, Sumatra, Java und den Aru-Inseln.—*Treubia*, Bogor, **6** (3-4), pp. 360-419.
- KEMNER, N. A. 1934. Systematische und biologische studien über die Termiten Javas und Celebes.—*K. Sev. Vet. Akad. Handl.*, Stockholm, (3) **13** (4), pp. 1-241.
- KRISHNA, K. 1965. Termites (Isoptera) of Burma.—*Am. Mus. Novit.*, New York, No. 2210, pp. 1-34.

- KRISHNA, K. 1968. Phylogeny and generic reclassification of the *Capritermes*-Complex (Isoptera : Termitidae : Termitinae).—*Bull. Am. Mus. nat. Hist.*, New York, **138** (5), pp. 265-323.
- KUSHWAHA, K. S. 1960. A note on infestation of termites (Insecta : Isoptera) around Udaipur (Rajasthan).—*Sci. & Cult.*, Calcutta, **26** (1), pp. 39-40.
- LEFROY, H. M. 1909. *Indian Insect Life*, Thacker Spink & Co., Calcutta, i-vi + 318 pp. (Termites, pp. 228-231).
- MAITI, P. K. 1975. Two new species of termites (Isoptera) from West Bengal, India.—*Oriental Ins.*, New Delhi, **9** (2), pp. 139-148.
- MAITI, P. K. 1976. A new species of termites of the genus *Glyptotermes* from India.—*Proc. zool. Soc.*, Calcutta, **27** (2), pp. 15-18.
- MAITI, P. K. 1977. First record of the genus *Bulbitermes* from India, with description of a new species.—*Proc. zool. Soc.*, Calcutta, **30** (1979), pp. 25-29.
- MAITI, P. K. 1977. Bioecological observations on termites (Isoptera) of West Bengal, with special emphasis on wood-destroying species.—*Proc. All India Sym. on Environmental Biology*, Univ. of Kerala, Trivandrum, 27-29 Dec. 1977, p. 16 (Abs.).
- MARGABANDHU, V. 1934. An annotated list of Indo-Ceylonese termites.—*J. Bombay nat. Hist. Soc.*, Bombay, **37** (3), pp. 700-714.
- MATHUR, R. N. 1962. Enemies of termites (white ants).—*Proc. New Delhi Symp.*, 1960, pp. 137-139, UNESCO, Paris.
- MATHUR, R. N. and CHHOTANI, O. B. 1959. Revision of *Stylotermes* Holmgren and Holmgren.—*Zool. Anz.*, Leipzig, **163** (1-2), pp. 40-53.
- MATHUR, R. N. and SEN-SARMA, P. K. 1958. Hitherto unknown imago caste of the species of *Globitermes*, *Microcerotermes* and *Odontotermes* from Indo-Malayan region (Isoptera : Termitidae).—*Indian Forest. Bull.*, Dehra Dun, No. 219, pp. 1-9.
- MATHUR, R. N. and SEN-SARMA, P. K. 1959. Notes on the habits and biology of Dehra Dun termites. Part I.—*J. Timb. Dry. Preserv. Ass. India*, Dehra Dun, **5** (3), pp. 3-9.
- MATHUR, R. N. and SEN-SARMA, P. K. 1960. *Glyptotermes nigrifrons* sp. n. from South India (Insecta : Isoptera : Kalotermitidae).—*Entomologist*, London, pp. 79-85.

- MATHUR, R. N. and SEN-SARMA, P. K. 1961. A new species of *Angulitermes* from South India (Insecta : Isoptera : Termitidae).—*Ann. Mag. nat. Hist.*, London, (13) 3 [1960], pp. 401-406.
- MATHUR, R. N. and SEN-SARMA, P. K. 1962. Notes on the habits and biology of Dehra Dun termites. Part III.—*J. Timb. Dry. Preserv. India*, Dehra Dun, 8 (1), pp. 1-18.
- MUKHERJI, D. and CHOWDHURI, R. 1962. Developmental stages of *Odontotermes redemanni* (Wasmann).—*Proc. New Delhi Symp.*, 1960, pp. 77-95, UNESCO, Paris.
- MUKHERJI, D. and MITRA, P. K. 1948. Ecological studies on *Odontotermes redemanni* (Wasmann).—*Proc. Ind. Sci. Congr. Assoc.*, 1948 (abs.).
- MUKHERJI, D. and MITRA, P. K. 1949. Ecology of the moundbuilding termite, *Odontotermes redemanni* (Wasmann) in relation to measures of control.—*Proc. zool. Soc. Bengal*, Calcutta, 2 (1), pp. 1-25.
- PATEL, G. A. and PATEL, H. K. 1952. Control of termites as pests of fruit trees.—*Proc. zool. Soc.*, Calcutta, 5, pp. 133-140.
- PRASHAD, B. and SEN-SARMA, P. K. 1959. Revision of the termite genus *Nasutitermes* Banks (Isoptera : Termitidae) from the Indian Region.—*Indian Counc. agric. Res., Ent. Monogr.*, New Delhi, Code No. 10.23, pp. 1-66.
- PRUTHI, H. S. and NARAYANAN, E. S. 1939. A statistical study of the loss caused by borers and termites to mature sugar cane at Pusa in 1935 and 1936.—*Indian J. agric. Sci.*, New Delhi, pp. 15-37.
- RATTAN LAL and MENON, R. D. 1953. *Catalogue of Indian Insects*.—Part 27, Isoptera, pp. 1-94, Delhi (Govt. India Publ.).
- ROONWAL, M. L. 1954. Biology and ecology of Oriental termites (Isoptera). No. 1. *Odontotermes parvidens* Holmgren and Holmgren severely damaging the bark and contributing to the death of standing teak trees in Uttar Pradesh, India.—*J. Bombay nat. Hist. Soc.*, Bombay, 52 (2-3), pp. 459-462.
- ROONWAL, M. L. 1954a. Biology and ecology of oriental termites (Isoptera) : No. 2. On ecological adjustment in nature between two species of termites, namely *Coptotermes heimi* (Wasmann) and *Odontotermes redemanni* (Wasmann) in Madhya Pradesh, India.—*J. Bombay nat. Hist. Soc.*, Bombay, 52 (2-3) pp. 463-467.

- ROONWAL, M. L. 1955. Termites ruining a township.—*Z. angew. Ent.*, **38**(1), pp. 103-104.
- ROONWAL, M. L. 1959. Biology and ecology of oriental termites (Isoptera). No. 4. The drywood termite *Coptotermes heimi* (Wasmann) in India.—*J. Bombay nat. Hist. Soc.*, Bombay, **56**(3), pp. 511-523.
- ROONWAL, M. L. 1970. Termites of the Oriental Region. In : Krishna, K. and Weesner, F. M. (ed.). *Biology of Termites*, Acad. Press, New York, **2**, pp. 315-391.
- ROONWAL, M. L. and BOSE, G. 1964. Termite fauna of Rajasthan, India.—*Zoologica*, Stuttgart, **113**, pp. 1-57.
- ROONWAL, M. L. and BOSE, G. 1970. Taxonomy and Zoogeography of the termite fauna of Andaman and Nicobar Islands, Indian Ocean.—*Rec. zool. Surv. India*, Delhi, **62**(3-4), pp. 109-170.
- ROONWAL, M. L. and CHHOTANI, O. B. 1962. Termite fauna of Assam region, eastern India.—*Proc. natnl. Inst. Sci. India*, New Delhi, (B) **28**(4), pp. 281-406.
- ROONWAL, M. L. and CHHOTANI, O. B. 1962a. *Indian species of Termite genus Coptotermes*. ix. + 115 pp.—(Indian Counc. Agric. Res., Ent. Monogr. No. 2), Delhi (Govt. India Publ.).
- ROONWAL, M. L. and CHHOTANI, O. B. 1962b. A new species and a new subspecies of the termite *Speculitermes* (Termitidae : Amitermitinae) from India.—*Zool. Anz.*, Leipzig, **168**(1-4), pp. 57-63.
- ROONWAL, M. L. and CHHOTANI, O. B. 1965. Zoogeography of termites of Assam region, India, with remarks on speciation.—*J. Bombay nat. Hist. Soc.*, Bombay, **62**(1), pp. 1-13.
- ROONWAL, M. L. and CHHOTANI, O. B. 1966. The mound of the termite *Odontotermes feae* (Wasm.).—*Proc. 2nd All-India Congr. Zool.* (Varanasi, 1962), Calcutta, pp. 426-428.
- ROONWAL, M. L. and CHHOTANI, O. B. 1977. Ergebnisse der Bhutan-Expedition, 1972 des Naturhistorischen Museums in Basel., Isoptera (Termites).—*Ent. Basil.*, **2**, pp. 39-84.
- ROONWAL, M. L. and PANT, G. D. 1953. A systematic catalogue of the main identified entomological collection at the Forest Research Institute, Dehra Dun, Pt. 9. Order Isoptera, *Indian Forest Leaflet*. (Ent.), Delhi, No. 121 (3), pp. 40-60.

- ROONWAL, M. L. and SEN-SARMA, P. K. 1956. Systematic of Oriental termites. (Isoptera). No. 3. Zoological Survey of India Collections from India and Burma, with new termites of the genera *Parrhinotermes*, *Macrotermes*, *Hypotermes* and *Hospitalitermes*.— *Indian J. agric. Sci.*, Delhi, **26** (1), pp. 1-37
- ROONWAL, M. L. and SEN-SARMA, P. K. 1960. *Contributions to the Systematics of Oriental Termites*. xiv+407 pp. (*Ent. Monogr.*, Indian Counc. Agric. Res.), New Delhi.
- SEN-SARMA, P. K. and MATHUR, R. N. 1957. Further record of occurrence of *Cryptotermes dudleyi* (Banks) in India (Insecta : Isoptera : Kalotermitidae).— *Curr. Sci.*, Bangalore, **26** (12), p. 399.
- SEN-SARMA, P. K. and MATHUR, R. N. 1961. *Trinervitermes biformis* (Wasmann), a mound building termite in South India.— *Indian Forester*, Dehra Dun, **87** (4), p. 1.
- SEN-SARMA, P. K. *et. al* 1975. Studies on wood-destroying termites in relation to natural termites resistance of timber.— Final Tech. Rep., P. L. 480 Project No. A/7-F5-58 (Grant No. FC-IN-377), pp. 1-187.
- SNYDER, T. E. 1933. New termites from India. *Proc. U. S. nat. Mus.*, Washington, **82** (16), pp. 1-15.
- SNYDER, T. E. 1934. New termites from India.— *Indian Forest Rec.*, Delhi, **20** (11), pp. 1-88.
- SNYDER, T. E. 1949. Catalog of the termites (Isoptera) of the world.— *Smith. misc. Coll.*, Washington, **112**, 1 + 490 pp.
- VISHNOI, H. S. 1954. On neotenic termites from a colony of *Microcerotermes beelsoni* Snyder (Isoptera : Termitidae).— *Curr. Sci.*, Bangalore, **23**, pp. 28-29.
- WASMANN, E. 1896. Neue termitophilen und termiten aus Indien. Viaggio di Leonardo fea in Birmania e regioni vicine.— *Ann. Mus. Civ. di Stor Nat. Genova*, Genoa, (2) **16** (36), pp. 613-630.