

INTRODUCTION

1.1 General : The sustainable conservation of biological resources is a great concern to everyone due to its rapid depletion everywhere. One of the most important area of conservation is the biological diversity especially contained in the forest ecosystems. Such ecosystems support immense wild life, regulate various life supporting ecological processes and supply goods and services to mankind. However, such forest community is constantly deteriorated by large majority of insects including other natural agents like diseases, fire, hazards, etc. Among known insects, termites belonging to the Order Isoptera are one of the important destructive biological agents in one hand and enhancing forest growth as decomposers in other hand.

Apart from this, termite attracts the attention of scientists of varied interests due to their organisational supremacy, polymorphic caste systems, symbiotic and crybtobiotic life, superb architectural ability, ubiquitous in the topics and even causing environmental pollution by liberating methane, etc. Lastly, they cause enormous damage to live plants, dead and decaying logs, timbers in human use, books, clothes and anything of cellulosic origin.

Reasonably, these insects have increased the curiosity of scientists from time immorial to undertake varied types of research. However, the recognition of species which is the basic task of taxonomy, still remains to be prerequisite of any types of investigations. But the progress of taxonomic work on the family Rhinotermitidae does not atall commensurate with the importance of the group. There is no consolidated work on the world species of the family inspite of so much so importance as follows :

(i) The family contains some of the most destructive species, as for example, *Heterotermes indicola* (Wasmann) alone can causes great economic loss inflicting severe damage to

structural timbers and any household articles of cellelosic origin in the Indian subcontinent.

(ii) Large majority of species indirectly enhance plant growth by increasing soil fertility through disintegrating wood and other plant material.

(iii) Many rhinotermitid members of the genera, namely *Prorhinotermes* and *Schedorhinotermes* are capable of tolerating saline seawater as a result are trasported large water gaps through floating legs, rafts, coconuts, etc. In the process, these species are established in the foreign countries as exotic pests replacing the native ones especially in the coastal area (Emerson, 1955).

(iv) The family predominantly occurs in the tropical islands in their abundance and helps thereby in understanding easily the processes of speciation (Maiti, 1966), evolution and principles of insular biology.

(v) Further, the family provides excellent material for understanding the reciprocal phylogeny and co-evolution of termites, termitophilous insects in nests and intestinal flagellates in their gut (Emerson, 1971). It also facilitates to the study the mode of unique ecological adjustment among all these organisms living together in harmony.

(vi) The occurrence of the members of the genus *Reticulitermes*, both living and fossil, becomes the key indicator of temperate climate of the northern border of the tropics in Eurasia and North America (Ander, 1942).

Keeping all these in view, it has been proposed to bring out a taxonomic monograph on world rhinotermitids based on the study of types as well as authentically identified material. Fortunately, the Forest Research Institute, Dehra Dun and Zoological Survey of India, Kolkata, contain an excellent collection of rhinotermitid species, donated mostly by Prof. A. E. Emerson,

A.M.N.H., New York; C.S.I.R.O., Australia and other foreign agencies including their own valuable collections. All these material have been thoroughly studied in the present endeavour. Moreover, during the last 100 years of taxonomic study of termites all over the World, many revisionary works are at our disposal to have taxonomic knowledge of the World species as a whole which have been taken into account in the present context.

The monograph deals with the framing of keys to the subfamilies, genera, species based on soldiers (except imagos and soldiers minor). The different genera have been dealt with their general characters, history, synonymies, composition, distribution, etc. Each species has been dealt with reference to its current scientific name, detailed synonymies, diagnostic characters, measurements, type repository, distribution, remarks, etc. Numerous illustrations and exhaustive bibliography are the added features of the monograph. Apart from these, the phylogeny, centre of origin, dispersal, zoogeography, etc. of the family and its included genera have briefly been discussed based on existing literature. The diagnostic characters and measurements of species are mostly based on the material studied as mentioned under 'Material' in each species, otherwise taken from the literature. The species not available for study, are dealt

mainly with existing illustrations and measurements. It goes without saying that the measurements are taken in millimetre which are not mentioned everywhere.

1.2 General Characters of the Family

1. **Imago** : Head oval to round, lateral sides parallel or convex; Y-suture distinct or indistinct. Fontanelle either minute or moderately prominent, fontanelle plate absent. Postclypeus either flat or weakly swollen. Mandibles each with an apical and three marginal teeth, first marginal of right mandible greatly reduced. Antennae with 14-23 segments, pronotum flat. Forewing scale generally large, overlapping the hindwing scale except in *Reticulitermes* and *Psammotermes*. Apical tibial spurs 3:2:2; tarse with 4 segments; cerci 2-jointed.

2. **Soldier** : Monomorphic or dimorphic. Head oval or subrectangular. Fontanelle always present, opening variable in size and placement, sometimes placed either just on and near the clypeus (*Coptotermes*) or on head-dorsum or on the frontal tube drawn out anteriorly (*Acorhinotermes*); frontal furrow or fronto-clypeo-labral furrow either present or absent. Labrum variable, either with or without hyaline tip; either broadly tongue-shaped or pentagonal or long drawn out; either with a few bristles near apical tip or a daubing brush. Mandibles well

Tabulated characters of rhinotermitid subfamilies

Psammotermatinae	Coptotermatinae	Heterotermatinae	Termitogetoninae	Rhinotermitinae
Soldier's mandibles with more number of teeth.	Soldier's mandibles with crenulations at base.	Soldier's head parallel sided	Soldier's head strongly narrowed anteriorly	Soldier's head narrowed anteriorly
Forewing scale small not overlapping hindwing	Frontal gland in soldier considerably developed with its large opening	Antennal segments reduced	Reduction of wing venation (R and M either prominent or faintly marked)	Forewing large with scale
	Tarsal formula 3:2:2.	Pronotum flat	Tarsal formula 2:2:2	Clypeus swollen 2nd marginal tooth shorter than 1st (except <i>Prorhinotermes</i> .) worker's pronotum saddle-shaped

developed, at times reduced in minor soldier (*Rhinotermes*; *Dolichorhinotermes*; *Acorhinotermes*), either with marginal teeth (*Psammotermes*; *Parrhinotermes*; *Schedorhinotermes*; *Rhinotermes*; *Dolichorhinotermes*) or with a few crenulations on left mandible in basal half (*Coptotermes*; *Heterotermes*, *Reticulitermes*) or without any marginal teeth and crenulations (*Prorhinotermes*; *Termitogeton*). Antennae with 12–17 segments. Pronotum flat. Apical tibial spur formula 3 : 2 : 2 (except in *Glossotermes* 2 : 2 : 2); tarsi 4-jointed, cerci 2-jointed.

History of the Family Rhinotermitidae

Froggatt: Froggatt (1896) was the first author to name the subfamily Rhinotermitinae which was subsequently raised to the family rank by Froggatt (1896) and Light (1921), Emerson (1955), Chatterjee and Thakur (1964), Roonwal and Chhotani (1989), Emerson (1971) and many other authors. However, many genera had either been excluded or included under the family from time to time.

Holmgren (1911) had incorrectly named Rhinotermitidae as Mesotermitidae and committed some nomenclatural errors including erection of some subfamilies of valid status today. He also included the rare monobasic subfamily Serritermitinae with a lone known species *Serritermes serrifer* from Brazil which had now been raised to the family rank by Emerson (1965). Earlier, Ahmad (1950) relegated this subfamily from Rhinotermitidae and placed it in the family Termitidae on the basis of its specialised characters, such as dentition of imago-mandibles and serrated long mandibles of soldiers which were highly specialised character. Further, the characters like tibial spur (2 : 2 : 2) arrangement and absence of styli had also been considered.

However, Serritermitinae had branched off early from Heterotermitinae stem in having large pronotum, forewing scale and with reticulate wing membrane which had been shared from Rhinotermitidae (Emerson, 1965).

Another subfamily Stylotermitinae was given the status of a family by Chatterjee and Thakur

(1954) that too had been treated by Emerson (1965) as a subfamily of Rhinotermitidae. Although many authors supported Emerson's view, but most of the Indian authors, followed Roonwal and Chhotani (1989) and considered it as separate family Stylotermitidae. Reasonably, the lone living genus *Stylotermes* of this family has not been included here.

The family Rhinotermitidae contains about 168 living and fossil species grouped under 13 genera so far recognised. The family is primitive in its morphology, nesting behaviour and social organization. The time of geological origin, phylogenetic sequence, zoogeographical distribution of the included genera under the family framed by Emerson (1971) have been given here with some modification such as, *Stylotermes* and *Parastylotermes* being kept aside (Table-I)

The classification of the Family as considered by different authors stands as follows :

- A. Family RHINOTERMITIDAE Light, 1921 (After. Snyder, 1949)
 - Subfamily 1. PSAMMOTERMITINAE Holmgren, 1911
 - Subfamily 2. HETEROTERMITINAE Froggatt, 1896 (= Leucotermitinae)
 - Subfamily 3. STYLOTERMITINAE Holmgren and Holmgren, 1917
 - 4. COPTOTERMITINAE Holmgren, 1910, 1911
 - 5. TERMITOGETONINAE Holmgren, 1910, 1911
 - 6. RHINOTERMITINAE Froggatt, 1896
- B. Family : RHINOTERMITIDAE Light, 1921 (After, Grasse, 1949) (= Mesotermitidae Holmgren, 1909)
 - Subfamily 1. PSAMMOTERMITINAE Holmgren, 1911
 - Subfamily 2. HETEROTERMITINAE Froggatt, 1826 (-1896)

- Subfamily 3. COPTOTERMITINAE
Holmgren, 1909
- Subfamily 4. ARRHINOTERMITINAE
Sjostedt, 1925 [= 1926]
- Subfamily 5. TERMITOGETONINAE
Holmgren, 1909
- Subfamily 6. RHINOTERMITINAE Froggatt,
1896
- Subfamily 7. SERRITERMITINAE
Holmgren, 1909
- C. Family RHINOTERMITIDAE Light, 1921
(After, Roonwal and Chhotani
1989)
- Subfamily 1. PSAMMOTERMITINAE
Holmgren, 1911
- Subfamily 2. COPTOTERMITINAE
Holmgren, 1909
- Subfamily 3. TERMITOGETONINAE
Holmgren, 1909
- Subfamily 4. HETEROTERMITINAE
Froggatt, 1826 (=1896)
- Subfamily 5. RHINOTERMITINAE
Froggatt, 1909

The family Rhinotermitidae, as considered here has been divided into five subfamilies, namely, Coptotermitinae, Heterotermitinae, Psammotermitinae, Termitogetoninae and Rhinotermitinae (Roonwal and Chhotani, 1989).

Coptotermitinae is the most primitive subfamily of the Rhinotermitidae. It includes a single genus *Coptotermes* with 53 living species occurring in the all major Zoogeographical Regions with a single amber fossil species from the Dominic Republic. The Heterotermitinae has probably originated from the Coptotermitinae and includes two genera, *Heterotermes* and *Reticulitermes*. Of these, the former is more primitive with about 27 species known to occur in all the Regions except Palaearctic Region. It is also represented by fossil species in amber from Chiapas, Mexico (Snyder, 1960) which has recently been revised by Emerson (1971). *Reticulitermes* is predominantly a temperate genus

with known living species and also represented by fossil species. The members live in temperate regions for many million years without having representatives in the tropics.

The Psammotermitinae is represented by two genera *Psammotermes* and *Glossotermes*. The former genus confines to arid zones with four species in Ethiopian, Palearctic and Malagasy including in the Indo-Pakistan arid areas.

Glossotermes is represent by a single species from the Neotropical Region.

The Rhinotermitinae is considered as most advanced subfamily of the family possessing swollen clypeus and saddle shaped pronotum in the imago castes. The development of a monomorphic soldier (as in *Prorhinotermes* and *Parrhinotermes*) to a dimorphic soldier (as in *Macrorhinotermes*, *Schedorhinotermes*, *Rhinotermes* and *Dolichorhinotermes*) is a striking feature. The gradual reduction of mandibles and development of prolonged labrum are used for dispersing the volatile repellent fluid.

The specialised *Rhinotermes*, *Dolichorhinotermes* and *Acorhinotermes* are endemic to the Neotropical Region and have originated from *Schedorhinotermes* like ancestor.

1.4. Classification followed : Classification has been given here based on Roonwal and Chhotani (1989) :

Subfamily (i) PSAMMOTERMITINAE
Holmgren, 1911

- 1. Genus *Psammotermes* Desneux
- 2. Genus *Glossotermes* Emerson

Subfamily (ii) HETEROTERMITINAE Froggatt,
1896

- 3. Genus *Heterotermes* Froggatt
- 4. Genus *Reticulitermes* Holmgren (not dealt)

Subfamily (iii) COPTOTERMITINAE Holmgren,
1910, 1911

- 5. Genus *Coptotermes* Wasmann

Subfamily (iv) TERMITOGETONINAE
Holmgren, 1910, 1911

6. Genus *Termitogeton* Desneux

Subfamily (v) RHINOTERMITINAE Froggatt,
1896

7. Genus *Prorhinotermes* Silvestri

8. Genus *Macrorhinotermes*

9. Genus *Parrhinotermes* Holmgren

10. Genus *Schedorhinotermes* Silvestri

11. Genus *Rhinotermes* Hagen

12. Genus *Dolichorhinotermes* Emerson and
Snyder

13. Genus *Acorhinotermes* Emerson

1.5. Material and Methods : The monograph is based on the study of the excellent 'Types' as well as authentically identified rhinotermid material by the world Termitologists which are preserved mainly in the 'National Zoological Collections' at the Zoological Survey of India, Kolkata and 'Entomological Collection' at the Forest Research Institute, Dehra Dun, India. These collections were received either as donation or on exchange from different International Institutes especially from A.M.N.H., New York and C.S.I.R.O., Australia. Besides, the 'Types' of different new taxa discovered by the Indian experts during the last 50 years or so, both from India and foreign countries were made available for the present study. Further, the last century has witnessed the good progress of the termite-taxonomy around the world, which had made it possible to bring out this monograph utilizing the existing literature.

The alcohol preserved termites were studied under a Sterioscopic Binocular for their morphology, measurements, illustrations, etc. Measurements are expressed in terms of millimetre.

1.6. INDICES AND ABBREVIATIONS

A. Important Indices Used : The following Indices have been used

1. Head Index (Width / Length)

- 2. Head Contraction Index (minimum width of head at the side base of mandibles/ maximum width of head)
- 3. Mandible Head Index (Length of mandible/ length of head)
- 4. Postmentum Index (Minimum width/ Maximum width)
- 5. Pronotum Index (Pronotum Length/ Pronotum width)
- 6. Pronotum Head Index (Minimum width of pronotum/Maximum width of head)

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

- alt., – altitude (above mean sea-level)
- AM.N.H., – American Museum of National History, New York
- BM.N.H., – British Museum (Natural History), London
- Cm., – Centimetre
- Coll., – Collected by, Collection
- Dist., – District
- E., – East
- ex., – from, out of
- exs., – examples
- F.R.I., – Forest Research Institute, Dehra Dun
- Im., – Imago
- Km., – Kilometre
- lat., – Latitude
- long., – longitude
- lit. – literature
- m., – metre
- maj., – major
- max., – maximum
- min., – minimum; minor
- 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
Z.S.I.,	–	Zoological Survey of India, Kolkata

2.0 DISTRIBUTION OF GENERA AND SPECIES

2.1. Genera : Termites are predominantly tropical insects, occurring in their greatest abundance both in colonies and population in the tropical rain forests and very sparsely so in the temperate regions. Rhinotermitids are no exception. However, cool loving genus *Reticulitermes* invades some temperate territories which has been replaced in the tropics by its allied genus *Heterotermes*.

It has been deduced that Rhinotermitidae had its main center of origin and dispersal in the

2.2. Species Distribution

Family RHINOTERMITIDAE Froggatt

Subfamily PSAMMOTERMITINAE Holmgren

Genus *Glossotermes* Emerson

G. oculatus Emerson

South America : Guayana

Genus *Psammotermes* Desneux

P.alloceros (Silvestri)

Africa : Abassas, Namaqualand;

Oriental Region based on evidences of endemism of genera and concentration of species in the area. Two genera, *Termitogeton* and *Macrorhinotermes* are endemic to the Orient represented only by a few species in each. *Psammotermes* being mostly confined to the arid zones, is found in the Ethiopian, Palaearctic, Malagasy and Oriental Regions. *Glossotermes* is represented by a single species so far known only from Guayana. By far the largest genus *Coptotermes*, easily recognised by the presence of their large fontanelle openings on the head-dorsum of soldiers, spreads all over the world containing many injurious and introduced species.

The subfamily Heterotermitinae is represented by two genera, namely, *Heterotermes* and *Reticulitermes*. The former genus contains both fossil and living species being found in all the Zoogeographical Regions of the world except in the Palaearctic.

Rhinotermitinae is the largest and most specialised subfamily in having swollen clypeus and saddle-shaped pronotum in the imago caste. *Schedorhinotermes* is the most primitive representative of the family with many species found in the Oriental, Australian, Papuan and Ethiopian Regions with maximum concentration of species in the Orient. *Prorhinotermes* is more widely distributed with more species than its allied genus *Parrhinotermes* predominantly oriental in distribution containing only few species.

The genera *Rhinotermes*, *Dolichorhinotermes* and *Acorhinotermes* are most specialised endemic group of the Neotropical Region.

<i>P. hybostoma</i> (Desneux)	Africa : Algeria Ludbucht : Abo-EL-Risk; Saudi Arabia
<i>P. rajasthanicus</i> Roonwal and Bose	Asia : India : Rajasthan, Pakistan
<i>P. voeltzkowi</i> (Wasmann)	Africa : Madagascar: Ambovombe

Subfamily COPTOTERMITINAE Holmgren

Genus *Coptotermes* Wasmann

<i>C. acinaciformis acinaciformis</i> (Froggatt)	Australia and New Zealand
<i>C. acinaciformis reffrayi</i> Wasmann	Australia (West)
<i>C. amanii</i> (Sjöstedt)	Africa : South of Tropic of Cancer
<i>C. amboinensis</i> Kemner	Asia : Amboina Isl.
<i>C. beckeri</i> Mathur and Chhotani	Asia : India :
<i>C. bentongensis</i> Krishna	Asia : Malaysia
<i>C. boetonensis</i> Kenber	Asia : Indonesia Boitan Isl., SE. of Celebes
<i>C. bornensis</i> (Oshima)	Asia : Indonesia : Borneo
<i>C. brunneus</i> Gay	Australia : (West)
<i>C. ceylonicus</i> Holmgren	Asia : Sri Lanka and India
<i>C. communis</i> Xie and He	Asia : China
<i>C. crassus</i> Snyder	N. and C. America
<i>C. crassus</i> Ping	Asia : China
<i>C. communis</i> Xie and He	Asia : China
<i>C. curvignathus</i> Holmgren	Asia : Malaysia, Myanmar and Singapore, and Orissa.
<i>C. dobonicus</i> Oshima	Asia : Indonesia : Aru Isl.
<i>C. dreghorni</i> Hill	Australia : Quensland
<i>C. elisae</i> (Desneux)	Australia and Asia : (New Guinea)
<i>C. emersoni</i> Ahmad	Asia : Sri Lanka
<i>C. eucalyptus</i> Ping	Asia : China : Xianling, Dianbai City
<i>C. formosanus</i> Shirake	Worldwide
<i>C. frencki</i> Hill	Australia and New Zealand
<i>C. gaurii</i> Roonwal and Krishna	Asia : Sri Lanka and India (Great Nicobar Island)
<i>C. gestroi</i> (Wasmann)	Asia : Malaysia, Myanmar, Thailand and India
<i>C. grandiceps</i> Snyder	Asia : Solomon- Isl., Russell and Santa Cruz Groups
<i>C. guangdongensis</i>	Asia : China
<i>C. guanzhouensis</i> Ping	Asia : China
<i>C. harrisi</i> Emerson	Africa : Uganda
<i>C. havilandi</i> Holmgren	Asia : Indonesia; Thailand, Moriticus West Indies and Brazil (India)
<i>C. heimi</i> (Wasmann)	Asia : India, Pakistan, Bangladesh, Bhutan Nepal and Oman (Intr.)

<i>C. heteromorphus</i> Ping	Asia : China
<i>C. intermedius</i> Silvestri	Asia : Indonesia : Java and Sumatra and Thailand
<i>C. kalshoveni</i> Kemner	Africa :
<i>C. kishori</i> Roonwal and Chhotani	Asia : India:
<i>C. lacteus</i> (Froggatt)	Australia : Queensland, Victoria and N.S. Wales, and New Zealand
<i>C. menadoensis</i> Oshima	Asia : Indonesia
<i>C. michaelsoni</i> Silvestri	Australia (West) :
<i>C. minutissimus</i> Kemner	Asia : Indonesia Moena Isl
<i>C. niger</i> (Snyder)	C. America : Panama, Costa Rica, and Guatemala
<i>C. obiratus</i> Hill	Asia : Papua New Guinea : New Britain Waina, Rabaud
<i>C. orchraceus</i> Ping and Xu	Asia : China
<i>C. oshimai</i> Light and Devis	Asia : Indonesia : Celebes (Manos)
<i>C. pamuae</i> Snyder	Asia : Solomon Isl.
<i>C. perigrenator</i> Kemner	Asia : Saleir Isl.
<i>C. premasmii</i> Ahmad	Asia : Thailand : Ka-chong
<i>C. rectangularis</i> Ping and Xu	Asia : China
<i>C. reticulatus</i> Ahmad	Asia : Thailand
<i>C. remotus</i> Hill	Asia : Papua New Guinea : New Areland (Kaewieng)
<i>C. sepangensis</i> Krishna	Asia : Malaysia : Sepang
<i>C. sinabangensis</i> Oshima	Asia : Indonesia : Sumatora (Sinabang and Simalur)
<i>C. sjostedti</i> Holmgren	Africa : Wide areas.
<i>C. testaceus</i> (Linnaeus)	C. America : West Indies : Tobago, Trinidad
<i>C. travians</i> (Haviland)	Asia : India, Malaysea Indonesia Myanmar and Singapore
<i>C. truncatus</i> (Wasmann)	Africa : Madagascar, Scychelles
<i>C. vastator</i> Light	Asia : Philippines : Lugon
<i>C. xiaoliangensis</i> Ping	Asia : China

Subfamily HETEROTERMITINAE Froggatt

Genus *Heterotermes* Froggatt

<i>H. aculabialis</i> (Tasai and Huang)	Asia : China
<i>H. aureus</i> (Snyder)	S. N. & C America, Mexico, La Venta, Jalisco
<i>H. balwanti</i> Mathur and Chhotani	Asia : India (Orissa and Goa)
<i>H. canalifrons</i> (Emerson)	S. America : Brazil : Recife, Pernambuco
<i>H. cardini</i> (Snyder)	C. America, West Indies
<i>H. ceylonicus</i> (Holmgren)	Asia : Sri Lanka, Hali Ela, Peradinya

<i>H. convexinotatus</i> (Snyder)	C. America : Mexico, Panama, Costa Rica, Honduras, West Indies
<i>H. crinitus</i> (Emerson)	S. America, Guyana, Kartabo
<i>H. ferox</i> (Froggatt)	Australia : New Castle
<i>H. gaoyaoensis</i> (Tsai and Huang)	Asia : China
<i>H. gertrudae</i> Roonwal	Asia : India (Uttaranchal and H.P.)
<i>H. gingjiangensis</i>	Asia : China
<i>H. hainanensis</i> (Tsai and Huang)	Asia : China
<i>H. hunanensis</i> (Tsai and Huang)	Asia : China
<i>H. indicola</i> (Wasmann)	Asia : India, Pakistan and Afghanistan
<i>H. insularis</i> (Wasmann)	Australia : Cocos Isl.
<i>H. latilabrum</i> Tsai and Chen	Asia : China
<i>H. leptomandibularis</i> (Tsai and Huang)	Asia : China
<i>H. longiceps</i> (Snyder)	S. America : Argentina; S. Ana
<i>H. maculatus</i> (Light)	C. America, Mexico (Western)
<i>H. malabaricus</i> Snyder	Asia : India (South)
<i>H. omanae</i> Chhotani	Asia : Oman
<i>H. pamatensis</i> Kemner	Asia : Indonesia
<i>H. paradoxus paradoxus</i> (Froggatt)	Australia : Queensland
<i>H. paradoxus intermedius</i> Hill	Australia : Western Australia
<i>H. paradoxus validus</i> Hill	Australia : Northern Territory
<i>H. paradoxus venustus</i> Hill	Australia : Northern Territory and Western Australia
<i>H. perfidus</i> (Silvestri)	Asia : St. Helena Island
<i>H. philippinensis</i> (Light)	Asia : Philippines : Manila
<i>H. sulcatus</i> Mathews	S. America : Brazil
<i>H. tenuior</i> (Haviland)	Asia : Malayasia
<i>H. tenuis</i> (Hagen)	C. and S. America
<i>H. vagus</i> Hill	Australia : Brooks Creek and North Territory
<i>H. wittmeri</i> Chhotani and Bose	Asia : Saudi Arabia

Subfamily TERMITOGETONINAE

Genus *Termitogeton* Desneux

<i>T. minor</i> Thapa	Asia : Malaysia, Sabah
<i>T. planus</i> Thapa	Asia : Malaysia, Sabah
<i>T. umbilicatus</i> (Hagen)	Asia : Sri Lanka

Subfamily RHINOTERMITINAE Froggatt

Genus *Prorhinotermes* Silvestri

<i>P. canalifrons</i> (Sjostedt)	Africa : Madagascar; Seychelles.
----------------------------------	----------------------------------

<i>P. cranicus</i> (Wasmann)	Australia : Cocos Isl
<i>P. flavus</i> (Bugnion and Popoff)	Asia : Sri Lanka, India and Bangladesh
<i>P. gracilis</i> Light	Asia : Philippines
<i>P. inopinatus</i> (Silvestri)	Asia : Samoa Isl; Fiji Isl. etc.
<i>P. japonicus</i> (Holmgren)	Asia : Taiwan : Botel-Tobago Isl
<i>P. krakataui</i> (Holmgren)	Asia : Indonesia : Krakatau Isl.
<i>P. mollnoi</i> Snyder	C. America : Panama : Boro Colorado Isl., Canal Zone
<i>P. oceanicus</i> (Wasmann)	Australia : Cocos Isl.
<i>P. panaitanensis</i> Thakur and Thakur	Asia : Indonesia : Krakatau Isl.
<i>P. ravani</i> Roonwal and Maiti	Asia : Indonesia : Java
<i>P. rugifer</i> Kemner	Asia : Amboina Isl.
<i>P. simplex</i> (Hagen)	S. America : Coral Gables and North America, Miami
<i>P. tibiaoensisformis</i> Ahmad	Asia : Thailand
<i>P. tibiaoensis</i> (Oshima)	Asia : Philippines and Malaysia

Genus *Parrhinotermes* Holmgren

<i>P. aequalis</i> (Haviland)	Asia : Malaysia : Malacca ; Selangor Group
<i>P. buttel-reepani</i> (Holmgren)	Asia : Malaysia : Malacca; Indonesia
<i>P. inaequalis</i> (Haviland)	Asia : Malaysia Indonesia
<i>P. khasii khasii</i> Roonwal and Sensarma	Asia : India : Khasi Hills
<i>P. microdentiformis</i> Thapa	Asia : Malaysia : Sabah
<i>P. microdentiformisoides</i> Thapa	Asia : Malaysia : Sabah
<i>P. minor</i> Thapa	Asia : Malaysia : Sabah
<i>P. pygmaeus</i> John	Asia : Malaysia : Kuala Lumpur; Indonesia sumatra
<i>P. queenslandicus</i> Mjoborg	Australia : Queensland ; Malanda
<i>P. shamimi</i> Bose	Asia : India : Arunachal Pradesh : Itanagar

Genus *Macrorhinotermes*

<i>M. maximus</i>	Asia : Indonesia, south-east Kalimantan
-------------------	---

Genus *Schedorhinotermes* Silvestri

<i>S. bidentatus</i> (Oshima)	Asia : Philippines
<i>S. brachyceph</i> Kemner	Asia : Amboina Isl.
<i>S. brevialatus</i> (Haviland)	Asia : Malaysia
<i>S. browni</i> Harris	Asia : Solomon Isl.
<i>S. butteli</i> Holmgren	Asia : Malaysia
<i>S. celebensis</i> Holmgren	Asia : Indonesia : Celebes and Sumatra
<i>S. dimorphus dimorphus</i> Desneux	Asia : New Guinea, New Britain and Palough Isl.
<i>S. dimorphus robustior</i> Silvestri	Asia : New Guinea

<i>S. eleanorae</i> Roonwal and Bose	Asia : India : Andaman and Nicobar Isls :
<i>S. fortignathus</i> Xfa and He	Asia : China, Yunnan province
<i>S. ganlanbaensis</i> Xia and He	Asia : China, Yunnan Province
<i>S. holmgreni</i> Emerson	Asia : Indonesia : Sumatra
<i>S. insolitus</i> Xiz and He	Asia : China
<i>S. intermedius actuosus</i> (Hill)	Australia : Queensland and Northern Territory
<i>S. intermedius breinli</i> (Hill)	Australia : Queensland
<i>S. intermedius derosus</i>	Australia : Western Australia
<i>S. intermedius intermedius</i> (Hill)	Australia : New South Wales and Queensland
<i>S. intermedius seclusus</i> (Hill)	Australia : Queensland
<i>S. javanicus</i> Kemner	Asia : Indonesia, India : Gt. Nicobar
<i>S. lamanianus lamanianus</i> Sjostedt	Africa : Batswana, Mozambique Zimbabwe and Malawi
<i>S. leiboensis</i> Gao and Xia	Asia : China
<i>S. leopoldi</i> Kemner	Asia : Indonesia : Sumatra
<i>S. longirostris</i> Brauer	Asia : India : Nicobar Isl. Indonesia
<i>S. magnus</i> Tsai and Chen	Asia : China : Yunnan, Kwangtung
<i>S. makassarensis</i> Xemner	Asia : Indonesia : Celebes
<i>S. malaccensis</i> (Holmgren)	Asia : Malaysia; Indonesia : Malacea, Maxwell's Hills
<i>S. marjoriae</i> (Snyder)	Asia: Solomon Isl.
<i>S. maximus</i> Holmgren	Asia : Indonesia : Borneo
<i>S. medioobscurus</i> (Holmgren)	Asia : India; Malaysia : Malacca Singapore and Thailand
<i>S. nancowriensis</i> Maiti and Chakraborti	Asia : India : Nicobar Isl.
<i>S. putorius</i> (Sjostedt)	Africa : Cameroon, Longgi
<i>S. pyricephalus</i> Xia and He	Asia : China
<i>S. rectangularis</i> Ahmad	Asia : Thailand
<i>S. reticulatus</i> (Froggatt)	Australia : W. Australia
<i>S. sanctae-crucis</i> (Snyder)	Asia : Solomon Isl.
<i>S. sarawakensis</i> Holmgren	Asia : Indonesia, Thailand, Myanmar and Malaysia
<i>S. solomonensis</i> (Snyder)	Asia : Solomon Isl.
<i>S. tarakanensis</i> (Oshima)	Asia : Philippines (Luzon) and Indonesia
<i>S. tewarii</i> Roonwal and Thakur	Asia : India : Andaman and Nicobar Isls
<i>S. translucens</i> (Haviland)	Asia : Malaysia (Sarawak); India and Bangladesh
<i>S. umbraticus</i> (Hill)	Asia : New Britan Isl.

Genus *Rhinotermes* Hagen

<i>R. hispidus</i> (Emerson)	S. America : Guayana, Kartabo
------------------------------	-------------------------------

R. marginalis (Linne)

S. America : Guayana, Kartobo; Oronoque River

R. nasutus (perty)S. America : Guayana : Kamakusa Bolivia :
RurrenabaqueGenus *Dolichorhinotermes* Emerson and Snyder*D. hageni* (Emerson)

S. America : Equador : Gualaquiza

D. latilabrum (Snyder)

S. America : Boliira : Rio Ibon

D. longidens (Snyder)

S. America : Borro Colorado Isl; Canal Zone

D. longilabius (Emerson)

S. America : Guayana, Kartabo

D. tenebrosus (Emerson)

S. America : Guayana, Kartabo

Genus *Acorhinotermes* Emerson*A. subfusciceps* (Emerson)

S. America : Guayana, Kartabo

3.0 CENTER OF ORIGIN AND EVOLUTION
OF THE FAMILY

Based on the detailed comparative study of the imago-worker mandibles along with other characters, Ahmed (1950) had deduced that the family had evolved from an extinct ancestor which had shared the primitive hodotermitid imago-worker mandibles of *Archotermopsis*—*Stolotermes* type with three marginal teeth in the left mandibles and which also possessed ocelli. Further study of numerous characters and circumstantial evidences indicates that the Rhinotermitidae had evolved from an unknown group of termites possessing ocelli, but were otherwise similar to the primitive Hodotermitidae (Emerson, 1968, 1971).

In the Rhinotermitidae, the phylogentic relation of the included genera are more hypothetical than the other genera of different families with more consistency and conviction. The phylogenetic relations and common ancestry of different genera within each subfamily are more authentic than that of the different subfamilies. Since, it is presumed that the phylogenetic intergrades between subfamilies became extinct before the upper Cretaceous. The hypothetical phylogenetic trees of different genera under the family have been depicted in Table-I (Emerson, 1971).

Based on the study of fossil as well as the

circumstantial evidences, Emerson (1971) discussed in details the centre of origin, dispersion and evolution of the family. The concentration of a large number of species usually indicates the region of the origin of termites taxa, which may be augmented by the other circumstantial evidence. As such, it is speculated that the main centre of the origin of Rhinotermitidae is in the Oriental Region. The genera *Coptotermes* and *Heterotermes* are widely distributed in all the major tropical regions of the world. This indicates that these genera had mostly originated in early or late Cretaceous times when tropical land connections were existed which helped dispersal between the Oriental and Neotropical Regions (Emiliane, 1966) and between the Oriental and Australian Regions. The majority of the genera like *Coptotermes*, *Psammotermes*, *Heterotermes*, *Prorhinotermes* have their many species in the tropics with a few species extended to the temperate zones. *Prorhinotermes* is the only genus of the family the members of which are evidently dispersed by means of floating logs or other vegetation.

The most advanced genera of the family, such as *Rhinotermes*, *Dolichorhinotermes* and *Acorhinotermes* found in the Neotropical region only, seem to be tertiary origin.

Schedorhinotermes has originated in the oriental Region and dispersed to the different

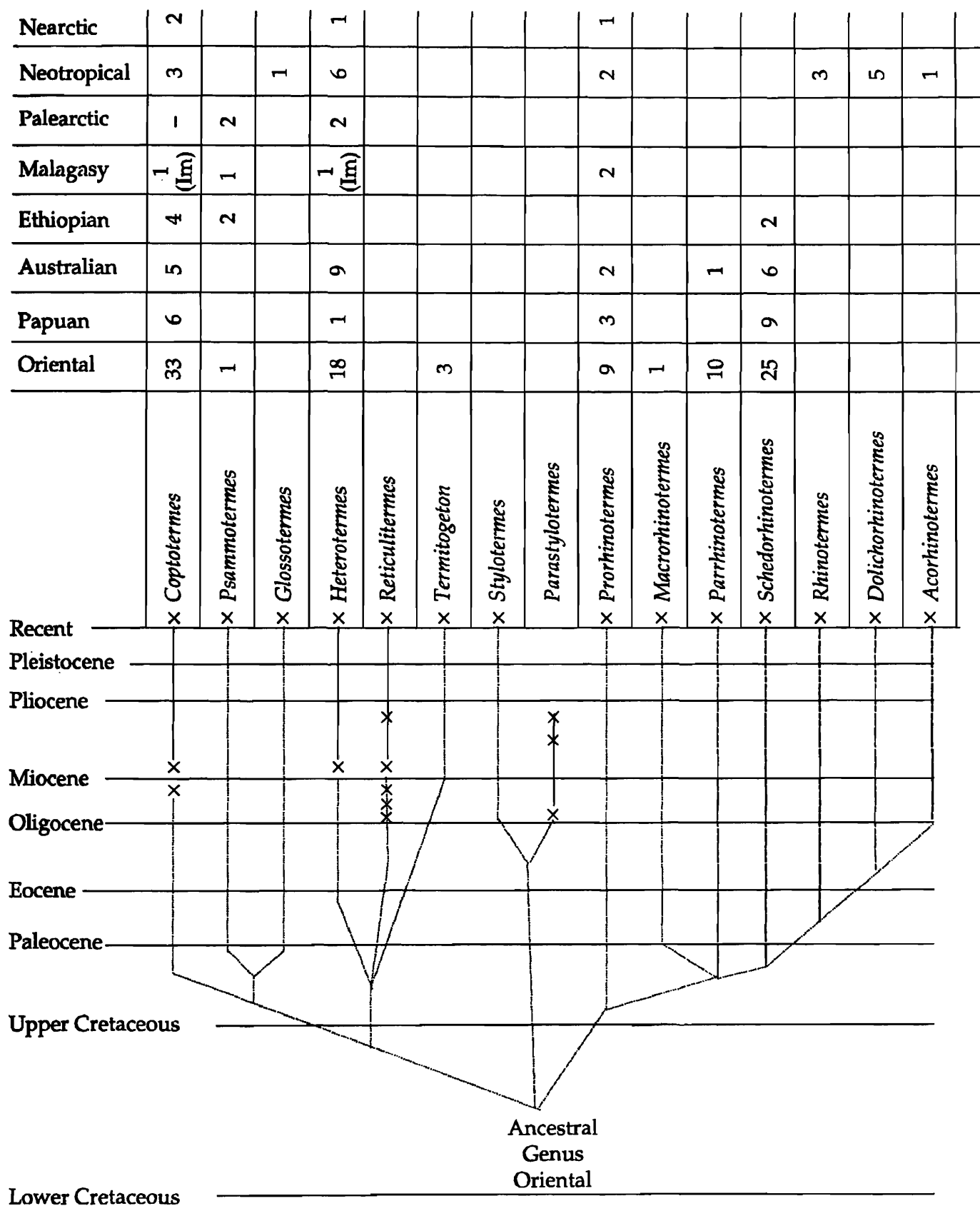


Table-I. Hypothetical phylogenetic relation, time of origin, region of Origin, geographical occurrence of fossil and living genera of the Rhinotermitidae. Dotted lines based upon structural relations. Dashed lines based upon structural and geographical relations. Solid lines based upon known fossil. X= known specimens. O = Oriental Region. A = Australian Subregion. P = Papuan Subregion. E = Ethiopian Subregion. M = Malagasy subregion. Neo = Neotropical Region. Pal. = Palaearctic Region. Nea = Nearctic Region. Number of species known from each region (Modified after, Emerson (1971).

Zoogeographical Regions in different time periods. Other tropical rhinotermetid genera are *Glossotermes* found in the Neotropics, *Termitogeton* and *Macrorhinotermes* in the Orient and *Parrhinotermes* in the Oriental, Australean and Papuan Regions.

4.0. BIOLOGY

The members of the family usually nest inside the moist wood generally buried in soil or tree trunk, but forage to dry wood above the ground. The foraging tunnels are normally coated with chewed wood and excreta, through which the insects reach the food sources. Mound-building species of *Coptotermes* in Australia are only exception, whose mounds are characterized by a tough, clab outer wall enclosing a tough woody honey comb interior. Apart from the mandibular defence of soldier the defensive measure of the colony is taken by exuding copious amount of white fluid from the frontal pore of the soldiers. Digestion of wood is carried out by the intimate symbiosis of the intestinal protozoan flagellates with termites. Termites being primarily tropical insects. *Reticulitermes* occurs in the northern Temperate Zone, while the genus is replaced by *Heterotermes* in the tropics. The genus *Coptotermes* is widely distributed throughout the tropics which contains most destructive species of Isoptera. Of course, some species of pest status belong to *Heterotermes* also, with its extended distribution in all the major Zoogeographical Regions except in the Palaearctic and Papuan Regions. Some members of the family especially belonging to *Reticulitermes* (8 spp.) are quite capable of being introduced in different countries from its Centre of Origin.

5.0. SYSTEMATIC ACCOUNTS

5.1 Key to the Subfamilies of RHINOTERMITIDAE

A. IMAGOS

1. Forewing scale not longer than of hindwing scale PSAMMOTERMITINAE

- Forewing scale always longer than of hindwing scale. 2
- 2. Postclypeus strongly convex, generally projected medially in front, fontanelle groove running in front, sometimes upto tip of labrum or a little shorter RHINOTERMITINAE
- Postclypeus almost flat or weakly convex, not projected medially in front, fontanelle groove not marked.
- 3. Head triangular in shape, pronotum small with strong antero-median projection TERMITOGETONINAE
- Head not triangular, rather either round or oval, pronotum large and devoid of any antero-median projection.
- 4. Head suboval, lateral margins substraight HETEROTERMITINAE
- Head subround, lateral margins strongly convex COPTOTERMITINAE

B. SOLDIER

1. Head and body strongly pilose, Head subtriangular, dorso-ventrally strongly flattened, posterior margin uniformly incurved with a median outbulge, pronotum small with strong antero-median projection TERMITOGETONINAE
- Head and body not so strongly pilose; head subsquarish or rectangular or oval, dorso ventrally not so flattened, posterior margin normally rounded or substraight; pronotum large, flat, weakly saddle shaped in some cases.
2. Head subsquarish or rectangular 3
- Head oval or roundly oval 4
3. Species either dimorphic or trimorphic, head either subsquarish or subrectangular; mandibles with more marginal teeth, labrum broadest slightly below the middle with strong median projection, generally in large soldiers PSAMMOTERMITINAE

- Species generally monomorphic, at times dimorphic, head generally subrectangular, mandibles devoid of any marginal teeth, rather with a few crenulations at base, labrum triangular, either with hyaline needle like apex or without needle..... HETEROTERMITINAE
- 4. Species either monomorphic or dimorphic, each mandible with 1-2 sharply pointed teeth, fontanelle small and placed anteriorly at the level of antennae with a forwardly running groove either reaching to clypeus or tip of labrum..... RHINOTERMITINAE
- Species monomorphic, mandibles with a few crenulations on basal half; fontanelle large, placed slightly below the clypeus and devoid of any fontanelle groove COPTOTERMITINAE
- 5. Soldier either dimorphic or trimorphic; apical tibial spure 3 : 2 : 2 ; left mandible with number of crenulations on almost entire inner margin; labrum with a apical median projection and devoid any transverse band *Psammotermes* Desneux
- Soldier monomorphic; apical tibial spurs 2 : 2 : 2; left mandible with crenulations only on basal inner margin; labrum devoid of any median apical projection, but with transverse band *Glossotermes* Emerson
- 6. Labrum tongue-shaped, sometimes weakly pointed at apex otherwise blunt *Reticulitermes* (Holmgren)
- Labrum tongue-shaped, either with a needle-like hyaline apex (oriental species) or not so pointed apex (other than Oriental species), rather somewhat round *Heterotermes* Froggatt
- 7. Frontanelle opening larger and placed behind the clypeus *Coptotermes* Wasmann
- Frontanelle opening smaller and placed much below the clypeus 8
- 8. Labrum without daubing brush (fringe of hairs) at tip *Prorhinotermes* Silvestri
- Labrum with daubing brush at tip 9
- 9. Soldier monomorphic *Parrhinotermes* Holmgren
- Soldier dimorphic *Schedorhinotermes* Silvestri
- 10. Labrum broadly tongue-shaped wider than long. Head narrow, sides converging posteriorly (sold. min.) *Rhinotermes* Hagen
- Labrum elongate, longer than wide (sold. maj. which lacking in *Acorhinotermes* Emerson.
- 11. Fontanelle lying anteriorly on head (sold. min.) *Dolichorhinotermes* Snyder
- Fontanelle lying on forward projection of head *Acorhinotermes* Emerson

5.2 Key to the genera of Rhinotermitidae
Froggatt

- 1. Head triangular, profusely hairy and strongly flattened dorso-ventrally, posterior margin strongly incurved with a distinct median bulge; pronotum small with sharp projection *Termitogeton* Holmgren
- Head subsquarish, rectangular or oval, not flattened dorso-ventrally, posterior margin normally rounded or weakly wavy, head moderately hairy; pronotum large, flat or slightly saddle-shaped 2
- 2. Fontanelle devoid of any forwardly running groove 3
- Fontanelle with distinct groove either running upto base or clypeus or tip of the labrum. 8
- 3. Head subsquarish or rectangularish 4
- Head oval or roundly oval 7
- 4. Labrum very broad at the middle, generally longer than broad 5
- Labrum not so broad at the middle, generally longer than broad 6

6. CHARACTERS OF THE GENERA AND SPECIES

Subfamily PSAMMOTERMITINAE

Genus *Glossotermes* Emerson

1. *Glossotermes* Emerson

1950. Emerson, *Amer. Mus. Novit.*, No. 1444, p. 2. Type Locality Itabu Creek, Tributary of upper New River, Acary Mountains, Guayana, South America (of *G. Oculatus* Emerson).
1955. Emerson, *Fieldiana Zool.*, 37 : 492
1989. Roonwal and Chhotani, *Fauna of India* (Isoptera). 1 : 406, 408.
1970. Krishna, In : *Biology of Termites* (Eds. Krishna and Weesner), 2 : 137, 138.
1970. Araujo, In : *Biology of Termites* (Eds. Krishna and Weesner), 2 : 533
1971. Emerson, *Bull-Amer-Mus.nat.His.*, 146, 248, 251.

(Type of Genus : *Glossotermes oculatus* Emerson a. History, Distribution, Composition, etc.

The genus was established by Emerson (1950) based on a single soldier of *G. oculatus* Emerson collected in a rain forest about 2000 feet elevation, Acary Mountains, Guayana. The soldier of *G. oculatus* is characterised by eye spot and distance clypens which are considered more primitive characters. However, the genus is closely related to *Psammotermes* which is more primitive with reference to its mandibles, antennae and tibial spur formula. The common ancestral genus of these two genera evolved in Mesozoic time (Emerson, 1950). *G. oculatus* is the only species represented so far in the genus.

b. General character : IMAGO : Unknown.

Soldier : Head subrectangular, almost devoid of hairs. Fontanelle very small and circular, placed slightly above the middle. Antennae with 1...segments, 2-4 variable in shape and size. Postclypeus well marked from frons, much broader than long, anterior margin somewhat uneven. Labrum large, elongately dome-shaped, widest slightly above the base whence gradually narrowing anteriorly and terminating into a feeble outcurved anterior margin, a few

transverse faint marking of visible size. Mandibles slender with broad base and very tapering fine apices, left without any tooth and right with numerous cremulations gradually increasing in size towards basal portion. Ocelli suboval, placed below the antennal incision. Postmentum club-shaped with broad anterior margin, waist at posterior fourth, few hairs on anterior end. Pronotum much narrower than head, anterior margin distinctly outcurved with tuft of hairs on either side of the deep median notch, antero-lateral angles round, lateral margins outcurved and gradually narrowing posteriorly and terminating into a distinct median notch.

1. *Glossotermes oculatus* Emerson

1950. Emerson, *Amer. Mus. Novit.*, No. 1444, p.2. S. only. Type-Locality : Itabu Creek, Tributary of upper New River, Acary Mountains, Guayana, South America.
1970. Araiyo, in : *Biology of Termites* (Eds. Krishna and Weesner), 2 : 533.

Material : No material was available for study, the diagnostic characters are based on Emerson (1950).

Diagnostic character : Since the genus is represented by only species *G. Oculatus*, the general characters of the genus stand for the species also (i) Imago – Unknown. (ii) Soldier – (Fig. 1, A-D)

Measurements : Head–Length 1.56; Head – Width 1.10; Widest width of postmentum 0.43; Narrowest width of postmentum 0.22; Labrum width 0.53; Mandible length (Lt.) 1.09; Pronotum length 0.47; Pronotum width 0.78

Types – Holotype : S in AMNH New York

Distribution : SOUTH AMERICA ; Guayana, Itabu-creek, Acary Mountains.

Remarks : This is the only species of the genus so far known from its type-locality in South America represented by a single soldier collected in a rain forest at about 2000 ft. elevation (Emerson, 1950).

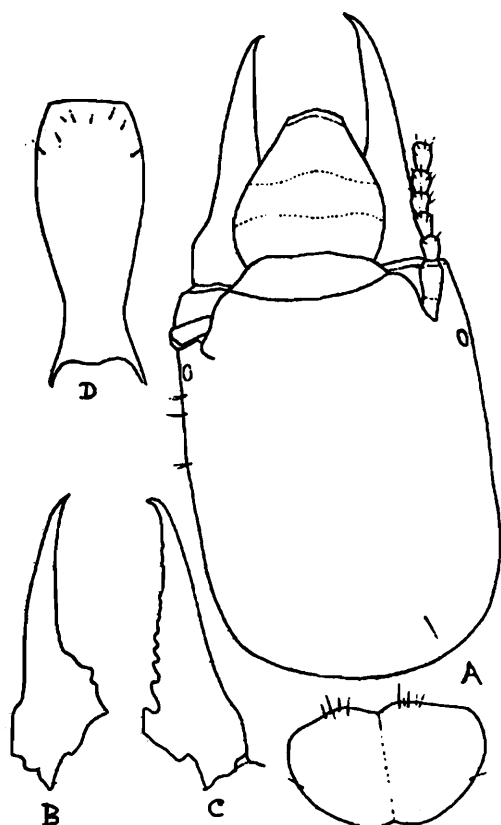


Fig. 1. *Glossotermes oculatus* Emerson; A–D soldier, A. Head and pronotum in dorsal view; B. Left mandible; C. Right mandible; D. Postmentum.

Genus *Psammotermes* Desneux

1902. Desneux, *Ann. Soc. Ent. Belg.*, 46(10), : 436.
1904. Desneux, In P. Wytman's *Genera Insect*, 25 : 24.
1911. Holmgren, K. *Sv. Vet. Akad. Handl*, 46 (6) : 62, 65-66, 67, 68.
1921. Fuller, S. *Afr. J. nat. Hist*, 6(2) : 20, 23, 46.
1926. Sjostedt, K. *Sv. Vet Akad. Handl*, (3) 3(1) : 45.
1928. Emerson, *Bull-Am-Mus.nat.Hist.*, 57(Art. 7) : 406, 423.
1949. Snyder, *Smiths. misc. Colls.*, 112 : 64-66.
1950. Emerson, *Am. Mus. Novit*, No. 1444 : 4.
1950. Ahmad, *Bull. Am. Mus. nat. Hist*, 95(Art.2) : 53, 54, 75.
1955. Weidner, In *Die Termiten* (Ed. Schridt) : 54, 69.
1955. Emerson, *Fieldiana : Zool*, 37 : 473, 479, 483, 484, 509.
1961. Harris, *Termites : Their Recognition and Control* 50 (2nd Edition, 1971).
1962. Roonwal and Bose, *Rec. Indian Mus.*, 58 (3 & 4) : 151-152.
1962. Roonwal, Chhotani and Bose, In *Termites in Humid Tropics* (Proc. N. Delhi Symps., Oct. 1960) : 51-54.
1964. Roonwal and Bose, *Zoologica*, 40 (13) : 8.
1965. Buillon and Mathot, *Zooleo*, No. 1 : 20.
1966. Buillon and Mathot, *Zooleo*, No. 1 (Suppl. 1) : 4, 6 and Table.
1970. Krishna, In *Biology of Termites* (Eds. Krishna and Weesner) 2 : 137, 138.
1970. Roonwal, In *Biology of Termites* (Eds. Krishna and Weesner) 2 : 332.
1971. Emerson, *Bull. Am. Mus. nat. Hist*, 146 (Art. 3) : 251, 256, 257, 259, 262.
1971. Buillon and Mathot, *Zooleo*, No. 1 (Suppl. 2) : 7.
1972. Chaudhry and Ahmad, *Termites of Pakistan* (Final Tech. Rep. PL 480 Proj.) : 12.
1973. Coaton and Sheasby, *Cimbebasia*, (4) 3 (3) : 20.
1973. Chhotani and Bose, *Zool. Anz.*, 190(3/4) : 233, 234.
1974. Akhtar, *Pakistan J. Zool*, 6(1/2) : 90, 91, 96, 97, 98, 99, 100.
1975. Emerson, *Am. Mus. Novit*, No. 2570 : 13, 14, 15, 16, 17, 18, 19, 20, 21, 22.
1979. Chhotani and Bose, *Fauna of Saudi Arabia*, 1 : 82.
1979. Roonwal, Verma and Thakur, *Proc. Indian natnl. Sci. Acad*, (B) 45 (4) : 333-334, 351.
1983. Roonwal, *Proc. Indian natnl. Sci. Acad*, (B) 49 (5) : 363, 387.
1983. Chhotani, *Oriental Insects*, 17 : 111, 112, 114, 119.
1983. Chhotani and Bose, *Fauna of Saudi Arabia* 5 : 124, 127.
1985. Chhotani, *Z. ang. Ent*, 100 : 91, 92, 93.
1986. Grasse, *Termitologia*, 3 : 519.
1989. Thakur, *Indian For. Rec. (N.S.) (Ent.)*, 15(1) : 13.

Type of Genus : Psammotermes hybostoma Desneux.

a. History, Distribution and Composition

The genus *Psammotermes* Desneux was established by Desneux in 1902 to accommodate his species *P. hybostoma* from Algiers (Biskra) based on soldier major only. However, quite a number of species had been described upto to 1924 from Africa of which some species lost their identity as synonymies. Prior to discovery of a species, *P. rajasthanicus* from the Indian Thar desert, three species stand valid. Four specis are on record now respectively from the palaeartic,

oriental, Malagasy and Ethiopian Regions : *P. hybostoma* Desnux (of which *P. assuanensis* Sjostedt, *P. fuscofemorales* (sjostedt) and *P. senegalensis* Sjostedt are junior synonymy) is widely distributed in the Arabian peninsula and desert areas of Africa. *P. voeltzkowi* Wasmann is found in the arid South-Western region of Madagascar, while *P. allocerus* Sivestiri occurs in Namib Desert, northern Zululand and Southern Mocambique. *P. rajasthanicus* Roonwal and Bose is distributed in the arid areas of North-west India and South-West Pakistan. The genus is presumed to have originated in Africa in Eocene period (Emerson 1955, 1971) and well spread to the arid habitats with its four valid species known so far.

Some of the included species are represented by dimorphic and trimorphic soldiers and workers.

b. General Character

(i) IMAGO : Head broadly oval and dorso-ventrally flattened. Fontanelle large, round, placed almost medially. Antennae with 15-17 segments, gradually narrowing toward apical segments. Eyes blackish and small. Postclypeus short, convex, pilose. Mandibles with apical and two marginal teeth. In left, apical finger-like and larger than 1st and subequal to 2nd, 3rd smaller than 2nd and with long posterior margin. In right, apical as in left, 1st small and very small and adpest at base of 2nd marginal, 2nd as in apical, 3rd smaller and with long posterior margin being almost equal to molar plate. Pronotum shorter than head width, slightly raised anteriorly.

Wings short, moderately broad, membrane transparent, devoid of hairs. Forewing : costa thick and running along the margin, subcosta indistinct, radius close and parallel to costa, joining it at distal end, media and cubitus joined together separating just before middle of wing. Cubitus with 6-10 branches. Hind wing : Costa, subcosta and radius as in forewing; media separating from radius just outside scale. Curbitus arising separately and with 6-10 branches. Apical tibial spur formula 3 : 2 : 2. Styli present in male.

(ii) SOLDIER : Dimorphic or trimorphic. Head subrectangular and dorso-ventrally much flattened, head almost squarish in large soldier. Eyes and Ocelli absent. Fontanelle distinct and circular with a chitinised boarder, placed a little above the middle with a forwardly running groove almost reaching the base of labrum. Antennae with 12-17 segments, segments gradually narrowing anteriorly, 3 distinctly large. Postclypeus flat with distinct posterior boarder. Labrum somewhat pentagonal with a medially pointed tip in larger soldiers and roughly tongue-shaped in smaller soldiers. Mandibles with broad base, gradually narrowing anteriorly and terminating into weakly incurved apices, inner margin with 5-9 marginal teeth. Postmentum roughly club-shaped and more slender at waist. Pronotum flat and almost as wide as head. Tibial spur formula 3 : 2 : 2. Tarsi 4- joined. Cerci 2-jointed and styli 1-jointed.

Key to the species of *Psammotermes* Desneux

1. Pronotum longish in proportion to its width, pronotum index (length/width) 0.74 - 0.83; Labrum broadly dome-shaped 2
 - Pronotum not longish in proportion to its width, pronotum index 0.63 - 0.69; labrum not so dome-shaped 3
2. Larger species, head-length 2.14, head width 1.80; head densely hairy; Labrum almost as long as broad, width almost at the middle; postmentum waist much above the posterior margin *P. voeltzkowi* Wasmann
 - Smaller species, head-length 1.80, head width 1.03; head very sparsely hairy; labrum much wider than long, widest much above the middle; postmentum-waist almost on posterior margin *P. allocerus* Silvestri
3. Larger species, head-length 1.80-2.00, head-width 1.35-1.50; Labrum as long as broad or slightly broader, lateral sides less outcurved; incurved lateral margins of postmentum above the widest width; pronotum sparsely hairy *P. rajasthanicus* Roonwal & Bose

- Smaller species, head-length 1.69, head width 1.26; Labrum much broader than long; lateral sides strongly outcurved; not incurved lateral margins of postmentum above the widest width; pronotum fairly densely hairy
..... *P.hybostoma* Desneux

2. *Psammotermes allocerus* Silvestri

1. *Psammotermes allocerus* Silvestri

1908. Silvestri, *Denkschr. Nat. Ges.*, 13 : 3, pls. 8-10, S. and W. Type-locality : Liideritz bucht, south Africa, Coll. L. Schultze, 1904.
1914. Sjostedt, In : Michaelsen, W. (Ed.) *Beitr. Kenn. Land and Suss wass erfauna Deut. Sudwest*, Hanburg, p. 17.
1919. Fuller, *Ann. Natal. Mus.*, 4 (1) : 79.
1920. Fuller, *Ann. Natal. Mus.*, 4 (2) : 290.
1921. Fuller, *S. Afr. J. nat. Hist.*, 3 (1) : 46.
1949. Snyder, *Smiths. misc. Coll.*, 112 : 65.
1949. Coaton, *Bull. Dept. agric. For. Un. S. Afri. Ent.*, 299 : 5.
1962. Coaton, *Koedoe*, 5 : 148.
1963. Coaton, *Koedoe*, 6 : 47.
1970. De Carvalho, *Rev. Cienc. Agron.*, 3 (4) : 151.
1972. Coaton and Sheasby, *Cimbeb. Mem.*, 2 : 57.
1973. Coaton and Sheasby, *Cimbeb.*, (A) 3 : 20 28.
1989. Roonwal and Chhotani, *Fauna of India*, 1 : 410.

2. *Psammotermes fuscofemoralis*

(nec. Sjostedt)

1913. Holmgren, *Ent. Tidskr.*, 34 : 323.
1926. Sjostedt, *K. Sw. Vet. Akad. Hand.*, (3) 3 : 48, (Zululand record only).

Material : In Z.S.I., Kolkata : 1 Im. (Metatype) from Ambassa and 2s. (cotypes) from Luderutzvycht.

Diagnostic character : (i) *Imago* : Not available for study.

(ii) **SOLDIER MAJOR** Fig. 2(S.) : Head yellowish brown, labrum slightly paler, pronotum yellowish white, antennal base and mandibular apices blackish brown. Head almost devoid of

hairs, pronotum sparsely and abdomen minutly and densely hairy.

Head rectangular, lateral sides parallel, feebly diverging anteriorly, posterior margin subround. Antero-lateral corners prominent. Frontanelle circular, very small with short anteriorly running groove becoming indistinct towards postclypeus. Postclypeus strip-like and weakly swollen. Labrum dome-shaped, lateral sides strongly convex, maximum width at anterior third whence converging anteriorly and terminating into a blunt and hyaline apex with incurved margins on either sides. Mandibles of typical *Psammotermes*-type.

Antennae with 12 segments ? 3 subequal to basal one, 2 smallest, 4 slightly larger than 3. Postmentum club shaped, maxium width on anterior fifth and waist almost half the maximum width.

Pronotum as wide as head, anterior margin feebly outcurved with deep median notch, lateral margins converging posteriorly, posterior margin feebly incurved at the middle.

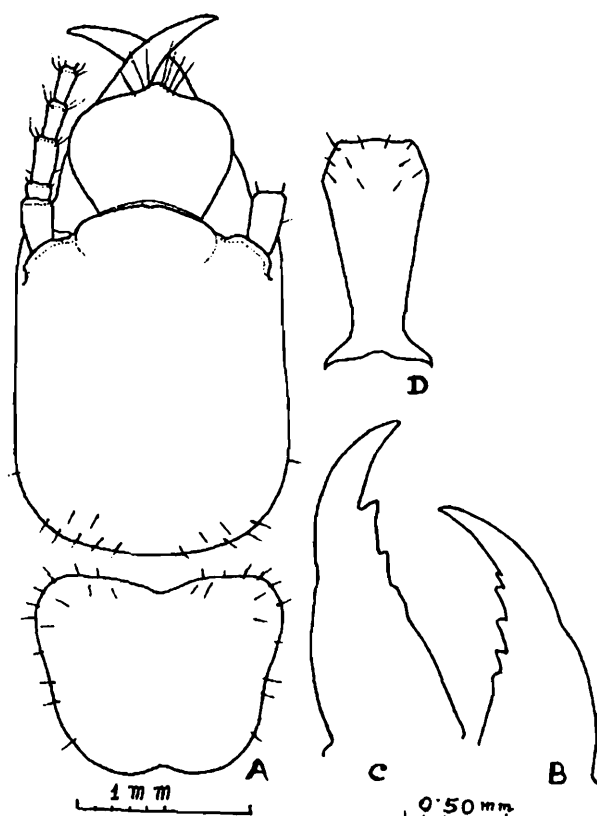


Fig. 2. *Psammotermes allocerus* (Silvestri); A-D. Soldier (Major). A. Head and pronotum in dorsal view; B. Right mandible; C. Left mandible; D. Postmentum.

(iii) **SOLDIER (Minor)** : Very similar to *S.* major, but smaller in size, except the following characters. Head very light yellowish, elongately oval and sides weakly convex. Labrum unlike major, lanceolate in shape. Antennae with 14 segments, 2 smallest, 3 conical and largest, other becoming narrower towards apex. Postmentum fairly narrowed at the waist.

Measurements : Table 2 (*S.*, maj. and min.)

Types : All types donated by Prof. A. E. Emerson, New York, to the following Institution :

(i) **In F.R.T. Dehra Dun** : Metatypes : 13s. and 3w. from Abassas; *Cotypes* : 15s. from Luderitzbucht South West Africa.

(ii) **In Z.S.I., Kolkata** : 1 Im and 2s. *Metatypes* from Abassas and 2 s. *Cotypes* from Luderitzbucht, South West Africa.

(iii) **In N.C.I., Pretoria** : *Syntypes* *S.* from Luderitz bucht, *L. Schultze Coll.*, 1904.

Distribution : Africa : South West Africa : Nomaland, Salsola-Dunen; Angolan Batswana; Mocambique; South Africa; South West Africa, Rhodesia (For detail, distribution, Coaton and Sheasby, 1972). The distribution of the species in South and South West Africa have been demarcated clearly, but its northern limit will be established after survey of Southern Angola, Botswana, Southern Zambia, Rhodesia and Mocambique.

Remarks : The species inhabits in colonies occupying nests of their own construction situated in the soil. It survives under widely differing conditions of rainfall, altitudes and soil types. The species causes serious damage to structural timber, wooden fitting, books, flooring boards, dwelling house, etc. It also attacks the growing plants. Very little is known about the swarming flights, although imagoes are found in the nest in July (Coaton and Sheasby, 1972).

3. *Psammotermes hybostoma* Desmeux

1. *Psammotermes hybostoma* Desmeux

1902. Desmeux, *Ann. Soc. Ent. Belg.*, 46 (10) 437, *S.* maj. and *S.* min., 2 figs. *Type-locality* : Biskra, Algiers.

1926. Sjöstedt, K. *Sven. Vet. Akad. Handl.*, (3) 13 (1) : 7.

1949. Snyder, *Smiths, misc. coll.*, 112 : 65.

1970. Harris, *Biology of Termites*, Eds. Krishna and Weesner, p. 306.

1979. Chhotani and Bose, *Fauna Saudi Arabia*, 1 : 75-77

2. *Psammotermes assuanensis* Sjöstedt

1912. Sjöstedt, *Ark. iv. Zool.*, 7 (27) : 3, *S.* *Type-locality* : Assuan, Upper Egypt.

3. *Psammotermes fusofemoralis* Sjöstedt

1904. Sjöstedt, K. *Sven. Vet. Akad. Handl.*, 38 (4) : 62, Im. and W. *Type-locality* : Red Sea.

4. *Psammotermes senegalensis* Sjöstedt

1924. Sjöstedt, *Rev. Zool. Africaine*, 12 (4) : 495, *S.* maj. and min. *Type-locality* : Dakar, Senegal.

Material : (i) *In Z. S. I., Kolkata* : 1 Im. and 1 W. from Abo-El-Rish and 1S. from Kasr - El-Gibaly; *In F. R. I., Dehra Dun* : 8 Im., 6S. and 8W, Kasr-EL-Gibaly near Faiyam, Abo-El-Risk, Egypt.

Diagnostic character : (i) **IMAGO** (Fig. 3A.) Head, pronotum, abdomen profusely hairy. Head deep brown posteriorly, other parts mostly pale brown, except antennae with yellowish white.

Head somewhat round, narrowing posteriorly with rounded posterior margin. Fontanelle dot-like, placed on anterior margin of prominent mid-dorsal spot. Postclypeus not so swollen with a distinct median line. Labrum roundish with some uniform hairs. Mandibles of typical *Psammotermes* type. Antennae with 16 segments, 2 larger than 3 and 4, 3 smaller, 4 slightly larger than 3. Pronotum slightly narrower than head width, anterior margin weakly outcurved with a broad median emargination, lateral margin feebly narrowing posteriorly, posterior margin with indistinct emargination.

(ii) **SOLDIER** (Fig. 3B-C; 4 A-D) : Head yellowish brown, paler anteriorly. Labrum, pronotum and distal end of antennae yellowish white. Head sparsely, pronotum and abdomen somewhat densely hairy.

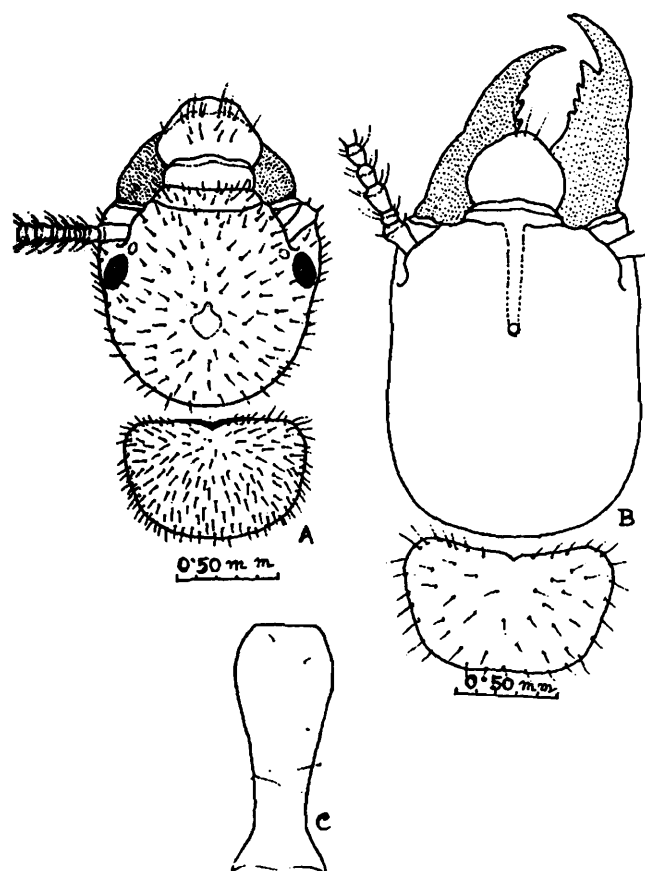


Fig. 3. *Psammotermes hybostoma* (Desneux); A. Imago. A. Head and pronotum in dorsal view. B-C. Soldier (Major). B. Head and pronotum in dorsal view; C. Postmentum.

Head rectangular slightly longer than wide, sides weakly depressed. Frontanelle distinct, circular, placed at slightly above the middle with forwardly running groove becoming faint anteriorly. Labrum widest on the posterior third whence narrowing anteriorly terminating into bleent hyaline apex set with erect bristle. Mandible of typical *Psammotermes*-type. Antennae with 13 segments, 3 conical and more chitinised, double of 2 and much longer than 4. Postmentum club-shaped, widest on anterior fifth, waist slightly below the middle.

Measurements : Table 1 (1m.) ; 2 (S.).

Types : Syntype S. in National Collection of Insect, South Africa.

Distribution : Africa : Algeria : Abo-El-Rosh; Kasr-El-Gibaly. Saudi Arabia : Riyadh, Riyadh Wireless Station, Pe trif. Forests, Wadi Araidam, Wadi Tumair, Wade Shaib Luha, Hofuf Road and Horeimele Chhotani and Bose, 1979) and Al Lith (Harrus, 1957).

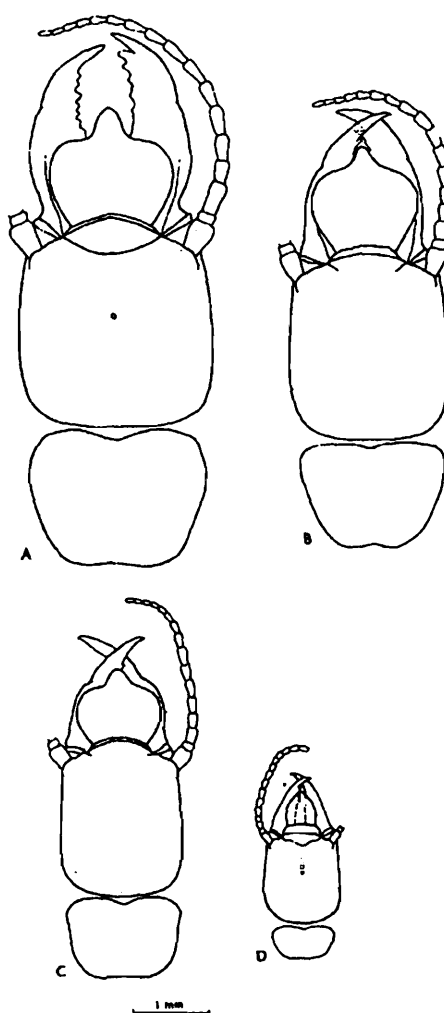


Fig. 4. *Psammotermes hybostoma* (Desneux). A-D. Soldier (Maj. and Min.).

Remarks : *P. hybostoma* Desneux is widely distributed in the Arabian Peninsula and in the desert regions of Africa, north of a line linking Eritrea in the east with Senegal in the west (Coaton and Sheasby, 1973). Soldier (major) of the species is variable in size measuring three types. Apart from the very smaller size of the soldier (minor), its labnum is devoid of any emargination on either side of the apex.

4. *Psammotermes rajasthanicus*

Roonwal and Bose

Psammotermes rajasthanicus

Roonwal and Bose

- 1960. Roonwal and Bose, *Sci. & Cult.*, 26 (1) : 38-39. S. and W. Type-locality : Balana, 30 km. E. of Mohangarh, Dist. Jaisalmer, Rajasthan, India.
- 1962. Roonwal and Bose, *Rec. Indian Mus.*, 58 (3 and 4) : 152-158, S. and W.
- 1962. Roonwal, Chhotani and Bose, *In Termites in Humid Tropics* (Proc. New Delhi symp.), 51-54.

1964. Roonwal and Bose, *Zoologia*, 40 (13) : 12-14.
 1969. Roonwal and Bose, *Rec. Zool. Surv. India*, 61 (3-4) : 438, 445, pl. 21.
 1970. Roonwal, In : *Biology of Termites*, (Eds. Krishna and Weesner), P. 332.
 1974. Akhtar, *Pakistan J. Zool.*, 6 (1-2) : 90, 101.
 1976. Roonwal, *Zool. Jb. (Syst.)*, 103 : 464, 465, 483.
 1978. Roonwal and Bose, *Proc. Indian natn. Sci. Acad. (B)* 44 (5) : 320, 322.
 1986. Grasse, *Termitologia*, 3 : 520.
 1988. Roonwal, *Indian J. Ent.*, 47 (4) : 455-460.
 1989. Thakur, *Indian For. Rec., (Ent)*, N.S., 15 (1) : 13-14, S. and W. Gujarat.

Material : In Z.S.I., Kolkata : Holotype S. and paratypes S. and W. from the type-locality.

Diagnostic characters : (i) *Imago* : Unknown.

(ii) **SOLDIER** : Polymorphic soldiers (major, medium and minor) **Soldier (maj.)** (Fig. 5.A-B)—Head straw yellow, with brownish mark between fontanelle and clypeus. Head hairy and rest of the body densely hairy. Head subrectangular flat, longer than broad, sides substraight, posterior corners rounded. Fontanelle distinct, rounded and situated slightly above the middle with a groove meeting upto base of labrum. Eyes and ocell absent. Antennae with 14-15 segments, 2 shortest and half the 3, 4 shorter than 3. Mandibles long, sabre-shaped. Left with 6-8 and right with 4-6 irregular teeth. Labrum subpentagonal, crown-shaped and demarcated into 3 lobes - an apical and 2 lateral ones. Postmentum club-shaped, slightly narrowing at waist. Pronotum flat and subtrapezoidal.

(iii) **SOLDIER (medium)** and **SOLDIER (minor)**—very similar in all morphological characters, but smaller in size in all respect.

Measurements : Table-2 (S. maj., medium, min.)

Types In Z. S. I., Kolkata : Holotype S. from the type-locality.

Distribution : Asia : India (North-Western India) and Pakistan in the arid areas.

India : Arid districts of Rajasthan (western India). e.g. Barmer, Jaisalmer, Jodhpur and

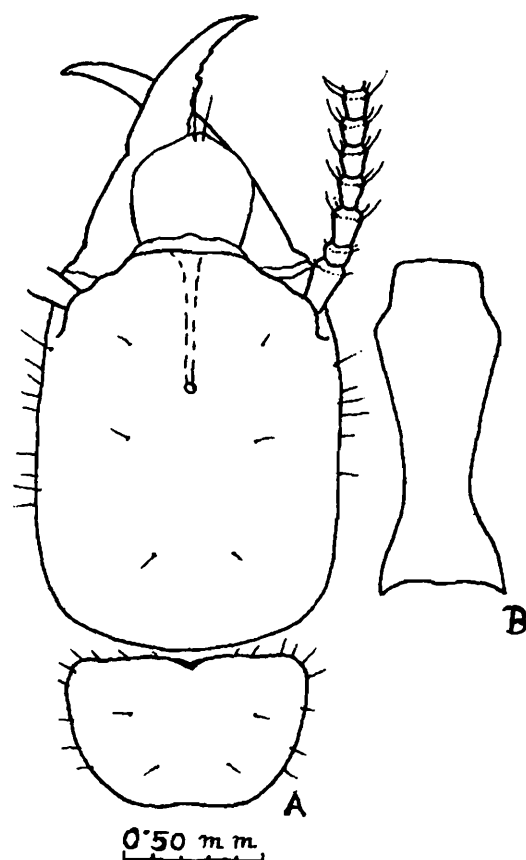


Fig. 5. *Psammotermes rajasthanicus* Roonwal and Bose. A-B. Soldier (major). A. Head and Pronotum in dorsal view; B. Postmentum.

Bikaner. Pakistan : All over southern and western Pakistan (for details, vide Roonwal and Chhotani, 1989). Gujarat.

Remarks : The species is generally found under the bark of trees in wooden works in building, cowdung, stones, in open area in the arid zones of Rajasthan and Gujarat in India and Pakistan.

5. *Psammotermes voeltzkowi* Wasmann

Psammotermes voeltzkowi Wasmann

- 1910a. Wasmann, In. Voeltzkow, Reise in Ostafrika. *Wise. Ergeb.*, 3 (2), p. 122, S. (maj.) and S. (min.) *Type-locality* : Madagascar : Tulear.
 1926. Sjostedt, K. *Svensk. Vet. Akad. Handl.*, (3) 3 (2), p.50.
 1949. Synder, *Smiths. Mus. Coll.*, 112 : 66, Madagascar, p. 5.
 1970. Paullan, In : *Biology of Termites* (Eds. Krishna and Weesner) 2, P292, Madagascar.

Material : In Z.S.I., Kolkata, Metatype IS. (maj)", IS. (min) and 1W. 25 km. E. of Ambavombe; near Mandrany R., Madagascar, Coll. H. Kirby, 12. vi. 1935, det. and Comp. A.E. Emerson.

Diagnostic character : (i) Imago : Unknown. (ii) **Soldier (major)** (Fig. 6, A-B), Head, base of mandible and antennae pale yellow; labrum and pronotum paler. Head very sparsely and pronotum sparsely hairy.

Head much longer than broad, somewhat narrowing anteriorly with much broader towards the posterior end. Labrum dome-shaped with pointed apex, almost as long as broad widest at the middle whence narrowing both anteriorly and posteriorly tip with tapering end with erect hairs. Antennae with 16 segments, 2 less than half the 3, rest of the segments gradually narrowing anteriorly. Mandible much more than half the head length with much pointed apices.

Postmentum long and narrow, widest width at the anterior fourth and waist more towards posterior end, one and a half times less than its maximum width. Pronotum much elongated, anterior end with feeble emargination and posterior end almost substraight, lateral margins converging posteriorly.

(iii) **Soldier (minor)** (Fig. 6, C-D) : Very similar to soldier major, smaller in size and paler in

colour; head almost rectangular with much rounded posterior end; labrum roughly dome-shaped reaching almost half the length of mandible. Antennae with 15 segments not narrowing anteriorly like the soldier (major). Mandibles somewhat substraight with denticular serration on both the mandibles. Postmentum broadly elongated, not so narrowed at the waist. Pronotum with distinct median emargination on anterior end and substraight posteriorly.

Measurements : Table 3 (S., maj. min.)

Types : Metatypes 1s. (major) 1s. (Min) and 1W. from 25 km. E. of Ambavombe, near Mandrany R., Madagascar, Coll. H. Kirby, 12.vi.1935, det. and comp. A. E. Emersen.

Distribution : Madagascar : Ambavombe, near Mandrany R., Tulear.

Remarks : The species is highly destructive to timbers in buildings in the arid south west as *Heteretermes* in the humid north-west. The species is also a serious pest of Sorghum in the field in South Madagascar (Paulian, 1970).

Table-1. Measurements (in mm) etc., of Caste -Imago

<i>Psammotermes</i> sp.	<i>P. hybostoma</i>
Length of head to lateral base of mandibles	1.00
Max. width of head (without eyes)	1.11-1.14
Max. length of postclypeus	0.11-0.15
Max. width of postclypeus	0.53-0.54
Max. length of labrum	0.123
Max. width of labrum	0.42
Max. diameter of compound eye (with ocular sclerite)	0.11-0.13
Max. diameter of lateral ocellus	0.07
Min. eye-ocellus distance	0.03
Max. length of pronotum	0.57
Max. width of pronotum	0.92
Max. width of pronotum	0.96
Length of forewing	6.50
Number of antennal segments	16

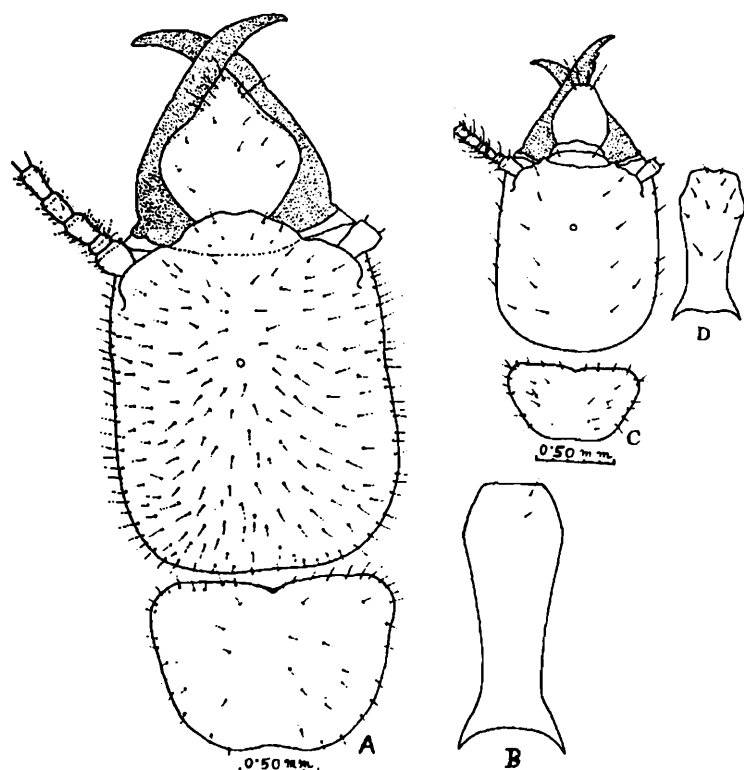


Fig. 6. *Psammotermes voeltzkowi* (Wasmann) A-B. Soldier (major). A. Head and pronotum in dorsal view; B. Postmentum. C-D. Soldier (minor). C. Head and pronotum in dorsal view; D. Postmentum.

Table-2. Measurements (in mm) etc., of Caste - Soldier

<i>Psammotermes</i> spp.	<i>P. allocerus</i>		<i>P. hybostoma</i>	<i>P. rajasthanicus</i>		
	S(maj.)	S.(min.)	S	S.(maj.)	S(medium)	S(minor)
Length of head to lateral base of mandibles	1.80	1.38	1.69	1.80-2.00	1.50-1.65	1.08-1.40
Max. width of head	1.03	1.15	1.26	1.35-1.50	1.20-1.25	0.85-1.05
Width of head at anterior end	1.42					
Head index (width/length)						
Max. length of labrum	0.61	0.50	0.38	0.70-0.93	0.55-0.70	0.30-0.43
Max. width of labrum	0.96	0.42	0.53	0.73-0.95	0.55-0.70	0.30-0.43
Length of mandible (Upper base of condyle to tip)	1.38	1.00	1.00	1.43-1.80		
Min. median length of postmentum	1.20	0.90	1.19	1.25-1.48		
Max. width of postmentum	0.61	0.58	0.53	0.53-0.58		
Width of postmentum at waist	0.38		0.32	0.35-0.38		
Max. length of pronotum	1.19	0.61	0.65	0.78-0.95		
Max. width of pronotum	1.42	0.92	1.03	1.13-1.35	0.98-1.10	0.63-0.83
Pronotum index (length/width)	0.83	0.60	0.63	0.69		
Number of antennal segments	—	14	14-15	14-15	—	

Table-3. Measurements (in mm) etc., of Caste - Soldier

<i>Psammotermes</i> sp.	<i>P. voeltzkowi</i>	
	S (maj.)	S (min.)
Length of head to lateral base of mandible	2.14	1.23
Max. width of head	1.80	1.03
Max. length of labrum	0.92	0.42
Max. width of labrum	0.92	0.38
Length of mandible (Upper base of condyle to tip)	1.65	0.88
Min. median length of postmentum	1.76	0.80
Max. width of postmentum	0.65	0.38
Width of postmentum at waist	0.42	0.23
Max. length of pronotum	1.14	0.50
Max. width of pronotum	1.53	0.84
Number of antennal segments	16	15

Subfamily COPTOTERMITINAE Holmgren

Genus *Coptotermes* Wasmann
(syn. *Arrhinotermes* Wasmann)1. Subgenus *Coptotermes*
(of genus *Termes* Linn.) Wasmann

1896. Wasmann, *Ann. Mus. Civ. Stor. Nat. Genova*, 16 (36) : 629.
1897. Wasmann, *Abhndl. Senckenb. Naturf. Ges.*, 21(1) : 151.
1904. Desneux, in P. Wytman's *Genera Insectorum*, Fasc. 25 : 29, 32.

2. Genus *Coptotermes* Wasmann

1898. Haviland, *J. Linn. Soc. Lond. (Zool)*, 26 (169) : 390.
1903. Silvestri, *Redia*, 1 : 46.
1909. Holmgren, *K. Sv. Vet. Akad. Handl.*, 44(3) : 28, 110, 169.
1911. Holmgren, *K. Sv. Vet. Akad. Handl.* 46(6) : 73.
1913. Holmgren, *K. Sv. Vet. Akad. Handl.*, 50(2) : 71
1923. Oshima, *Capita Zool.*, 11(3) : 5
1925. Sjostedt, *K. Sv. Vet. Akad. Handl.*, 3(1) : 55
1925. Snyder, *J. Wash. Acad. Sci.*, 15 (17) : 401
1928. Emerson, *Bull. Amer. Mus. nat. Hist.* 57(7) : 423.
1928. Emerson, *Zoologica*, 11(3) : 5
1934. Kemner, *K. Sv., vet. Akad. Handl.*, 13(4) : 57.
1942. Hill, *Termites Isoptera Austr. Region* : 140-141.
1949. Snyder, *Smiths. misc. Coll.*, 112 : 75.
1955. Weidner, In *Die Termiten* (Ed. Schmidt) : 54-55.
1955. Ahmad, *Biologia*, Lahore, 1(1) : 212, 213.
1958. Ahmad, *Biologia*, Lahore, 4(1-2) : 59, 60-68.
1960. Roonwal and Chhotani, *J. Zool. Soc. India*, 11(2) : 126
1961. Harris, *Termites : Recognition & Control* : 6-7, 46-47.
1962. Roonwal and Chhotani, *Indian Species Termite Genus Coptotermes* (ICAR Ent. Monogr.2) : 3-9.
1962. Roonwal and Chhotani, *Proc. natnl. Inst. Sci India*, (B) 28(4) : 294, 295, 306.
1965. Bouillon and Mathot, *Zooleo*, No. 1 : 20.
1965. Ahmad *Bull. Am. Mus. nat. Hist.* 131(Art. 1) : 7, 8, 17.

1966. Harrus, *Proc. R. ent. Soc. Lond.*, (B) 35 (11-12) : 161
1970. Krishna, In *Biology of Termites* (Eds. Krishna and Wesner) Vol. 2 : 137-138.
1970. Roonwai, In *Biology of Termites* Vol. 2 : 336-339.
1971. Emerson, *Bull. Am. Mus. nat. Hist.*, 146 (Art. 3) : 248, 251, 256, 257, 258, 260, 265, 268, 298.
1974. Coaton, *Ent. Me;* ..
1975. Akhtar, *Bull. Dept. Zool., Univ. Panjab* (N.S.) 7 : 36
1976. Coaton and Sheasby *Cimbabasia A* 3(11) : 140
1977. Mathews, *Acad. Brasil. Ciencias*, p. 87
1977. Chhotani, Viii int. Congr. Int. Un. Study Social Insects (Wageningen Sept., 1977) : 116.
1979. Roonwal, Verma and Thakur, *Proc. Indian natnl. Sci. Acad.*, (B) 45(4) : 340-347.
1979. Sen-Sarma and Thakur, *Indian For. Rec. Ent* (N.S.), 13(1) : 4, 5.
1982. Thapa, *Sabah For. Rec.*, No. 12 : 4, 5, 74.
1983. Roonwal, *Proc. Indian natnl. Sci Acad*, (B) 49(5) : 364, 379, 387.
1983. Chhotani, *Orient. Insects*, 17 : 111, 112.
1983. Maiti, *Occ. Pap., Rec. zool. Surv. India*, No. 42 : 17, 22.
1984. Bose, *Occ. Pap., Rec. zool. Surv. India*, No. 49 : 71 (fig. 54), 78, 81, 82.
1985. Chhotani, *Z. ang. Ent.*, 100 : 91.
1986. Grasse, *Termitotogia*, 3 : 523
1992. Thakur and Thakur, *Treubia*, 30 (3) : 245.
1994. Maiti and Chakraborty, *Occ. Pap., Rec. Zool. Surv. India*, No. 167.
1999. Bose, *Occ. Pap., Rec. Zool. Surv. India*, No. 171, p.46

3. Genus *Arrhinotermes* Wasmann

1902. Wasmann, *Zool. Jb. (Syst.)*, 17(1) : 103-104, 139, 160. (Wasmann did not designate the type of genus. But as the genus was originally described for *A. heimi* nov., and *A. oceanicus* was added only later on in the same paper as an Appendix, the former species should, on the basis of page priority, be regarded as the type of genus. Furthermore, the second species, *A. oceanicus* does not belong to genus *Arrhinotermes* Wasmann at all but to *Prorhinotermes* Silvestri described later (vide Roonwal and Chhotani, 1962, p. 3).

4. Subgenus *Arrhinotermes* (of genus *Termes* Linn.) Wasmann

1904. Desneux, in P. Wytman's *Gen. Insect*, Fasc. 25 : 31.

Type of genus : *Termes* (*Coptotermes*) *gestroi* Wasmann.

a. History, Distribution, Composition, etc.

The name of the genus *Coptotermes* (from the Greek "cut") was proposed by Wasmann (1898) as a subgenus of *Termes* to accommodate his species *C. gestroi* from Myanmar on account of the truncated frontal process and the truncated anterior margin of the prothorax' of the soldier caste. Subsequently, the same author in 1897 described another species under the genus *Termes* (*Coptotermes*) *truncatus* from Nossi-Be, Madagascar. Silvestri (1961) gave the sub-genus *Coptotermes* to the generic status based on the South American species *Termes* (*Eutermes*) *marabitanas* Hagen (now a synonymy of *C. testaceus* and defined briefly the diagnostic characters of the genus in 1903.

However, prior to the erection of this subgenus *Coptotermes*, for species under the genera *Hemerobius* and *Termes* could be traced from literature which were actually *Coptotermes* comprising only two valid species. Wasmann (1902) described a genus *Arrhinotermes* to accommodate his species. *A. heimi* from Walton, Ahmednagar District, Maharashtra, India, which had now been placed under the genus *Coptotermes*. Hence, *Arrhinotermes* had been synonymised under *Coptotermes*. Another species, *Arrhinotermes oceanicus* from Cocos Island, Neotropical Region, remained as such until 1909, when Silvestri erected another genus *Prorhinotermes*, under which the species was placed latter.

However, Desneux (1904 and 1905) still continued to consider the genus as the subgenus of *Termes*. Latter, Sjöstedt (1926) also named a genus *Vastitermes* for a species based on imagoes only from Togo, Africa, which had ultimately been considered as the sub-genus as *Coptotermes*

parradoxus (Sjöstedt) by Emerson (1928). Subsequently many authors, namely, Holmgren (1911), Banks (1919), Emerson (1928), Ahmed (1950) and others. Hill (1942) and Roonwal and Chhotani (1962) in the recent times defined the diagnostic characters of the genus, which treating the species from the Australian and Indian subregion respectively. Now it is a well established genus, the recognition of which is not at all difficult by its morphological characters especially of soldiers.

The genus *Coptotermes* was derived from some more generalized ancestral group (unknown) so far either as fossil or living. Further postulation based on ecological and geographical data stands as the origin of the genus in the Upper Cretaceous in the Oriental Region. It is a species rich and wide spread genus among all Rhinotermitid genera with maximum concentration of living species in the orient to a total of 33 (Table) The discovery of Tertiary fossil of *Coptotermes* in the Neotropical Region fits the hypothesis of the centre of origin of the genus in the orient and its probable dispersal in the Cretaceous period (Emerson 1955, 1971). Many species of the genus have been established as pests of agriculture plantations and in structural timbers in houses and building. Their general habit of nesting in wood and wood-works serves as the passive mode of spread all over the tropics.

All the 53 species, so far known from all the zoogeographical regions, except the palaearctic, have been dealt except *C. menadoensis* Oshima from the Philippines, has not been included in the key. Maximum number of 33 species occur in the orient. while 6 species are found in the Papuan, followed by 5 in the Australian, 4 in the Ethiopian, 3 in the Neotropical, 2 in the Nearctic and 1 in the Malagasy Regions.

b. General character

1. IMAGO : Head dark to dark brown, head and pronotum fairly densely and abdomen densely hairy. Head subround. Eyes of medium

size. Ocelli either subround or elongately oval, either almost touching or slightly separated from the eyes. Fontanelle minute, placed almost at the middle of head. Mandibles each with an apical and three marginal teeth. Left with apical only slightly longer than 1st marginal and almost equal to or slightly shorter than or subequal 2nd and 3rd marginal. Right with apical thinner and slightly shorter than 2nd, 1st marginal rudimentary placed at the anterior base of 2nd, 3rd smaller with long posterior margin, generally longer than the molar plate. Postclypeus flat or weakly swollen with or without medium line. Apical tibial spur formula 3 : 2 : 2 (no 3 : 3 : 3) as referred to others).

Wings generally moderate to densely hairy, all veins arising independently from the scale. In forewing, costa and subcosta marged, strongly chitinised, running along the anterior margin. Radius thick and running parallel and close to costa and sub-costa. Medium thin and with 1-3 branches distally, cubitus also weak and with 6-13 branches to posterior margin. Hindwing as in forewing except medium arising from radius just outside the scale.

2. SOLDIER : Head light yellow to deep brown in colour and with moderate to densely hairy, in some species head pyreform to broadly oval. Eyes generally absent, eyes spot at times visible. Ocelli absent. Fontanelle large with round to oval large opening placed much anteriorly and in some species placed at the base of clypus. Mandibles sabre-shaped, gradually narrowing anteriorly and strongly to weakly hooked at apices, left with a few to maximum of 4 crenulations in basal half and with a large knob-like projection. Right with a few basal crenulations also. Antennae with 13-17 segments, 3-4 variable in shape and size. Postmentum long and club shaped with distinct widest and narrowest width, sometimes with hairs anteriorly. Pronotum narrower than head, flat, sometimes a little raised on anterior margin, anterior margin with medium notch and posterior margin with weak medium emargination.

C. Key to the species of *Coptotermes*
Wasmann (Soldiers)

- 1. Head much broader in proportion to head-length; head index (width/length) more than 0.90 2
- Head not so broader in proportion to head-length; head index 0.70-0.90 7
- 2. Smaller species, head-length 1.03 - 1.15 mm.; narrowest width at the anterior end of head almost half the maximum width of head; head contraction index (min. width / max. width) 0.49-0.52 3
- Larger species, head-length 1.38 - 1.69 mm; narrowest width much more than half the maximum width of head; head contraction index 0.52-0.62.
- 3. Postmentum at waist less wide; lateral sides of head less bulging out; head dorso-ventrally more flattened; antennae with 13-14 segments; head-length 1.00-1.15 mm; head-width 0.90-0.99 mm.
..... *C. kalshoveni* Kemner
- Postmentum at waist more wide; lateral sides of head strongly bulging out; head dorso-ventrally not so flattened; antennae with 14 segments; head-length 1.03-1.08 mm; length-width 0.91-1.03 mm
..... *C. gaurii* Roonwal and Krishna
- 4. Head more constricted anteriorly, head contraction index 0.55 - 0.56; comparatively larger species, head length 1.40-1.69 mm.. 5
- Head less constricted anteriorly, head contraction index 0.60 - 0.62; head length 1.20-1.45 mm. 6
- 5. Head almost subround and as wide as long, head index (width/length) 0.95-0.97; mandibles not so incurved at apices and only slightly longer than the half the head-length, mandible-head index (mandible-length/head-length) 0.57; postmentum waist broader head-length 1.26-1.53 mm; antennae with 14-15 segments *C. premrasmii* Ahmad

- Head elongately oval and slightly longer than the head-width; head index 0.90; mandibles strongly incurved at apices and more longer than the half the head-length; mandible-head index 0.61-0.65; postmentum waist narrower; head-length 1.34-1.69 mm; antennae with 15-16 segments *C. curvignathus* Holmgren
- 6. Head dorsum behind fontanelle somewhat wavy; mandibles elongated and less hooked; head distinctly constricted anteriorly; postmentum waist broad (0.30 mm); pronotum fairly broad, pronotum-head index 0.73; head length 1.21-1.46 mm, head-width 1.06-1.28 mm. *C. lacteus* (Froggatt)
- Head dorsum not wavy, rather somewhat straight; mandibles not so elongate and distinctly hooked; head less constricted anteriorly; postmentum waist narrow (0.23 mm); pronotum distinctly narrow, pronotum-head index (0.66); head-length 1.35-1.45 mm, head-width 1.32 mm. *C. sinabangensis* Oshima
- 7. Head narrower in proportion to head length; head index (width/length) 0.70-0.80 8
- Head broader in proportion to head length, head index 0.80-0.89 19
- 8. Mandibles shorter in proportion to head-length, mandible-head index 0.58; head not so narrowed anteriorly 9
- Mandibles longer in proportion to head-length, mandible-head index 0.65 - 0.67; head much narrowed anteriorly 10
- 9. Head sparsely hairy, antennae with 14-15 segments; postmentum waist broad; head-length 1.50-1.53 mm, head-width 1.20-1.25 mm. *C. gestroi* (Wasmann)
- 10. Posterior margin of pronotum almost straight; head-length 1.28-1.48; mandibular apices distinctly pointed; head moderately and pronotum more hairy *C. guanzhouensis* Ping
- Posterior margin of pronotum distinctly emarginate; head-length 1.43-1.65; mandibular apices not so pointed; head and pronotum sparsely hairy *C. formosanus* Shiraki
- 11. Large species, head-length 1.40-1.73 mm 12
- Medium species, head-length 1.13-1.36 mm 18
- 12. Basal condyles of mandibles very prominent and hump-like; fontanelle opening smaller; mandibles long; mandible head index 0.69; head; length 1.53-1.55 mm *C. guangdongensis*
- Basal condyles of mandibles not so prominent, not hump-like; fontanelle opening large; mandibles of moderate sizes; mandible-head index 0.60 - 0.65 13
- 13. Postmentum-waist less than half the maximum width, mandibular apices much hooked; smaller species, head length 1.41 - 1.48 mm *C. eucalyptus* Ping
- Postmentum waist more than half the maximum width; mandibular apices not so hooked or weakly hooked; larger species; head elongately oval, head length 1.50 - 1.79 mm 14
- 14. Head elongately oval, lateral margins uniformly outcurved being its maximum width at the middle 15
- Head somewhat rectangular, lateral margins feebly outcurved being its maximum width almost at the posterior end 16
- 15. Head dimorphic; pronotum narrower in proportion to head-width; mandibles uniformly incurved (in soldier major) ; head-length 1.61-1.66 mm (major) *C. heteromorphus* Ping
- Head monomorphic; pronotum not so narrower in proportion to head-width; mandibles hooked towards apices; head-length 1.50 mm *C. communis* Xia and He

16. Mandibles shorter, mandible-head index 0.6-0.69; head less narrowed anteriorly, head contraction index (min. head-width/max. head-width) 0.67-0.71; head-length 1.50-1.79 mm; head-width 1.24-1.39 mm *C. acinaciformes raffrayi* Wasmann
- Mandibles longer, mandible-head index 0.73-0.75; head distinctly narrowed anteriorly, head contraction index 0.68; head-length 1.54-1.76 mm, head-width 1.21-1.35 mm *C. acinaciformis acinaciformis* Froggatt
17. Mandibles only slightly longer than half the head-length, mandible-head index 0.57; mandibular apices very weakly incurved; fontanelle opening smaller and placed slightly below the fronto-clypeal suture; antennae with 14 segments; head-length 1.17-1.35 mm; head width 0.66-1.21 mm *C. frenchi* Hill
- Mandibles more longer than half the head-length; mandible-head index 0.60-0.67; mandibular apices fairly hooked 18
18. Head-length 1.11-1.36 mm; head distinctly narrowed anteriorly; head contraction index 0.63; mandibles fairly hooked apically *C. havilandi* Holmgren
- Head-length 1.17-1.32 mm; head-width 0.93-0.99 mm; head less narrowed anteriorly, head contraction index 0.62; mandibles almost straight with a very feebly apices *C. michaelsoni* Silvestri
19. Larger species, head-length 1.50-2.00 mm... 20
- Medium to smaller species, head-length below 1.50 mm 28
20. Mandibles only slightly longer than half the head-length, mandible-head index 0.50 - 0.58 21
21. Species larger, head-length 1.66-1.70 mm.... 22
- Species smaller, head-length 1.57-1.60 mm 23
22. Pronotum much narrower than head-width, pronotum head-width index 0.68; head-length 1.50-1.72 mm, head-width 1.18-1.41 mm; pronotum-length 0.50 mm, pronotum-width 1.00 mm *C. grandiceps* Snyder
- Pronotum wider in relation to head width, pronotum-head width index 0.75 *C. dobonicus* Oshima
23. Mandibles short, almost half the head-length, mandible-head index 0.50; head-length 1.57-1.65 mm, head-width 1.28-1.32 mm; mandible length 0.81-1.10 mm *C. dregghorni* Hill
- Mandibles somewhat long, slightly longer than the half the head-length, mandible head index 0.58; head-length 1.40-1.60 mm, head-width 1.14-1.36 mm; mandible length 0.80 mm *C. testaceus* (Linnaeus)
24. Larger species, head subrectangular in shapes, head not so narrowed anteriorly; head-length 2.00 ; head-width 1.69; mandible-length 1.19; head at the anterior end 1.00 *C. brunneus* Gay
- Smaller species, head-length 1.50-1.70 mm, head suboval, slightly narrowed anteriorly 25
25. Mandibles sickle-shaped, strongly hooked at apices; frontanelle opening with a ring-like chitinised margin; head-length 1.59 mm, head-width 1.44 mm; mandible-length 1.03 mm *C. hyaloapex* Holmgren
- Mandibles not sickle-shaped, not so hooked at apices 26
26. Fontanelle opening large, placed almost on the posterior margin of postclypeus; head-length 1.55-1.68 mm, head-width 1.28-1.32 mm; mandible-length 1.03-1.10 mm *C. obiratus* Hill
- Fontanelle opening of medium size, placed slightly below the posterior margin of postclypeus 27
27. Smaller species, head-length 1.50 mm, head-width 1.23 mm; mandible length 0.96;

- postmentum-length 0.84 mm, waist 0.19 mm
..... *C. crassus* Snyder
- Larger species, head-length 1.63-1.68 mm...
..... *C. crassus* Ping**
28. Head more constricted anteriorly, head contraction index 0.52-0.59 29
- Head less constricted anteriorly, head contraction index 0.60-0.69 41.
29. Pronotum narrower in proportion to head-width, pronotum-head index 0.59-0.66 30
- Pronotum wider in proportion to head width, pronotum-head index 0.70-0.79 35
30. Mandibles only slightly longer than the head-length, mandible-head index 0.53-0.59 31
- Mandibles much longer than head-length, mandible-head index 0.66-0.70 33
31. Anterior end of head wider in proportion to head-width; head contraction index 0.59; head-length 1.24-1.31 mm, head-width 1.07-1.13 mm; head-width at anterior end 0.65 mm; labrum as long as broad
..... *C. boetonensis* Kemner
- Anterior end of head narrower in proportion to head-width, head contraction index 0.53 32
32. Fontanelle opening wide (0.14 mm), head somewhat flattened, head-length 1.13-1.17 mm, head-width 1.00-1.02 mm; antennae with 13 segments *C. remotus* Hill
- Fontanelle opening not so wide, fontanelle opening narrow (0.11 mm), head not so flattened; head-length 1.10-1.35 mm, head-width 0.91 1.20 mm; antennae with 14 segments *C. pamuae* Snyder
33. Fontanelle opening placed slightly below the fronto-clypeal suture; pronotum with prominent median emargination on both anterior and posterior margins; head-length 1.14-1.29 mm, head-width 0.96-1.08 mm; mandible length 0.82-0.88 mm
..... *C. xiaoliangensis* Ping
- Fontanelle opening placed almost on the fronto-clypeal suture; pronotum with faint median emargination on both anterior and posterior margins; head-length 1.09-1.25 mm 34
34. Fontanelle opening efaced posteriorly and more chitinised ; maximum head-width posteriorly; mandibles somewhat sickle-shaped ; head-length 1.09-1.13 mm, head-width 0.90-1.00 mm; mandible-length 0.74 mm *C. amboinensis* Kemner
- Fontanelle opening not efaced posteriorly and not so chitinised; maximum head-width almost at the middle; mandibles substraight with feeble incurved apices; head-length 1.13-1.25 mm, head-width 0.95-1.08 mm; mandible length 0.73 - 0.83 mm
..... *C. kishori* Roonwal and Chhotani
35. Mandibles shorter in relation to head-length, mandible-head index 0.53-0.59 36
- Mandibles longer in relation to head length, mandible-head index 0.60-0.70 37'
36. Postmentum strongly constricted in the middle; average width 0.19 mm; antennae with 13 segments; pronotum narrower, width 0.60-0.67 mm; head-length 1.05-1.08 mm, head width 0.90-0.93 mm; postmentum width 0.33, waist 0.18-0.22 *C. bentongensis* Krishna
- Postmentum not so strongly constricted in the middle, average width 0.22 mm; antennae with 13-14 segments; pronotum wider, width 0.71- 0.75 mm; head-length 1.13-1.16 mm, head width 0.98-1.01 mm; postmentum width 0.33-0.38 mm, waist 0.18-0.23 mm
..... *C. sepangensis* Krishna

** The species *C. crassus* Ping from China needs its name to be changed, since it is preoccupied by *C. crassus* of Snyder. Due to nonavailability of material, both the species are kept as such here.

** *C. alfredi*, a species designated as new species by Emerson has been examined in F.R.I. from which key characters has been incorporated but its description not given.

37. Small to medium size species, head-length 0.95-1.32 mm 38
- Medium species, head-length 1.14-1.32 mm 39
38. Head ovoid, head-width 0.86-1.00 mm; pronotum with outcurved lateral margins and somewhat rounded anterolateral corners *C. sjöstedti* Holmgren
- Head pyriform, width 1.00-1.02 mm; pronotum with straight and distinctly converging lateral margins, narrowly angular antero lateral corners; head length 1.20-1.25 mm; mandible-length 0.70-0.73 mm *C. amanii* (Sjöstedt)
39. **Head elongately oval; fontanelle opening larger and placed almost on the fronto-clypeal suture; mandibles smaller and somewhat straight with abruptly incurved apices; head-length 1.20 mm, head-width 0.97 mm; mandible length 0.65 mm** *C. harrisi* Emerson
- Head roundly oval, incurved at the base of antennae; fontanelle opening smaller and placed slightly below the fronto-clypeal suture; mandibles longer and distinctly hooked at apices; antennae with 14 segments (at time 15) ; head-length 1.14-1.32 mm, head width 0.95-1.18 mm, mandible length 0.68 mm, postmentum-width 0.37 mm, waist 0.21-0.25 mm *C. intermedius* Silvestri
40. Smaller species, head-length 1.10-1.22 mm 41
- Larger species, head-length 1.22-1.45 mm 45
41. Pronotum weakly saddle-shaped *C. minutissimus* Kemner
- Pronotum not at all saddle-shaped, rather flat 42
42. Postmentum wide at waist, contraction index (waist/max. width) 0.64; mandibles smaller in proportion to head-length; head-length 1.10-1.13 mm and head-width 0.90 - 0.98 mm; postmentum width 0.35-0.38 mm, postmentum-waist 0.20-0.21 mm; mandible-length 0.73-0.78 mm *C. beckeri* Mathur and Chhotani
- Postmentum at waist much narrow, contraction index 0.51; mandibles longer in proportion to head-width, head-width 0.88-0.96 mm, mandible length 0.82 mm, postmentum-width 0.35 mm, postmentum-waist 0.18 mm *C. emersoni* Ahmad
43. Right mandible with cutting edge markedly convex; head-length 1.18-1.32 mm and head-width 0.97-1.03 mm *C. bornensis* (Oshima)
- Right mandible with cutting edge not convex, rather feebly concave 45
44. Mandibles shorter in proportion to head-length, mandible-head index 0.62-0.70 47
45. Mandible almost half the head-length, mandible-head index 0.51; head-length 1.24-1.40 mm, head-width 1.00-1.13 mm; labrum long and tongue-shaped reaching almost beyond the middle of mandibles; postmentum at waist (0.20-0.23 mm), more than half the maximum width, mandible-length 0.82 mm; labrum-length 0.38 mm *C. vastator* Light
- Mandibles more than half the head-length, mandible-head index 0.56-0.58 46
46. Smaller species, head-length 1.22-1.35 mm, head-width 1.08 mm; mandible-length 0.75 *C. perigrenator* Kemner
- Larger species, head-length 1.38 mm, head-width 1.14 mm; mandible-length 0.78 mm; postmentum width 0.42 mm, postmentum-waist 0.26 mm *C. truncatus* (Wasmann)
47. Pronotum very wide in relation to head-width; pronotum-head index 0.87; both anterior and posterior margins of pronotum with distinct notch; head-length 1.34 mm, head-width 1.14 mm, mandible-length 0.92

- mm; pronotum-length 0.44 mm, pronotum-width 0.96 mm..... *C. niger* (Snyder)
- Pronotum moderately wide, pronotum head index 0.66-0.72 48
48. Head dorsum behind fontanelle in lateral view swollen and wavy 49
- Head dorsum behind fontanelle in lateral view not so swollen and wavy 52
49. Postmentum at waist very narrow, minimum width 0.20-0.29 mm, postmentum contraction index 0.57-0.69 50
- Postmentum at waist wider, maximum width 0.38-0.45 mm, minimum width 0.25-0.34 mm, contraction index 0.63-0.76; head-length 1.20-1.45mm, head-width 1.00-1.35 mm; mandible-length 0.70-1.00 mm 51
50. Head elongately oval, mandible somewhat straight, weakly hooked, head-capsule thicker; head-length 1.25-1.50 mm, head-width 1.00-1.20 mm; mandible-length 0.80-0.90 mm *C. ceylonicus* Holmgren
- Head somewhat roundly oval, mandible somewhat hooked; head-capsule thinner; head-length 1.23-1.40 mm, head-width 1.00-1.18 mm; mandible length 0.75-0.88 mm *C. travians* (Haviland)
51. Smaller species, head-length 1.27-1.34 mm, head very wider *C. oshimai* (Light and Devis)
- Larger species, head-length 1.42-1.43 mm, head not so wide, rather moderately bulging out 52
52. Fontanelle opening obliquely facing posteriorly; pronotum very wide, width 0.90-1.02 mm; mandibles uniformly rounded at apices *C. orchraceus* Ping and Xu
- Fontanelle opening not oblique, rather facing anteriorly, pronotum not so wide, width 0.75 mm, mandibles somewhat abrupt and weakly hooked at apices *C. rectangularis* Ping and Xu

6. *Coptotermes acinaciformis acinaciformis* (Froggatt)

1. *Termes acinaciformis* Froggatt

1898. Froggatt, *Proc. Linn. Soc. N.S.W.*, 22 (4) : 740, Im. S. and W. Type-locality : Western Australia.

2. *Termes (Eutermes) acinaciformis* Froggatt

1904. Desneux, *Ger. Insectorum*, 25 : 40

3. *Coptotermes acinaciformis* (Froggatt)

1905. Froggatt, *Agric. Gaz. N.S.W.*, 16 : 754 and 752.
1911. Holmgren, K. *sv. Vet. Akad. Handl.* 46 (16) : 73
1915. Froggatt, *Dept. Agric. N.S.W., Farmers' Bull.*, No. 60 (2nd Ed.) : 34 and 36.
1916. Hill, *Proc. Linn. Soc. N.S.W.*, 40 (1) : 92, pl. 14 (Biology).
1922. Hill, *Proc. Linn. Soc. N.S.W.*, 47 (2) : 159. Pl 25, figs. 2, 3 (taxonomy, biology).
1926. Hill, *Proc. Roy. Soc. Viet.*, 38 : 205 (taxonomy and distribution).
1942. Hill, *Termites (Isoptera) from the Australian Region*, Im. and S., CSIRO, pp. 141-147, Melbourne.
1949. Snyder, *Smiths. misc. coll.*, 112 : 76.
1967. Gay, *A world review of introduced species of Termites*, CSIRO, Bull No. 286, p. 29.

4. *Coptotermes acinaciformis acinaciformis*, Calaby and Gay

1956. Calaby and Gay, *Australian J. Zool.*, 4 (1) : 20-30 (distribution and biology).
1970. Gay and Calaby, *Termites of the Australian Region*, 412-414, In, *Biology of Termites* (Ed. by Krishna and Weesner) Vol.2. New York and London (Academic Press).

Material : A. Present in ZSI, Kolkata : (i) One vial (AMNH) with Im., 1S. and 1W. *Metatype*, Auckland, New Zealand, G. Plucki coll., 18 xii. 1941, det. J. M. Kelsey, Comp. A. E. Emerson. (ii) one vial with 3 Im., 3S. and 2W; Cairns, Queensland, A. H. Nichells coll., 11.iv.1937, des. CSIRO, Australia.

B. Present in F.R.I., Dehra Dun : (i) One vial (AMNH) with 9 Im. 6W., *Metatype*, Auckland, New

Zealand, G. *Plucki Coll*, 18 xii. 1941, det. J. M. Kelsey, comp. A. E. Emerson, (ii) one vial (AMNH) with 2 Im, 2S and 2W, CSIRO, Canberra.

Diagnostic character : (IMAGO) (Fig. 7.A) Head, pronotum and wing-scale light brown; vertex darker brown; antennae and legs yellowish, wing vein brown. Head and pronotum moderately hairy wings and abdomen densely hairy.

Head almost circular, slightly arched dorsally, postero-lateral margin faintly rounded. Eyes moderately large and variable. Postclypeus about one-quarter as long as wide. Antennae with 17-21 segments, 2-4 variable. Ocelli small (0.14-0.18) and elongate. Pronotum narrower than head, anterior margin weakly incurved with a weak median notch, antero-lateral corners narrowly rounded, posterior margin with deep median emargination.

Anterior wing-scale very large, almost twice as long as the hind wing-scale. Costal and radian-sector well marked, other veins weakly marked. Wing membrane hairy.

(ii) SOLDIER (Fig. 7.B) : Head straw yellowish and sparsely hairy; antennae, pronotum and legs paler. Head rectangularly oval, slightly longer than broad, sides subparallel and narrowing both anteriorly and posteriorly almost from the middle. Fontanelle small with chitinished rim around the opening placed almost on the posterior margin of clypeus. Eyes and ocelli absent. Antennae with 16 segments, 2 and 3 subequal or 3 sometimes smaller than 2, 4 longer than 3. Postclypeus distinct. Labrum subtriangular with very much outcurved lateral margins, apex hyaline somewhat pointed with a pair of bristle in addition to small hairs on the margins. Mandibles of normal feature. Postmentum club-shaped, broadest on anterior third and narrowest width slightly below the middle.

Pronotum subrectangular, much broader than long, anterior margin with a strong median notch, posterior margin substraight with weak median emargination.

Measurements : Table 4(Im.) ; 12 (S.).

Types : *Hololectotype* winged adult and morphotype. Soldier in Hill Coll., paratypes from type colony in CRIRO collection.

Distribution : AUSTRALIA : Western Australia, Northern Territory, Queensland, New South Wales, Victoria and South Australia, New Zealand : North Island (introduced).

Remarks : Imagos are very similar to that of *C. frenchi*, separated by its larger size of head and pronotum. Soldiers are very similar to *C. acinaciformis raffrayi*, hence caution to isolate them especially where they coexist as found in Western Australia (Hill, 1942).

Biologically, the species is well known as a mound building pest species found almost throughout Australia, excepting the alpine areas of the southeast and Tasmania. In addition to its extensive damage to *Eucalyptus* trees, the species attacks timbers in man-made structures, poles, pests, bridge, wharftimbers, fruit-trees, vines, ornamental trees, etc. (Gay, 1970).

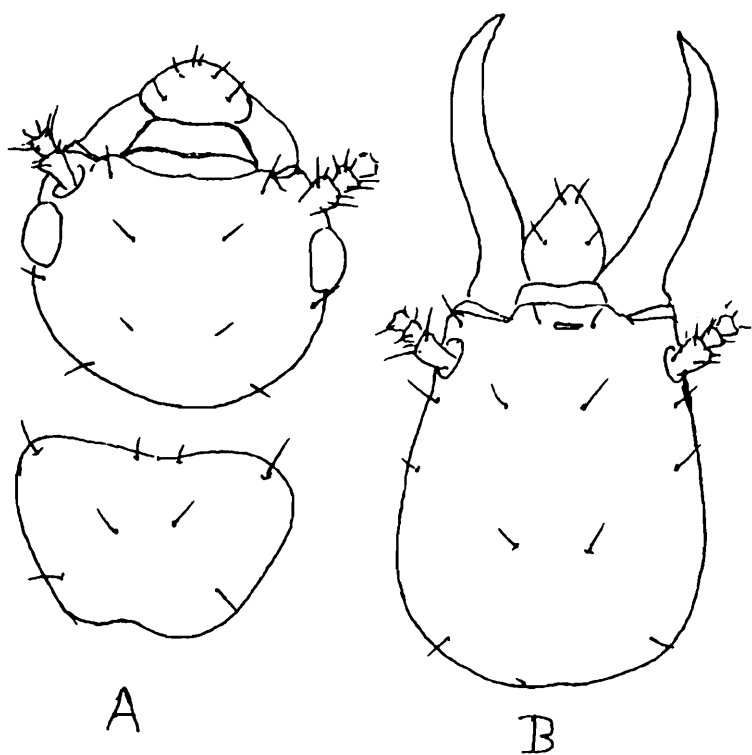


Fig. 7. *Coptotermes acinaciformis* Froggatt A, Imago. A. Head and pronotum, dorsal view; B. Soldier, B. Head, dorsal view.

7. *Coptotermes acinaciformis raffrayi*
Wasmann

1. *Coptotermes raffrayi* Wasmann

1900. Wasmann, *Proc. Linn. Soc. N. S. W.*, 25 (2) : 224, S. and W.

Type locality : Swan River, Western Australia.

2. *Termes (Coptotermes) raffrayi*, Wasmann

1904. Desneux, *Gen. Insectorum*, 25 : 35

3. *Coptotermes raffrayi* Wasmann

1905. Froggatt, *Agric. Gaz. N. S. W.* 16 : 760 and 762

1909. Silvestri, *Fauna S dwest Australiens*, 2 (17) : 293

1911. Holmgren, *K. Svena Vet. Akad, Handl.* 46 (6) : 74

1915. Forggatt, *Deptt. of Agric. N. S. W., Farmers' Bull.*, No. 60 (2nd Ed.) : 34 and 36.

1921. Hill, *Proc. Linn. Soc. N. S. W.*, 46 (2) : 263, Im. S. and W.

1922. Hill, *Proc. Linn. Soc. N. S. W.* 47 (2) : 160.

1926. Hill, *Proc. Roy. Soc. Viet.*, 38 : 206.

1942. Hill, *Termites from the Australian Region*, CSIRO, 168-169

1949. Snyder, *Smiths, misc. Coll.*, 112 : 82.

4. *Coptotermes acinaciformis raffrayi*
Wasmann

1956. Calaby and Gay, *Australian J. Zool.*, 4 (1) : 20-30 (distribution and biology)

1970. Gay and Calaby, *Termites of the Australian Region*, pp. 414 Im. *Biology of Termites* Krishna and Weesner (Eds.) Acad. Press, London.

Material : A. Present in Z.S.I., Kolkata : (i) One vial (Z. S. I. Reg. No. 2768/H8) with 7 Im., 5S. and 6W, Denmark, West Australia, D. H. Perry coll., 25, xi, 1960, (Don CSIRO, Ent-Div.). (ii) One vial (Z. S. I. Reg. No. 3806/H8) with 1S., Wonnerup, south west Australia, Oct. 1920, det. G.F. Hill (From AMNH, New York).

B. Present in F.R.I., Dehra Dun : (iii) One vial with 3 Im., 4s. and 1w, *Morphotype* Wonnerup, south West Australia, October, 1920, det. G. F. Hill, (from AMNH, New York).

Diagnostic character : IMAGO (Fig. 44.A) Head and pronotum dark chestnut brown, head more darker; labrum, antennae and other body parts paller. Head and pronotum sparsely and abdomen densely hairy.

Head almost subcircular, slightly depressed on the vertex. Fontanelle indistinct. Antennae with 17-20 segments, 3 and 4 almost subequal, sometimes 3 smallest and narrowest. Eyes moderately large (.029-0.36) and ocelli smaller (0.11-0.16). Pronotum narrower than head or almost as wide as head, slightly concave in front and feebly emarginate behind. Wings very similar to that of *Coptotermes acinaciformis acinaciformis* sometimes more hairy.

(ii) SOLDIER (Fig. 44. BC) : Head light to deep brown paller anteriorly, other parts paller. Head and pronotum sparsely and abdomen specially posterior half densely hairy.

Head subrectangular with lateral and posterior margins weakly convex with very weak constriction above the antennal favirole, longer than broad and distinctly narrowing anteriorly. Fontanelle small with chitinished opening, placed slightly below the posterior margin of

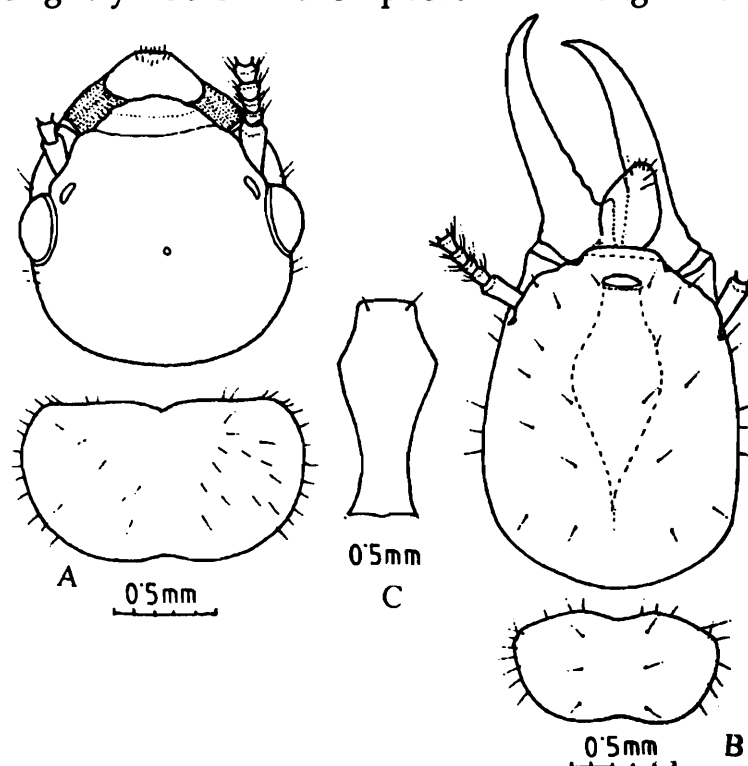


Fig. 44. *Coptotermes raffrayi* Wasmann A, Imago. A. Head and pronotum, dorsal view; B-C, Soldier. B. Head and pronotum, dorsal view; C. postmentum.

postclypeus. Antennae with 16 segments, 3 variable, 4 smallest. Postclypeus distinct. Labrum subtriangular with hyaline somewhat pointed apex. Postmentum club-shaped, broadest on anterior fourth and narrowest on posterior fourth.

Pronotum broader than long, anterior margin convex but with deep median emargination and posterior margin with weak median emargination.

Measurements : Table 7(Im.); 26 (S.)

Types : *Holotype* S. in Wasman's collection and *Morphotype* Im. and W. in National Mus., Melbourne.

Distribution : AUSTRALIA : Western Australia, from numerous localities (Hill, 1942).

Remarks : Very much close to *C. acinaciformis acinaciformis* and for further affinities, biology, etc. vide, under that species.

8. *Coptotermes amanii* (Sjöstedt)

1. *Eutermes (Coptotermes) amanii* (Sjöstedt)

1911. Sjöstedt, *Arkiv. zool.* 7 : 17, S. and W. *Type-locality* : Amani, Usambara, Tanganyika, Africa.

2. *Coptotermes amanii* (Sjöstedt)

1926. Sjöstedt., *K. Sven. vet. Akad. Handl.* 3 (3) : 58

1936. Harris, *Bull. ent. Res.*, 27 :

1961. Harris, *Termites, their recognition and control*, p...Acad. Press, London.

1963. Harris, *Isoptera. Explor. Proc. Nat. Garamba Miss. De Saeger*, 42 : 6-8.

1966. *Proc. Roy. ent. Soc. London*, (B) 35 : 163-165

1972. Coaton and Sheasby, *Cimbebasia Mem.*, 2 : 571

1976. Coaton and Sheasby, *Cimbebasia*, (A) 3 (2) : 140-143

3. *Coptotermes sjostedti* var. *subintactae* Silvestri

1914-15. Silvestri, *Bull. Lab. Zool. Gen. Agr.*, 9 : 10. *K. Sven. vet. Akad. Handl.* 3 (3) : 58

Type-locality : Senegal

Material : A. Present in F. R. I., Dehra Dun : (i)

One vial (No.89) with 2 1m and 6s. *Topotypes*, Amani, Tenganyika, Africa, H. Kirby coll., 21. xii. 1921 (T. 1052).

Diagnostic character : (i) IMAGO (Fig. 8.A) Head chestnut brown; antennae, labrum, pronotum and body paler than head. Head sparsely and pronotum and body densely hairy; wing-scale with a few longer hairs.

Head subcircular; broader than long, frons weakly sloping in front. Fontenelle minute and circular and slightly raised, situated almost at the level of lower margins of eyes. Antennae with 14 segments, segment 2 short, 3 smallest, 4 as long as 2. Eyes subround and large. Ocelli oval and separated from the eyes by its smaller diameter. Postclypeus weakly swollen having no median line. Labrum broader than long with some setae near distal margin and on the body, lateral sides and apical tip subround. Mandibles of typical *Coptotermes*-type.

Pronotum subovoidal form, slightly narrower than head capsule, broader than long, anterior margin weakly concave with an indistinct median notch, posterior margin with a median emargination.

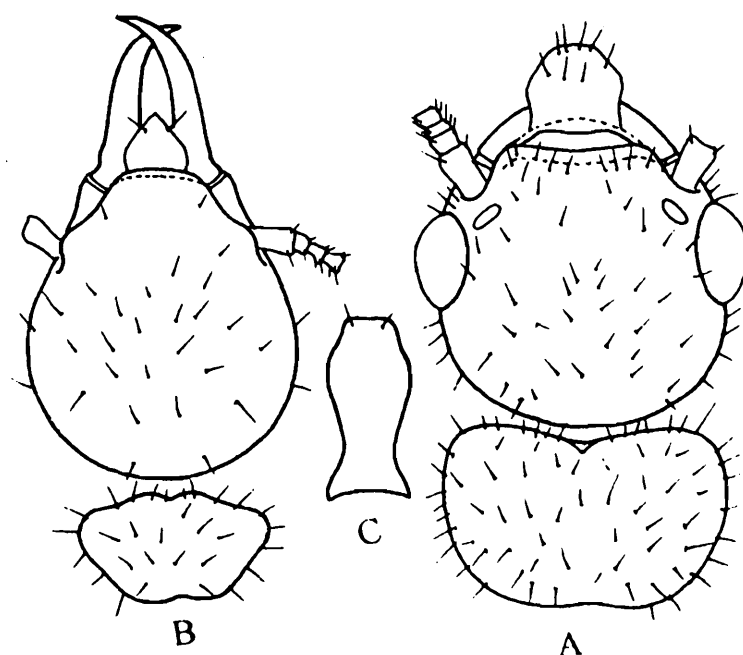


Fig. 8. *Coptotermes amanii* (Sjöstedt) A, Imago. A. Head and pronotum, dorsal view; B-C, Soldier. B. Head and pronotum, dorsal view, C. Postmentum.

(ii) SOLDIER (Fig.8.B-C) : Head light brown; antennae, legs, pronotum and labrum much paler than head. Head with a few erect bristle, thorax sparsely and abdomen densely hairy.

Head pyriform, longer than broad; anterior end almost half the maximum width. Fontanelle large, placed almost at the base of labrum. Eyes and ocelli absent. Antennae with 14 segments, 3 subequal to 4. Labrum subtriangular, longer than broad, apex hyaline and somewhat pointed with two bristles almost at the apex. Mandibles sabre-shaped. Postmentum club-shaped, long and narrow with a few short hairs anteriorly, broadest on anterior one-third, narrowest in the posterior one-third, widest width almost one and a half times the narrowest width.

Pronotum flat, subreniform, much broader than long, anterior margin broadly concave with somewhat deep median emargination, anterolateral corners narrowly rounded, posterior margin with a weak median emargination.

Measurements : Table 5 (Im.); 28 (S.) *Types*— In Stockholm Mus. in Berlin Mus. and *Paratype* S. in the National Coll. of Insects, Pretoria.

Distribution : Africa : South Africa : Darban (introduced), Gay, 1967; Tanganyika, Kenya, Malawi, Somalia, Zanzibar and Zimbabwe (detailed Coaton and Sheasby, 1976).

Remarks : The imagoes of *C. amanii* are the smallest of all the indigenous species with anterior margin of pronotum more roundly concave. The distinctly pyriform head and slender mandibles of this species keeps it separate from that of *C. intermedius* which have more oval head.

The species is known to inhabit in dead trees, fallen logs, in structural timbers where covered runways are visible. Sometimes, its nest is found in walls of *Macrotermes* mounds. Swarming takes place at about sun set during the early part of the rainy season. Much damage is caused in the buildings on the coastae areas of Tanganyika and Kenya. Growing cotton plants are sometimes damaged by the species (Coaton and Sheasby, 1976).

9. *Coptotermes amboinensis* (Kemner)

1. *Coptotermes amboinensis* Kemner

1931. Kemner, *Lunds Univ. Arask. N.F.Avd.* 2, 1, 42 (13) : 20-23. S. and Im. (?), *Type-locality* : Ambon, Amboina Isl.

1949. Snyder, *Smiths.misc. Coll.*, 112 : 76, Amboina Island.

1970. Boss, In Krishna, K. and Weesner, F. M. (Eds.), *Biology of Termites* p. 472, Acad. Press, New York and London.

Material : Since no material is available for study, the description and measurements of soldier caste are based on the original paper by Kemner (1931). The imagoes unassociated with soldiers have also been doubtfully placed by Kemner (1931) under the species which is also not available for study. Hence the imago description has not been incorporated here.

Diagnostic character : (IMAGO) (i) Doubtful (?). SOLDIER (Fig. 9.A-B) : The body with antennae yellowish brown, mandible at its anterior three-fourth brown, basal portion of same colour as head. Body along with antennal segments whitish yellow. Head sparsely and body thickly hairy. Head oval and narrowing anteriorly. Fontanelle large, tube-like and projecting anteriorly. Labrum

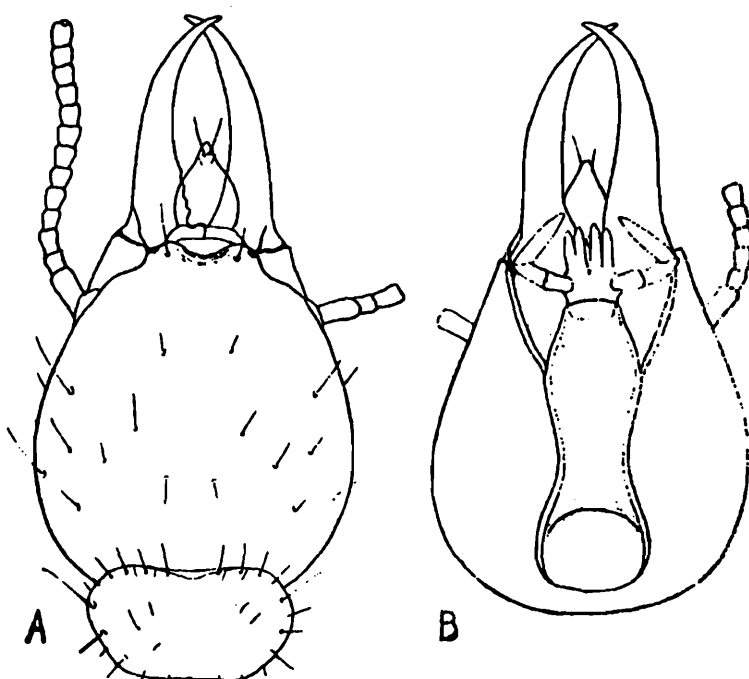


Fig. 9. *Coptotermes amboinensis* Kemner; A-B, Soldier. A. Head and pronotum, dorsal view; B. Head, ventral view (after, Kemner, 1931)

strongly narrowing anteriorly reaching almost half the mandible and with usually two bristles at apex. Mandibles long and slender. Antennae small, hardly reaching the tip of the mandible. Antennae with 13-14 segments; in 13 segmented antennae, segment 3 large, larger than 2 and 4; in 14 segmented antennae segments 3 smaller than 2 and slightly larger than 4.

Postmentum width almost twice its length. Pronotum width almost twice the length and posterior margins substraight with a few scattered erect hairs on the margins as well as on the disc.

Measurements : (in mm.) of the soldier (Kemner, 1931). also vide Table 13.

Head with mandible	1.84
Head without mandible	1.09-1.13
Head width	0.99-1.00
Width of pronotum	0.63-0.68
Length of pronotum	0.31-0.35

Types : Repository unknown.

Distribution : ASIA : Amboina Island : Ambon and also South Pacific Island (Bees, 1970).

Remarks : The characteristic fontanelle opening faced posteriorly and fairly chitinised, and maximum head-width towards posterior and keep the species separate from others. Biology of the species is known.

10. *Coptotermes beckeri* Mathur and Chhotani

1. *Coptotermes beckeri* Mathur and Chhotani

1969. Mathur and Chhotani, *J. Timb. Develop. Assoc. India*, 15 (4) : 1-45, S and W. Type-locality : Tamil Nadu, India.

1983. Chhotani, *Oriental Insects.*, 17 : 117.

1984. Bose, *Occ. pap., Rec. Zool. Surv. India*, No.49, 82-83.

1989. Roonwal and Chhotani, *Fauna of India, Isoptera* (Termites), 1 : 422-425, figs. 222 and 223.

Material : Present in F. R. I., Dehra Dun : (i) one vial (No. 199) with *Holotype* S., Tamil Nadu, India, G. Baker Coll., 5.xi.1956, ex. "galleries in

interior of a building", det. R. N. Mathur and O. B. Chhotani. (ii) One vial (No. 199) with 1S. *Paratype* and *Morphotype* 1W. other data same as in (i).

Diagnostic character : IMAGO (i) Unknown (ii) SOLDIER (Fig. 10.A-B) : Head pale yellow; antennae, labrum pronotum, legs lighter than head; head very sparsely, pronotum fairly and abdomen somewhat densely hairy.

Head ovoid in shape, sides narrowing anteriorly, minimum width at the base of mandible, much more than half the maximum width, head-dorsum weakly depressed in the middle. Fontanelle tubular, opening marked by sclerotised margin. Antennae with 13 segments, segments 2 almost of half of 1, 3 variable, either smaller or larger than either 2 or 4. Eyes and ocelli absent. Labrum subtriangular, broadest slightly below the middle, sides strongly converging anteriorly and terminating into hyaline, pointed apex with two long bristles below the hyaline apex. Postmentum club shaped, as long as or slightly longer than the length of mandibles, broadest at anterior one-third and

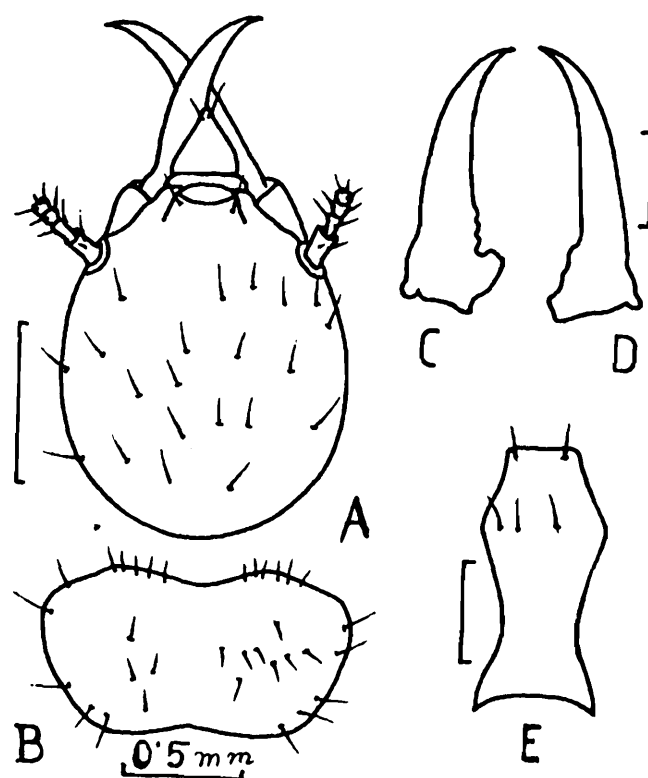


Fig. 11. *Coptotermes bentongensis* Krishna; A-E, Soldier. A. Head, dorsal view; B. Pronotum, dorsal view; C. Left mandible; D. Right mandible; E. Postmentum.

minimum width below the middle of maximum width and anterior margin substraight and posterior margin weakly concave.

Pronotum subreniform, length a little more than half the width, much narrower than head-width, anterior margin weakly convex with a median emargination, sides broadly rounded and posterior margin substraight.

Measurements : Table 13 (S.).

Types : *Holotype* S. and *Morphotype* W. in a single vial in spirit, deposited in Ent. Coll., F. R. I., Dehra Dun, India. (ii) *Paratype* : Deposited as follows as : (a) Several paratypes S. in a single vial and on slide (No. 263) in Ent. Coll., F. R. I., Dehra Dun, India (b) 1 paratype S. in A.M.N.H., New York, U.S.A. (c) 2 paratype S. in Z.S.I., Calcutta, India.

Distribution : ASIA : India : Tamil Nadu (Type-locality). Known only from the type-locality.

Remarks : The species is one of the smallest one of the genus and is very close to *C. emersoni* Ahmad. Comparatively wider waist of postmentum and shorter mandibles keep the species distinct from *C. emersoni*.

11. *Coptotermes bentongensis* Krishna

1. *Coptotermes bentogensis* Krishna.

1956. Krishna, *Amer. Mus. Novit.*, No. 1809, pp. 4-5. Type-locality : Bentong, Malaysia.

1957. Harris, *Malayan Nat. J.*, 12 : 23, Malaysia.

1958. Ahmad, *Biologia*, 4 (1) : 65 (key).

Material : Since no material is available for study, the description and measurements are based on those of Krishna (1956).

Diagnostic character : (i) IMAGO : Unknown.

(ii) SOLDIER (Fig. 11. A-E) : Head brownish yellow (holotype yellow), labrum yellowish brown; pronotum, abdomen and legs light brown with yellowish tinge. Head with sparsely scattered hairs; pronotum with erect long hairs along its entire margins as well as on disc;

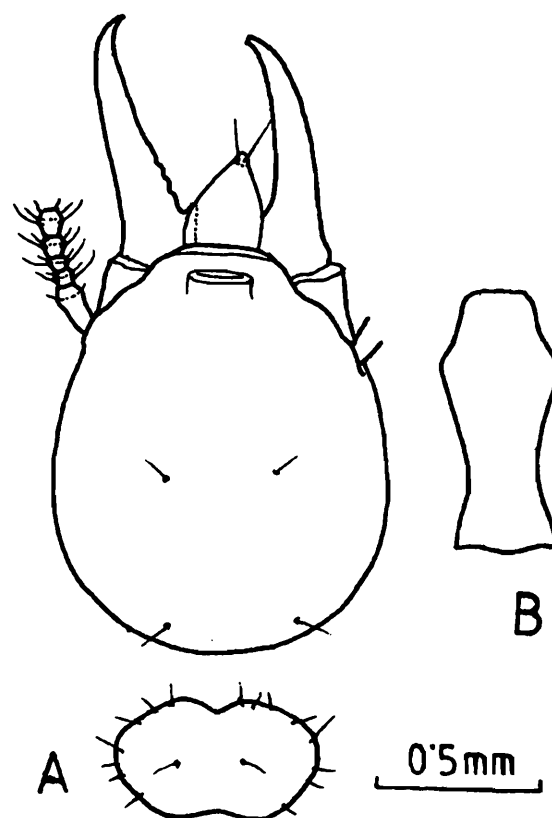


Fig. 10. *Coptotermes beckeri* Mathur and Chhotani A-B, Soldier. A. Head and pronotum, dorsal view; B. Postmentum.

abdomen densely hairy, with a marginal hind row of hairs. Head oval, long and narrow, head shape very similar to that of *Coptotermes sepangensis* Krishna but smaller, less broad and thick. Mandible short but apex bent inward. Antennae with 13 joints; second segment longer than third; third a little shorter than or equal to fourth.

Postmentum short, strongly constricted in the middle. Pronotum flat, narrower than head, markedly wider than long; anterior margin convex, slightly raised with median incision; the lateral sides sloping down, rather straight to rounded and slightly emarginate posterior margin.

Measurements : Table 14 (S.)

Types : *Holotype* S. in AMNH., New York ; *paratypes* in BMNH, London; in FRI; Dehra Dun.

Distribution : ASIA : Malaysia : Benton.

Remarks : The species could hardly be distinguished from its closely allied Malayan species *C. sepangensis* Krishna which is slightly larger than this species.

12. *Coptotermes boetonensis* Kemner**1. *Coptotermes boetonensis* Kemner.**

1934. Kemner, K. *Sven. Vet. Akad. Handl.*, (3), 13 (4) : 66, S. *Type-locality* : Boeton Island, South-east point of Celebes, Indonesia.

1949. Synder, *Smiths. misc. Coll.*, 112 : 76.

1958. Ahmad, *Biologia*, 4 (1) : 68 (key).

Material : Present in F. R. I., Dehra Dun : One vial with 1S. and 1W., Mangrove Swamp, Augke, near Batavia, Java, Indonesia, Coll. H. Kirby., 26.vii. 1935, det. and comp., A. E. Emerson.

Diagnostic character : (i) IMAGO : Unknown. (ii) SOLDIER : Head yellowish brown; labrum, antennae, pronotum and legs paler than head; head with a few erect hairs; thorax sparsely and abdomen densely hairy.

Head rather broadly oval, weakly narrowing anteriorly; slightly longer than broad, maximum width at posterior third, lateral margins out curved and posterior margin rounded. Fontanelle opening small (0.13), with chitinated rim and e faced. Eyes and Ocelli absent. Antennae with 14 segments, segment 2 as long as 3, 3 and 4 subequal. Labrum as long as wide with short terminal hyaline portion.

Mandibles short, distinctly incurved with pointed apex, as long as slightly longer than half the head width. Left mandible with distal two-third of inner margin smooth, proximal one-third with a broad basal projection and two crenulations increasing in size proximally. Right mandible with very indistinct crenulation in preximal one-third. Postmentum club-shaped, broadest on anterior third and narrowest much below the middle.

Pronotum much narrower than head-width, about three-fourths of head-width, length almost half the width, anterior margin weakly concave with a median weak emargination, posterior margin weakly emarginate, both margins and disc with a few short and long hairs.

Measurements : Table-15 (S.).

Types : In Kemner's collection at the Zoological Institute, Lund University, Lund Sweden (not mentioned in Snyder, 1949).

Distribution : Asia : Indonesia : Beeton Isl.; Augke, near Batavia, Java.

Remarks : The species is very close to *C. peregrenator* Kemner in form, colour and hairiness, except with smaller mandibles.

13. *Coptotermes bornensis* Oshima**1. *Coptotermes bornensis* Oshima**

1914. Oshima, *Annot. Zool. Jap.*, 8 : 556-557, S. W. *Type-locality* : Balikpapan, Dutch Borneo, Indonesia.

1929. Davis, *Proc. Soc. Victoria* (N.S.), 42 (1) : 53-61.

1949. Synder, *Smiths. misc. Coll.*, 112 : 16.

1958. Ahmad, *Biologia*, 4 (1) : 63 (key)

1982. Thapa, *Sabah. For. Roc.*, No. 12, pp. 74-76 : Sabah.

Material : Present in F. R. I., Dehra Dun : one vial with 2S. and 1W., Sabah, Umas Umas, Kalabakan Dist., Coll. Lodjim, 16.vii.1970, ex. "rotten wood", det. R. S. Thapa.

Diagnostic character : (i) IMAGO : Unknown.

(ii) SOLDIER (Fig. 12.A-F) : Head and labrum deep yellowish brown, antennae and pronotum paler. Head with moderately scattered short and long bristles, postmentum with a few erect hairs; pronotum and abdomen more densely hairy.

Head broadly oval and distinctly narrowed anteriorly, lateral margins less outcurved. Fontanelle small (0.10 - 0.11 mm.), placed almost on the posterior margin of trapezoidal postclypeus. Antennae with 13-14 segments, 2 subequal to 3, 4 shorter than 3. Labrum slightly longer than broad with a hyaline tip. Mandibles almost straight with abrupt pointed apices, cutting edge of right mandible distinctly convex (Ahmad, 1958). Postmentum club-shaped, slightly less than one and a half times as wide at widest point as at waist. Pronotum on anterior margin with deep median notch and posterior margin with a feeble emargination.

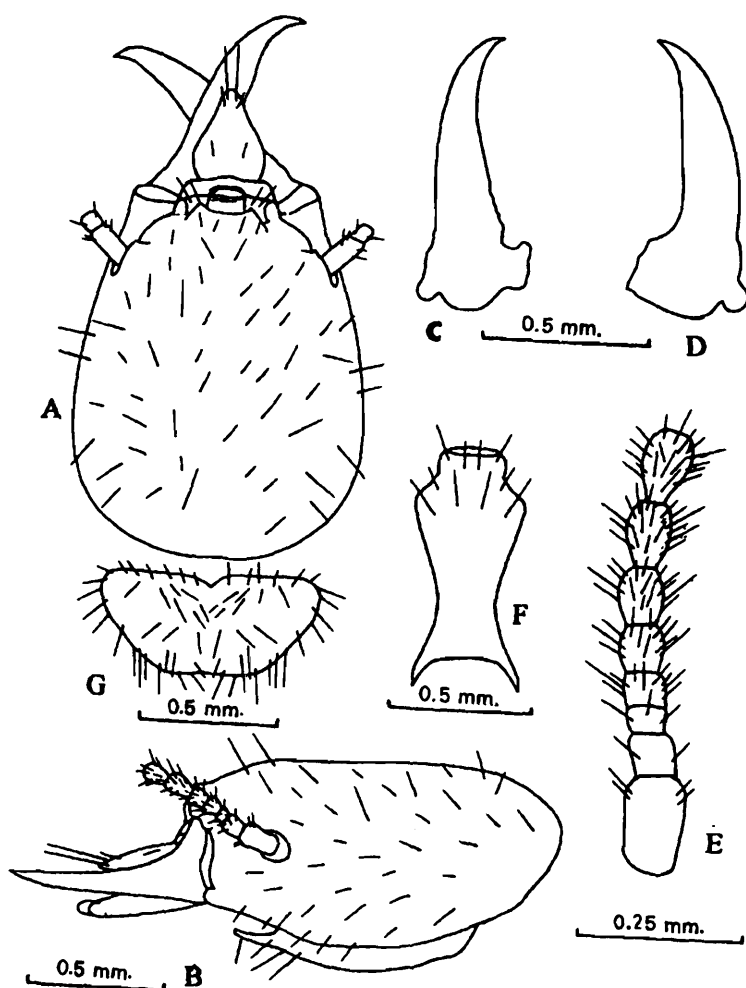


Fig. 12. *Coptotermes bornensis* Oshima; A-F, Soldier. A. Head and pronotum, dorsal view; B. Head in lateral view; C. Left mandible; D. Right mandible; E. Antennae; F. Postmentum (after, Thapa, 1982)

Measurements : Table 22 (S.).

Type : Repository unknown.

Distribution : ASIA : Indonesia : Borneo, Balikpapan; Sabah : Beaufort, Umas Umas and Lumat.

Remarks : The cutting edges of the right mandibles of soldiers are distinctly outcurved which keep it distinct from its close species with incurved cutting edges. Biologically, the species is quite unknown except its habit of occurring in rotten wood in Sabah (Thapa, 1982).

14. *Coptotermes brunneus* Gay

1. *Coptotermes brunneus* Gay

1955. Gay, Proc. Linn. Soc. N. S. W., 79 (1-6) : 177-180, Im. and S. Type-locality : near Galena, N. of Murchison River. Western Australia.

1956. Calaby and Gay, Australian J. zool., 4 (1) : 38-39.

1970. Gay and Calaby, N : *Biology of Termites*, Krishna and Weesner (Eds.), 2 : 415, Acad. Press. New York and London (Biology).

Material : Present in Z.S.I., Kolkata : (ZSI Reg. No. 2764/H8) one vial with 4 1m, 3S and 3W., 45 miles NNW of Galena, Western Australia, J. H. Calaby coll., 26 x. 1955, det. J. H. Calaby and F. G. Gay, doner CSIRO, Australia.

Diagnostic character : (i) IMAGO (Fig. 13.A) : Head, thorax and abdomen dark brown and hairy, paler ventrally ; wing scale darker than other portion.

Head hemispherical behind and narrowed in front of eyes. Fontanelle not distinct. Antennae with 20 segments, either 3 or 4 shortest and narrowest. Postclypeus more than three times as wide as long. Eyes moderately large. Ocelli 0.10 - 0.14 mm., long and separated from eyes by almost half the length.

Pronotum narrower than head with widely and shallowly concave anterior margin and weakly sinuate posterior margin. Forwing scale

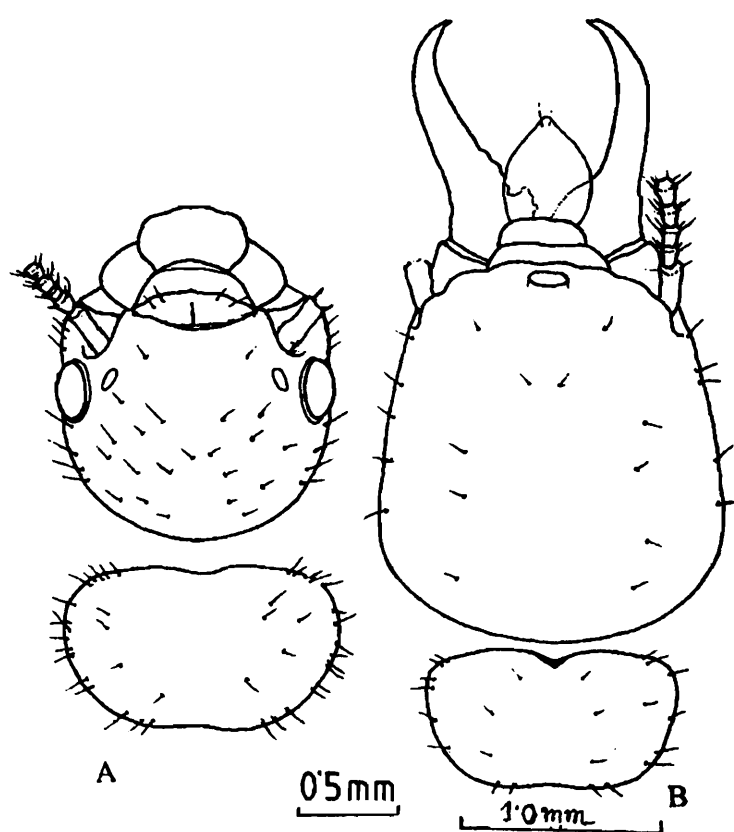


Fig. 13. *Coptotermes brunneus* Gay; A, Imago. A. Head and pronotum, dorsal view; B, Soldier, B. Head and pronotum, dorsal view.

almost double the hind-wing scale. Costal border, radial sector and basal sections of median and cubitus well defined, other veins weakly developed. Wing membrane devoid of any hair, but covered with micrasters.

(ii) SOLDIER (Fig. 13.B) : Head and pronotum deep brown and head darkest anteriorly. Labrum bright golden yellow with hyaline tip. Head and thorax moderately hairy.

Head longer than wide, widest on posterior third and gradually converging anteriorly. Antennae with 17-18 segments, 3 shortest. Fontanelle of medium size. Labrum widest at basal third whence converging anteriorly and terminating into a narrowly rounded apex.

Pronotum distinctly narrower than head width and wider than long, with broad median concavity on anterior margin and shallowly emarginate posterior margin.

Measurements : Table-16 (S.)

Types : *Holotype* : Im (Female) and *Morphotype* S. and W. in division of Ent. Mus., CSIRO, Canberra, Australia.

Distribution : AUSTRALIA : W. Australia : Several localities NNW of Galena, N. of Murchison River.

Remarks : The species is so far only known from its type-locality and around. The characteristic colour and large size of the soldiers keep the species distinct from all other species of Australian *Coptotermes*. The imagos are very close to *C. dreghorni* Hill and *C. lacteus* (Froggatt), but are more dark in colour with one more antennal segment.

The species constructs clay mound of about 5-8 ft. height in the sclerophyl woodland and mallee scrub in western Australia. Mounds are placed close to *Eucalyptus* trees or clump of mallee. Wings adults are generally found on wings during in day time and in mounds in October (Gay, 1955 ; Gay and Colaby, 1970).

15. *Coptotermes ceylonicus* Holmgren

1. *Coptotermes ceylonicus* Holmgren

1911. Holmgren, In *Escherichos and Termitenleben auf Ceylon*, pp. 192-193, Im. and S., *Type-localities* : Seenigoda Estate : Ebenda : Paradeniya : Heneratgoda.
1949. Synder, *Smiths. misc. Coll.*, 112 : 76, Sri Lanka.
1962. Roonwal and Chhotani, *I. C. A. R., Mongr. No.* pp. 9-17, Im and S. Sri Lanka and South India (with extensive synonymy list).
1984. Bose, *Occ. Pap., Rec. zool. Surv. India*, No. 49, pp. 71, 81, 82, 84, 85.
1989. Roonwal and Chhotani, *Fauna of India Isoptera (Termites)*, 1 : 425-431.

Material : A. Present in F. R. I., Dehra Dun : (i) one vial with one S. *Cotype*, Seenigoda, Sri Lanka, coll. K. Escherich, 25th January, det. N. Holmgren. (ii) one vial with 2Im., 5S. and W., *Metatype*, Kelavi Valley? Sri Lanka, 12.xii.1909, det. and Comp., A. E. Emerson.

Diagnostic characters : (i) IMAGO (Fig. 14.A-E) : Head, pronotum and abdominal tergites dark brown; fontanelle area, labrum, antennae and sternite paler; head fairly, pronotum and abdomen densely hairy, wing-scale with dense long and wing membrane with sparse and short hairs.

Head broadly oval, broader than long; dorsum somewhat convex, with depressed fontanelle area, lateral and posterior margins outcurved. Fontanelle very minute, placed almost at the middle. Eyes of median size and circular. Ocelli longer than broad, either touching or slightly touching the ocular sclerite. Antennae with 18-33 segments, segment 2 half of 1, 3 smallest. Labrum broader than long, hyaline apical and lateral margins with a few hairs and on body. Postclypeus convex, yellowish and pilose with a median line. Mandibles of typical *Coptotermes* type.

Pronotum flat, subreniform, narrower than head, much broader than long, anterior margin weakly concave and posterior margin convex with weak median emargination.

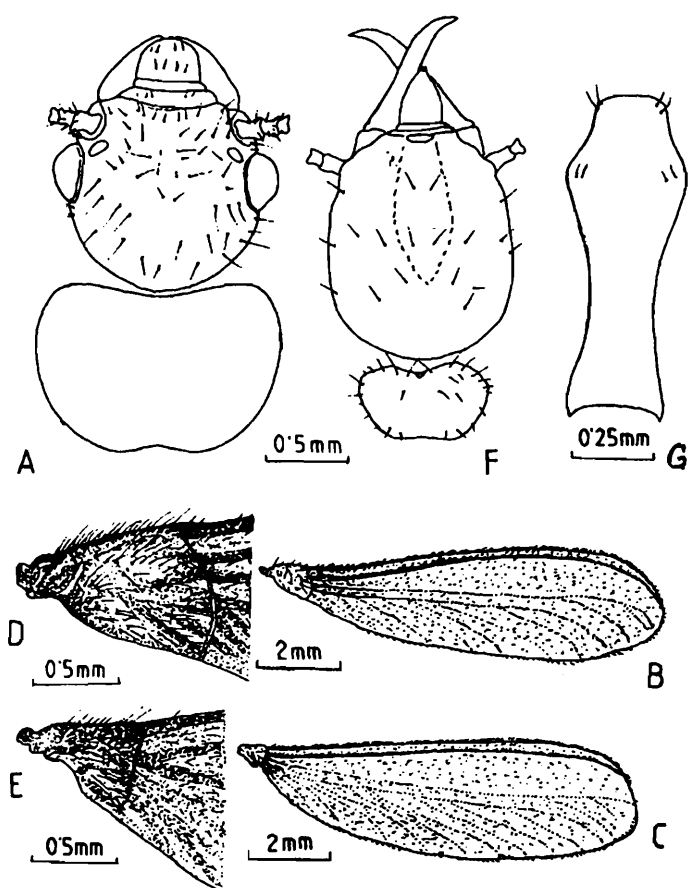


Fig. 14. *Coptotermes ceylonicus* Holmgren; A-E, Imago. A. Head and pronotum, dorsal view; B. Forewing; C. Hindwing; D. Forewing-scale; E. Hindwing-scale. F-G, Soldier. F. Head and pronotum, dorsal view; G. Postmentum.

Forewing : Median, cubitus and its branches prominent in proximal one-third, in distal two-thirds very weak and thin, their course marked by a single row of hairs. Forewing scale longer than the hindwing. Costa fused with subcosta, boadering the anterior margin. Radius running close to costa. Median weak, arising independently from scale margin traversing midway along the entire length of wing with 1-3 weak branches in distally one-third. Cubitus running parallel to median, with 8-13 branches running to postero-lateral margin. Hindwing : Costa, subcosta and radius as in forewing. Median as in forewing except arising from radius just outside scale. Cubitus with 9-12 branches.

(ii) **SOLDIER** (Fig.14.F-G) : Head yellowish brown with paler fontanelle area. Head and pronotum sparsely and abdomen moderately hairy. Head elongately oval, much longer than broad, converging anteriorly, posterior margin round. Fontanelle opening just behind posterior

margin of postclypeus. Eyes and ocelli absent. Antennae with 13-15 segments, segment 2 half of 1, 3 variable, either subequal to or slightly longer than either 2 or 4. Labrum slightly longer than broad, with a pointed hyaline apex, with a pair of long bristle below the apex, postclypeus narrow, trapezoid. Mandibles sabre-shaped with pointed incurved tips. Postmentum long and club-shaped, widest in anterior one-third, from where narrowing posteriorly, anterior margin slightly convex and posterior margin concave.

Pronotum flat, narrower than head-width, anterior margin convex, with a marked obtuse median notch, antero-lateral margins broadly rounded, posterior margin substraight with faint median emargination.

Measurements : Table 5 (Im.) ; 17 (S.).

Types : *Holotype* : Holmgren (1911) did not designate any Holotype. *Cotypes* : present as follows : (i) Wien Museum (Austria) (collected from Paradeniya and Heneratogoda) ; (ii) Im., S. and W., in *Amer. Mus. Nat. Hist.* New York; (iii) Im., S. and W., in Silvestri's coll., Italy; (iv) S. in Ent. Coll., F. R. I., Dehra Dun; (v) probably also in Holmgren's coll., Hogskola, Stockholm.

Distribution : **ASIA :** Sri Lanka : Ambalangoda, Avisavella, Balangoda, Chilaw, Colombo, Ebenda, Elpitya, Gampaha, Gampola, Hantana. India : Tamil Nadu State : Coimbatore, Madras, Mandapam Camp and Krusadi Island.

Remarks : The species in its imago characters in very close to *C. travians*, but differs in having wider head (1.30-1.45 mm vs. 1.18 mm) and wider pronotum (1.10-1.33 mm). In the characters of soldier, the species is very similar to *C. travians* and can hardly be isolated. The soldiers are also very similar to *C. gestroi*, but differs in having narrower head and heavy dorsal margin behind the fontanelle opening.

The species is well known as wood destroying termites in Sri Lanka infesting numerous living plants including *Acacia*, *Albizia*, tea bushes, rubber, cocconut trees, etc. and wood works in buildings and wood in storage. Winged forms are

found in the nests in December in Sri Lanka and in February, March and July in South India. The species had been referred by many authors in various occasions (Escherich, 1911; Bathellier, 1927; Jepson, 1929; Beeson, 1941; Roonwal, 1970).

16. *Coptotermes communis* Xia and He

Material : The description and measurements are based on Xia and He

Diagnostic character : (i) *Imago* : Unknown

(ii) *Soldier* (Fig. 15.A-E) : Head almost devoid of hairs, elongately round and slightly narrowed anteriorly; frontanelle smaller and placed slightly below the postclypeal suture labrum dome-shaped with fairly pointed tip. Mandibles elongate with pointed hooked apices. Antennal segment 2, 3 and 4 subequal. Postclypeus club-

shaped, widest width on anterior third and waist on basal fourth, distinctly arched. Pronotum narrower than head-width, anterior margin shallowly and posterior margin broadly incurved, margins sparsely hairy.

Measurements : Head-length 1.50 mm; Head-width 1.20 mm; Mandible-length 0.96 mm; Head index (W/L) 0.76 mm; Mandible head index 0.60 mm; Head contraction index 0.57 mm; Widest width of postmentum 0.40 mm.

Types :

Distribution : ASIA : China.

17. *Coptotermes crassus* Snyder

1. *Coptotermes crassus* Snyder

1922. Snyder, *Proc. U. S. nat. Mus.*, 16 (20) : 21 and 22, S., Type-locality : San Juan pueble, Honduras.
1933. Light, *Calif. Univ. Publ. (Ent.)*, 6 (5) 105-107, Im and S., Colima, West Mexico (introduced).
1949. Snyder, *Smith. misc. coll.*, 112 : 77.
1984. Gay, *CSIRO, Australia, Bull No.286*, p. 71-73, Im and S. Honduras, Western Mexico, Japan, Taiwan and South China; Texas and Hawaii (introduced).
1970. Araujo, *Termites of the Neotropical Region*, In : *Biology of Termites*, 2, p.543, Guatemala, K. Krishna and F. M. Weesner (Eds.), Acad. Press.
1977. Araujo, *Cat. Isopt. Acad. Brasil. Ciencias*, p. 241. : 425-431.

Material : A. Present in Z. S.I., Calcutta : (i) one vial with 1s, Mexico, det. S. F. Light.

B. Present in F. R. I., Dehra Dun : (i) One vial with 2 Im. 5S. and 2W., Mexico, W. V. Hagen. coll., det. S. F. Light

Diagnostic character : (i) *IMAGO* (Fig. 16.A.) : Head blackish brown, thorax and abdomen much paler; antennae and labrum yellowish brown; basal portion of mandibles yellowish and toothed margins brown; wings with uniform long hairs, with very long hairs on the wing-scale. Head fairly, antipronotum and body densely hairy.

Head subcircular, slightly broader than long, frons weakly sloping in front. Frontanelle minute,

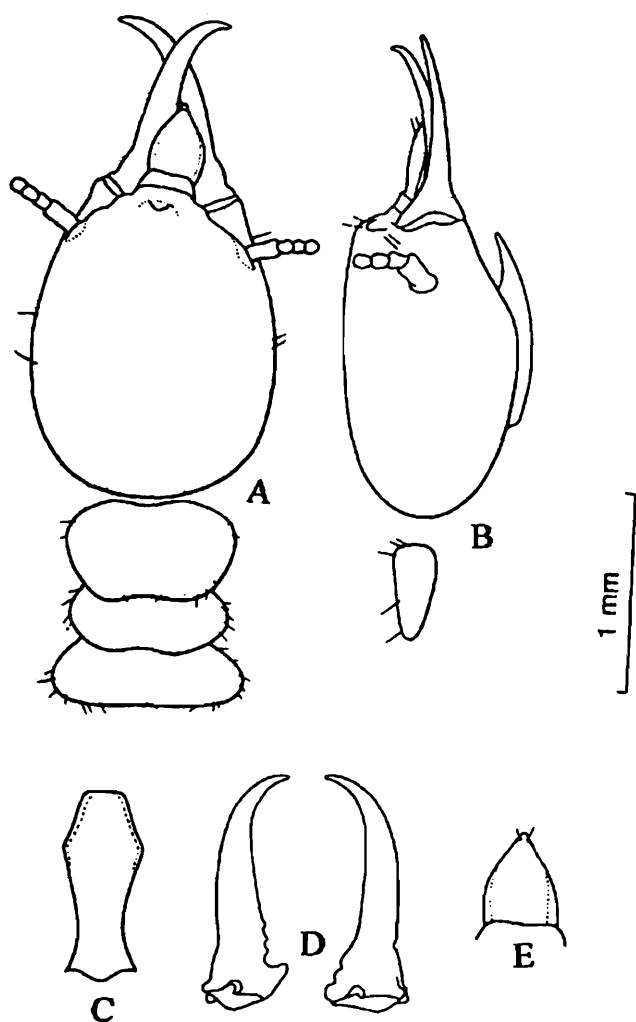


Fig. 15. *Coptotermes communis* Xia and He; A-E, Soldier. A. Head and pronotum, dorsal view; B. Head and pronotum, lateral view; C. Postmentum; D. Right and left mandible; E. Labrum (after, Xia and He, 197?).

somewhat circular, placed in a weakly depressed area just in the middle of head. Antennae broken, segment 3 shorter than 2, 4 smallest and with convex margins. Eyes subround, fairly large. Ocelli oval and translucent, separated from the eyes by its minimum diameter. Postclypeus weakly swollen with a complete median line. Labrum slightly broader than long with a few long erect hairs near distal margin on body, lateral and apical margins rounded. Mandibles of typical *Coptotermes*-Type.

Pronotum subreniform, slightly broader than the head; one and a half times broader than long; anterior margin weakly concave, without any distinct median notch; posteriorly convex, with a very weak median emargination.

Wing membrane transparent and hairy, somewhat punctate, all veins marked by hairs. Forewing scale longer than hindwing and partly overlapping on the latter. In forewing costa-subcosta fused and highly chitinised, bordering the anterior margin of wing. Radius as thick as the costa-subcosta; running closely parallel to costa-subcosta and fusing with it distally. Median thin, emerging separately from the scale with

2-3 branches in the distal one-third. Cubitus also thin with 16 branches to the posterior border. In hind-wing, costa-subcosta and radius as in forewing. Median arising from the radius just outside the scale with 2 branches in the distal one-third. Cubitus as in forewing, but with 9-11 branches to the posterior margin.

(ii) SOLDIER (Fig.16.B) : Head deep brown ; antennae, pronotum, labrum and legs paler than head ; abdomen yellowish white. Head with a few erect hairs, thorax sparsely and abdomen densely hairy.

Head pyriform in shape, longer than broad, anterior end at the base of mandible more than half the maximum width. Fontanelle large, placed slightly below the posterior margin of postclypeus. Eyes and ocelli absent. Antennae with 14 segments, segment 3 smaller than 2, 4 slightly longer than and broader than 3. Clypeus short, trapezoidal, divided into an ante- and a post-clypeus. Labrum subtriangular, a little longer than broad, with a hyaline somewhat pointed apex and with two bristles. Postmentum club-shaped, long and narrow with a few short hairs in anterior end, broadest in the anterior one-third, narrowest in the posterior third.

Pronotum flat, much broader than long, length little more than half the width, anterior margin convex with a median strong emargination, antero-lateral corners narrowly rounded, posterior margin weakly convex with a median depression.

Measurements : Table 6 (Im.) ; 16 (S.).

Types : S. (No. 34571) in USNM, Washington.

Distribution : CENTRAL AMERICA : Mexico Honduras, Guatemala. Asia : Japan, Taiwan, South China. NORTH AMERICA : Texas and Hawaii (introduced).

Remarks : The species occurs in the stumps, posts and dead wood on the ground and within the trunks of living trees. The species was found infesting a floating dry dock in Houston, Texas (Darward, 1956). The presence of this species in situation like this indicates certainly a case of

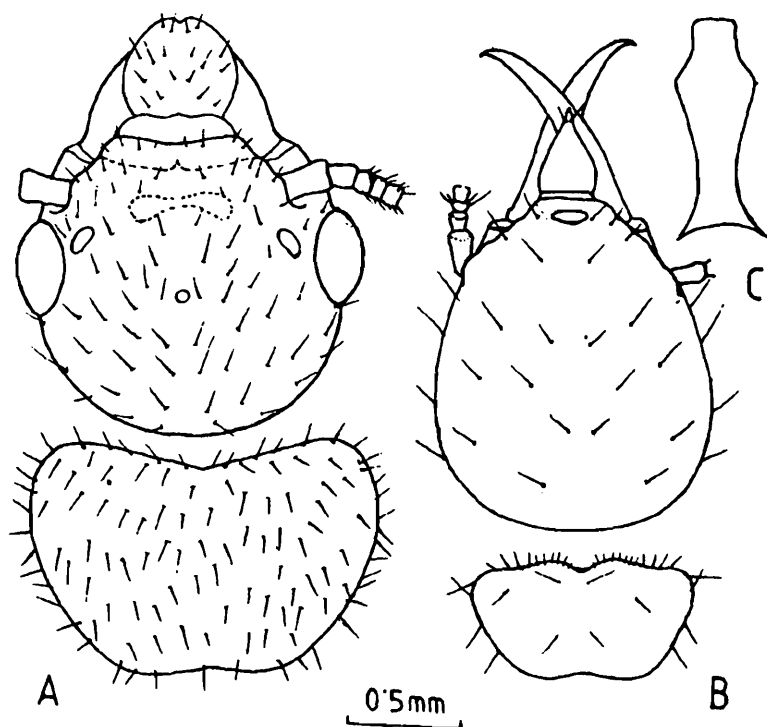


Fig. 16. *Coptotermes crassus* Snyder A, Imago. A. Head and pronotum, dorsal view; B-C, Soldier. B. Head and pronotum, dorsal view; C. Postmentum.

introduction. But it is believed to have been eradicated. However, the alates at colima state flight in mid July and late August, 1930 (Gay, 1967; Weesner, 1970).

18. *Coptotermes crassus* Ping

1. *Coptotermes crassus* Ping

1985. Ping, *Entomotaxonomia*, 7 (4) : 319-320. Type-locality : Guangzhou, China.

Material : Diagnostic characters and measurements are based on ping. (1985).

Diagnostic character : (i) IMAGO : Unknown (ii) SOLDIER (Fig. 17.A-E) : Head sparsely hairy, elongately round with narrow anterior end. Fontanelle opening smaller, placed slightly below the fronto-clypeal suture. Labrum lanceolate in shape with a fine apex. Mandibles thin, elongate with fine incurved apices. Antennal segment 3

smallest. Postmentum elongate, anterior third with some transverse serration and hairs, widest width on anterior third and waist on posterior third. Pronotum margins with numerous hairs, anterior margin broadly concave and posterior margin with somewhat distinct median invagination.

Types : Soldier (*Holotype* and *paratypes*) and worker from type series (I. No. E754), coll. Xie vling sha et al., 12.iii.1983 ex "stump" in Guangdong Inst. Ent., China.

Distribution : Asia : China : Guangzhou City.

Remarks : According to Ping (1985), "This new species can be separated from *C. formosanus* Shiraki, by the width of head 1.35-1.38, by the height of head including postmentum 1.02-1.04, and by the width of pronotum 0.97-1.02.

From *C. guangdongenses* Ping, by the left mandible 1.07, by the height of head including postmentum 0.96, by the fontanelle triangular-shaped.

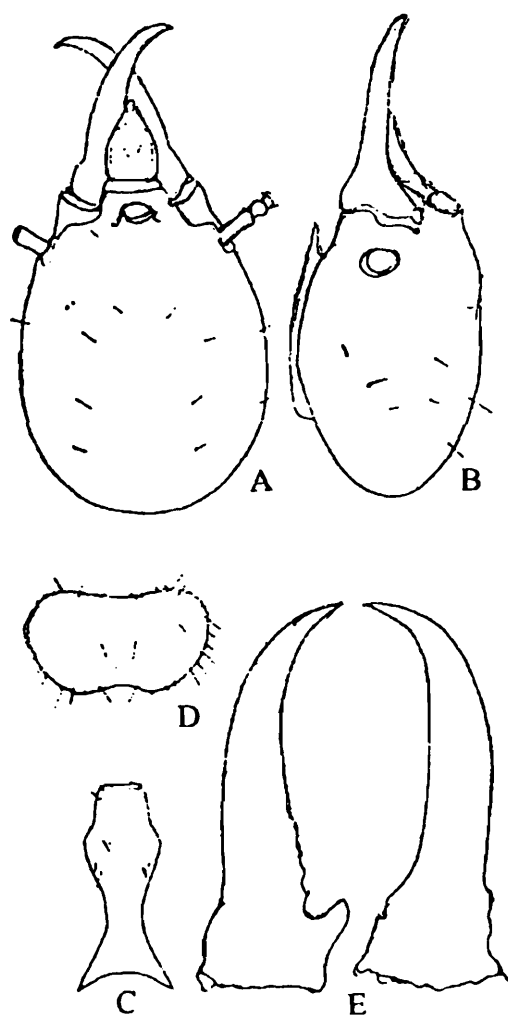


Fig. 17. *Coptotermes crassus* Ping; A-E, soldier. A. Head, dorsal view; B. Head, lateral view; C. Postmentum; D. Pronotum; E. left and right mandible (after, Ping 1985)

19. *Coptotermes curvignathus* Holmgren

1. *Coptotermes curvignathus* Holmgren

1913. Holmgren, K. *Sven. Vet. Acad. Handl.*, 50 (2) : 77-78, 266, S. and W., Type-localities : Singapore, Sarawak and Myanmar (according to Roonwal and Chhotani, 1962, P. 8 restricted in Singapore only, *vide infra*).

1914. Holmgren, *Zool. Jb. (Syst.)*, 36 : 236, East Sumatra and Malacca.

1925. John, *Trebuia*, 6 (3-4) : 381-382, S. and W., Malaya peninsula and E. Sumatra.

1949. Snyder, *Smiths. misc. Coll.*, 112 : 77, Malaysia and Myanmar.

1957. Harris, *Malayan. Nat. J.*, 12 : 23, Malaysia.

1958. Ahmed, *Biologia*, 4 (1) : 60 and 63.

1961. Harris, *Termites, their recognition, biology and control.*, p.88.

1962. Roonwal and Chhotani, *Indian species of the termite genus Coptotermes.*, I.C.A.R., Mongr.No.2, p.8 and 34-35, New Delhi.

1962. Kalshoven, *Symp. genet. Biol. Italica*, 11 : 223.

1963. Kalshoven, *Ent. Ber. Amst.*, **23** : 90.
1965. Ahmad, *Bull. Amer. Mus. Nat.*, **131** (1) : 20-21, Thailand.
1966. Roonwal and Maiti, *Treubia*, **27** (1) : 79-81, S. Gn. Batu, Java.
1968. Harris, *Opusc. ent.*, **33** : 144.
1970. Roonwal, *Termites of the Oriental Region*, p.336, In : Krishna and Wesner, (Eds.), *Biology of Termites*, 2, New York : Academic Press.
1976. Coaton and Sheasy, *Cembebasia A* **3** (11) : 143-145.
1982. Thapa, *Sabah. For. Rec.*, **12** : 77-80.
1992. Thakur and Thakur, *Treubia*, **30** (3) : 246-248. Para 4.

2. *Coptotermes robustus* Holmgren

1913. Holmgren, K. *Sven. Vet. Akad. Handl.*, **50** (2) : 78. S. and W. Type-locality : North Borneo.

3. *Coptotermes gestroi* Wasmann

1913. Oshima, *Philipp. J. Sci.*, **8** (4) : 283-284 (really *C. curvignathus*, vide, Snyder, 1949, p. 77).

Material : A. Present in Z. S. I., Kolkata : (i) one vial (Z. S. I. Reg. No.3794/H8) with 1S. and 1W., Sepang, Malaysia, Coll. G. H. Corbett, 15.v.1934, ex. "in crown of oil palms", det. A. E. Emerson. (iii) one vial with 4S. and sev. W., Gn. Batu, Bogor, Java, Indonesia, *Bogor Mus. Coll.*, No.53, 8.ix.1959, det. M.L. Roonwal and P. K. Maiti.

B. Present in F. R. I., Dehra Dun : (iii) One vial with 1S. *Topotype*, Singapore, Malaysia, Coll. H. Kirby, 29.iii.1935, det. A. E. Emerson (material from AMNH, New York); (ii) one vial with 2Im., Tandjong Slamat, East Sumatra, Coll. M. V. Bultel-Reepen, May, 1912, ex. "at light", *Coptotermes robustus* Holmgren det. N. Holmgren; redet. A. E. Emerson as *C. curvignathus* Holmgren (specimens from A.M.N.H.); (v) one vial 3S. and 2W. (from A.M.N.H.), probably paratype colony, Los-Banos, Luzon, Philippines, Coll. C. F. Backer, *Coptotermes flavicephalus* Oshima det. M. Oshima, redet. A. E. Emerson as *C. curvignathus* Holmgren, (vi) one vial with 2 Ims., Maco, Tajum, Dava Province, Mindano, Coll. H. R. Hoogstraal, October, 1946, det. A. E. Emerson.

Diagnostic character : (i) IMAGO (Fig. 18.A-C) : Head chesnut brown; antennae, postclypeus, labrum, pronotum oval body paler than head. Wings straw yellowish, non-reticulate and sparsely hairy. Pronotum densely and body sparsely hairy. Body length with wings 16.00.

Head subcircular with outcurved lateral margins. Fontanelle small, elongately oval, slightly raised amidst weakly depressed area slightly above the middle. Antennae with 20 segments, 3 smallest and 4 subequal to 2. Eyes circular, large and distinctly budging out. Ocelli oval, large, translucent, only slightly separated from the eyes. Postclypeus weakly swollen and devoid of any distinct median line. Labrum broader than long lateral sides diverging anteriorly and terminating with broadly rounded apical margin with a few scattered setae.

Pronotum subreniform, slightly narrower than head, anterior margin broadly concave with

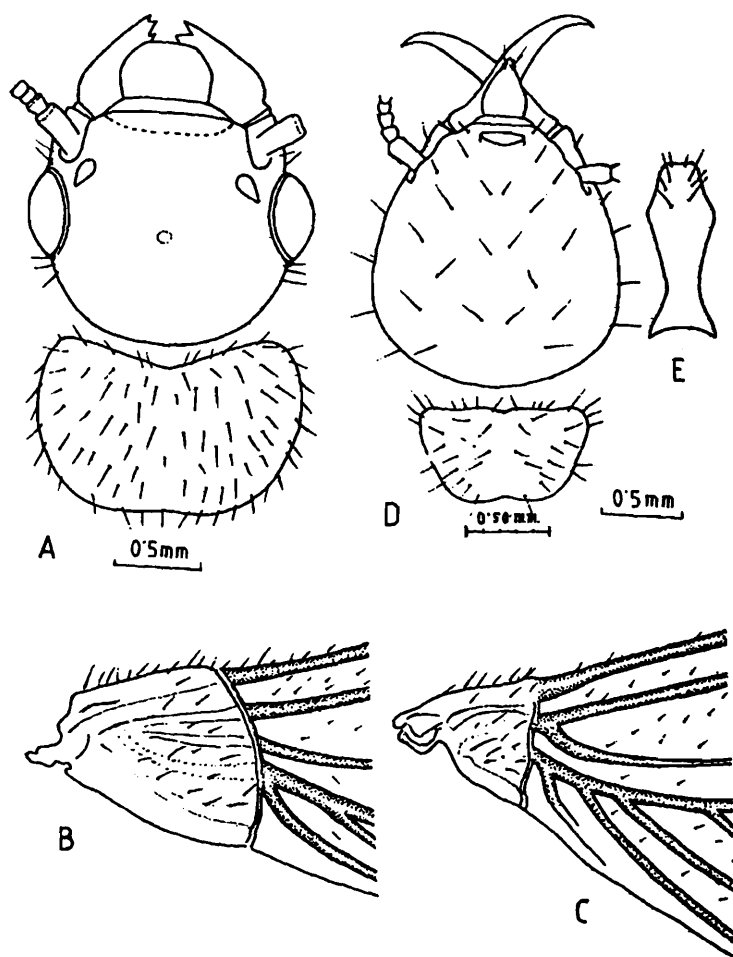


Fig. 18. *Coptotermes curvignathus* Holmgren A-C. Imago. A Head and pronotum, dorsal view; B. Forewing, C. Hindwing. D-E. D. Soldier ant pronotum, dorsal view E. Postmentum

indistinct median notch; posterior margin weakly convex with a weak median emargination.

Wing membrane transparent and hairy, all veins marked by long and short rows of hairs. Forewing scale longer than in hindwing and partly overlapping the latter. Costa-subcosta fused and highly chitinized, bordering the anterior margin of wing. Radius as thick as the costa-subcosta; running parallel to costa-subcosta and fusing with it distally. Median thin (basally thick), emerging separately from the scale with A-3 branches in the distal one-third. Cubitus also thin with 11-12 branches to the posterior border. Hind wing: Costa-subcosta and radius as in forewing. Median arising from the radius just outside the scale, with 2 branches in the distal one-third. Cubitus as in forewing, but with 10-11 branches to the posterior border.

(ii) SOLDIER (Fig. 18.D-E) : Head chestnut brown; antennae pronotum, labrum and legs paler than head. Head with a few erect hairs, thorax sparsely and abdomen densely hairy.

Head broadly oval, slightly longer than broad, lateral margins strongly bulging out, weakly constricted above the level of antennal flaveole; anterior width slightly more than half the maximum width. Fontanelle large placed slightly below the posterior margin of postclypeus, fontanelle opening strongly effaced. Antennae with 14-16 segments, 2 or 3 almost one and a half time longer than either 2 or 4. Labrum subtriangular, apex hyaline, either somewhat pointed or bluntly rounded, with two bristles on either side of apex. Mandibles sabreshaped, like typical *Coptotermes*-type. Postmentum clubshaped, narrowest width almost half the broadest width and lying below the middle of broadest width and posterior margin.

Pronotum flat, much broader than long; length little more than half the width, anterior margin convex with a deep median emargination, posterior margin with a weak median emargination.

Measurements : Table. 11 (Im.); 25 (S.)

Distribution : Asia : Malaysia : Saba, Malacca, Indonesia : Java, Sumatra Borneo. Myanmar. Thailand and Singapore.

Remarks : (On Z.S.I. material) : The characters of specimens from sepang having saddle shaped pronotum with deep median notch and with prominent postero-median emargination, blunt labrum, etc. which are not present in material from Gin Batu.

20. *Coptotermes dobonicus* Oshima

1. *Coptotermes dobonicus* Oshima

1914. Oshima, *Annot. zool. Jap.*, 8 : 554-555. S. and W. Type-locality : Dobo, Aru Island, New Guinea.
1949. Snyder, *Smiths. misc. Coll.*, 112 : 77, New Guinea.
1970. Boss, *Biology of Termites*, (Eds. Krishna and Weesmer) 42, p.472, South Pacific.

Material : Since no material is available, description, measurements etc. are based on the original paper by Oshima (1914).

Diagnostic character : (i) IMAGO : unknown.

(ii) SOLDIER : Head pale yellow; mandible brown; abdomen whitish. Head sparingly pilose; abdominal tergites densely provided with delicate hairs.

Head ovoid, slightly flattened; fontanelle opening directed forward, somewhat inclined. Clypeus short. Labrum tongue-shaped with hyaline triangular tip reaching beyond middle of mandibles. Mandibles sabre-shaped with incurved piercing tip. Antennae with 17-segments, 3 shorter than 2. Pronotum broad, anterior and posterior border indented in the middle.

Measurements (in mm) of Soldier : Length of body-6.00; Length of head with mandible-2.69; Length of head without mandible-1.66; Width of head-1.41; Width of pronotum-1.06; Length of pronotum-0.59.

Types :

Distribution : Asia : Indonesia Dobo, Aru Island.

Remarks : Since the material is not available, the remarks of Oshima (1914b) in quoted below : "The species is clearly allied to *Coptotermes curvignathus* Holmgren. However, a close comparison of these two species shows several discrepancies. Thus in *dobonicus* the soldier is provided with much longer head and with antennae which are 17-jointed instead of being 14-16 jointed. In the workers, the most notable difference lies in the number of antennal joints, which in the present species numbers 16, the 2nd joint being as long as the 3rd, while in *curvignathus* the antennae are 15-jointed, the 2nd joint being much longer than the 3rd"

Though the original author has compared the species, *C. dobonicus* Oshima with *C. curvignathus* Holmgren, but the species seems to be more close to *C. grandiceps*. However, the wider pronotum of *C. grandiceps* keeps the species separate.

21. *Coptotermes dreghorni* Hill

1. *Coptotermes dreghorni* Hill

1942. Hill, *Termites (Isopters) from the Australian Region*, C.S.I.R.O., Melbourne, 170-171, *Type-locality* : Queensland : Timber reserve No.213, Parish of Dirran, about 5 miles E. of Ravenshoe.
1949. Snyder, *Smiths. misc. Coll.*, 112 : 77.
1970. Gay, *Termites of the Australian region* p.415, In *Biology of Termites*, Krishna and Weesner (eds.), 2, Acad. Press, London.

Material : A. Present in F.R.I., Dehra Dun : 5 Im., 1S. and 1W., paratypes from the type-colony, Timber Reserve No. 263, Parish of Dirran, 5 miles E. of Ravenshoe, North Queensland, Australia, R. V. Dreghorn Coll., 11.xii.1938, det. G. F. Hill.

Diagnostic character : (i) IMAGO : Very similar to that of *C. lacteus*, except the following character. Narrowed head, pronotum less narrowed posteriorly, wings shorter and paler in colour. Antennae with 18-19 segments, 3 very short, Ocelli long (0.11) and separated from the eyes by half their length.

(ii) SOLDIER : Very similar to that of *C. acinaciformis* and *C. raffrayi* by its larger size.

Antennae with 16 segments, 3-5 variable, 3 shortest.

Measurements : Table 4 (Im.); 26 (S.)

Types : Holotype Im. and Morphotypes S. and W. in Mus. Ent. Div., C.S.I.R.O., Canberra, Australia.

Distribution : AUSTRALIA : Timber Reserve No.263, Parish of Dirran, about 5 miles E. of Ravenshoe (*Type-locality*). Fishery Creek (Near Gordonvale), Gadgarra, Cedar Creek, Closhees River, Evelyn Table land, Utchee Creek (17 miles S.S.E. of Innisfail).

Remarks : The soldiers are very close to *C. acinaciformis* and *C. raffrayi*, but larger in size. The imagoes seem to be close to *C. lacteus*. The species is known to infest wallnut tree *Endiandra palmerstoni* in the table lands and coastal areas of North Queensland and is unusual in being recorded in the rain-forest. It is also collected from stumps, logs, timber, litter, etc. The imagoes stage flight in the middle of day during August and September (Gay, 1970).

22. *Coptotermes elisae* (Desneux)

1. *Termes (Coptotermes) elisae* (Desneux)

1905. Desneux, *Ann. (Hist. nat.) Mus. nat. Hung.*, 3 (1) : 368, Im. *Type-locality* : Simbang (Huon Gulf), New Guinea.

2. *Coptotermes elisae* (Desneux)

1911. Holmgren, *Mitt. Zool. Mus. (Kais-with-Land; Fluss A ; Lager II)*. Berlin, 5 (3) : 456, Im,
1942. Hill, *Termites from the Australian Region*, Melbourne, pp. 147-149, Kokoda, Papua.
1949. Snyder. *Smiths. misc. coll.*, 112 : 77, New Guinea.
1963. Gay, *Pacific Ins.*, 5 (2) : 421 423, Bulobo, New Guinea (syn.)
1970. Bees, *Termites of the Hawaii and the Oceanic Islands* p. 472, IN : *Biology of Termites* (Krishna and Weesner eds., Acad Press, London).

3. *Coptotermes hyaloapex* Holmgren

1957. Harris, *Pacific Ins.*, 5 (2) : 422 (Synonymised).

Material : Present in F. R. I., Dehra Dun (i) One vial with 3S. and 3 W., Strickland River, Papua, C.E. Pamberton Coll., 6.viii.1928, det. A. E. Emerson as *Coptotermes hyaloapex* Holmgren.

Diagnostic character : (1) IMAGO (Fig. 19.A) : The following is from Desneux's paper : 8-9 mm. long., Upperside yellowish-brown, mesonotum and metanotum pale, head brown. Head ovate, without distinct fenestra. Eyes slightly large and prominent, rounded. Ocelli approximated to the eyes, distant from these by less than half a diameter. Antennae long, of 21 segments, the end larger than the 3rd which is short. Beyond the 5th the segments are larger and subglobose. Epistoma not prominent. Pronotum large, not quite as broad as the head with eyes, the anterior margin concave, anterior corners rounded, postero-lateral margins but little arched and converging, posterior border distinctly lobed. Posterior border of mesonotum and metanotum obscurely concave. Anterior wing stumps much larger than the posterior and covering the base. Wings very hairy, the anterior ones 12.5-14.00 mm long by 3.9-4.3 mm broad. The base of the costal border and of the radius brownish. Median very faint, running nearer to the cubitus than to the radius, nearly straight, and reaching unbranched to the apex of the wing (sometimes, with one offset). Cubitus very faint with about 9-10 offsets. Male with minute style.

New Guinea : Simbang (Huon Gulf), September, 1898.

These species possesses the typical characters of the subgenus *Coptotermes*, to which I have no doubt it belongs. It is remarkable for its large size."

Measurements (in mm; 3 exs.) after Holmgren, 1911b, in Table-4.

(ii) SOLDIER : Not dealt with description, but diagram provided.

Measurements : Table-4 (Im)

Type : Holotype : Im., in Desneux Collection.

Distribution : ASIA : New Guinea : Simbang

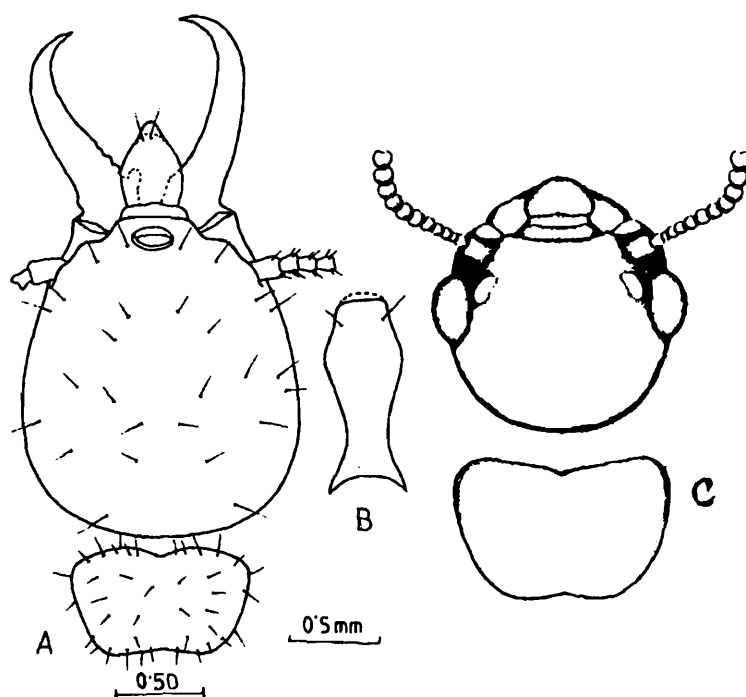


Fig. 19. *Coptotermis elisae* (Desneux), A-B, Soldier. A Head and pronotum, dorsal view; B, forewing, C. Imago. Head and pronotum, dorsal view; E, Postmentum

(Huon Gulf); Kais-with-Land.; Fluss A; Lager II; Kokoda (Papua); Strickland River (Papua).

Remarks : Very large and prominent eyes (0.66-0.69) keep the species apart from others. Soldiers may have been described under the names of *C. hyaloapex* or *C. obiratus* considering the corresponding large size of the imagoes of these species (Hill, 1942) Gay (1963) has shown that *C. elisae* (Desneux) and *C. hyaloapex* Holmgren are synonymous, with the former name having priority which have been followed here. Hill (1942) mentioned that the specimens referred to under *C. hyaloapex* has the potentialities to attack both structured timbers and living trees and shrubs. Several species of living trees of *Hopea*, *Araucaria*, *Pometia*, paw paw, mango are known to be attacked by this species in prime forest areas near Bulolo, New Guinea. Serious damage to timber in use includes attacks on klink pine boards and flour joints in houses, sheaves, stored boxes, sawn timber, etc. (Gay, 1963).

23. *Coptotermes emersoni* Ahmed

1. *Coptotermes emersoni* Ahmad

1953. Ahmad, *Spol. Zayl.*, 27 (2) : 37-38.

S. Type-locality Colombo, Sri Lanka.

1958. Ahmad, *Biologia*, 4 (1) : 65. (key).
 1962. Roonwal and Chhotani, *Indian species of the termite genus Coptotermes*, I.C.A.R., Mong. No.2 : 9, 17-20, 74, 84-87.
 1983. Chhotani, *Orient. Insects*, 17 : 117
 1989. Roonwal and Chhotani, *Fauna of India (Isoptera)*, 1 : 431-434, Figs. 227 and 228.

Material : A. Present in Z. S. I., Kolkata : one vial (Reg. No. 2627/H8) with 1S and 1W., Paratypes from Holotype colony, Colombo (W. P. Sri Lanka), 10.x.1934, ex. "electric wire-casing in Museum"

B. Present in F. R. I., Dehra Dun : One vial with 1S and 1W paratype and Topotype, Colombo, Western Province, Sri Lanka, 10.x.1934, ex. "electric wire casing in Museum"

Diagnostic character : (i) IMAGO : unknown. (ii) SOLDIER (fig. 20.A.B.) : Head light brown, antennae, labrum, pronotum and abdominal segments paler than head capsule; head with only one hairs on either side of the fontanelle; pronotum sparsely and abdomen somewhat densely and irregularly hairy. Head pyriform, longer than broad, posterior margin rounded.

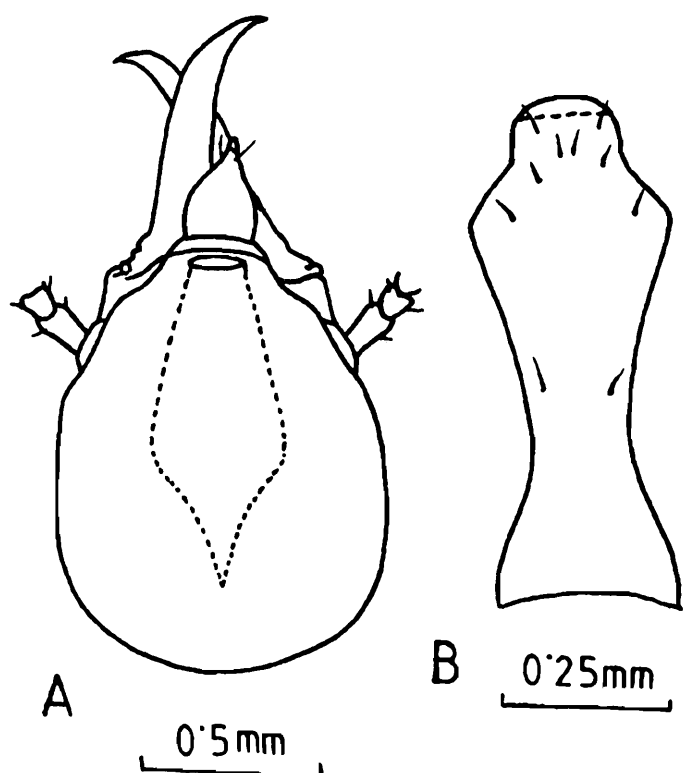


Fig. 20. *Coptotermes emersoni* Ahmad ; A-B, soldier. A. head, dorsal view; B. Pronotum.

Fontanelle opening oval lying just behind the clypeus. Antennae with 13 segments, 3 smaller than 2 or 4. labrum longer than broad, with a pointed hyaline apex below of which with two long bristles.

Measurements (in mm.) : Table 18(S.)

Types : Holotype S. in National Mus., Sri Lanka.

Distribution : ASIA : Sri Lanka : Colombo, so far known only from type-locality only.

Remarks : The soldier of *Coptotermes emersoni* is close to *C. gaurii* R & K, *C. kisheri* R & Chj., *C. minutissimus* Kem. and *C. kalshoveni* Kem., but differs from as indicated in the key.

24. *Coptotermes eucalyptus* Ping

1. *Coptotermes eucalyptus* Ping

1919. Ping *Type-locality* : Xiaoliang of Diankai Country, Guangdong Province, China.

Material : Characters and measurements are taken from that of Ping.

Diagnostic characters : (i) IMAGO : Unknown

2. SOLDIER (Fig. 21.A-E) : Body medium-sized. Head scantily hairy, pale yellowish brown, pronotum pale yellow and abdomen milky white. Head oval, head with index 0.75-0.80, head-contraction index 0.54-0.76. Fontanelle opening slightly sloping posteriorly. Head in profile almost straight in dorsal margin. Antennae with 15 segments. Labrum subtriangular. Mandibles curved inward at the tips, left mandible with basal crenulations. Mandible head index 0.57-0.61. Postmentum widest at anterior one-fourth and waist at posterior one-third, length about 4.4 times as wide as waist. Pronotum flat, weakly depressed anteriorly and posteriorly, lateral sides convex.

Measurements : Table 27 (S.)

Types : Soldier (Holotype and Paratypes) S. and Worker from type series (1No. E. 7617), coll. Ping, 8.iv.1983, ex. living tree, *Eucalyptus tereticornis* in Guangdong Inst. Ent., China.

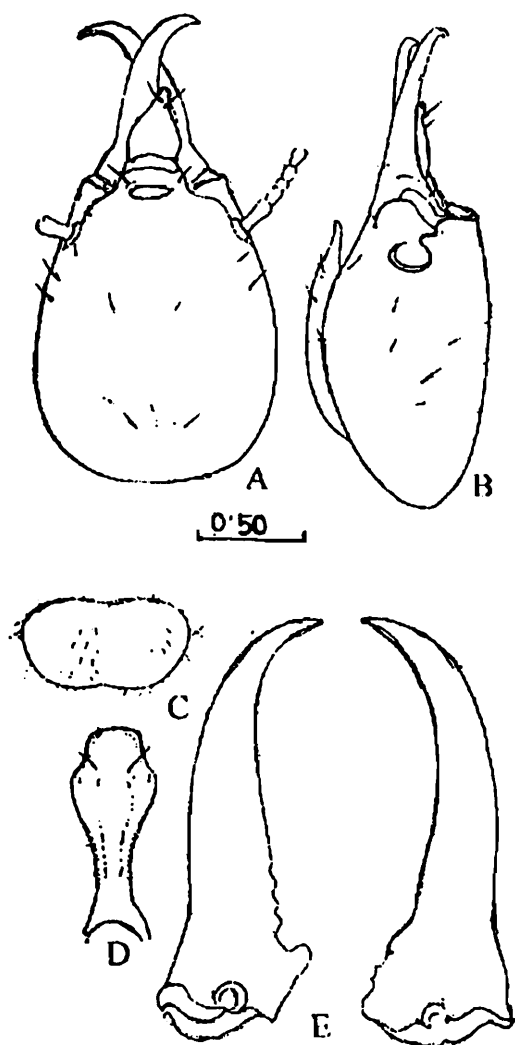


Fig. 21. *Coptotermes eucalyptus* Ping; A-E, Soldier. A. Head, dorsal view; B. Head, side view; C. Pronotum, dorsal view; D. Postmentum; E. Left and right mandibles (Ping, 1985).

Distribution : ASIA : China, Guangdong Province, Xiaoliang of Dianbai Country.

Remarks : The species differs from *C. formosanus* by its smaller mandibles and posteriorly directed fontanelle opening. Further, it differs from *C. xiaoliangensis* in having larger head, smaller mandibles and weakly depressed anterior margin of pronotum. It has been collected from a living tree of *Eucalyptus tereticornis* in Guangdong province of China being considered as a pest.

25. *Coptotermes formosanus* Shiraki

1. *Coptotermes formosanus* Shiraki

1909. Shiraki. *Trans. ent. Soc. Japan*, 2 (10) : 239-240, Type-locality : Taihiku, Formosa Is., (off China).
 1912. Oshima, *Third official Report of termites*, Taihoku, p.75.

1913. Holmgren, K. *Sven. Vet. Akad. Handle.*, 50 (2) : 76-77, Im. S. and W. (described as a new species from Formosa, but conspecific with *C. formosanus shikari*, according to Snyder, 1949).
 1919. Oshima, *Philipp. J. Sci.*, 15 (4) : 321-324. Im; Q., K., S. and W., South China, Formosa and Japan.
 1929. Light, *Philipp. J. Sci.*, 40 (4) : 422, 432 and 439.
 1931. Light, *Lignan Sci. J.*, 7 (1929) : 583, 584, 591, 593, China.
 1949. Snyder, *Smiths. misc. Coll.*, 112 : 78. Formosa, Japan, China Coast, Hawali, South Africa.
 1953. Ahmad, *Spol. zeyl.*, 27 (1) : 35-36. Formosa, Japan, China, Sri Lanka and South Africa.
 1958. Ahmad, *Biologia*, 4 (1) : 61, 65 (key).
 1962. Roonwal and Chhotani, *Indian species of the termites Genus Coptotermes*, I.C.A.R., Mongr. No.2, pp. 20-30, Im., S. and W. (detailed synonymies and distribution).
 1963. Harris, *Mem. Hong Kong nat. Hist. Soc.*, No.6, pp. 3-4, Hong Kong.
 1986. Harris, *Proc. R. ent. Soc. Land. (B)*, 35 (11-12) : 162, 165-166, Cape province and Eastern Transvaal.
 1970. Roonwal, *Termites of the Oriental Region*, pp.337-338, Oriental, Ethiopian and Nearctic Regions.
 1970. Weesner, *Termites of the Nearctic Region*, p.508-510, In : *Biology of Termites*, 2, 643 pp. (eds. K. Krishna and F. M. Weesner, Academic Press, Ney York and London).
 1989. Roonwal and Chhotani, *Fauna of India : Isoptera (Termites)*, 1 : 434-441.

2. *Coptotermes formosae* Holmgren

1911. Holmgren, In Escherich's *Termiten. Leben auf*, Ceylon, p. 192. in Formosa. Yana, Rep. Forest Exp. Stat., No. 9, p. 63.
 1912. Holmgren, *Annt. Zool. Japan*, 8 : 121-122, in. S. & W., Formosa and Japan.

3. *Coptotermes formosae* Holmgren

1913. Holmgren, K. *Sev. vet. Akad. Handl.*, (conspecific with *C. formosanus* Shiraki, vide snyder, 1949, p.18) syntypes probably in Holmgren Coll, National Mus., Stockholm Type-locality : Formosa), 50(2) : 76-77, Im. S. and W.

4. *Coptotermes hongkonensis* Oshima

1914. Oshima, *Annot. Zool. Japan*, 8 : 559-560, S. and W., Type-locality : Hongkong.

5. *Termes raffrayi* Matsumura

1910. Matsumura, *Die Schädlichen and nützlichen Insecten von Zuckermohr Formosas*, p. 1.

6. *Coptotermes intrudens* Oshima

1920. Oshima, *Proc. Hawaiian ent. Soc.*, 4 (2) : 262. *Holotype* : Repository not known. *Type-locality* : Honobule (Hawaii Isl.).
 1924. Synder, *Proc. Hawaiian ent. Soc.*, 5 (3) (1923) : 381-382.
 1926. Fullaway, *Hawaiian For. & Agric.*, 23 (23) : 69.

7. *Coptotermes remotus* Silvestri

1928. Silvestri, *Bull. Lab. Zool. Gen. Agri. Portici.*, 21 : 93. *Im.* and *S. Type-locality* : Simonatown (S. Africa).

8. *Coptotermes* n. sp. c. Fuller

1925. Fuller, *J. Un. S. Africa, Dept. Agric.*, 18 : 1.

Wrong determinations :

9. *Coptotermes formosae* Oshima

1920. Oshima, *Philipp. J. Sci.*, 17 (5) : 491-492, Mamta (Specimens determined as *C. formosanus*, but are really *C. vastator*, vide, light (1929), p. 422.

10. *Coptotermes formosanus* Light

1921. Light, *Philipp. J. Sci.*, 18 (3) : 250. Philippines, Formosa, China and Japan (Specimens from Philippines are *C. vastator*, see Light, 1929, but others are *C. formosanus*).

The following were determined as *Coptotermes* or *Termes gestroi*, but are *C. formosanus* (vide, Synder, 1949).

11. *Termes (Coptotermes) gestroi*, Wasmann (Wrong determination)

1910. Oshima, *Doubtsugaku Zasshi*, 22 : 376.

12. *Coptotermes gestroi* Nawa

1910. Nawa, *Konchu Sikai* (Insect World), Gifu, 14 : 597.
 1911. Oshima, *Konchu Sekai* (Insect World), Gifu, 15 : 359.

Material : A. Present in F. R. I., Dehra Dun : 5 Adults, Sev. S. and W., from Colombo, Sri Lanka,

B. present in Z. S. I., Kolkata : 1S from Simonstoun, Cape province and 1 S. and 3 W from Taihoku

Diagnostic Characters : (i) IMAGO (Fig. 22.A) : Head light brown to dark brown with moderately hairy, other parts generally dark brown, wings with yellowish tinge.

Head subcircular, broader than long. Fontanelle minute and slightly raised, placed almost at the middle in a slightly depressed area on head dorsum. Antennae with 20-21 segments, 3 shorter than 2, 4 shorter than 3. Eyes of medium size. Ocelli oval, separated from the eye by almost its smallest diameter. Postclypeus pilose, weakly swollen and divided by an incomplete median suture. Labrum with a few hairs on anterior margin.

Pronotum subreniform, almost as wide as head-width or slightly narrow, anterior margin broadly incurved with a indistinct median notch with hairs, lateral margins strongly outcurved and gradually sloping posteriorly terminating into outcurved posterior margin with distinct median emargination.

Wing membranes transparent and hairy, somewhat punctate; all veins marked by single

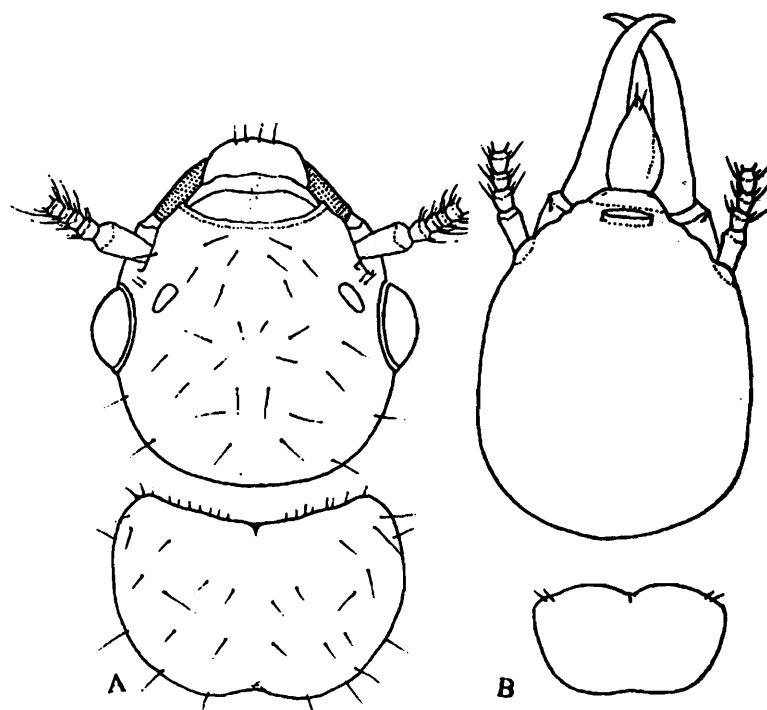


Fig. 22. *Coptotermes formosanus* Shiraki A, Imago. A. Head and pronotum, dorsal view; B, Soldier. B. Head and pronotum, dorsal view.

row of hairs. Forewing : scale longer than in hindwing and partly overlapping the later. Costa-subcosta fused and highly chitinized, bordering the anterior margin of wing. Radius as thick as the costa-subcosta, running parallel to costa-subcosta and fusing with it distally. Median thin, emarginating separately from the scale with 2-3 branches in the distal one-third. Cubitus also thin and running parallel to the median with 8-9 branches to the posterior border. Costa-subcosta and radius as in forewing. Median arising from the radius just outside the scale, with 2 branches in the distal one-third. Cubitus as in forewing, but with 9-11 branches to the posterior border.

(ii) SOLDIER (Fig.22.B) : Head yellow and sparsely hairy, other body parts smaller.

Head variable in shape, oval to somewhat rectangularly oval. Fontanelle fairly large with a margin. Antennae with 14-16 segments, 3 variable, either smaller or longer than 2, 4 smaller than 3. Labrum elongate with uniformly outcurved lateral margins, with a hyaline apex. Mandibles uniformly hooked at apices. Postmentum club-shaped widest width at anterior one-third and narrowest width at the posterior one-third.

Pronotum narrower than head, anterior margin outcurved with distinct median emargination and posterior margin substraight with a very weak invagination.

Measurements : Table 5 (Im.), 19 (S.)

Types : Repository not known.

Distribution : The species is the most widely distributed one of the genus *Coptotermes* and introduced in many areas of the world. ASIA : Colombo; Taiwan : Bokoto, Horisha, Koshun, Kotosho (Botel-tobago Is.), Maruyama, Nanto Dist., Niha chisui, Shushu, Taihoku and Ta-Kao; China : Amoy, South Africa : Cape Province : Simonstown. Canton, Cheung Chauis. (Hong Kong), Foochow, Fukian, Hainan, Hoihow, Hong Kong, Juian, Wenchow, Kalangsu Is. (Amoy); Kinki (S. China); Kiungchow, Kinrgshan (Hainan); Kuliang, Kwangtung, Mif, Pakhoi (Kwangtung);

Shanghai, Tin Wu Shan Monastery (West River; Kwangtung); Yenping; Japan; Chubu, Chugoku, Fukuoka (Kiushiu), Hachijo-jima, Honshu, Ishigakijima, Iwa and Naha Shimabuku, Kadena (all in Okinawa Is.), Izu-Sliccheto, Kagoshima (Kiushiu); Kiushiu; Marugame (Shikoku), Mixama, Omishima (Hokaido), Rice kiu Isl., Sanuki, Shikoku Is., Shushu, Takamatsu, Wakamatsu, Wakanoura, Wakayama; Howall Is. : Hilo, Honolulu, Kawahi, Lanai, Oahu; U. S. A. : San Francisco, harbour (from a vessel) ; SOUTH AFRICA : Simonstown (Cape Pround).

Remarks : It is a wide spread and variable species of considerable economic importance in different countries including its home country in China. In morphological features, another chinese species, *C. guanzhouensis* comes close to this one. Biology of the species is studied by different authors which has been dealt in details by Roonwal (1970). The species might have originated in Japan, Formosa or South China and introduced in Hawaii (Honolulu) probably in 1990 (Gay, 1967).

26. *Coptotermes frenchi* Hill

1. *Coptotermes flavus* Hill

1926. Hill, *Proc. Roy. Soc. Viet.*, 38 : 207, Im. *Type-locality* : Victoria, Australia.

1932. Hill, *CSIRO, Australia*, 25 : 22 (biology)

2. *Coptotermes lakiosus* Hill

Hill, *Proc. Roy. Soc. Vict.*, 38 : 213.

3. *Coptotermes frenchi* Hill

1932. Hill, *Proc. Roy. Soc. Viet.*, 44 (2) : 142, (new name for *C. flavus* Hill (nec Bugnion and Popoff).

1942. Hill, *Termites (Isoptera) from the Australian Region* CSIRO, pp. 149-152, Australia;

1949. Snyder, *Smiths misc. Coll.* 112 : 78, Im. S. and W. South Australia.

1956. Calaby and Gay. *Australian J. Zool.*, 4 (1) : 35-38 (distribution and biology).

1967. Gay, *CSIRO, Australia, Bull No.* 286 : 75-76.

1970. Calaby and Gay, In : *Biology of Termites*, Krishna and Weesneer (eds.), 2 : 418 (biology)

Material : A. Present in Z.S.I., Kolkata (i) one vial (from ANNH) with 1 Im., 1S, *Metatype* (Z.S.I. Reg. No.3797/H8), onehunga, New Zealand, J. M. Kelsey coll., 28.11.1941, det. J. M. Kelsey, Comp. A. E. Emerson (ii) one vial (AMNH) with 4 Im., 4S., 3W; (Z. S. I. Reg. No. 2766/H8) N. of Nyabing W. A., Australia, J. H. Calaby coll., 20.10.53, don CSIRO, Australia. B. Present in F.R.I., Dehra Dun : (i) One vial (ANNH) with 37 m., 8S, 5W., *Metatype*, onehunga, New Zealand, J. M. Kelsey coll., 28.11.41, det. J. M. Kelsey, Comp. A. E. Emerson (ii) one vial with 2S. and 2W. 2 Im., CSIRO, Ent. Division, Canberra, Australia, (iii) 2S., 1W on Card from No.1.

Diagnostic character : (i) IMAGO : Head yellowish brown with long fuscous wings; other body parts paler. Head and pronotum sparsely, and body somewhat densely haiy. Entire insect densely hairy (Hill, 1942).

Head subcircular, broader than long; lateral sides weakly outcurved. Fontanelle whitish, slit-like situated almost in the middle. Antennae with 19 segments, 3 smallest. Eyes subround and fairly large. Ocelli suboval. Postclypeus swollen and devided by a median line. Labrum with subround apical margin.

Pronotum subreniform narrower than head, concavity with median notch in front and faint emargination behind.

(ii) SOLDIER (Fig.23.A) : Head yellowish brown, other parts paler. Head with few erect hairs; pronotum and abdomen more hairy.

Head elongately oval with much narrowed anterior end, fontannele fairly large with distinctly chitinized margin. Antennae with 14 segments, sometime with 13-14 segments, 3 subequal to 4 or variable. Labrum with pointed hyaline apex and with two bristles. Mandibles somewhat straight with feeble incurved apices. Postmentum broadly elongate with a few short hairs on the body particularly on anterior part, broadest on the anterior third and almost double the narrowest width at below the middle.

Measurements : Table 7 (Im.); 12 (S.)

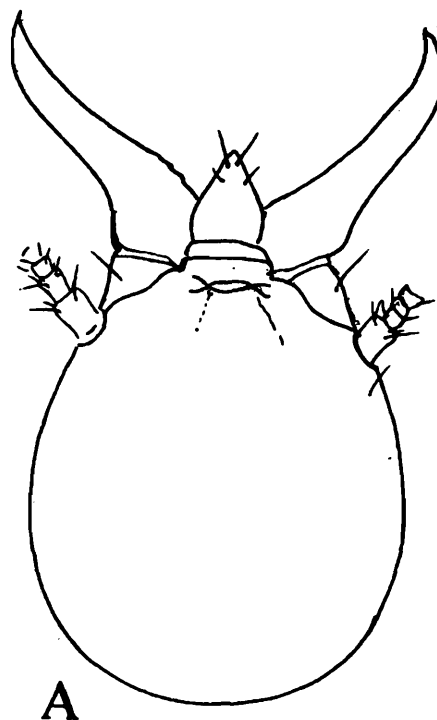


Fig. 23. *Coptotermes frenchi* Hill A, Soldier. A. Head, dorsal view.

Types : *Holotype* Im. and *Morphotype* S. and W. in National Mus., Melbourne.

Distribution : AUSTRALIA : Victoria, New South Wales, Queensland and South Australia. New Zealand : North Island (introduced).

Remarks : The species seems to be very close to *C. reffreyi* and *C. michaelsoni*. It nests strictly within tree trunk in the forest and savanah woodland, while the species constructs dome-shaped mounds of 1-2 feet height in semi arid mallee and sclerophyll woodland from New South Wales accross to Western Australia.

The species generally, attacks poles, fence posts, timber in building, fruit trees and vines, as well as living trees in the hardwood forests of victoria and New South Wales. (Gay and Calby, 19).

27. *Coptotermes gaurii* Roonwal and Krishna

1. *Coptotermes gaurii* Roonwal and Krishna

1956. Roonwal and Krishna, *Indian J. agric. Sci.*, **25** (2), 143-152, S. & W. *Type-locality* : Merambekendra, Sri Lanka.

1958. Ahmad, *Biologia*, **4** (1) : 65 (key).

1962. Roonwal & Chottani, *Indian species of the termites genus Coptotermes*, I.C.A.R. Monogr. No.2, pp. 30-34, Sri Lanka.
1977. Maiti *Proc. Zoo. Soc.*, 30 : 133, Gt. Nicobar.
1994. Maiti and Chakraborti, *Occ. Paper., Rec. Zool. Surv. India*, No.167 : 33.

2. *Coptotermes exiguus* Jepson

1930. Jepson, *Trop. Agric.*, 75 (3), 155, Sri Lanka, *Nom. nud.*
1930. Jepson, *Tech. Rep. Dept. Agric. Ceylon*, 1929, Colombo, p.6, Sri Lanka, *Nom. nud.*
1949. Kemner (MS name), vide, Snyder, *Smiths. misc. Coll.*, 112 : 346, Sri Lanka.

3. *Coptotermes exiguus* (Hagen)

1953. Lal and Menon, *Catal. Indian Insects*, pt. 27, *Isoptera*, p. 25, Wrong Identification.

4. *Coptotermes exiguus* Desneus

1953. Lal and Menon, *Catal. Indian Insects*, pt. 27, *Isoptera*, p.25, Sri Lanka, Wrong identification.

5. *Coptotermes exiguus* Kemner

Roonwal and Pant, *Indian For Leaflet* (Ent.), No. 121 (3), p. 47, Sri Lanka, *Nom. nud.*

6. *Coptotermes ceylonicus* Holmgren

Roonwal and Pant, *Indian For Leaflet* (Ent.), No. 121 (3), p.47, Sri Lanka, only specimens from "Merambekenda, 400 ft." are *C. gaurii*, others are *C. ceylonicus*.

Material : A. Present in F.R.I., Dehra Dun : (i) One vial (No. 3619) with 1S. *Holotype* and 1 *Morphotype*, Merambekenda, 400 ft. alt., Sri Lanka *Gauri Duttcoll.*, (F.C. No. 170), 31.xii.1934, ex. "unknown rotten wood"; "*Coptotermes ceylonicus* Holmgren *det.* J.C.M. Gardner", *det.* M. L. Roonwal and K. Krishna as *Coptotermes gaurii*, Roonwal and Krishna. (ii) One vial with 32 *paratype* S. and 2 *Morphotype* W., other data same as in A (i); (iii) one vial with sev. S. and W., Sri Lanka, 10.iv.1940, "*Coptotermes exiguus* Kemner *det.* Hutson" *det.* M. L. Roonwal and K. Krishna as *C. gaurii*. B. present in Z.S.I., Kolkata (iv) one vial with 3 *paratypes* S. with other data same as in A (i).

Diagnostic character : (i) IMAGO : Unknown. (ii) SOLDIER (Fig.24.A-B) : Head pale yellow and with a few scattered erect hairs; antennae, labrum, pronotum and legs paler than head.

Head pear-shaped, slightly longer than broad, width of head at anterior end almost half or less than the maximum head width; lateral margins exceptionally bulging out at posterior forth; posterior margin weakly outcurved. Fontanelle opening fairly large placed atmost at the posterior margin of postclypeus. Antennae with 14 16 segments, 3 variable, usually smaller than 2, as long as or longer than 3. Mandibles almost straight with fine incurved apices. labrum dome shaped with somewhat pointed hyaline apex and with pair of bristles. Postmentum short and stumpy with narrowest width at posterior fourth.

Pronotum subreniform with a few scattered hairs, anterior margin with weak median emargination and posterior margin with broad emargination.

Measurements : Table. 20 (S.)

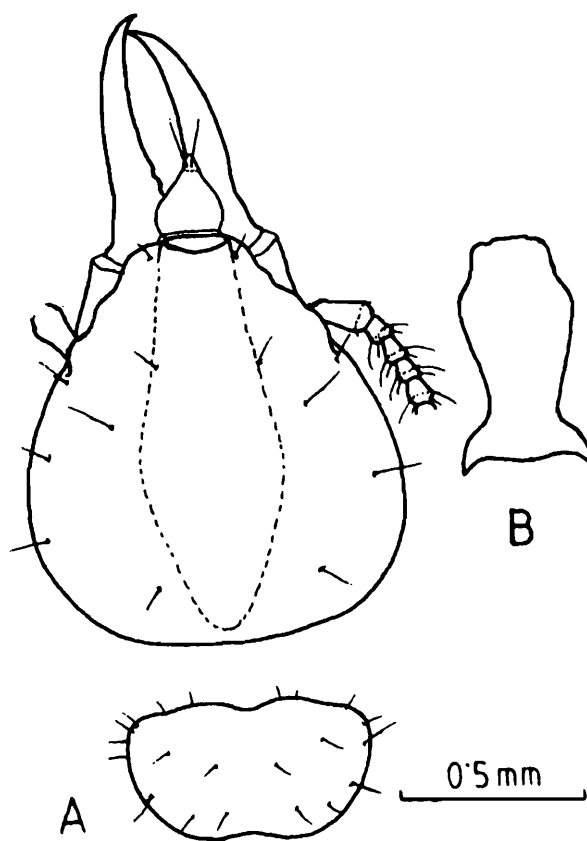


Fig. 24. *Coptotermes gaurii* Roonwal and Krishna A-B, Soldier. A. Head and pronotum, dorsal view; B. Postmentum.

Types : Holotype S. in FRI, Dehra Dun.

Distribution : ASIA : Sri Lanka : Merembekenda, known only from type-locality. India : Great Nicobar Island.

Remarks : The species is sparsely known from its place of occurrence. So far, it is not known from the mainland of India, but is recorded from the Nicobar Island.

28. *Coptotermes gestroi* Wasmann

1. *Termes (Coptotermes) gestroi* Wasmann

1986. Wasmann, *Ann. Mus. Civic. Stor. Nat. Geneva*, (2) 16 : 628-629, S. Type-locality : Bhamo : Myanmar.

1904. Desneux *Gen. Insect.*, 25, *Isoptera* : 34, Myanmar (And Sumatra, Singapore, Borneo = *c. curvignathus*).

2. *Coptotermes gestroi* Wasmann

1909. Lefroy. *Indian Insect Life*. P. 119, Myanmar (And Malaya = *C. curvignathus*).

1913. Holmgren, K. *Sv. Vet. Akad. Handl.*, 50 (2) : 78 and 266-267, S., Bhamo, Myanmar.

1916. Fletcher. *Bull. Agri. Res. Insc. Pusa*. No.59 ; p.39, Myanmar and Assam, India.

1917. Holmgren. *Mem. Deptt. Agric. India (Ent.)*, 5 (3) : 146, Dibrugarh : Assam : India.

1922. Hegh. *Termites*, pp. 46, 49-51. India : Assam (And Java and Sumatra; Malaysia = *C. curvignathus*).

1949. Snyder. *Smiths. misc. Coll.*, 112 : 78. Myanmar, India (And Malaya = *C. curvignathus*).

1958. Ahmad, *Biologia*, Lahore, 4 (1-2) : 64.

1965. Ahmad, *Bull. Am. Mus. nat. Hist.*, 131 (1) : 17, 22-23.

1973. Morimoto, *Bull. Govt. For. Exp. Sta.*, No. 257 : 61.

1962. Roonwal and Chhotani, *Indian species of Genus Coptotermes* (ICAR, Ent. Monogr. 2), 34-38 (detailed syn.).

1989. Roonwal and Chhotani, *Fauna of India Isoptera (Termites)*, 1 : 445-449.

1999. Bose, *Rec. zool. Surv. India, Occ. Paper*, No. 171, 44-46 North East India (Arunachal Pradesh).

Material : A. Present in Z. S. I., Kolkata : (i) One vial with 1S., Dibrugarh, Assam, India, T B. Fletcher Coll., det. N. Holmgren.

B. Present in F.R.I., Dehra Dun : (i) One vial with 4S. and sev. nym. Jaypore Range, Lakhimpur, Assam, India T2009, J112) ex. "*sapium baccafum*" (ii) Silonijam, Golaghat, Assam, India, R.N.Mathur Coll., 5-9, iii. 1961, ex. "rotten wood", (iii) one vial (RRD 2653, J. 164) with 4W, Hot spring, Golaghat, Assam, India, R. N/ Mathur Coll., 5.iii.1961, ex. "rotten wood", det. R. S. Thapa.

Diagnostic character : (i) IMAGA : Unknown.

(ii) SOLDIER (Fig.25.A-B) : Head pale yellow with a few hairs, other parts of the body stil paler. Head broadly oval, gradually narrowing anteriorly, lateral margins very weakly outcurved, anterior and posterior margins uniformly outcurved. Fontanelle fairly large, placed nearer to clypeus. Antennae with 14-15 segments, 3 smallest, 4 slightly longer than 3. Labrum dome-shaped with broadest width basally and terminating into a hyaline apex with a few small hairs. Mandibles somewhat straight with finely pointed gradually incurved apices. Postmentum with broadest width at anterior one third and

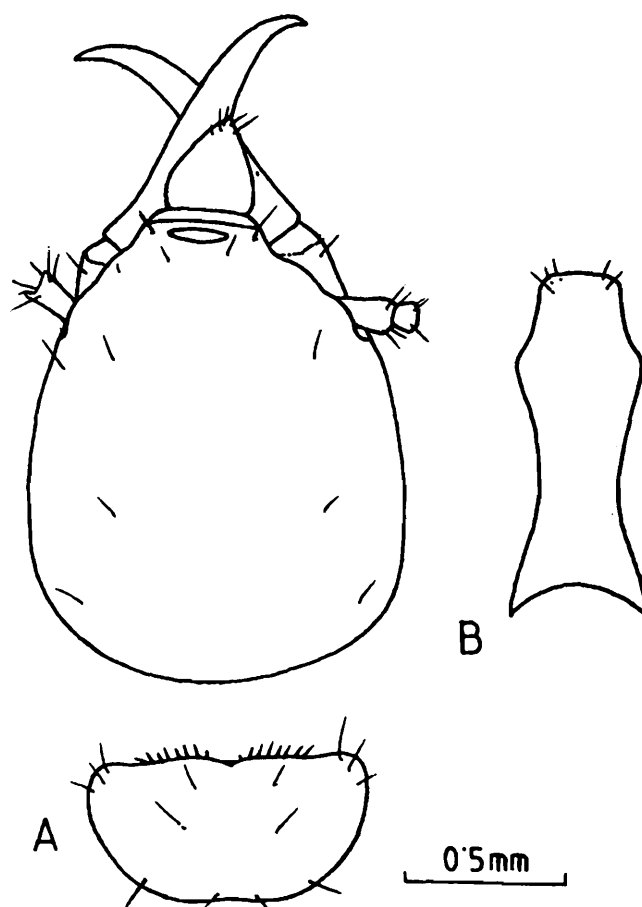


Fig. 25. *Coptotermes gestroi* (Wasmann); A-B, Soldier. A. Head and pronotum, dorsal view; B. Postmentum.

narrowest width slightly above the posterior one-third.

Pronotum much narrower than head-width, anterior margin with weak emargination on either side of which with a number of smaller hairs; posterior margin almost substraight with very weak emargination.

Measurements : Table 19(S.)

Types : *Holotype* S. Not. designated by Wasmann. *Syntype* not traceable in wasmann's coll. in *Nat. Hist. Mus.*, Maastricht. Type-locality : Bhamo, Myanmar.

Distribution : ASIA : India : Assam : Kaziranga, Dibrugarh, Lakhimpur; Arunachal Pradesh : Myanmar : Bhamo (Type locality) : Thailand : Bangkok and Khao Chong.

Remarks : It is a very variable species and comes close to *C. formosanus*. The species is least known biologically, except its recorded in the dead and decaying wood in its place of occurrence.

29. *Coptotermes grandiceps* Snyder

1. *Coptotermes grandiceps* Snyder

1925. Snyder, J. Wash, Acad. Sci., 15 (17) : 401-402, S. Type-locality : Tulagi, Solomon Island.
1942. Hill, *Termites (Isoptera) from the Australian Region*, Melbourne, pp.153-155, Im. and S. from type-locality, Savo Island.
1934. Lever, *Agric. Gaz.*, 2 (4) : 10, (biology).
1949. Snyder, *Smiths. misc. coll.*, 112 : 79, Im. and S.
1957. Harris, *Nat. Hist. Renell Isl., Birt. Solomon Isl.*, Lavanggu and Hutuna.

2. *Coptotermes solomonensis* Snyder

1925. Snyder, J. Wash, Acad. Sci., 15 (17) : 403, S. Type-locality : Malaita Isl.
1927. F. G. Hill. *Mem. nat. Hist. Mus.*, No.7, p. 19, S and W., Banika Island.

3. *Coptotermes froggatti* Light and Davis

1929. Light and Davis : *Proc. Roy. Soc. Vict.*, 42 (1) : 62, S. type-locality : Banika Isl.

Material : Present in F. R. I., Dehra Dun : (i) one vial with 1 Im. and loose wings, *Topotype*, Tulagi, Solomon Island, R. A. Lever Coll., 11.xi.1935, G. F. Hill (ii) one vial with *Cotype* Is from type colony, Banika Isl., Russel Group, Solomon Island, *det. and comp.*, A. E. Emerson (labeled as Metatype).

Diagnostic character : (i) IMAGO (Fig. 26.A) : Very similar to that of *C. acinaciformis*, except the following characters. Larger in most of its measurements, eyes larger, triangular impression on vertex with its apex close to the fontanelle (impression conical in *C. acinaciformis*).

(ii) SOLDIER (Fig.26.B-C) : Head pale brown; antennae, labrum and legs paler than head; abdomen yellowish white. Head devoid of any hairs, pronotum with a few hairs on the margins; abdomen sparsely hairy. Body length 6.70 mm.

Head much narrowed anteriorly longer than broad, anterior end slightly more than half the head-length, posterior margin rounded. Fontanelle fairly large, almost touching the posterior margin of clypeus. Eyes and ocelli absent. Antennae broken, normally with 19-20 segments, sometimes with 14-16, segmentations variable, 3 longer than 2 and 4 (Hill, 1942).

Clypeus short, trapezoidal, labrum subtriangular, a little longer than broad; hyaline apex somewhat blunt. Mandibles thin and slender, and with weakly hooked apices. Postmentum club-shaped with a few small hairs on anterior fourth, broadest at anterior third and narrowest on posterior third, broadest width slightly more than minimum width, anterior margin substraight and posterior margin concave.

Pronotum as broad as anterior end of head capsule, flat, much narrower than maximum head-width; anterior margin weakly convex with broad median emargination; posterior margin substraight with very weak median emargination.

Measurements : Table 7(Im.) ; 12 (S.) *Holotype* : S. in Mus. Comparative Zool., U.S.A.; *Morphotype* : Im. in C.S.R.O., Canberra; *cotype* 1S. in F. R. I., Dehra Dun.

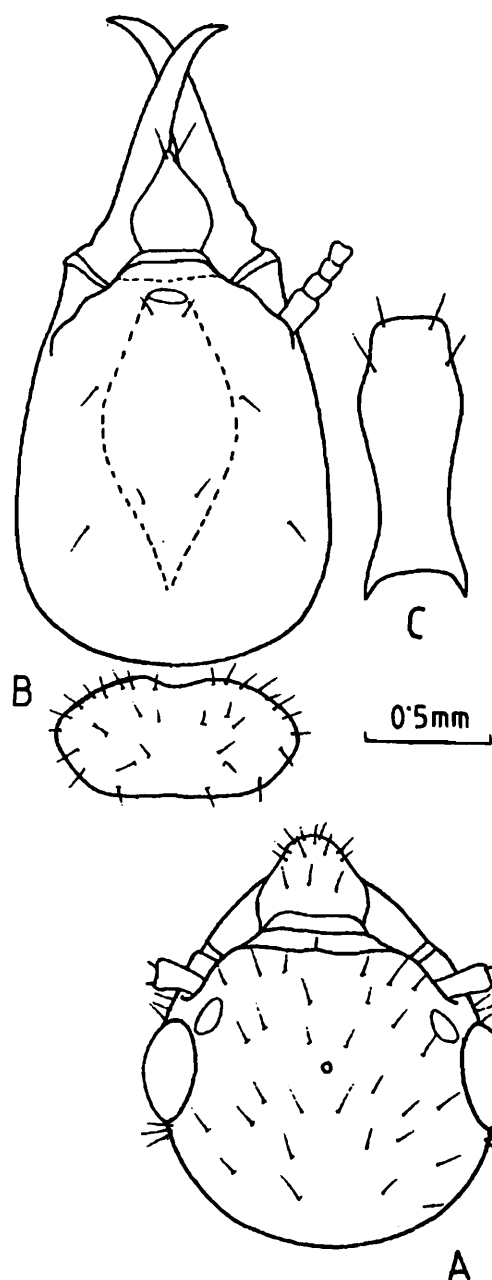


Fig.26. *Coptotermes grandiceps* Snyder A, Imago. A. Head, dorsal view; B-C, soldier, B, Head and Pronotum dorsal view; C. postmentum.

Distribution : ASIA : Solomen Isl. : Tulagi Isl. (Type-locality), Malaita Isl., Banika Isl. (Russell Group), Vanikoro Isl. (Santa Cruz Group), Savo Isl.

Remarks : The imagos are larger than those of *C. acinaciformis* and smaller than *C. elisae*. Soldiers are inseparable from that of *C. obiratus*, the imagos of which are unknown.

The species inhabits tree stumps, pillars and construction timber in buildings. Imagos on wings are collected during February and November at light in Tulagi Island.

30. *Coptotermes guangdongensis* Ping

1. *Coptotermes guangdongensis* Ping

1985. Ping. *Entomotaxonomia*, 7 (4) : 318-319. S. Type-locality : Guangzhou City, China

Material : Characturs and Measurements are based on Ping (1985).

Diagnostic characters : (i) IMAGO : Unknown

(ii) SOLDIER (Fig. 27.A-D) : Head sparsely hairy, suboval with much narrowed anterior end at the side base of mandibles, posterior margin uniformly round. Fontanelle opening fairly large and placed almost on fonto-clypeal suture. Labnum dome-shaped with spine like process with some fine hairs around. Mandibles elongated with very fine incurved apices, side bases of mandibles with distinct hump. Antennal segment

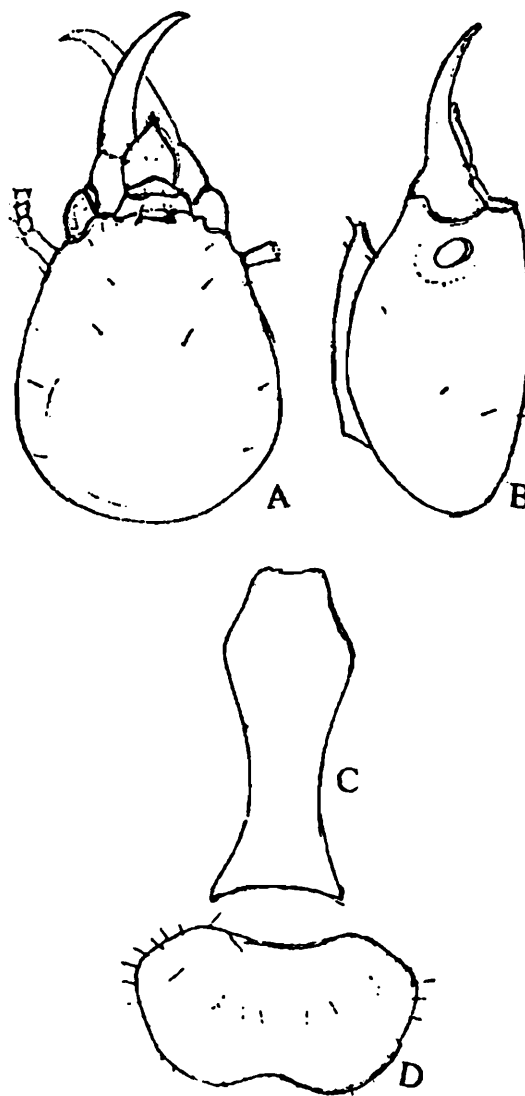


Fig. 27. *Coptotermes guangdongensis* Ping A-D, soldier. A. Head, dorsal view; B. Head, side view; C. Postmentum; D. Pronotum, dorsal view (after, ping 1985).

3 smallest, segment 2 and 4 subequal. Postmentum club-shaped, widest width one and a half times wider than waist anterior end with some transverse crenulations and hairs. Pronotum with broadly and narrowly concavity both on anterior and posterior margin entire margins with some hairs.

Measurements : Table 27 (S)

Types : Soldier (*Holotype* and *paratype*), queen and workers from type series (1. No. A0055), coll. Zhangsham, 18.iv.1968 ex building' inh Guang dong Inst. Ent., China, Guangzhon city.

Distribution : ASIA : China : Guangzhau city.

Remarks : According to Ping (1985), "This new species can be separated from *C. formosanus shiraki* by the width of head 1.33-1.35, by the length of left mandible 1.07, and by the width of pronotum 0.94-0.99"

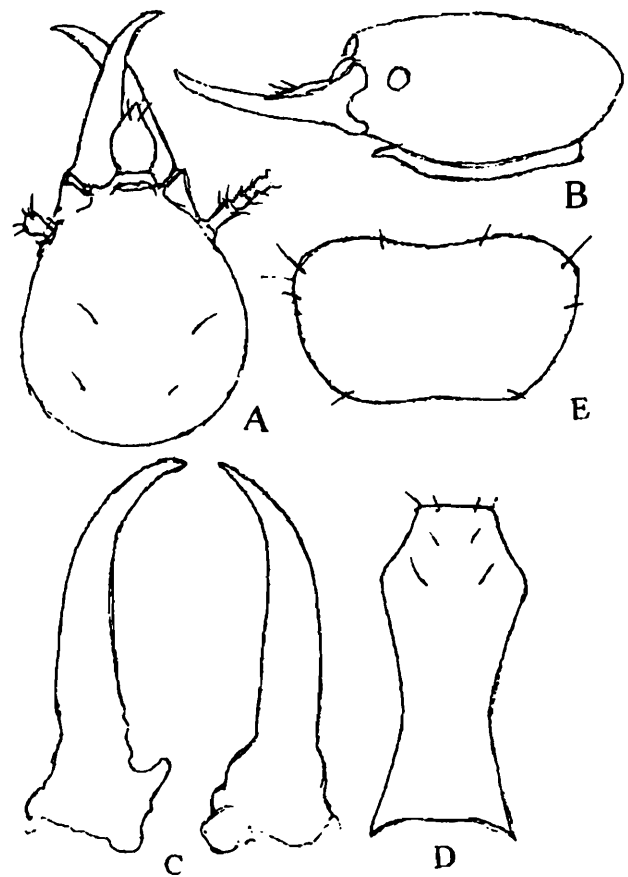


Fig. 28. *Coptotermes guangzhouensis* Ping A-E, Soldier. A. Head, dorsal view; B. Head, side view; C. Left and right mandibles; D. Postmentum; E. Pronotum, dorsal view (After Ping, 1985).

31. *Coptotermes guangzhouensis* Ping

1. *Coptotermes guangzhouensis* Ping

1985. Ping. *Entomotaxonomia*, 7 (4) : 317-318, 326 *Type-locality* : Guangzhou city. S. (*Holotype* and *paratypes*) and W. from type series (I. No. A0075), coll. Ping, 19.x.1982, ex. doorframe', China

Material : Brief description is based on original diagrams (Ping, 1985) since no material has been studied.

Diagnostic character : (i) IMAGO : unknown. (ii) SOLDIER (Fig.28.AE). Head Kyriform with fairly scattered hairs, much narrowed at the base 7 mandibles and with uniform posterior margin, fontanelle opening quite large and placed near the posterior margin of fronto clypeal suture. Labrum dome-shaped with pointed apex. Mandibles thin and with fine apices. Antennal segment 3 smallest, 2 and 4 almost equal. Postmentum club-shaped with somewhat broad waist. Pronotum with both anterior and posterior margin weakly concave.

Types : *Holotype* and *paratypes* S. and W. in Guangdong Inst. of Entomology, China.

Distribution : ASIA : China : Guangzhou City.

Remarks : According to ping (!985). This new species can be separated from *C. formsanus shiraki*, by the length of left mandible <0.95, by the posterior margin of pronotum almost straight, and by the width of 0.99-1.12 (1.06)"

32. *Coptotermes harrisi* (Emerson)

Material : Present in F. R. Dehra Dun : one vial with 1 paratype S. from type-colony, near kampala, Uganda, H. Kirby coll. 13. xii. 1934, ex. "stump", det. A. E. Emerson (coll. from AMNH., New York).

Diagnostic character (Fig. 29.A-B) : (i) Soldier : Head brownish yellow, antennae, legs, pronotum and labrum paler than head, abdomen, yellowish white with dense hairs. Head with a few erect hairs.

Head pyriform, moderately longer than broad narrowest width at the anterior end slightly more than half the maximum width. Fontanelle-large,

placed just at the posterior margin of clypeus. Eye and icilli absent. Antennae with 13 segments, 3 smallest and narrowest. Clypeus short trapizoidal. Labrum subtriangular with pointed hyaline apex with two bristles near its tip.

Mandibles somewhat straight with weakly incurved apex. Postmentum club shaped, long and narrow with a few short hairs on anterior part of the body.

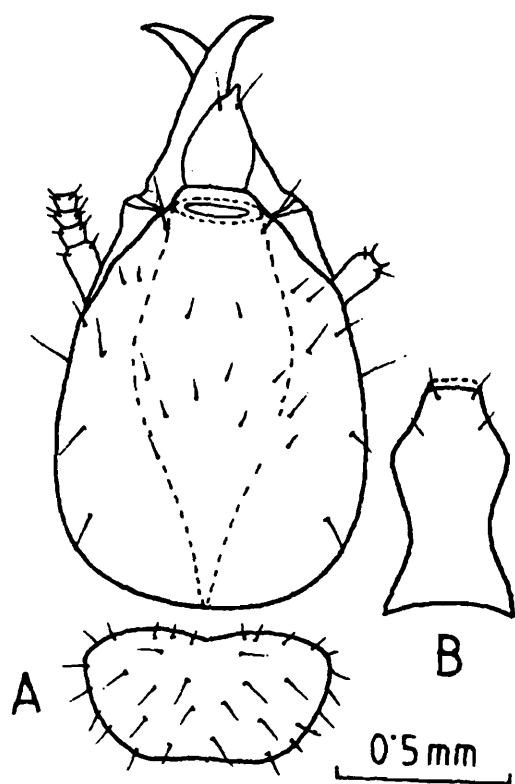


Fig. 29. *Coptotermes harrisi* Emerson; A-B, Soldier. A. Head and pronotum, dorsal view; B. postmentum.

Pronotum flat, much broader than long, anterior margin weakly convex with a weak median emargination, antero-lateral and postero-lateral corners round posterior margin with very weak emargination.

Measurements : Table -15(S.)

Types : In F.R.I., Dehra Dun (also in AMNH; New York)

Measurements : Table No.

Distribution : AFRICA : Uganda : Kampala

Remarks : The material was known to be collected from 'stump' only.

33. *Coptotermes havilandi* Holmgren

1. *Coptotermes havilandi* Holmgren

1911. Holmgren, K. *Syen. Vet. Akad. Handl.*, **46** (6) : 74, Thailand (nom. nud.).
1911. Holmgren, In *Escheriches Termitenleben auf Ceylon*, p. 192, Im.
1912. Holmgren, *Ent. Mitt.*, **1** (9) : 280, Anping.
1913. Holmgren, K. *Sven. Vet. Akad. Handl.*, **50** (2) : 75; Malacca and Thailand, Im.
1913. Holmgren, *Tijds. Ent.*, **56** : 17.
1913. Bugnion, *Bull. Soc. Vaudoise Sci. Nat.*, **49** (180) : 3.
1934. Kember, K. *Sven. Vet. Akad. Handl.*, **13** (4), 62, Im.
1949. Snyder, *Smiths. misc. Coll.*, **112** : 79.
1957. Harris, *Malaya Nat. J.*, **12** : 23, Malaya.
1958. Ahmad, *Biologia*, **4** (1) : 61 and 67-68.
1961. Harris, *Termites, their recognition and control.*, p.52, etc., Longman : London.
1962. Kalsoven, *Beaufortia*, **9** (10) : 121-137.
1965. Ahmad, *Bull. Am. nat. Hist.*, **131** (1) : 19-20, Im. and S. Thailand.
1967. Gy, C.S.I.R.O., *Australia, Bull. No.*, 286, p.13, 33 and 77-78, Southeast Asia (origin) and introduced in Marquesas Isl. Mauritius, Reunion, Barbados, Jamaica and Brazil.
1968. Harris, *Opusc. Ent.*, **33** (1-2), 153, Thailand.
1973. Morimoto, *Bull. Govt. for Exp. Stn. No.* 257, p.256.

2. *Coptotermes javanicus* kemner

1934. Kemner, K. *Sven. Vet. Akad. Handl.*, **13** (4) : 59, Im. and S. Buitenjorg and Samarang (Middle Java).

3. *Coptotermes pacificus* Light

1932. Light, *Bull. B. P. Bishop Mus.*, **98** : 84-86. Im. Type-locality : Marquesas Isl.
1949. Snyder, *Smiths. misc. Coll.*, **112**, 81.
1967. Gay, C.S.I.R.O., *Australia Bull*, No. 286, p. 33 (syn.).

4. *Coptotermes* sp. near *intermedius* Moutia

1936. Moutia, *Bull. Mauritius Agr. Sci., Ser.*, **21** : 14, Im. and S. Mauritius (introduced).
1938. Adamson, *Trop. Agric.*, **15** : 221-223, Barbados.

Material : A. Present in Z.S.I., Kolkata : (i) one vial with 1S. (head) and 1W., Semarang, Java, Indonesia, Coll. L. Kalshoven, 19.ii.1928, F. C. No. t-266, det. A. E. Emerson.

B. Present in F.R.I., DehraDun : (ii) one vial with 1S. and 1W. *paratype*, Buitenzorg, Java, Indonesia, Coll. N. A. Kemner, 14.i.1911, det. N. A. Kemner as '*Coptotermes javanicus*, redet., A.E. Emerson as *C. havilandi* Holmgren (iii) one vial with 1 Im., Buitenzorg, Java. Indonesia, Coll. L. Kalshoven, 5.ix.1930, det. A. E. emerson (iv) one vial with 3S. and 2W., Semarang, Java, Indonesia, Coll. L. Kalshoven, 19.ii.1928, F.C. No. t-266, det. A. E. Emerson.

Diagnostic character : (i) IMAGO (Fig. 30.A-E) : Head chestnut brown; antennae, labrum, pronotum and body paler than head; head moderately hairy, pronotum and body comparatively densely hairy; wing-scale with a few longer hairs.

Head subcircular, slightly broader than long, lateral margin convex and posterior margin rounded, frons weakly sloping in front. Fontanelle minute, rectangularly elongated, situated almost in the middle. Antennae with segments, 2 shortest segments. Eyes circular and highly bulging out. Ocelli rectangularly oval, separated from the eyes by its minimum diameter. Postclypeus weakly swollen and divided incompletely by a median line. Labrum broader than long, with a few setae, near distal margin and on body, lateral and apical margins outcurved.

Pronotum sub-reniform, slightly broader than head-width, much broader than long, anterior margin substraight or very weakly concave, posterior margin with a median emargination.

Wing membranes transparent and hairy, somewhat punctate, all veins marked by row of hairs. Forewing scale longer than the hind-wing and partly overlapping the later. Costa-subcosta fused and highly chitinized, bordering the anterior margin of wing. Radius as thick as the costa-subcostal; running parallel to costa-subcosta and fusing with it distally. Median thin emerging

separately from the scale with 2-3 branches in the distal one-third.

Hindwing : Costa-subcosta and radius as in forewing. Median arising from the radius just outside the scale, with 3 branches in the distal one-third. Cubitus as in forewing, but with 9-11 branches to the posterior border.

(ii) SOLDIER (Fig. 30.F-K) : Head light yellowish to reddish yellow; labrum, antennae, pronotum and abdomen yellow. Head with a few

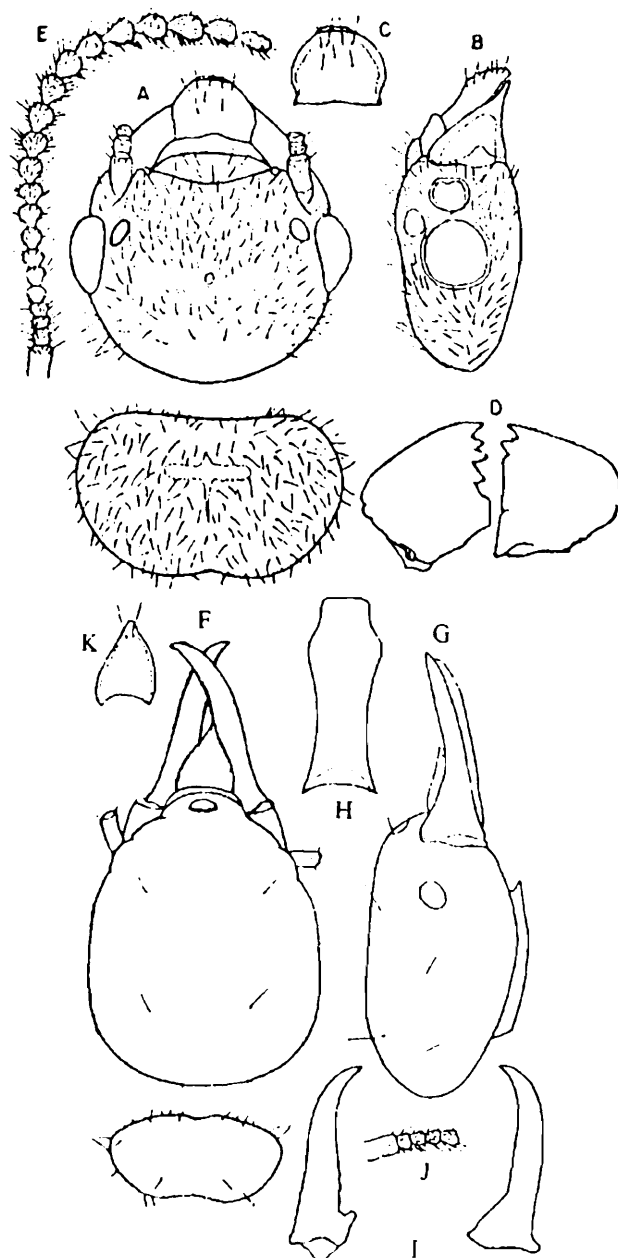


Fig. 30. *Coptotermes havilandi* Holmgren; A-E, Imago. A. Head and pronotum, dorsal view; B. Head, side view; C. Labrum. D. Left and right mandibles; E. Antenna. F-J, Soldier. F. Head and pronotum, dorsal view; G. Head, side view; H. Postmentum; I. Left and right mandibles; J. Basal part of antenna.

scattered bristles. Labrum with two long bristles. Pronotum sparsely hairy, abdominal tergites with row of bristles along posterior margin.

Head elongately oval, widest at the middle. Fontanelle opening small, placed more forwardly. Labrum domeshaped, tip hyaline and not needle like. Mandibles long, weakly incurved. Postmentum not so constricted at waist, only slightly narrower than widest width. Antennae with 14 segments, 2 slightly longer than 3. Pronotum twice as broad as long, anterior margin with weak median notch and posterior margin with a median broad emargination.

Measurements : Table -8(Im.); 21 (S.)

Types : In Berlin Museum, Germany

Distribution : ASIA : Thailand : Bangkok ; Kachong, Huay Yang, Tung Sa long - Luang, Indonesia ; Malacca, Java; Anping, introduced into Marquessas Isl., (prior to 1932), Mauritius (prior to 1936), Reunion, Barbados and Jamaica (West Indies), Brazil: Sao Paulo, Santos and Rio de Janeiro.

Remarks : *C. havilandi* occurs as a native to South east Asia in the tree trunk and other wood. The species seems to be very successful in getting introduced in different countries, such as, Hiraoa, Marquesas Island (Light, 1932), Mauritius (Moutia, 1936), Reunion (Paulian, 1957), Jamaica and Barbados (Anderson, 1948), Bridgetown (Tucker, 1939; Saint, 1949). It is ultimately recorded from timber, books and magazines in house, stored cotton seed and avocado trees (Goncalves and Silva, 1962).

However, the species remains responsible to cause considerable damage to timber works in buildings, sugarcane, in remote native forest or woodland and even from a man-made environment in Mauritius in 1936.

34. *Coptotermes heimi* (Wasmann)

1. *Arrhinotermes heimi* Wasmann

1902. Wasmann, *Zool. Jahrb. (Syst.)*, 17 (1) : 104, Im. Type-locality, Wallon, Ahmednagar District, Maharashtra, India.

1904. Desneux, *Genera Insect.*, 25 : Isoptera, p.34, India.
 1911. Holmgren, in Escherichis *Termitenleben auf Ceylon*, p. 266.
 1921. Light, *Philipp. J. Sc.*, 19(1) : 48 (Wrongly states that it is described and recorded from Sri Lanka).
 1934. Margavabdhhu, *J. Bombay nat. Hist. Soc.*, 37 (3) : 703, (wrongly states that is described and recorded from Sri Lanka).

2. *Coptotermes heimi* (Wasmann)

1911. Holmgren, *K. Sven. Vet. Akad. Handl.*, 46 (6) : 73, India.
 1912. Holmgren, *J. Bombay nat. Hist. Soc.*, 21 (3) : 777-778, Im. S. and W. Bombay.
 1913. Holmgren, *K. Sven. Vet. Akad. Handl.*, 50 (2) : 74-75, Im. S. and W., Bombay.
 1913. (Sept.). Assmuth, *J. Bombay nat. Hist. Soc.*, 22 (2) : 374, 690-691, India.
 1917. Holmgren, *Mem. Dept. Agric. India (Ent.)*, 5 (3) : 144-145, India and Bangladesh.
 1923. Annandale, *Rec. Indian Mus.*, 25 (2) : 236-237 and 250-252, India.
 1923. Silvestri, *Rec. Indian Mus.*, 25 (2) : 225, India.
 1927. Light, *Univ. Calif. publi. (Ent.)*, 4 (5) : 78, 81, 85 and 86.
 1929. Light, *Philipp. J. Sci.*, 40 (4) : 432, 439, 440.
 1929. Light and Davis, *Proc. R. Soc. Victoria (N.S.)*, 41 (1) : 70.
 1931. Dover, *Indian For.*, 57 (7) : 343.
 1934. Margabandhu, *J. Bombay nat. Hist. Soc.*, 37 (3) : 704, India, and 20 (7) : 8, Pakistan.
 1941. Beesson, *Ecology and Control Forest Insects of India*, p. 543-544, India and Pakistan.
 1949. Snyder, *Smiths. misc. coll.*, 112 : 79.
 1953. Menon, *Catal. Indian Insects*, p.27, *Isoptera* (Erroneously mention, it is a synonym of *Coptotermes havilandi*).
 1953. Pant, *Indian For. Leaflet (Ent.)*, No.121 (3) : 47, India and Pakistan.
 1954. Roonwal, *J. Bombay ant. Hist. Soc.*, 52 (2) : 465-466, India.
 1955. Ahmad, *Biologia*, 1 (2) : 213-315.
 1958. Ahmad, *Biologia*, 4 (1) : Pakistan.
 1956. Roonwal and Sen-Sarma, *Indian J. Agric. Sci.*, 26 (1) : 2, 4 (Im. measurements only).

1961. Harris, *Termites, their recognition, biology and control*, p.111, Longmans, London.
1962. Chhotani, *Proc. Natn. Inst. Sci. India*, (B) 28.
1962. Chhotani, *J. Bombay nat. Hist. Soc.*, 62:
1962. Chottani, *Indian species of the termite genus Coptotermes I.C.A.R. Mongr.*, No.2, pp.38-57, Im. S. and W. India and Pakistan.
1975. Aktar, *Bull. Deptt. Zool. Univ. Punjab (N.S.)*, 7 : 36-42, Im. and S. Bangladesh.
1983. Maiti, *Rec. Zool. Surv. India, Occ. paper No. 42* : 48-51.
1994. Maiti and Chakraborti, *Rec. zool. Surv. India, Occ. paper*, No. 167, pp.34-35.
1999. Bose, *Rec. Zool. Surv. India, Occ. Paper*, No.

3. *Coptotermes parvulus* (Holmgren)

1913. Holmgren, *J. Bombay nat. Hist. Soc.*, 22 (1) : 102, 104, S. & W., Type-locality : Anand and Vidtal, India.
1913. Holmgren, *K. Sven. Vet. Akad. Handl.*, 50 (2) : 73-74, S. & W., India : Anand.
1913. Assumuth, *J. Bombay nat. Hist. Soc.*, 22 (2) : 374.
1923. Silvestri, *Rec. Indian Mus.*, 25 (2) : 225, India.
1923. Annandale, *Rec. Indian Mus.*, 25(2) : 223, 245, India.
1929. Light, *Philipp. J. Sci.*, 40 (4) : 439 (Remarks).
1934. Kemner, *K.Sven. Vet. Akad. Handl.*, 3 (13) (4) : 59, S. Indonesia, Sermarang (Middle Java).
1941. Beeson, *Ecology and Control of Forest Insects of India*, p.544.
1949. Synder, *Smiths. misc.Coll.*, 112 : 82. India.
1953. Rattan Lal and Menon, *Catal. Indian Insects*, part 27, Isoptera, p.26, India and Pakistan (Pakistan record doubtful).

Material : Present in Z.S.I., Kolkata : 2 Im. from Park Circus, Kolkata, West Bengal, India O. B. Chhotani, 6.7.iii.1968, ex. "light" ; Sev. S. from Baruipur Rly.Stn., South 24-parganas, P. K.Maiti coll., 12. vi. 1966, Litchi tree trunk"

(i) IMAGO (Fig.31.A-B) : Head yellowish brown to dark brown, paler at sides; mandibles yellowish brown with dark margins, labrum, antennae, postclypeus and legs yellowish, pronotum paler than head, head fairly, pronotum

and abdomen densely hairy; wing scales with longer hairs and wing membrane with dense covering of small hairs.

Head round, broader than long; dorsum convex with shallowly depressed, fontanelle area, lateral and posterior margins outcurved. Fontanelle very minute. Eyes of median size and subcircular. Ocelli oval, either touching eyes or slightly separated. Antennae with 20-22 segments, 3 smallest. Postclypeus weakly convex, yellowish and pilose, with a incomplete median line. Mandible of typical *Coptotermes*-type.

Pronotum flat, much broader than long, anterior margin weakly concave and posterior margin convex with a median notch, a pale T-shaped mark on mid-dorsum.

(ii) SOLDIER (Fig. 31.C-F) : Head straw-yellow to yellowish; labrum, antennae, pronotum and legs paler than head, abdomen yellowish white. Head with a few erect hairs, thorax sparsely and abdomen densely hairy.

Head variable in shape, pyriform to almost round; usually longer than broad, converging

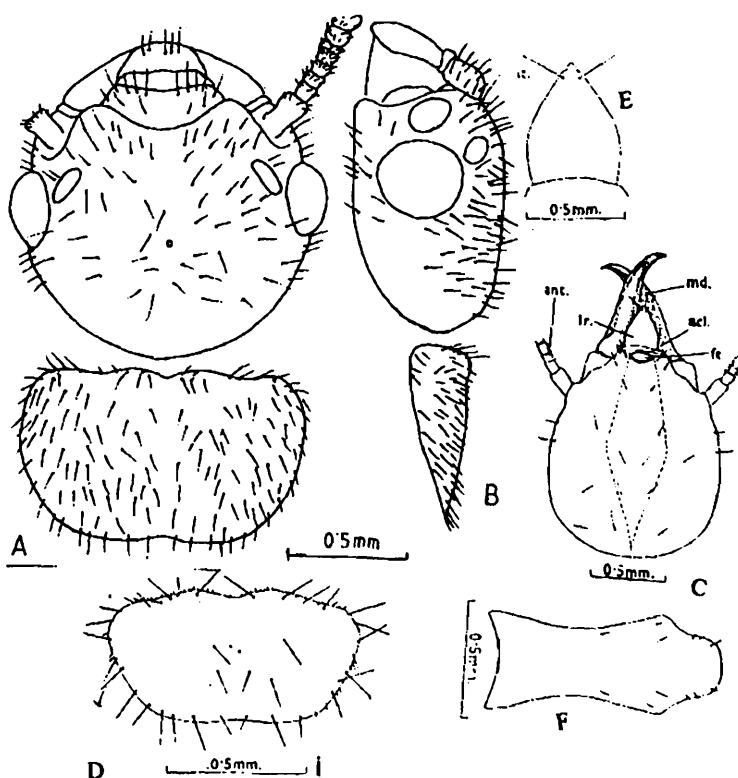


Fig. 31. *Coptotermes heimi* (Wasmann); A-B, Imago. A. Head and pronotum, dorsal view; B. Head and pronotum side view. C-F, Soldier. C. Head, dorsal view; D. Pronotum; E. Labrum; F. Postmentum.

anteriorly, posterior margin rounded. Frontanelle large, opening situated almost on posterior margin of postclypeus. Eyes and ocelli absent. Antennae with 14-16 segments, 3 variable either smaller or equal to or bigger than 2, 4 smaller or as long as 3.

Pronotum flat, subreniform, much broader than long, anterior margin somewhat wavy with distinct median impression, antero-lateral corners broadly rounded, posterior margin substraight with a weak median depression.

Measurements : Table 8(Im.); 22 (S)

Types of C. heimi : *Holotype* not selected by Wasmann (1902) ; *Cotypes* : (i) 2 Im. in Emerson's coll., Chicago Univ. (Chicago, U.S.A.) ; (ii) Im. probably in the Wasmann coll., *Naturlist. Mus.*, Maastricht, Holland.

(b) Of *C. parvulus* Holmgren : *Holotype* not selected, *Cotypes* : (i) 1S. and 1W. in Emerson's Coll., Chicago, U.S.A. (ii) S. and W. probably in Holmgren's Coll., *Zool. Dept.*, Stockholm.

Distribution : ASIA : India (widely distributed); Pakistan, Bangladesh, Bhutan and Nepal. Recently reported as introduced species in Oman (Chhotani,) and other southeastern Asia (Gay, 1967).

Remarks : This highly variable species is closely related to *C. ceylonicus* Holmg., *C. formosanus* Shri. *C. travians* Havil. and *C. gestroi* Wasm. (Roonwal and Chhotani, 1962).

The species is polyphagous and known to attack as many as 35 different species of plants, predominantly, bamboo, cactuses, *Ficus*, mango, palm, etc. it also attacks dead wood in multiple uses in building, houses, railways coaches including electric wire, paper, books, etc. The species generally nests in dead logs, soil, wooden boards of railway carriages. Swarming takes place at dusk or early part of night. The biological notes on the species go in the credit of many authors, (Assmuth, 1913; Annandale, 1923; Beeson, 1941 ; Maiti, 1983; Roonwal and Chhotani, 1987; Roonwal, 1970 and others).

35. *Coptotermes heteromorphus* Ping

1. *Coptotermes heteromorphus* Ping

1985. Ping, *Entomotaxonomia*, 7 (4) : 320-321. *Type-locality* : Guangzhou city, China

Material : Characters and Measurements one based on Ping (1985).

Diagnostic character : (i) *Imago*. Unknown

(ii) *Soldier* (major) (Fig. 32.A-C) : Head sparsely hairy, elongately oval with narrower anterior end, lateral and posterior sides outcurved. Fontanelle opening fairly large, almost touching the fronto-clypeal suture. Labrum short with somewhat pointed apex with some erect hairs at tip. Mandibles short, gradually and feebly incurved with fine apices. Antennal segment 3 smallest. Postmentum elongate with transverse fine wrinkles and hairs at apex, widest width one and a half times broader than the width of waist.

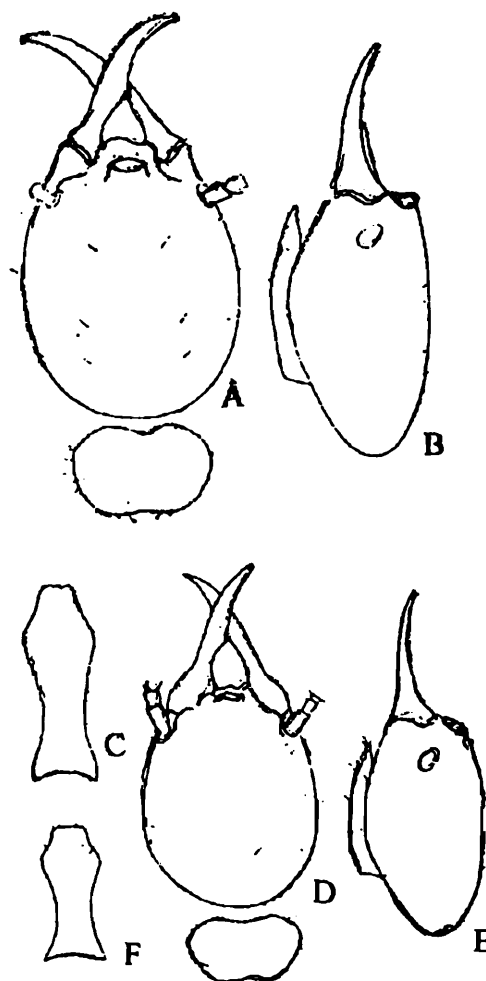


Fig. 32. *Coptotermes heteromorphus* Ping; A-C, Soldier major. A. Head and pronotum, dorsal view; B. Head, side view; C. Postmentum; D-F, Soldier minor. D. Head and pronotum, dorsal view; E. Head, side view; F. Postmentum (after Ping, 1958).

Pronotum with weakly invagination on anterior margin and broad one on posterior margins.

(iii) *Soldier* (Minor) (Fig. 32.D-F) : Very similar to *S. major* but smaller in size and with more straight mandibles.

Measurements : Head-length 1.61-1.66, Head-width 1.21-1.22

Types : Major Soldier (*Holotype* and paratypes) and Minor Soldier, Queen and Workers from type series (I. No. A0063), coll. Zhang Shan, 24.ix.1968, ex 'buidling' in Guangdong Inst. Ent., China.

Distribution : ASIA : China : Guangzhou City

Remarks : According to Ping (1985), "This species is dimorphic, mandibles of major soldier rather curved, mandibles of minor soldier rather straight, it can be used for distinguishing this species from all other members of the genus. This major soldier can be separated from *C. formosanus* Shiraki, by mandible rather curved, and by the pronotal median area abundantly hairy"

36. *Coptotermes intermedius* Silvestri

1. *Coptotermes intermedius* Silvestri

1912. *Ann. Mus. Civ. Stor. Nat. Genova*, (3) 5 : 218-219, S. and W., *Type-locality* : Rio Cassine, Portuguese Guinea, Africa.

1914-15. Silvestri, *Bull. Lab. Zool. Gen. Agr. Praefici*, 9 : 10.

1937. Grasse, *Ann. Soc. Ent. France*, 106 (1) : 28, S. Ivory Coast, Diebougou.

1966. Harris, *Proc. Roy. ent. Soc. Lond.*, B, 35 (11-12) : 167-168.

2. *Coptotermes truncatus* var. *reducta* Sjostedt

1926. Sjostedt, *K. Sven. vet. Akad. Handl.*, (3) 3 (1) : 57, Ghana (syn.)

3. *Coptotermes reductus* Sjostedt

1949. Snyder, *Smiths. misc. Coll.*, 112 : 82, Gold Coast, Africa.

Material : Present in F. R. I., Dehra Dun (i) one vial with 2S. and 2W. (*Metatype*) Yogi, Volta River, Gold Coast, A. W. J. Pomeroy Coll., det. and Comp. A. E. Emerson.

Diagnostic character : (i) IMAGO (Fig. 33.A) : Harris (1966) first described the imagoes from Diko Nigeria. Since no imago was available for study, the original description and measurements are quoted below :

"Previously undescribed. Colour medium brown with distinctly paler. Clypeus and pale spots anterior to Ocelli, antennae and legs also paler; lightly pubescent.

Head rounded, with protruding eyes; clypeus short and inflated; labrum short and broad, Ocelli oval, only a short distance from eyes; antennae with 21 segments, III smallest, IV and subsequent segments noticeably larger; mandibles as infigured.

Pronotum with shallow concave anterior margin, rounded sides and lightly emarginate posterior. Wings transparent; radius, radial sector and last two or three branches of Cubitus outlines in yellow colour, other veins barely visible; wing membrane densely covered with short, golden bristles."

(ii) SOLDIER (Fig. 33.B-C) : Head yellowish brown, other body parts paler than head. Head with a few erect hairs, thorax sparsely and abdomen somewhat densely hairy.

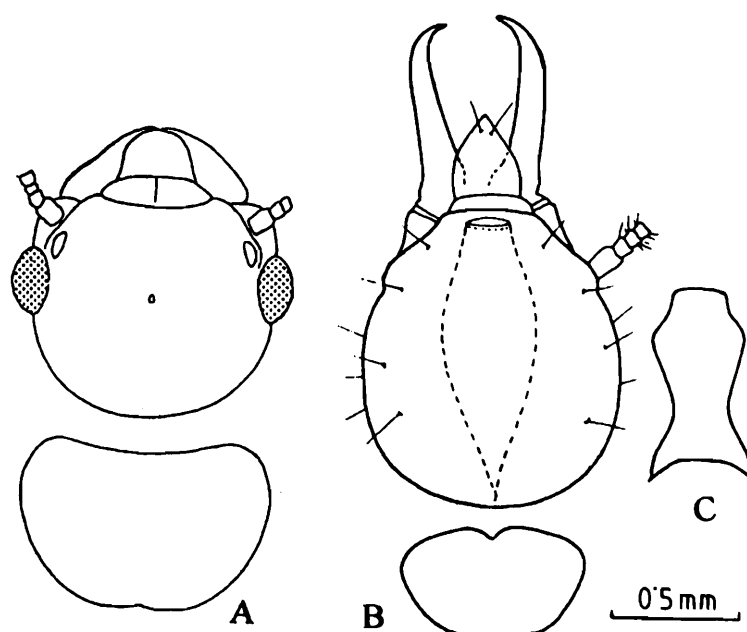


Fig. 33. *Coptotermes intermedius* Silvestri; A. Imago. A. Head and pronotum, dorsal view. B-C, Soldier. B. Head and Pronotum, dorsal view; C. Postmentum.

Head rectangularly oval, maximum width below the antennal flaveole whence narrowing both anteriorly and posteriorly. Fontanelle large. Eyes and Ocelli absent. Antennae with segments, 3 variable, 4 smaller than 3. Labrum subtriangular, almost as long as broad with somewhat pointed apex and a few erect hairs. Mandibles much incurved at apices. Postmentum club shaped with a narrowest width at posterior one-sixth.

Pronotum weakly saddle-shaped, much broader than long; anterior margin concave with a strong median notch and posterior margin substraight.

Measurements : Table-10 (Im.), 23 (S.)

(i) IMAGO (Harris, 1966) :

	Morphotype	Range 4 localities
Width of head and eyes	1.32	1.28-1.41
Diameter of eye	0.33	0.33-0.35
Diameter of Ocellus, long	0.13	0.11-0.15
Diameter of Ocellus, short	0.12	0.08-0.12
Ocellus to eye	0.03	0.03-0.06
Width of pronotum	1.14	1.09-1.26
Length of hind tibia	1.09	1.04-1.14
Length of fore wing	7.80	7.30-9.00

Types : Morphotype Im. (Female) lie BMNH., London

Distribution : AFRICA : Portuguese Guinea, Rio Cassine (type-locality), Ghana, Ivory Coast, Nigeria (Northern region), Senegal, Upper Volta, Sierra Leone.

Remarks : The species is very close to *C. sjostedti* but differs in its proportionately wider head, smaller and more oval Ocelli, sides of pronotum straighter, wings shorter and lighter in colour. It is also larger and darker than *C. amanii* with larger Ocelli, anterior margin of pronotum flat and paler wings.

However, *C. truncatus* var. *reducta* was described by Sjostedt (1926) based on specimens from Ghana. *C. truncatus* is restricted to Madagascar and the Seychelles. The variety *reducta* was given specific rank by Snyder (1949) which was however synonymised under *C. intermedius* by Harris (1966) based on the study of syntype series.

C. intermedius occurs in this natural and man-made savanna of the West Africa *Isoberrlinnia* Woodland and also extends to the margin of drier *Acacia* savanna in the north (Harris, 1966).

37. *Coptotermes kalshoveni* Kemner

1. *Coptotermes kalshoveni* Kemner

1934. Kamner, K. *Svan. Vet. Akad. Handl.*, (3) 13 (4) : 61, S. Type-locality : Smarang, Middle Java, Indonesia.
1949. Synder, *Smiths. misc. Coll.*, 112 : 80.
1958. Ahmad, *Biologia*, 4 (1) : 66 (Sold key).
1965. Ahmad, *Bull. Amar. Mus. nat. Hist.*, 131 : 21-22, Thailand.
1966. Roonwal and Maiti, *Treubia*, 27 (1) : 81, East Sumatra.
1982. Thapa, *Sabah For. Rec.*, No.12, pp. 81-83, Sabah.
1992. Thakur and Thakur, *Treubia*, 30 (3) : 249-251, West Java.

Material : Present in Z. S. I., Kolkata : one vial with 4S. and 5W., Aek-na-uli, E. Sumatra, Coll. F. R. I., Bogor, October, 1951, det. M. L. Roonwal and P. K. Maiti.

Diagnostic character : (i) IMAGO : Unknown.

(ii) SOLDIER (Fig. 34.A-B) : Head dark brown and very sparsely pilose; other body parts straw yellow.

Head pyriform strongly narrowing anteriorly from behind the antennal faveolae, narrowest width at the anterior end, almost half the head width; lateral sides strongly outcurved and widest width on the posterior third. Fontanelle fairly large encircled with hairs and overhanging on posterior margin of clypeus in lateral view. Antennae with 13 segments, 3 narrowest and

smallest, 4 longer than 3. Labrum subtriangular, strongly outcurved on lateral margins with a few hairs before the hyaline apex. Mandibles somewhat straight with fairly pointed apices. Postmentum short club-shaped, anteriorly depressed portion beyond the widest width with many long hairs and below that with minute hairs.

Pronotum flat with more hairs throughout, anterior margin somewhat convex with median notch, both antero-lateral and postero-lateral corners broadly rounded.

Measurements : Table 20 (S.)

Types : Repository not known.

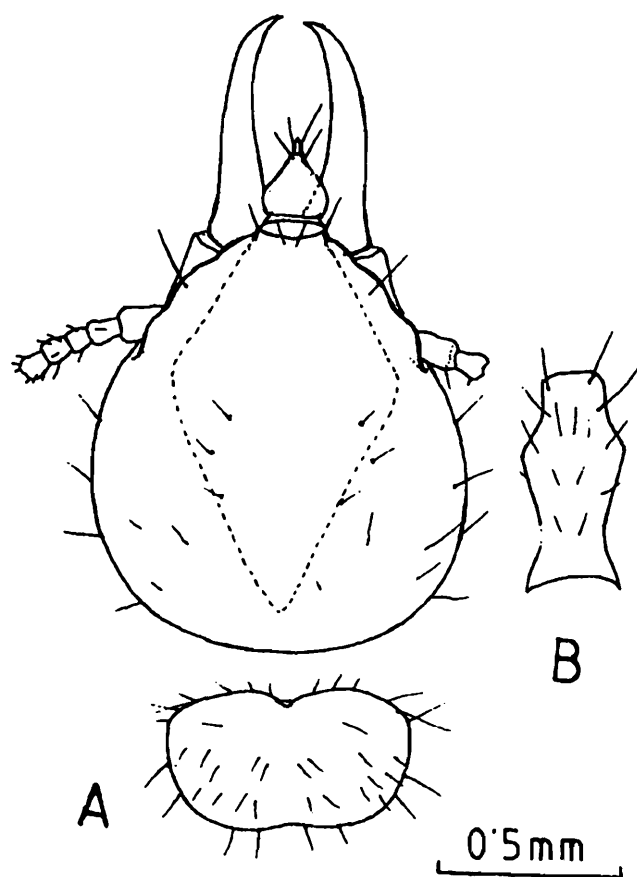


Fig. 34. *Coptotermes kalshoveni* Kemner ; A-B, Soldier. A. Head and pronotum, dorsal view; B. Postmentum.

Distribution : ASIA : Indonesia : Sumatra (Aek na Uli) ; Java (Semarang) and Sabah. Ka Chong.

Remarks : It is a very distinct species by its extremely narrowed width at the base of mandibles being almost half the maximum head width. From its closest species, *C. gaurii* it differs in having less narrowed head anteriorly.

Biologically, the species is least known, except its frequent occurrence in followed dried or rotten wood.

38. *Coptotermes kishori* Roonwal and Chhotani

1. *Coptotermes kishori* Roonwal and Chhotani

1960. Roonwal and Chhotani, *J. zool. Soc. India*, 11 (2) : 127 (Nom. Nud.).
1962. Roonwal & Chhotani, *Indian Species of Termites Genus Coptotermes* (ICAR Ent. Monogr. No. 2) pp. 9, 57-61, S. Type-locality : Berhampur, Murshidabad Dist., West Bengal, India.
1975. Sen-Sarma, et. al. *Wood Destroying Termites of India* (Final Tech. Rept., PL. 480 Proj.) 11, 26, 48, 64.
1980. Chhotani, *Tech. Monogr., Zool. Surv. India* No. 4 : 30, 33.
1983. Maiti, *Occ. pap., Rec. zool. Surv. India*, No. 42 : 23, 51-53.
1985. Verma, *Indian J. For.*, 8 (3) : 177-178.
1989. Roonwal and Chhotani, *Fauna of India, Isoptera* (Termites), 1 : 457-461.

Material : A. Present in Z. S. I., Kolkata : (i) one vial (ZSI Reg.No.3801/H8) with 1 paratype S. and 1 paramorphotype W. from Berhampur, Dist. Murshidabad, West Bengal, India, P. K. Sen-Sarma coll., January, 1954, F. C. No. 53a/19.1.54, ex. "Living *Mangifera indica*" det. M. L. Roonwal and O. B. Chhotanj, (ii) one vial (Z. S. I. Regno. 319/H") with sev. S. and W., Kalyani, Nadia Dist. W. Bengal, India, P. K. Maiti coll., September, 1965, det. P. K. Maiti, ex. "*Ficus relegiosus tree*"

B. Present in F.R.I., Dehra Dun : (i) one vial with Holotype S. and para-Morphotype w., other data same as A (i).

Diagnostic character : (i) IMAGO : Unknown.

(ii) SOLDIER (Fig. 35. A-B) : Head yellow; mandibles dark brown, yellowish at base; labrum, antennae, legs and abdomen pale yellow. Head sparsely hairy, pronotum thickly and abdomen densely hairy.

Head oval, longer than broad, narrowed at base the mandibles, lateral margins out-curved, frontal gland area paler than rest of the head,

dorsal profile somewhat wavy. Fontanelle opening circular with a cuticular ring, placed almost at the level of base of mandibles. Antennae with 13-14 segments, 3 smallest, either subequal to or longer than 2 or 4. Labrum subtriangular, little longer than broad, subparallel sided, apex pointed and hyaline. Mandibles long, sabre-shaped, sharply incurved at tips. Postmentum long, broadly vase-shaped, broadly at anterior third, anteriorly narrowed and posteriorly with broad waist.

Pronotum broader than long, narrower than head, anterior margin convex with a broad concavity and posterior margin incurved medially.

Types : Holotype S in FRI, Dehra Dun and paratype S. and paramorphotypes W. in ZSI, Kolkata.

Distribution : ASIA : India : West Bengal (Berhampur, Murshidabad Dist, type-locality and Kalyani, Nadia Dist.). Tripura, Rajasthan, Madhya Pradesh and Kerala.

Remarks : *Coptotermes kishori* hardly is similar to any Indian species in its soldier characters,

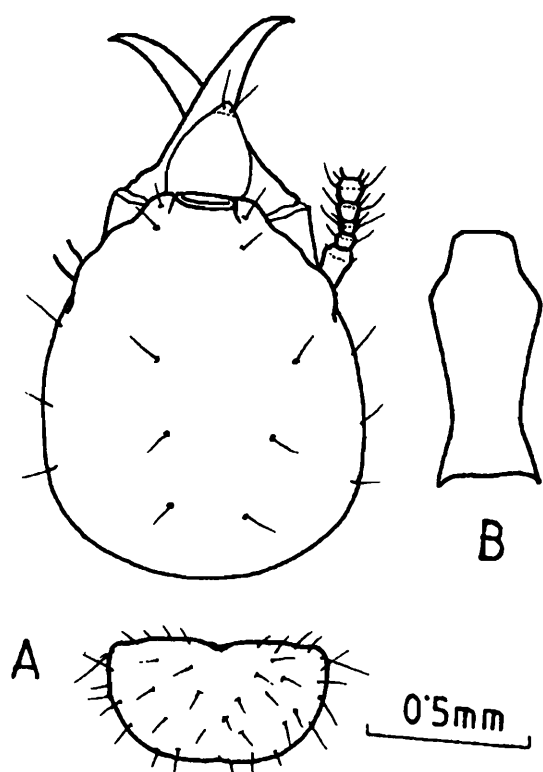


Fig. 35. *Coptotermes kishori* Roonwal and Chhotani; A-B, Soldier. A. Head and pronotum, dorsal view; B. Postmentum.

rather similar to some Indo-Malayan species, namely, *C. bornensis*, *C. minutissimus* and others (Roonwal and Chhotani, 1962). However, it also comes close to *C. amboinensis*, but differs in having non-e faced fontanelle opening, substraight mandible and widest head at the middle.

Measurements : Table 28 (S.) (Roonwal and Chhotani, 1962).

39. *Coptotermes lacteus* (Froggatt)

1. *Termes lacteus* Froggatt

1898. Froggatt, *Proc. Linn. Soc. N.S.W.*, 22 (4) : 721. pl.34, figs. 2, 2a (description of winged adult, soldier and worker; from New South Wales).

1903. Froggatt, *Agric. Gaz. N.S.W.*, 14 : 726. Pl. and figs. (description of nest).

2. *Termes (Coptotermes) lacteus* Froggatt

1904. Desneux, *Gen. Insectorum*, 25 : 34.

3. *Coptotermes (Termes) lacteus* (Froggatt)

1905. Froggatt, *Agric. Gaz. N.S.W.*, 16 : 760 (biology).

4. *Coptotermes lacteus* (Froggatt)

1909. Silvestri, *Fauna Sudwest Australiens*, 2 (17) : 293, pl. 19, fig.100-105 (from Western Australia).

1911. Holmgren, K. *Sven. vet. Akad. Handl.*, 4 (6) : 73.

1915. Froggatt, *Dept. Agric. N.S.W., Farmers' Bull.*, No.60 (2nd Ed.) : 34 (biology).

1920. Mioberg, *Arkiv for Zoologi*, 12 (15) : 29.

1921. Hill, *Proc. Linn. Soc. N.S.W.*, 46 (2) : 263.

1922. Hill, *Proc. Linn. Soc. N. S. W.*, 47 (2) : 159.

1926. Hill, *Proc. Linn. Soc. viet.*, 38 : 204.

1929. Nicholis, *J. Roy. Soc. W. Aust.*, 15 : 19.

1932. Hill, *Proc. Roy. Soc. viet.*, 44 (2) : 142 (Synonymy).

1932. Hill, *Coun. Sci. Ind. Res. (Aust.)*, 25 : 20 fig. 14a - c, pl.1, fig.a (biology).

1938. Clark, *N. Z. J. For.*, 4 : 179, New Zealand (Introduced).

1940. Gay and Greaves, *J. Coun. Sci. Ind. Res. (Aust.)*, 13 (2) : 145 (population of a nest).

1942. Hill, *Termites (Isoptera) from the Australian Region*, CSIRO, Melbourne, pp. 156-158.

1944. Kelsey, N. Z. J. Sci. Technol., (B) 25 : 236, New Zealand.
1967. Gay, C.S.I.R.O., Bull. No.286 : 34 (aspect of Introduction).
1970. Gay and Calaby, In : *Biology of Termites*, Krishna and Weesner (Eds.) 2 : 418 (Biology).

5. *Coptotermes sedulus* Hill

1923. Hill, *Proc. Linn. Soc. N.S.W.*, 48 (2) : 40, fig. 1-7, (description of winged adult, soldier and worker; from Victoria).

Material : A. Present in Z. S. I., Kolkata : (i) one vial (Z.S.I. Reg. No.3803/H8) with 1 Im., Federal Capital Territory, Australia, 11.xi.1929 (material from AMNH, New York); (ii) one vial (Z. S. I. Reg. No. 3802/H8) with 1S., Chevateer, Auckland, New Zealand, *Coll. C.V. Cromin, det. and comp., A. E. Emerson* (material from AMNH, New York). (iii) one vial (Z.S.I. Reg. No.2765-H8) with 4 Im., 6S. and 4W., Braid wood, Australia, *Coll. T Greaves and A. H. Waiherly*, 20.x.1936 (Material from C.S.I.R.O., Australia).

B. Present in F. R. I., DehraDun : (iv) one vial with 3 Im., 2S. and IW., other data same as in A(i) ; (v) one vial with 3S. *Metatype*, other data same as in A (ii); (vi) one vial with 2 Im., 2S. and 2W., Canbera, Australia (material from C. S. I. R. O., Ent. Div.).

Diagnostic character : (i) IMAGO (Fig. 36.A) : Head and pronotum chestnut brown; antennae and labrum paler than head, wings light brown. Head with some scattered erect hairs, pronotum and body comparatively densely hairy; wing-scale with a few long erect hairs.

Head subcircular, broader than its length, lateral margins outcurved and posterior margin broadly rounded, frons weakly sloping infront. Fontanelle minute, circular, slightly raised; situated slightly above the middle in a weakly depressed area. Antennae with 19 segments, 3 smallest, narrowest and parallel sided; 4 one and half times longer than 3. Eyes circular, fairly bulging out with fade black in colour. Ocelli oval, translucent, separated from the eyes by more than half its long diameter. Postclypeus very

narrow, fairly swollen and divided completely by a median line. Labrum as broad as long, with a few setae near distal margin and body, lateral and apical margin convex, apical margin somewhat rounded.

Pronotum, subreniform, narrower than head-width, broader than long, anterior margin with weakly median emargination, posterior margin convex with a weak median emargination.

Wing membranes transparent and hairy, somewhat punctate; all veins marked by rows of hairs. Forewing : Scale longer than in hind-wing and partly overlapping the later. Costa-subcosta fused and highly chitinized, bordering the anterior margin of wing. Radius as thick as the costa-subcosta, running parallel to costa-subcosta and fusing with it distally. Median thin, emerging separately from the scale with 3-4 branches in the distal one-third. Cubitus also thin with 9-11 branches to the posterior border, some of them branched also. Hindwing : Costa-subcosta and radius as in forewing. Median arising from the radius just outside the scale with 2 branches in the distal one-third. Cubitus as in forewing, but with 9-11 branches to the posterior border.

(ii) SOLDIER (Fig. 36.B-C) : Head yellowish brown; antennae, legs, pronotum and labrum

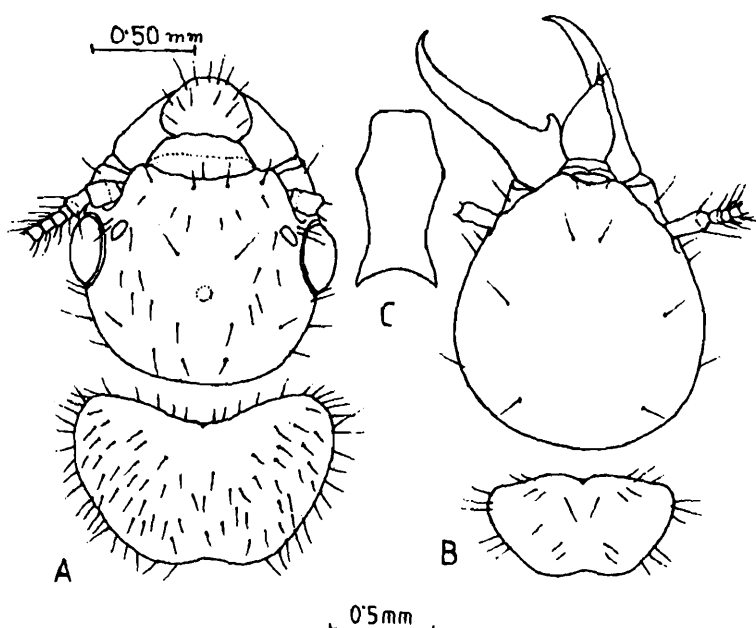


Fig. 36. *Coptotermes lacteus* (Froggatt) A, Imago. A. Head and pronotum, dorsal view; B-C, Soldier. B. Head and pronotum, dorsal view; C. Pronotum.

paler than head; abdomen yellowish white. Head with a few scattered hairs, thorax sparsely and abdomen densely hairy.

Head thick and broadly oval with narrower anterior end, weakly impressed in between antennal base and mandible base, longer than broad, anterior end almost two-third of maximum width, posterior margin round. Fontanelle large, placed almost on the basal margin of postclypeus. Eyes and Ocelli absent. Antennae with 15 segments, segment 3 narrower, longer than either 2 or 4. Labrum subtriangular, a little longer than broad, apex hyaline and somewhat pointed with two bristles. Mandibles thin and fairly incurved with pointed apices. Postmentum club-shaped, long and narrow with a few short hairs on the anterior third, broadest in the anterior third, narrowest in the posterior third, anterior margin substraight and posterior margin weakly concave. Pronotum flat and subreniform, much broader than long, length little less than half the width, anterior margin convex with a median weak emargination; antero-lateral corners narrowly and postero-lateral corners broadly rounded.

Measurements : Table 9 (Im.); 24 (S.)

Types : *Holotype* Im. and *Morpholectotype* S. in C.S.I.R.O. Collection, Australia.

Distribution : AUSTRALIA : Victoria, New South Wales and Queensland. New Zealand : North Island (introduced).

Remarks : It is a very variable species at least in the shape and size of the head of soldiers which brings it close to a number of Australian species. The wavy head dorsum brings the species close to *C. sinabangensis* Oshima of the Philippines. *C. lacteus* occurs in the coastal and adjacent table land districts of south eastern Australia from south Queensland to Victoria. The species is of no economic significance in Australia. It generally constructs large clay covered termitaria and infests dead wood in logs and stumps, in forested or savannah wood land areas (Gay, 1967).

The species is introduced in New Zealand

attacking timbers in building and in power poles (Clark, 1938; Kelsey, 1944).

40. *Coptotermes menadoensis* Oshima

1. *Coptotermes menadoensis* Oshima

1914. Oshima, *Annot. Zool. Jap.*, 8 : 557-558, Im. *Type-locality*, Manado, Celebes, Indonesia.

1949. Snyder, *Smiths. misc. Coll.*, 112 : 80.

1958. Ahmad, *Biologia*, 4 (1) : 61 (key).

Material : Since no material is available for study, the original description, measurements, etc. are given below (Oshima, 1914b).

Diagnostic character : (i) IMAGO : Body yellowish brown ; clypeus, antennae, legs, and the ventral side of abdomen straw-colored, mandibles reddish brown, apex dark; wings hyaline, outer border yellowish. Head densely provided with spiny hairs, along the posterior border of abdominal tergites two series of hairs, of which the anterior ones are the shorter.

Head rounded; fontanelle inditinet, dotted, slightly swollen, transversal band longer in the middle than in sides; forehead inclined; basal portion of clypeus very short, slightly swollen; eyes somewhat prominent. Ocelli approximated to eye; antennae 22-jointed, 2nd joint slightly longer than 3rd, 4th joint twice as long as 3rd, pronotum longer than half the width, anterior border broadly concave, posterior border weakly indented in the middle; mesonotum and metanotum considerably narrower than pronotum, their posterior border slightly emarginate at middle, anterior wing stumps much larger than the posterior wing, covering the basal parts of the latter; membranes of the wings provided with dense hairs, median nerve runs near to cubitus, branched in apical area; cubitus with 7 branches, of which the proximal ones are the stronger.

Measurements : Imago :

- | | |
|------------------------------|---------------|
| 1. Length of body with wings | 14.00 – 16.50 |
| 2. Length of anterior wing | 11.00 – 12.00 |
| 3. Length of body | 6.50 – 8.00 |

4. Lengh of head	1.30
5. Width of head	1.41-1.50
6. Width of pronotum	1.53-1.66
7. Length of pronotum	0.94-1.03

Types : Repository not known.

Distribution : ASIA : Indonesia : Menado, Celebes (Type-locality).

Remarks : The species is so far known by imagoes (4 exs.) only from its type-locality.

41. *Coptotermes michaelsoni* Silvestri

1. *Coptotermes michaelsoni* Silvestri

1909. Silvestri, *Fauna sudwest Australians*, 2 : 293. Im, S. and W. Type-locality : Mundijong, Western Australia.

1920. Mjoburg, *Ark. For. Zool.*, 12 (15) : 30

1942. Hill, *Termites (Isoptera) from the Australian Region*, CSIRO, pp. 162-164.

1949. Synder, *Smiths. misc. Coll.*, 112 : 80.

1970. Gay and Calaby, in: *Biology of Termites*. Krishna and Weesner (Eds.), 2 : 419

Material : A. Present in Z.S.I., Kolkata : (i) one vial (ZSI Reg. No.2767/H8) with 3 Im., 4S, and 3W., Perth, West Australia, D. H. Perry coll., 8.viii.1960 (Don. CSIRO, Ent. div., Australia). B. Present in F.R.I., Dehra Dun (ii) one vial with 1 Im., 2S and 2W., Merredin, West Australia, C.L.J.Newman coll., det. G.F.Hill, (from A. M. N. H., New York).

Diagnostic character : (i) IMAGO : Head chestnut brown, other parts paler. Wings smoky brown. Head sparsely, pronotum and abdomen more densely hairy.

Head subcircular, broader than long, lateral sides slightly convex, but weakly diverging anteriorly. Fontanelle minute and slightly raised and placed almost at the middle. Antennae with 16-19 segments, 3 smallest, 4 broad and one and a half times longer than 3. Eyes fairly large. Ocelli elongately oval and separated from the eyes by its smallest diameter or so.

Postclypeus with a median line. Labrum broader than long and with rounded apex.

Pronotum narrower than head, anterior margin weakly concave, but without any median notch, posterior margin substraight with a weak median emargination.

(ii) SOLDIER (Fig. 37.A) : Head light brown, other parts still lighter. Head with a few erect hairs, while pronotum and abdomen are more hairy. Head pyriform, width one and a half times broader than at the anterior end. lateral margin converging anteriorly. Fontanelle opening smaller with a collar-like rim everted posteriorly. Antennae with 14 segments, 3 variable. Labrum lanceolate shape with pointed hyaline apex and two bristles. Mandibles long and narrow, gradually incurved to fine apices.

Postmentum broadly club-shaped with a few minute hairs anteriorly, broadest at anterior third and narrowest on posterior third.

Pronotum much broader than long, length a little longer than half the width, anterior margin devoid of and posterior margin substraight and with a feeble median emargination.

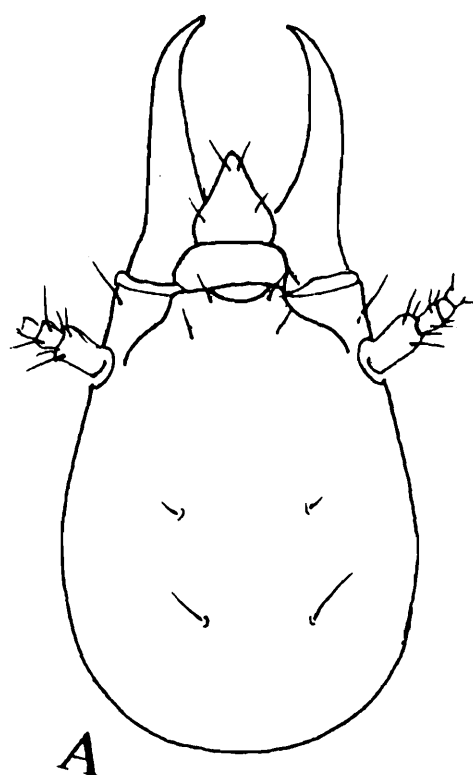


Fig. 37. *Coptotermes michaelsoni* Silvestri ; A. Soldier. A. Head, dorsal view;

Measurements : Table 9 (Im.); 24 (S.)

Types : In Nat. Hist. Mus., Stockholm and Hill's coll., Western Australian Mus.

Distribution : Australia : South-western Australia.

Remarks : The species is very closely related to *C. frenchi* Hill which can be distinguished by some minor characters. The species was originally described from Western Australia. Subsequently, Hill (1942) reported its occurrence from many locations of South Australia, Victoria and Queensland with some doubt. However, Calaby and Gay (1956) in recent times, undertook through study and confirmed the distribution only from the Western Australia. Those from South Australia, Victoria and Queensland are actually *C. frenchi* Hill.

It attacks small logs, weed litter and makes mud covered runways on different surfaces. It is not known to build mound and to cause economic loss. The alates are produced from July to November (Gay and Calaby, 1970).

42. *Coptotermes minutissimus* Kemner

1. *Coptotermes minutissimis* Kemner

1934. Kemner, K. *Sev. vet. Acad. Handl.*, 13 (4) : S. only.

Type-locality : Bera Massidi, Moena Island.

1949. Snyder, *Smiths. misc. Coll.*, 112 : 80.

1958. Ahmad, *Biologia*, 4 (1) : 66.

Material : Since no material is available for study, the following description, measurements, etc. are based on description by Kemner, 1934.

Diagnostic character : (i) IMAGO : Unknown.

(ii) SOLDIER : Head pale yellowish brown, with brown outer margin of mandibles. Body whitish. Head sparsely hairy. Abdominal tergites with one row of long bristles on its posterior margin in each, however, otherwise irregular. Head flat and archad, widest in the middle, whence narrowing anteriorly. Postmentum not strongly constricted, anterior part small and broad. Fontanelle tubelike, relatively small, outer

margin of its opening not projecting out. Labrum brightly acuminate. Antennae with 13 segments, segment 2 longer than 3, 3 smaller than 4.

Pronotum length longer than half the width, weakly saddle-shaped, with arched margin with a shallow median notch.

Measurements (in mm.) of Soldiers :

Head with mandibles	1.80–1.85
Head without mandibles	1.13–1.22
Head width	0.99–1.02
Width of pronotum	0.59–0.63
Length of pronotum	0.31–0.35

Types : Not traceable

Distribution : Asia : Bera Massidi, Cocos Isl., between Moena Island and south-east point of Celebes.

Remarks : The species is represented so far by Soldier Caste only, the pronotum of which appears somewhat like a saddle. This feature keeps the species separate from all other *Coptotermes* of the Papuan region.

43. *Coptotermes niger* (Snyder)

1. *Coptotermes niger* Snyder

1922. Snyder, *Proc. U. S. nat. Mus.*, 61 (20) : 19-21, 1m. and S. *Type-locality* : Juan Mina, Canal Zone, Panama.

1925a. Snyder, *J. Wash. Acad. Sci.*, 15 (7) : 162

1925. Snyder, *J. Wash. Acad. Sci.*, 16 (1) : 17, S. and W., Bohas, Guatemala, Colombina, Costa Rica.

1949. Snyder, *Smiths. misc. Coll.*, 112 : 81.

2. *Coptotermes morabitanus* Banks

Banks, *Bull. Amer. Mus. nat. Hist.*, 38 (17) : 662, *Acad. Sci.*, 9 : 159, 164-165, 168-169 Panama.

3. *Termes testaceus* Dudley and Beaumont

1890. Dudley and Beaumont, *Trans. New York Acad. Sci.*, 9 : 159, 164-165, 168-169, Panama.

Material : A. Present in Z. S. I., Calcutta : (i)

one vial (Z. S. I. Reg. No.3804/H8) with 1S. with Barro Colorado Isl., Canal Zone, Panama, Coll. A. E. Emerson, 2.v.1935, det. A.E. Emerson.

B. present in F.R.I., Dehra Dun : (ii) one vial with 2Im. (not studied) for description and 7S.

Description : (i) IMAGO : Known, only Measurements taken

(ii) SOLDIER : Head-brown; antennae, pronotum, labrum and legs paler than head; abdomen yellowish white. Head with a few erect hairs. thorax sparsely and densely hairy.

Head suboval, narrowed anteriorly, slightly longer than broad, anterior end more than half the maximum width. Fantanelle very much anteriorly placed. Eyes and ocelli absent. Antennae with 15 segments, segment 2 much smaller than 1, 3 subequal to or slightly longer than 2, 4 subequal to or smaller than 3. Labrum subtriangular, a little longer than broad, covering almost half the length the mandibles, apex hyaline, bluntly pointed with a few short and long hairs. Mandibles sabre-shaped. Postmentum club-shaped, comparatively short and narrow, with a few short hairs on the anterior part of the body, broadest in the anterior one-third, narrowest in the posterior two-thirds, narrowest width much more than half the broadest width and much below the middle of the broadest width.

Pronotum flat, much broader than long, length little less than half the width, anterior margin weakly convex with a median broad impression, antero-lateral corners weakly rounded, posterior margin weakly convex with a weak median emargination.

Measurements : Table 9(1m.) ; 21 (S.).

Type : Winged Male (No.24570) in U. S. N. M., Washington, (Type-locality) : Juan Mina, Canal Zone, Panama.

Distribution : CENTRAL AND SOUTH AFRICA : Panama, (Type-locality) ; Costa Rica, Guatemala, Colombia, British Honduras (Humming Bird Gap, Belize and Corozal).

44. *Coptotermes obiratus* Hill

1. *Coptotermes obiratus* Hill

1927. Hill, *Mem. Nat. Mus. Melbourne*, No.7, pp. 17-19, S. and W., Type-locality : Papua, Mekeo Dis., Waima; and New Britain, Rabaul.

1942. Hill, *Termites (Isopters) from the Australian Region*, C. S. I. R. O., Melbourne, pp. 164-165, S.

1949. Snyder, *Smiths. Misc. Coll.*, 112 : 81, Papua, New Britain.

Material : A. Present in Z. S. I., Calcutta : (i) one vial with 1S. and 1W., port Moresby, Papua.

B. Present in F.R.I., Dehra Dun : (ii) one vial with 4s. and 4W., Port Moresby, Papua, C. E. Pemberton Coll., 2.vi.1928, det. A. E. Emerson (from AMNH, New York).

Diagnostic character : (i) IMAGO : Unknown.

(ii) SOLDIER (Fig. 38.A.B) : Head yellowish brown ; antennae, labrum, pronotum and legs paler than head; abdomen yellowish white. Head-capsule with a few short and long hairs, thorax sparsely and abdomen densely hairy.

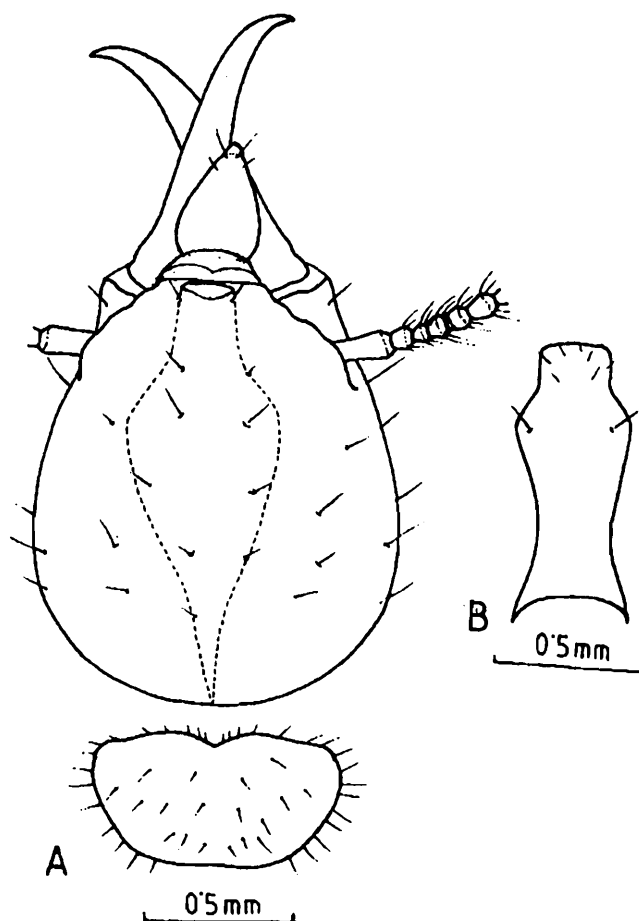


Fig. 38. *Coptotermes obiratus* Hill ; A-B, Soldier. A. Head and pronotum, dorsal view; B. postmentum.

Head pyriform, narrowed anteriorly, longer than broad, anterior end more than half the width and posterior margin round. Fontanelle large, opening almost touching the posterior margin of clypeus. Eyes and ocelli absent. Antennae with 16 segments, segment 1 longest, 2 smaller than 1, 3 smallest, 4 longer and broader than 3. Labrum subtriangular, a little longer than broad, apex hyaline, bluntly pointed with two bristles at the apex. Mandibles sabre-shaped. Left mandible with distal half of inner margin smooth, proximal half with a basal projection and 4 small crenulations which increase in size proximally. Right mandible with 4 small crenulations in the proximal one-third. Postmentum club-shaped, long and narrow with a few short hairs on anterior one-third, broadest in the anterior one-third, narrowest in the posterior one-third, narrowest width almost half the broadest width, anterior and posterior margins substraight.

Pronotum as broad as anterior end of head, flat, subreniform, much broader than long, length almost half the width, anterior margin convex with a median strong emargination, antero-lateral corner broadly rounded, posterior margin weakly convex with a median feable depression.

Measurements : Table 26 (S.).

Types : *Holotype* S. and *Morphotype* workers in National Museum, Melbourne.

Distribution : ASIA : New Guinea : Mekeo Dist. : Waima (*type-locality*) : New Britain : Rabaul.

45. *Coptotermes ochraceus* Ping and Xu

1. *Coptotermes ochraceus* Ping and Xu

1986. Ping and Xu, *Scientia Silvae Sinicae*, 22 (5) : 160 S. *type-locality* ; Xingyi County (alt. 700m.), China.

Material : Characters based on Ping and Xu (1986).

Diagnostic character : (i) *Imago* : Unknown

(ii) *Soldier* (Fig. 39.A-B) : Head elongately oval with less narrowed anterior end, lateral margins outbulged and posterior margin substraight.



Fig. 39. *Coptotermes ochraceus* Ping and Xu; A-B, Soldier. A. Head, dorsal view; B. head, side view (after, Ping and Xu.).

Fontanelle opening of medium size, opening efaced and almost touching the fontoclypeal suture. Antennal segment, 2,3,4 subequal Labrum somewhat dome-shaped with a pointed apex. Postmentum club-shaped with outcurved anterior margin, waist almost at the middle of widest and posterior points. Pronotum with a shallow and median emargination on anterior margin and slightly deeper one on posterior margin.

Measurements : Not taken.

Types : *Holotype*, and *Paratypes* S., and W from type-series (I.No. T.5008), coll. Ping, 22.5.1979, ex 'living *Prunus percica*'

Distribution : ASIA : China : Xingyi Country (alt. 700m.).

Remarks : According to Ping and Xu (1986), the soldiers of this species can easily be distinguished from known Chinese species *C. formosanus* Shirake by its opening slope of frontal gland in profile view is oblique. It resembles *C. havilandi* Holmgren, but its width of pronotum 0.90-1.02 instead of 0.70-0.85.

46. *Coptotermes pamuae* Snyder

1. *Coptotermis pamuae* Snyder

1925. Snyder, J. *Washington Acad. Sci.*, 15 (17) : 402-403, 5. *Type-locality* : Pamua, San Cristobal Island, Soloman Island.

1929. Light and Davis, *Proc. Roy. Soc., Victoria, N. S.* 42 (1) : 66.

1942. Hill, *Termites of the Australian Region*, CSIRO, Melbourne, pp 166, S. Banika Isl. (Russell Group);

1949. Snyder, *Smiths. misc. coll.*, 112 : 81, Solomon Isls.

1970. Bees, *Termites of Hawaii and the Oceanic Isl.* p.472, In : *Biology of Termites* (Krishna and Weesner, eds.), Acad. Press, London.

Material : Since the material is not available, the following description and measurements are based on the original description of Snyder (1925) as well as that of Hill (1942).

Diagnostic character : (i) IMAGO : Unknown.

(ii) SOLDIER (Fig. 40.A) : Head yellow-brown to light castaneous brown, area of frontal gland and sides of head lighter with scattered long hairs.

Head longer than broad, broadest posteriorly, narrowed anteriorly, sides and posterior margin rounded. Frontal tube fairly long and prominent.

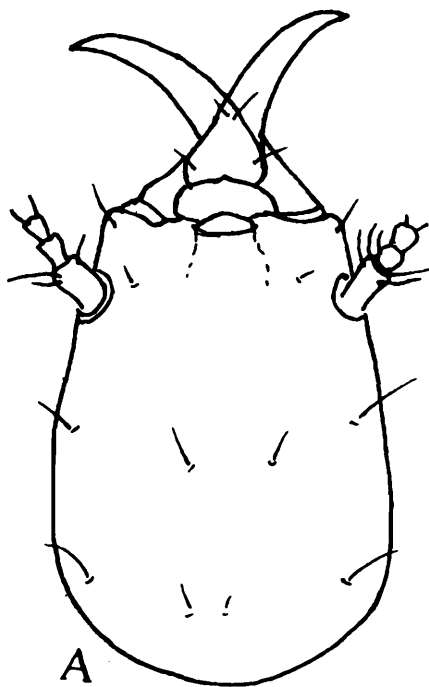


Fig. 40. *Coptotermes pamuae* Snyder A, Soldier. A. Head, dorsal view.

Eye spot not distinct. Mandibles sabreshaped with incurved pointed apex. Labrum subtriangular with hyaline pointed apex and with two long hairs at apex. Antennae with 14 segments, 3 subequal to 2 and 4, last one elongated.

Pronotum deeply and roundly emarginate anteriorly, posterior margin shallowly concave at middle with long hairs.

Measurements (in mm) : (Soldier)

	Snyder (1925)	Paratypes	Banika Is.
Length of head with mandibles	2.00-2.10	1.90-1.92	1.65
Length of head without mandibles	1.35	1.28	1.10
Maximum width of head	1.15-1.20	1.10-1.13	0.91
Length of left mandible	0.77	—	—
Length of pronotum	—	0.36	0.36
Width of pronotum	0.75	0.77	0.62

Types : *Holotype* S., in Mus. Comp. Zool., U.S.A. *Paratypes* S., in Hill's collection, CSIRO, Australia.

Distribution : SOLOMON ISLANDS : San Cristobal Island, Pamua, Banika Island (Russell Group) and South Pacific Island (Bees, 1970).

Remarks : The species is very close to *C remotus* Hill, but differs in having smaller fontaneller opening, less flattered head and with more antennal segments.

47. *Coptotermes perigrenator* Kemner

Coptotermes perigrenator Kemner

1943. Kemner, K. *Sven Vat. Akad. Handl.*, 13 (4) : 65-66, S. *Type-locality*, Saleier Isl.

1949. Synder, *Smiths. misc. Coll.*, 112 : 82.

1958. Ahmad, *Bilogia*, 4 (1) : 67 (key).

Material : Present in F. R. I., Dehra Dun : (i) one vial (A.M.N.H.) Pamatata, Sabyer Islands, S. of Celebes, with *paratypes* 1S., 1W. from type-

colony, N.A.Kemner Coll., 20.xii.1920. det. N.A. Kemner.

Diagnostic characters : (i) IMAGO : unknown.

(ii) SOLDIER (Fig. 41.A-B) : Head-yellowish brown; antennae, legs, pronotum and labrum paler than head; abdomen yellowish white. Head with a few erect bristles, thorax sparsely and abdomen densely hairy.

Head somewhat rectangularly oval, lateral margin weakly convex, slightly longer than broad, anterior end much more than half the head width; fontanelle comparatively small with a chitinized rim at the opening facing some what posteriorly. Eyes and ocelli absent. Antennae with 13 segments, 2 smaller than 1, 3 narrowest and smallest. Labrum short, a little broader than long, apex hyaline, not so pointed with a few hairs. Mandibles sabre-shaped, stout, distinctly incurved with finely pointed apices. Postmentum club-shaped, long broadly elongated, in lateral view convex upto maximum width and flattened.

Pronotum flat, subreniform, much broader than long, length little more than half the width;

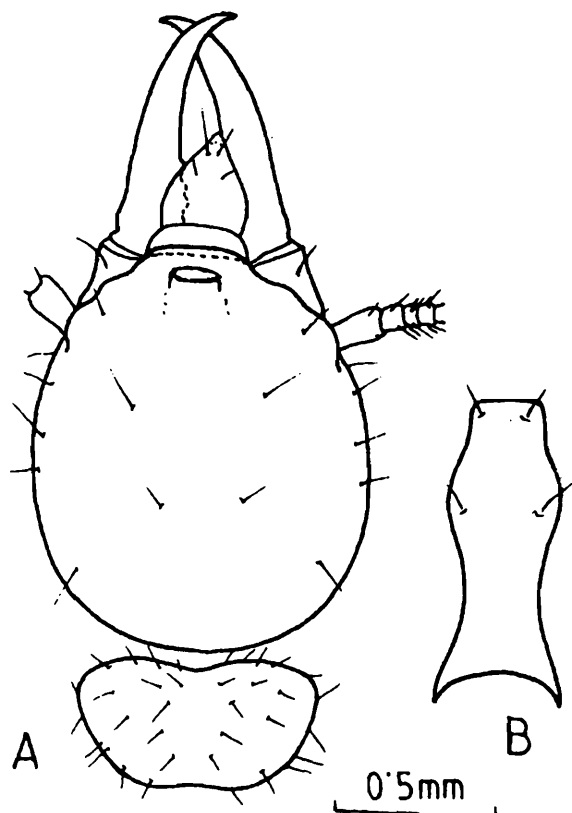


Fig. 41. *Coptotermes perigrinator* Kemner; A-B, Soldier. A. Head and pronotum, dorsal view; B. Postmentum.

anterior margin with a median shallow emargination, posterior margin substraight with a few short and long hairs, and disc with a few short hairs.

Measurements : Table 17(S.)

Types : Not traceable.

Distribution : ASIA : Saleier Isl.

Remarks : The species in its shape and size comes very close to *C. truncatus* (Wasmann) from Madagascar. It is so far known from a single locality by soldiers only. Nothing is known about its biology.

48. *Coptotermes premasmii* Ahmad

Coptotermes premasmii Ahmad

1965. Ahmad, *Bull. Amer. Mus. nat. Hist.*, 131 (1) : 17-19. Im. and S. *Type-locality* : Ka-Chong, Thailand.

1984. Maiti and Chakraborty, *Rec. Zool. Surv. India. Occ. paper*, No. 167, pp. 35-37, Nicobar Isl., Nancowry, India.

Material : Present in Z. S. I., Calcutta : one vial with 16S. and 2W., Champin Island, Nancowry Group, Nicobar Island, Coll. T. N. Khan and B. Mitra, 7.viii.1980, F. C. No.K1a/7.8.80, ex. "unknown log"

Diagnostic character : (i) IMAGO (Fig. 42.A-E) : Head dark brown with a crescent-shaped yellow margin in front of each ocellus; anteclypeus white; labrum brownish yellow; antennae light yellowish brown; pronotum lighter than head, with a faint T-shaped marking on disc; abdominal tergites brown to dark brown. Head moderately hairy, with a few scattered bristles and more numerous short hairs; post-clypeus with a few hair, pronotum with long bristles and short hairs along margins and on disc.

Head subcircular, wider than long without mandibles; fontanelle small and indistinct. Eyes large, bulging out and almost round. Ocellus broadly oval, separated from the eye by a distance of 0.02 mm. Postclypeus very narrow, more than three times as broad as long. Labrum broad, dome-shaped. Left mandible with three marginal

teeth, second longer than first. Right mandible with two marginal teeth and a subsidiary tooth at base of anterior cutting edge of first marginal tooth. Antennae with 20-23 articles, third shortest; articles becoming rounded from eighth onward.

Pronotum slightly narrower than head; anterior margin shallowly concave; lateral margins strongly convex; antero-lateral corners not distinct, broadly rounded; posterior margin slightly emarginate.

(ii) SOLDIER (Fig.42.G-L) : Head reddish yellow ; labrum brownish yellow; antennae and pronotum pale brown; legs and abdominal

segments pale yellow. Head sparsely hairy; pronotum with a few short and long hairs only on the margins but disc devoid of any hairs; abdominal tergites with a row of hairs along posterior margins along with a few scattered hairs elsewhere.

Head somewhat round, much narrowed anteriorly; narrowest width slightly more than half the maximum width; fontanelle opening fairly large and strongly sclerotized, placed a little below the fronto-clypeal suture. Antennae with 14-15 segments; in 15 segmented one, segment 2 as long as or slightly longer than 3, 4 slightly shorter than 3. Labrum subtriangular, slightly longer than broad with short hyaline tip. Left mandible with distal half of inner margin smooth and proximal half with a large basal projection and usually with 3 crenulations. Right mandible with entire smooth margin. Postmentum almost twice as long as its maximum width; a waist slightly below the posterior third and much more than half the maximum width; anterior margin substraight with two erect hairs.

Pronotum much narrower than head, slightly less than double its length; anterior margin with weak median notch, posterior margin with weak emargination.

Measurements : Table 8 (1m.); 25 (S.).

Types : *Holotype* S. in Ahmad's Coll., Dept. Zoology, Univ. of Panjab, Lahore, Pakistan. *Paratypes* in AMNH, New York.

Distribution : ASIA : Thailand : Ka-chong (type-locality). India : N Nicobar Isl., Nancowry : Champin Island.

Remarks : The species can be distinguished from its closer species, namely, *C. kalshoveni* Kemner and *C. gaurii* Roonwal and Krishna (Ahmad, 1965) by its larger size of the soldiers. But the discovery of long series of material from Nicobar Isl. has extended its range of measurements. However, it is a valid distinct species. (Maiti and Chakraborty, 1994). Nothing is known about its biology.

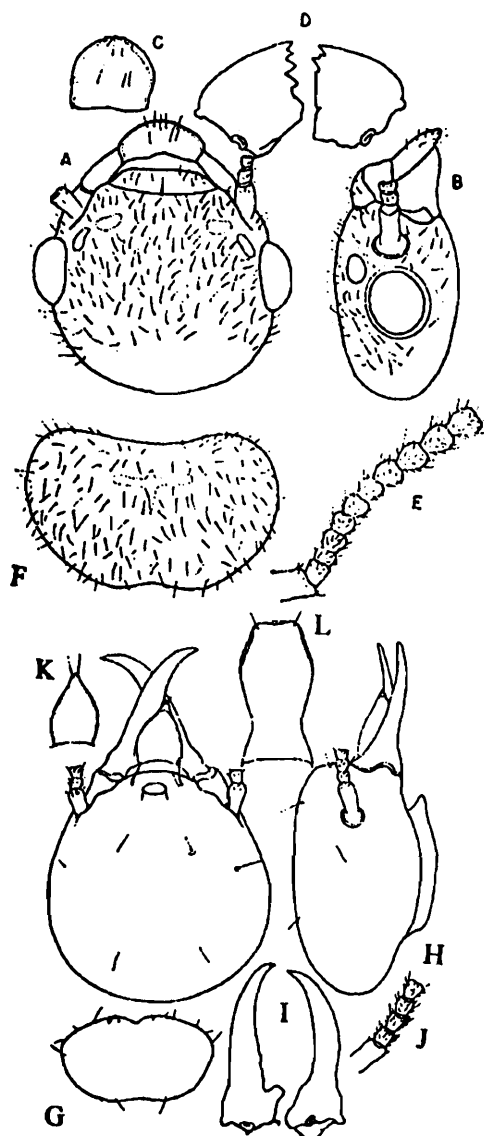


Fig.42. *Coptotermes premasmii* Ahmad; A-E, imago. A. Head, dorsal view; B. Head, side view; C. Labrum; D. Left and right mandibles; E. Basal part of antenna; F. Pronotum, dorsal view. G-L, Soldier. G. Head and pronotum dorsal view; H. Head, side view; I. Left and right mandibles; J. Basal part of antenna; K. Labrum; L. postmentum.

49. *Coptotermes rectangularis* Ping and Xu

1. *Coptotermes rectangularis* Ping and Xu

1986. Ping and Xu, *Scientia Silvae Sinicae*, 22 (5) : 160.
Type-locality : congjiang County, China.

Material : Characters are based on Ping and Xu (?)

Diagnostic character : (i) IMAGO : Unknown

(ii) SOLDIER : (Fig.43.A-B) : Head small, almost devoid of hairs, suboral with narrowed anterior end fontanelle smaller, not touching the fonto-clypeal suture. Labnum elongately lanculate shape with a almost blunt apex. Mandibles short, somewhat straight with abruptly incurved apices. Antennal segment 3 smaller. Postmestum club-shaped pronotum with a weak median notch and broadly incurved median emargination.

Measurements : Not taken.

Types : Holotype and Paratype S., and W. from type series (I.No.E. 7690), coll Ping *et al*, 28.v.1983, ex. tree, *Liquidam*.

Distribution : ASIA : China : Congjiang country.

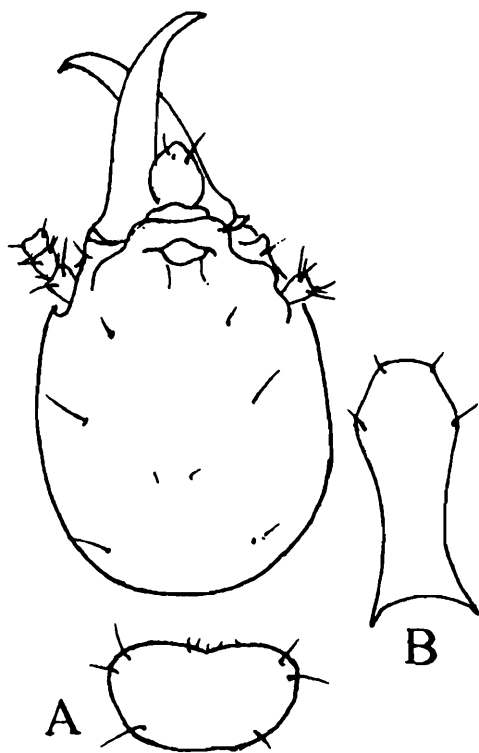


Fig. 43. *Coptotermes rectangularis* Ping and Xu; A-B, Soldier. A. Head and pronotum, dorsal view; B. postmentum; (After, Ping and Xu).

Remarks : According to Ping and Xu (1986) the soldier of this species can be easily distinguished from the known China species *C. formosanus* Shiraki by its 1. Length of left mandible generally 0.95 2. Length of head to lateral base of mandibles generally 1.43 3. Width of pronotum 0.75"

50. *Coptotermes remotus* Hill

1. *Coptotermes remotus* Hill

1927. Hill, *Mem. Nat. Mus. Melbourne*, No. 7, p. 16, S.
Type-locality : New Ireland.

1929. Light and Davis, *Proc. Roy. Soc. Victoria*, (n.s.) 42 (1) : 66.

1942. Hill, *Termites of the Australian Region*, CSIRO, Melbourne p.170, New Ireland : Kaewieng.

1970. Bees, *Termites of Hawaii and the Oceanic Islands*, I : p. 472, In : *Biology of Termites* (Krishna and Weesner eds.) Acad. Press, London.

Material : A. Present in Z. S. I., Kolkata : (i) one vial with 1S. and 1W., in Z.S.I. collection, 18.1.1948.

B. Present in F.R.I., Dehra Dun : (ii) One vial with 5S and 5W Metatype, Limestone ridges of korer ls., Palau Islands (430 ft. alt.), H. S. Dybas Coll., 18.1.1948, det. and comp. A. E. Emerson.

Diagnostic Character : (i) IMAGO : Unknown.

(ii) SOLDIER : Very close to *C. pamuae*, hence detailed description not given to avoid repetition.

Measurements : Table 18(S.)

Types : Holotypes S. and Morphotype W., in Nat. Mus., Melbourne.

Distribution : New Ireland : Kaewieng and Pacific Isl. (Bees, 1970).

Remarks : Vide, under *C. pamuae*.

51. *Coptotermes sepangensis* Krishna

1956. *Captotermes sepangensis* Krishna, *Amer. Mus. Novit.*, NO. 1809, pp. 1-14, S. Type-locality : Sepang, Malaysia.

1957. Harris, *Malayan Nat. J.*, 12 : 23.

1958. Ahmad, *Biologica*, 4 (1) : 66 (key).

1982. Thapa, *Sabah For. Rec.*, No. 12, pp.83-65, Sabah.

Material : A. In Z. S. I., Calcutta : (i) one vial (Z.S.I. Regd. No. 1777/H8) with *Paratypes* IS. and 1W., sepang, Malaysia, G. H. Corbett Col., 14.iii.1930, det. K. Krishna.

B. In F.R.I., Dehra Dun : (ii) one vial with S. and W., Swamp Forest, Lumat, Dist. Kota Kinabalu, Coll. Rakim O. T Dingki, 3.viii.1970, ex. "rotten wood"

Diagnostic Characters : (i) IMAGO : Unknown.

(ii) SOLDIER (Fig. 45.A-D) : Head brown, frontal gland area paler; labrum, antennae, pronotum and legs yellowish brown. Head with a few scattered erect bristles, two bristles on either side of the fontanelle.

Head distinctly longer than broad, pear-shaped and distinctly narrowing posteriorly with weak concavity near antennal flaveole, frontal area flat and sloping downward to fontanelle. Chitinous circular fontanelle opening directed anteriorly. Antennae with 13-14 segments, segment 2 slightly

longer than 3, 4 smaller than 2 and 3. Eyes and ocelli absent. Labrum subtriangular, reaching upto half the length of mandibles and with pointed apex with two bristles. Mandibles long and sabre-shaped, much incurved at apex, more than half the length of head. Postmentum strongly constricted on basal one-fifth, maximum width almost half the median length and at anterior one-third with a few erect hairs on the body.

Pronotum much narrower than head, broader than long, anterior margin projecting in front with a median emargination, posterior margin with a weak emargination, fairly densely covered with erect hairs.

Measurements : Table 14 (S.).

Types : Holotype S. in AMNH, New York; Paratype in Z.S.I., Kolkata.

Distribution : ASIA : Sepang, Tanjong, Mae Estate; Port Dickson, Sabah : Dist. Kota Kinabalu; Dist. Lahad Datu, Salam.

Remarks : The species is very similar to other Malayam species *C. bentongensis* krishna (vide, under that species).

52. *Coptotermes sinabangensis* Oshima

Coptotermes sinabangensis Oshima

1923. Oshima, *Cap. Zool.*, 2 (3) : 7-8, S. Type-locality : sinaband, Simalur, Sumatra, Indonesia.

1949. Synder, *Smith. misc. Col.*, 112 : 82, Sumatra.

1957. Harris, *Malaya Nat. J.*, 12 : 23, Malaysia.

1958. Ahmad, *Biologia*, 4 (1) : 64 (key).

Material : Present in F. R. I., Dehradun : (i) one vial (from AMNH) with 1S., Garden, Kuala Lumpur, Malaysia, Coll. Ent. Div. Agric. Dept., 22.iii.1927, det. A.E. Emerson.

Diagnostic character : (i) IMAGO : Unknown.

(ii) SOLDIER (Fig. 46.A-B) : Head straw-yellow and with a few scattered hairs, other body parts still paler. Head broadly pyriform, maximum width almost equal to one and a half times as broad as anterior end. Fontanelle fairly large,

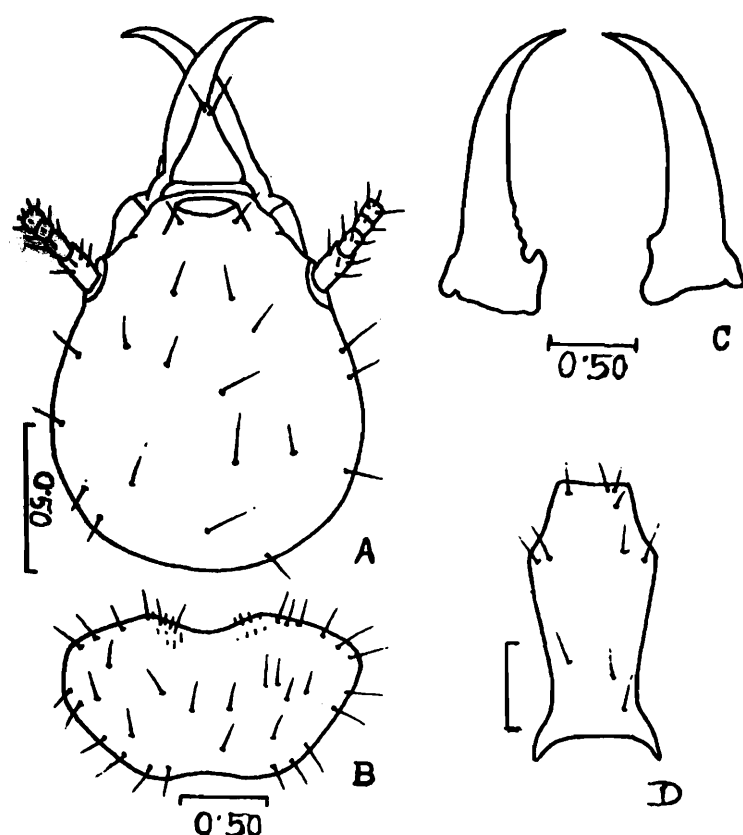


Fig. 45. *Coptotermes sepangensis* Krishna A-D, Soldier. A. Head, B. pronotum; C. Mandibles, D. Postmentum.

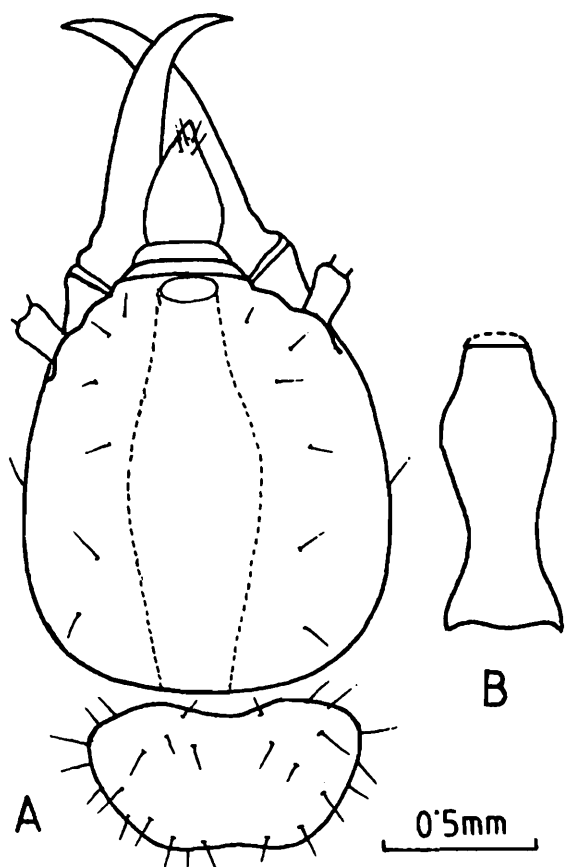


Fig. 46. *Coptotermes sinabangensis* Oshima, A-B, Soldier. A. Head and pronotum, dorsal view; B. postmentum.

weakly effaced posteriorly and almost touching postclypeus. Antennae with 15 segments, 3 narrowest and smaller than 2 and longer than 4. Labrum elongately dome-shaped with a hyaline apex. Somewhat pointed and incurved at apices mandibles and two pair of hairs at the commencement of hyaline portion. Postmentum vash-shaped, narrowest width almost half the maximum width and at posterior third.

Pronotum much narrower than head and more densely hairy, with broad median emargination whence outcurved on either side with 4-5 erect hairs at the anterior margin, posterior margin with shallow median emargination.

Measurements : Table 21 (S.)

Types : Repository not known.

Distribution : ASIA : Indonesia : Sumatra : Sinaband and Simalur, Malaysia.

Remarks : In morphological characters of soldier, the species comes close to *C. lacteus*, but differs in having no wavy head dorsum which is

the distinctive character of *C. lacteus*. Nothing is known about its biological criteria.

53. *Coptotermes sjostedti* Holmgren

1. *Eutermes lateralis* Walker

1990. Sjostedt, K. *sven. vet. Akad. Handl.*, 34 (4) : Cameroon and Tanganyika.

1905. Sjostedt, *Arkiv. Zool.*, 2 (16) : 15, Congo.

2. *Coptotermes sjostedti* Holmgren

1911. Holmgren, K. *Sven. vet. Akad. Handl.*, 46 (6) : 73 (new name of Soldier and Worker).

1912. Silvestri, *Ann. Mus. Civ. Stor. Nat. Genova*, (3) 5 : 220, S. and W. prince Island.

1912. Sjostedt, K. *Sven. vet. Akad. Handl.*, (3) 3 (1) : 56-57, Im. and S.

1928. Emerson, *Bull. Amer. Mus. nat. Hist.*, 57 (7) : 424, S.; Cameroon.

1937. Grasse, *Ann. Soc. Ent. France*, 106 (1) : 26, Ivory Coast.

1963. Harris, *Explor. parc. Nat. Garamba Miss. De Saeger*, 42 : 7, Im. and S., Congo.

1966. Harris, *Proc. Ray. ent. Soc. Land.*, (B) 35 (11-12) : 168-169, Western Africa.

Material : Present in F.R.I., Dehra Dun : one vial with 3S. and 3W. Leopoldville, Belgium Congo, A. E. Emerson Coll., 3.iv.1928, ex. "Wood pile near a house", det. A.E. Emerson.

Diagnostic character : (i) IMAGO : Since no imago is available for study the following description is based on that Harris (1966).

Red brown in colour, with head darker than the rest of the body; fairly pilose.

Head subround with protruding eyes; clypeus short and broad, not inflated; labrum longer than broad; ocelli large, roundly oval, close to the eyes; fontanelle a small triangular pale spot; antennae with 21 segments.

Pronotum with anterior margin only slightly concave, the corners broadly rounded and posterior margin slightly emarginate. Wings brown, the membrane densely covered with short bristles.

(ii) SOLDIER (Fig. 47.A-B) : Head yellowish brown, with few erect hairs; antennae, legs, pronotum and labrum paler than head.

Head pyriform and very thick, slightly longer than broad, anterior end almost equal to or slightly more than head width. Fontanelle large, almost encroaching the posterior margin of postclypeus. Eyes and ocelli absent. Antennae with 13 segments, 3 variable generally smaller than 2 and subequal to 4. Labrum dome-shaped with hyaline pointed apex. Postmentum club-shaped, very wide with a few short hairs.

Pronotum flat, sub reniform, much broader than long, anterior margin convex with a median weak notch, antero-lateral corners narrowly and postero-lateral corner broadly rounded.

Measurements : Table 10 (Im); 13 (S.)

Distribution : AFRICA : Victoria, Lolodorf, Senegambina, Bipindi, Bonge and Cape Debund Soha; and Kawende (type-locations) Lalago and Nyong Sierra Leone : Free town, Kenema and Bo

Ghana : Bobiri Forest Nigeria : Lagos-Ikoyi, Ibadan, Shagamu, Benin-Gbanokoro, Port Harcourt, Old Calabar and Aba. Congo : Mukimbungu; Leopoldville, Garamba, Ruindi, Albert National Park Uganda : Rhini Camp, Butiaba, Gulu-Nimuloe Road, Sudan border on road from Nimule, soroti, Karmoja, Nyabyeya, Lolui Island, Kampala, Guinea : Kindia, Camayenne, Conakry, Ivory Coast : Abidjan, Bingerville, Bouake, Banco Forest, Toumodi *principe* Ist. Angola : Dundo and Senegan : Cap Vert ; Bugala and Sese Isls.

Remarks : Sjostedt (1900) described some soldiers and workers of termites from Cameroun and Western Tanganyika as *Entermes laleralis* Walker which was so far known only by imagoes from Sierra Leone. Holmgren (1911) transferred the species to the genus *Coptotermes* and gave a new name to the same species as *C. sjostedti* without providing any description. Rosen (1912) described some dried specimens of imagoes from Mozambique as *C. sjostedti* which had been considered by Harris (1966) as *C. amanii*. However, the associated imagoes with soldiers from the Congo had been dealt by Harris (1963).

Some soldiers of *C. sjostedti* Holmgren from Gold Coast and Cameroun had been named as a variety *modica* with 12 antennal segments (12-13 in typical *C. sjostedti*) which has been considered by Snyder (1949) as Silvestri's other variety, *c. sjostedti* subintacta.

While working on the genus *Coptotermes* in Africa, Harris (1966) left the validity of both these varieties undecided (*C. sjostedti* var. *modica* silvestri and *c. sjostedti* var. *subintacta* Silvestri) which has been followed here due to lack of sufficient material in hand for steady.

C. sjostedti is found throughout the western Africa rain forest along with similar condition in Congo and especially cause much damage to building timbers along West African coast. Rotten logs, tree trunk, dead branches, etc. are the common sites for its nesting. Swarming had been on record in evening in July at Garamba.

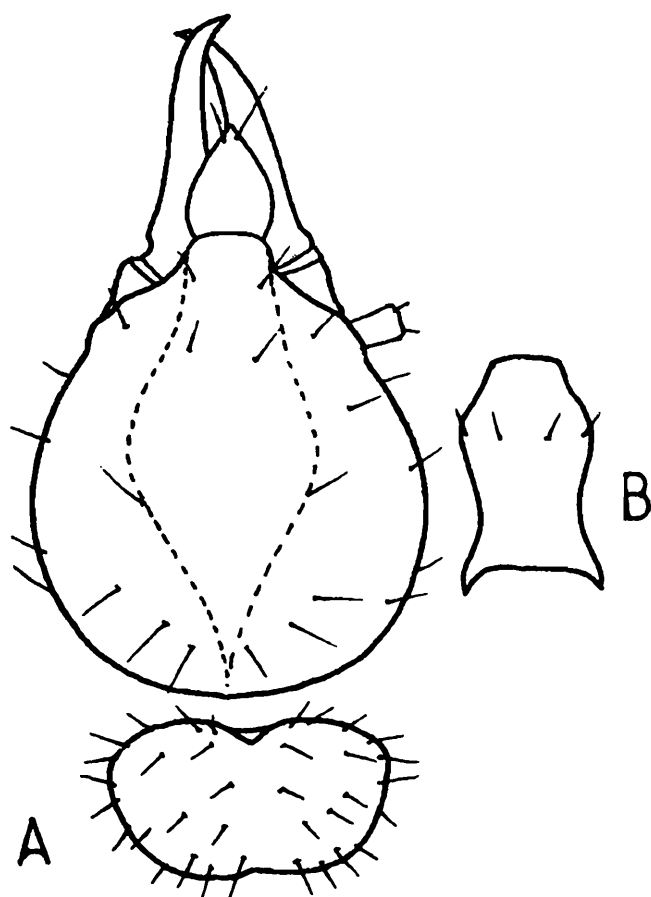


Fig. 47. *Coptotermes sjostedti* Holmgren; A-B, soldier. A. Head and pronotum, dorsal view; B. postmentum.

54. *Coptotermes testaceus* (Linnaeus)**1. *Hemerobius testaceus* Linnaeus**

1758. Linnaeus, *Systema Naturae*, 1, (10th ed.), p. 550; 12th ed. p. 912; 13th ed. p. 912; 13th ed. p. 2641, Im., America.

2. *Termes testaceus* Burmeister

1839. Burmeister, *Handb. Ent.*, 2 : 767.
1860. Hagen, *Linn. Entomol.*, 14 : 123, S., Surinum : paramaribo.

3. *Termes (Eutermes) testaceus*, Hagen

1858. Hagen, *Linn. Entomol.*, 12 : 198. Im. Surinam : Cayenne ; British Guiana; Venezuela : puerto Cabello; Brazil: para; Chile : Valpariso.

4. *Perla fusca* De Geer

1778. Geer, *Mem. pour Servir a Thistoires des Insects*, 7 : 567.

5. *Termes morio* Fabricius

1793. Fabricius, *Ent. Syst.*, No.3, p.90.
1842. Rambur, *Hist. nat. Inst. (Neuroptera)*, p.305, Im.

6. *Termes (Eutermes) marabitanus* Hagen

1858. Hagen, *Linn. Entomol.*, 12 (2) : 191, Im. and S. Type-locality : St. Jose de Marabitanas (Rio Negro), Brazil.

7. *Coptotermes marabitanus* Silvestri

1901. Silvestri, *Bull. Mus. zool. Anat. Comp. Torino*, 16 (389) : 4
1915. Desneux, *Coll. Zool. Baron Edm. Selys Longchamps*, 3 (3) : 7.

8. *Coptotermes testaceus* Holmgren

1911. Holmgren, *K. Sev. vet. Akad. Handl.*, 46 (6) : 73.
1915. Desneux, *Coll. Zool. Baron Edm. Selys Longchamps*, 3 (3) : 7.
1949. Snyder, *Smiths. misc. Coll.*, 112 : 83, West Indies and South America.
1956. Snyder, *J. Agric. Univ. Puerto Rico*, 40 (3) : 190, West Indies.
1959. Snyder, *Amer. Midl. and. Nat.*, 61 (2) : 318, Venezuela.

1967. Gay, *CSIRO, Australia, Bull. No. 286*, pp. 79 - 80, Im. and S. Trinidad, Tobago, and British Guiana; and Barbados (Introduced).

1970. Araujo, In : K. Krishna and F. M. Weesner (ed.). *Biology of Termites*, 2 pp. 543-544 (biology).

1977. Mathews, *Acad. Brasil Ciencias*, pp. 87-89, Im. and S., Brazil : Mato Grosso State.

1977. Araujo, *Acad. Brazil Ciencias*, p. 25.

Material : A. Present in F.R.I., Dehra Dun : (i) one vial with 29m and 3S., Maracas Valley, Trinidad, West Indies, R. Boodhoo Coll., det. A. M. Adamson as *Coptotermes marabitanus*, Redet. A. E. Emerson as *c. testaceus* (ii) one vial with 2S. 3W., Nove Horizonte, Sao paulo, Brazil, R. L. Araujo coll., 24.ii.1944, det. A. E. Emerson, ex. "in dry wud galleries"

B. Present in Z.S.I., Kolkata : (ii) One vial with 1S. (Z.S.I., Reg. No.3808/H8), Maracas Valley, Trinidad, West Indies, B. Boodhoo coll., det. A. Adamson as *C. marabitas* ; redet. A. E. Emerson as *C. testaceus*. (iii) one vial (Z.S.I. Reg. No.1/H₁₁) with 1S. 2W., Regiao Brag, para, Brazil, E. Sefer coll., 1956, det. M. L. Roonwal. (iv) one vial (Z.S.I. Reg. No. 2H11) with 1S., sev. W., Regiao Bragantina, para, Brazil, other data as above. (v) One vial (Z.S.I. Reg. No. 3/H11) with sev. S. and W., Mazagio, Estacao Experim, Territory of Ampa, Brazil, Inacio coll., 6.ix.1955.

Diagnostic character : (i) IMAGO (Fig. 48.A) Head chestnut brown; antennae, labrum, pronotum and abdomen slightly paler than head. Head moderately hairy, pronotum and abdomen somewhat fairly densely hairy; wing scale with some long bristles. Head subcircular, broader than long, frons weakly sloping in front. Fontanelle minute and circular, situated almost at the middle in a weakly depressed area. Antennae broken, 3 smallest and almost half the 2, 4 double the 3. Eyes circular, fairly large, moderately bulging out, oval, separated from the eyes by its smallest diameter. Post clypeus weakly swollen, much broader than long, median line indistinct, a weak depressed transverse line below the posterior margin of postclypeus. Labrum triangular with a point of apex.

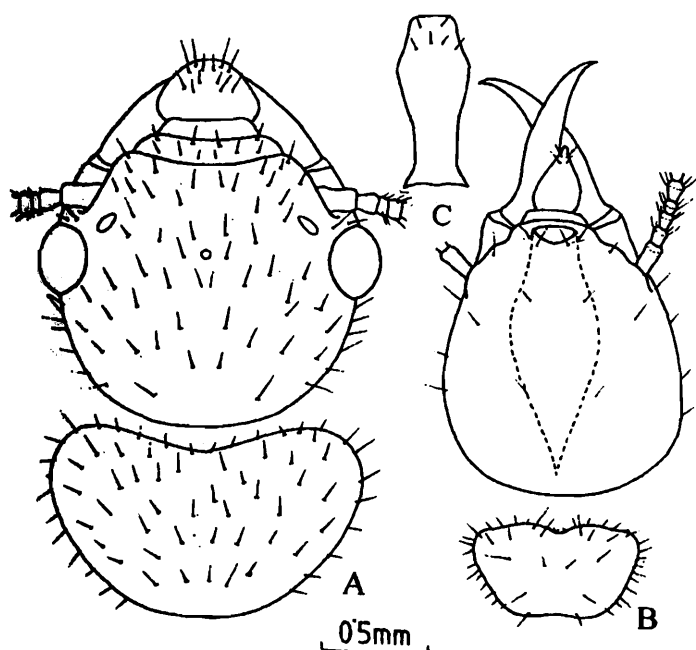


Fig. 48. *Coptotermes testaceus* (Linnaeus) A, Imago. A. Head and pronotum, dorsal view. B-C, soldier. B. Head and pronotum, dorsal view; C. Postmentum.

Pronotum slightly narrower than head width, one and a half times as long as wide, anterior margin weakly concave, without any median notch, posterior margin with a weak median emargination.

(ii) SOLDIER (Fig. 48.B-C) : Head, light brown; antennae, labrum, pronotum and legs paler than head. Head with a few erect hairs, thorax sparsely and abdomen somewhat densely hairy.

Head pyriform, longer than broad, anterior end much narrower than width, in profile, comparatively flattened. Fontanelle moderately large, placed almost at the posterior margin or postclypeus. Eyes and ocelli absent. Antennae with 14-16 segments, 3 equal or slightly longer than either 2 or 4. Labrum substraight, a little longer than broad, with somewhat hyaline pointed apex, with one bristles on either side. Mandibles sabre-shaped strongly pointed at apices and distinctly incurved. Postmentum club-shaped, long and narrow with a few short hairs on the anterior half, broadest at anterior one-third, narrowest at the posterior one sixth, narrowest width more than half the maximum width.

Pronotum flat, subreniform, much broader than long, length little more than half the width,

anterior margin convex with a median strong emergination, antero lateral corners strongly convex, posterior margin substraight with a median depression.

Measurements : Table 10 (1m.); 27 (S.).

Distribution : SOUTH AMERICA : Cuba, Dominican Republic, Guadelupe, Haiti, Jamaica, Montserrat, Puerto Rico, Barbados (Saint, 1940), Ecuador, Venezuela, Guiana, Surinam, French Guiana, Bolivia Argentina (of Beng, 1880) ?, Chile (Gusman, 1966), Panama, Brazil (Amazonas; Para; ? Sao Paulo; Mato Grosso : (Xavantina and Cerradao) West Indies : Tobago, Trinidad and Bahamas (introduced).

Types : (i) Mus. Vienna; (ii) ? Selys Longchamps coll., Brussels; (iii) Wing and Sold., in M.C.Z., Cambridge.

Remarks : *C. testaceus* is characterised by longish mandibles and close to *C. dreghorni* which has smaller mandibles. It is one of the oldest species of the genus since the time of Linnaeus (1758) who described it as a neuroptera. However, many species have been synonymised under it since its discovery from South America. It is a widely distributed species and remains responsible for considerable damage in building. The species is also recorded from West Indies (Adamson, 1938) and get introduced Barbados (Saint, 1940). Economically, the species is important both in South and Central America.

55. *Coptotermes travians* (Haviland)

1. *Termes (Coptotermes) travians* Haviland

1898. Haviland, J. Linn. Soc. Lond. (Zool.), 26 (169), 391-392, Im. S. & W. type-locality : Singapore and Sarawak.
1904. Desneux, *Genera Insect.*, 25, Isoptera, 34, Singapore and Sarawak.

2. *Coptotermes travians* Haviland

1911. Holmgren, Zool. Anz., 36 (26), 551-552, Im.
1911. Holmgren, K. Sv. Vet. Akad. Handl., 46 (6) : 70, Singapore and Sarawak.

1912. Holmgren, J. *Bombay nat. Hist. Soc.*, 21 (3) : 777.
1913. Holmgren, K. *Sven. Vet. Akad. Handl.*, 50 (2) : 72-73, Im. S. & W. Malaysia.
1914. Bugnion, *Bull. Soc. vaud. Sci. nat.*, 5 (49) : 180.
1914. Holmgren, *Zool. Jb. (Syst.)*, 36 (2-3) : 236, Singapore, Indonesia and Malaysia.
1914. Oshima *Annot. Zool. Japan*, 8 : 555-556, Borneo.
1917. Holmgren, *Mem. Dept. Agri. India (Ent.)*, 5 (3); 145, Bangladesh.
1925. John, *Trebuia*, 6 (3-4), 381, Singapore and Indonesia.
1927. Bathellier, *Faun. Colon. Fr.*, 1 (4) : 134-135.
1929. Light, *Philipp. J. Sci.*, 40 (4) : 439.
1929. Davis, *Proc. Roy. Soc. Victoria (N.A.)*, 42 (1) : 60.
1934. Kemner, K. *Sven. vet. Akad. Handl.*, (3) 13 (4) : 62-64; Im., S. and W., Malacca, Borneo, Sumtra and Java.
1936. Wheeler, *Proc. Amer. Acad. Arts. Sci.*, 71 (3) : 223, 227, 230 and 235.
1937. Light, *Pan-pacific Ent.*, 13 (1-2) : 16 and 22.
1941. Beeson, *Ecology and control of forest Insects of India*, etc., Dehra Dun, p.544.
1949. Snyder, *Smiths. misc. Coll.*, 112 : 83, Singapore, Indonesia and India (Bengal).
1953. Lal & Menon, *Catal. Indian Insect.*, p.27, *Isoptera*, p.27, Indonesia, Bangladesh (other localities given are for *c. heimi* which they treat incorrectly as a synonymy of *c. travians*).
1956. Roonwal and Sen-Sarma, *Indian J. agric. Sci.*, 26 (1) : 2 and 4.
1957. Harris, *Malayan Nat. J.*, 12 : 28, Malaysia.
1958. Ahmad, *Biologia*, 4 (1) : 62, 67.
1961. Harris, *Termites, their recognition and control*, p. 156, 160, Longmans; London.
1962. Roonwal and Chhotani, *Indian species of the termite Genus Coptotermes*, I.C.A.R. Monogr. No.2, p. 61-62, India, Bangladesh, Myanmar, Malaya Peninsula and Indonesia.
1962. Roonwal and Chhotani, *Proc. Inst. Sci. India*, (B), 28 (4) : 309-310, S. Assam.
1975. Akhtar, *Bull. Dept. Zool. Univ. Panj.*, (N.S.), 7 : 42-43, Bangladesh.
1989. Roonwal and Chhotani, *Fauna of India (Isoptera)*, 1 : 461-467, Fig. 244-247 (Detailed syn.).
2003. Maiti, et al., *Zool. Surv. India State Fauna Series 9*, Fauna of Sikkim, part 2 : 254.

Wrong determination : The following were determined as *Coptotermes travians*, but are *C. ceylonicus*, : *Coptotermes travians* E. Bugnion and N. popff. 1910. *Mem. Soc. Zool. Fr.*, 23 (8), 121 (Wrong for *C. ceylonicus*, S. Holmgren, 1911, p. 55).

Wrong determination : The following were determined as *Coptotermes travians*, but are *C. vastator*. vide. light 1929, *Phillip J. Sci.*, 40 (4) : 422. *Coptotermes travians*, M. Oshima 1917, *philipp. J. Sci.*, D. 12 (4) : 223, M. Ohima, 1920. *Phillip. J. Sci.*, 17 (5) : 491.

Wrong determination : The following were determined as *Coptotermes travians* but are partly either *C. vastator* or *C. travians* :- *Coptotermes*, *travians*, S.F. Light, 1921, *Phillip J. Sci.*, 18 (3), 250, Singapore, Sarawak (Borneo), Philippines : Manila (Lujon); Culasi (only specimens from Singapore and sarawak are *C. travians*; those from philippines are *C. vastator*).

Wrong determination : The following were determined as *Coptotermes travians*, but are partly either *C. heimi* or *C. travians* *Coptotermes travians*, M.L. Roonwal and G. D. pant, 1953. *Indian for Leaf* (*Ent.*).No. 121 (3) : 47, India, Calcutta, Kharagpur (Specimens from Calcutta only are *C. travians*.; others are *C. heimi*).

Material : A. *Present in F. R. I., Dehra Dun* : (i) One vial (from AMNH) with 1S., 1W. *Cotype*, Sarawak, Borneo, *det.* G.D. Haviland (ii) one vial (From I.A.R.I., Delhi) with 2S., 2W. *Cotype*, Singapore, *Haviland Coll.*, 1893, *det.* Haviland.

Diagnostic characters : (1) IMAGO (Fig. 49.A-B) : Head reddish brown, pronotum and abdominal tergites pale brown; postclypeus, antennae, labrum and legs pale brownish yellow; wing transparent, pale brownish.

Head subcircular. Frontanelle minute, circular, placed almost at the middle. Eyes subcircular. Ocelli oval, either touching or slightly touching the ocular sclerite. Antennae with 19-23 segments, 3 or 4 shortest. Labrum broader than long.

Postclypeus convex, pilose and with a median line separating it into right and left halves. Mandibles of typical *Coptotermes*-type.

Pronotum flat, subreniform, much broader than long, anterior margin weakly incurved and faintly or not notched; posterior margin with weak median emargination.

(ii) SOLDIER (Fig.49.C-D) : Head yellow; fontanelle area, antennae, labrum, pronotum, legs and abdomen much paler than head. Head sparsely hairy with a few scattered erect long hairs. Pronotum fairly densely and abdominal tergites densely hairy.

Head oval, slightly longer than broad; lateral sides weakly outcurved and converging towards anterior one-third; posterior margin rounded; head-dorsum swollen behind the fontanelle. Fontanelle large with big opening bordered by chitinised ring. Eyes and ocelli absent. Antennae with 14-15 segments; segment 2 about half of 1, 3 variable, either shorter or subequal to or longer than 2 or 4. Postclypeus yellowish white and

hardly differentiated from frons. Labrum subtriangular with outcurved lateral sides gradually converging anteriorly into a pointed hyaline tip with one long bristle on either side.

Mandibles sabre-shaped with sharply pointed incurved apices. Postmentum club-shaped with a few hairs on anterior half, broadest in anterior third and narrowest almost at the middle ; anterior margin weakly convex and posterior margin weakly concave.

Pronotum flat, much broader than long and narrower than head-capsule; anterior margin convex with a weak median notch; sides broadly rounded, posterior margin with weak median emargination.

Measurements : Table-11 (Im.); 22 (S.).

Types : *Holotype* not designated, *Syntypes* in BMNH, London, AMNH, New York; F. R. I., Dehra Dun and I.A.R.I., New Delhi.

Distribution : ASIA : India : Assam. Margherita, Lakhimpur. West Bengal : Kolkata; Orissa : Puri ; Andaman and Nicobar Isl. (Maiti and Chakraborti, 1994). Bangladesh; Choumohani; Myanmar : Akyab, Kyaukpya, Pokoku, Pyu, Sandoway and Wapyudaung. Malaysia, Singapore and Indonesia : Java, Sumatra and Sulawesi (For details, vide, Roonwal and Chhotani, 1962).

Remarks : The species is found from the eastern India to many countries of Asia eastward. It generally nests in the underground parts of the wooden stumps, posts etc. including wooden ships, timbers above ground level (Harris, 1957). Imagos occur in the months of January, February, August and October (Roonwal and Maity, 1966).

This species is very close to *C. heimi* (Wasm.) *C. ceylonicus* Holmg., *C. gestroi* Wasm and *C. formosanus* Shiraki, hence it needs caution for their respective identity (*vide* key).

Remarks : The soldier of *Coptotermes emersoni* is close to *C. garii* R & K, *C. kishori* R & Ch., *C. minutissinus* Kem. and *C. kalsheveni* Kem., but differs from as indicated in the key.

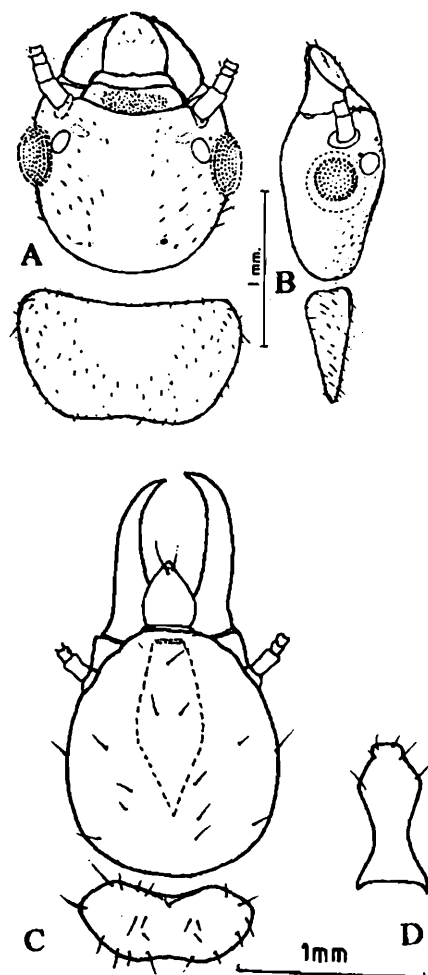


Fig. 49. *Coptotermes travians* (Haviland) ; A-B, Imago. A. Head and pronotum, dorsal view; B. Head and pronotum, lateral view. C-D, Soldier. C. Head and pronotum, dorsal view; D. postmentum.

56. *Coptotermes truncatus* (Wasmann)

1. *Termes (Coptotermes) truncatus* Wasmann

1897. Wasmann, *Abhandl. Sencki. Naturf. Gesell.*, 21 (1) : 164, S. Type-locality : Nossi-B1, Madagascar.
1904. Desneux, *Genera Insectorum*, 25 : 34.

2. *Eutermes truncatus* (Wasmann)

1900. Sjostedt, K. *Sven. vet. Akad. Handl.*, 34 (4) : 163.

3. *Coptotermes truncatus* (Wasmann)

1909. Holmgren, *Arkiv. Zool.*, 5 (13) : 2, S. and W., Madagascar.
1910. Holmgren, *Trans. Linn. Soc. Lond. (Zool.)*, (2) 14 (8) : 144, Seychelles.
1926. Sjostedt, K. *Sven. vet. Akad. Handl.*, (3) 3 (1) : 58. S. and W.
1949. Snyder, *Smiths. misc. Coll.*, 112 : 84.
1966. Harris, *Proc. Ray. ent. Soc. Lond.*, (B) 35 (11-12) : 162 and 166. Madagascar and the Seychelles.
1970. Paulian, *Biology of Termites*, Krishna and Weesner (Eds.), 2 : 284, Acad. Press, New York and London.

Material : Present in Z. S. I., Kolkata : (i) One vial with 1S., 24 km. of Malaimbandy, Madagascar, H. Kirby Coll. 30.vi.1935, det. A. E. Emerson.

B. Present in F. R. I., Dehra Dun : (ii) one vial with 8S. and 3W., 24 km. W. of Malaimbandy, Madagascar, H. Kirby Coll., 30.v.1935 (T.4360), det. A. E. Emerson.

Diagnostic character : (i) IMAGO : Unknown.

(ii) SOLDIER (Fig.50.A-B) : Head yellowish brown with a few erect hairs, other body parts paler than head and abdomen yellowish white.

Head pyriform, slightly longer than broad, width at anterior end almost half the maximum width of head. Fontanelle small, placed slightly below the posterior margin of postclypeus. Antennae with 14 segments, 3 smallest, 4 almost twice than 3. Labrum subtriangular, with almost blunt hyaline apex and with a pair long bristles. Postmentum club-shaped and short with a few short hairs on the anterior one-third.

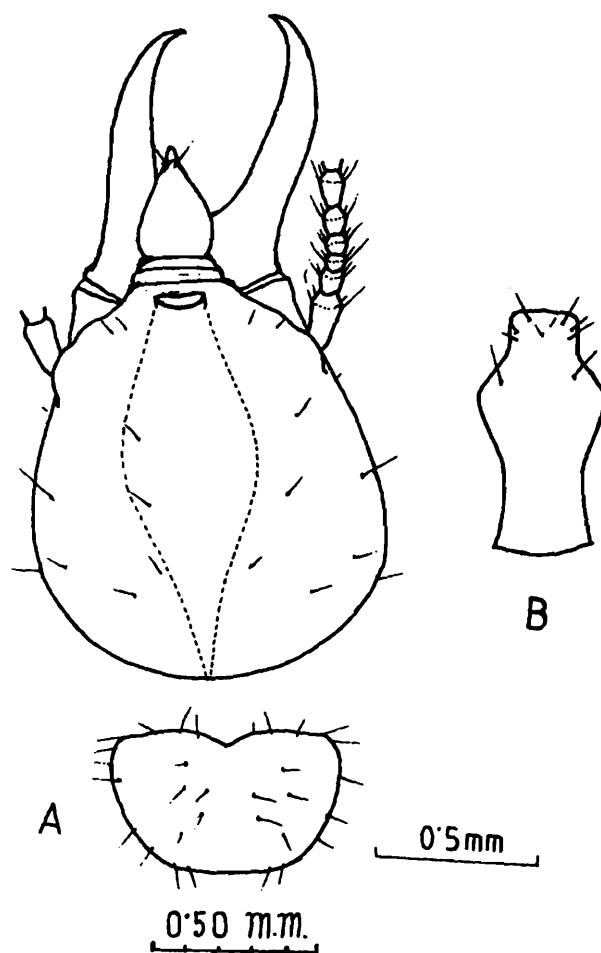


Fig. 50. *Coptotermes truncatus* (Wasmann); A-B, soldier. A. Head and pronotum, dorsal view; B. postmentum.

Pronotum flat, subreniform, much broader than long, anterior margin with W. and posterior margin with.

Measurements : Table 28 (S.).

Types : In Wasmann's Collection,

Distribution : Africa : Madagascar and Seychelles

Remarks : The species seems to be very similar to *C. perigrinator* but is slightly larger than this in morphometric characters encountered in timbers and buildings in Madagascar (Paulian, 1970).

57. *Coptotermes vastator* Light

1. *Coptotermes vastator* Light.

1929. Light, *Philip. J. Sci.*, 40 (4) : 422-440, Im. and S. Type-locality : Luzon, Philippines.
1930. Pierce, *Proc. Ent. Soc. Wash.*, 30 : 104.
1949. Snyder, *Smiths. misc. Coll.*, 112 : 84, Philippines.

1970. Roonwal, In : *Biology of Termites* (Eds. Krishna and Weesner), 2 : 339, Acad. Press.

2. *Coptotermes travians* (Haviland)

1917. Oshima, *Phillipp. J. Sci.*, 12 (4) : 223, 1, S. b.

1920. Oshima, *Phillipp. J. Sci.*, 17 (5) : 491, Panay and Luzon, Philippines.

1921. Light, *Phillipp. J. Sci.*, 18 (3) : 250.

3. *Coptotermes formosanus* Oshima

1920. Oshima, *Philipp. J. Sci.*, 17 (5) : 491–492, Philippines.

1921. Light, *Philipp. J. Sci.*, 18 (3) : 250.

Material : Present in F.R.I., Dehra Dun : (i) one vial with 1 Im. 1S. and 1W. **Paratype Topotype :** Manila, Philippines, R. C. Mc Gregor Coll., 1921, det, S. F. Light.

Diagnostic character : (i) IMAGO (Fig. 51.A) : Head chestnut brown; head sparsely, and pronotum and abdomen more hairy.

Head uniformly round. Eyes large and round. Ocelli elongately oval, almost touching the eyes or slightly separated. Antennae segments, 3 shortest. Postmentum with distinct median line, posterior median line emarginate. Labrum much broader than long with rounded apex.

Pronotum only slightly narrower than head-width, anterior margin broadly incurved with indistinct median notch, posterior margin broadly convex.

(ii) SOLDIER (Fig. 51.B-C) : Head with some erect hairs, yellowish brown; antennae, legs, pronotum and labrum paler than head; abdomen yellowish white.

Head elongately oval. Fontanelle large and efaced. Antennae with 14–16 segments, 2 smaller than 1, 3 long and narrow, and subequal to 2 or 4. Labrum subtriangular, longer than broad with hyaline and pointed apex. Mandibles substraight with weakly incurved very pointed apex. Postmentum club-shaped, long and narrow; broadest on anterior two thirds and narrowest at the posterior one-third.

Pronotum much broader than long. Anterior margin convex with a weak emargination.

Measurements : Table 11 (Im.); 17 (S.)

Types : Repository not known.

Distribution : ASIA : Philippine : Luzon, Manila and Panay.

Remarks : This is a philippine species whose soldiers are very similar in appearance to two Malayan species, *C. bentongensis* Krishna and *C. sepangensis* Krishna, but are larger in size. The species is highly destructive to wood work in buildings and vegetable crops including sugarcane. Swarming takes place between February and May, occasionally in June and early rainy season (Light, 1929, 1934; Pierce, 1930; Roonwal, 1970).

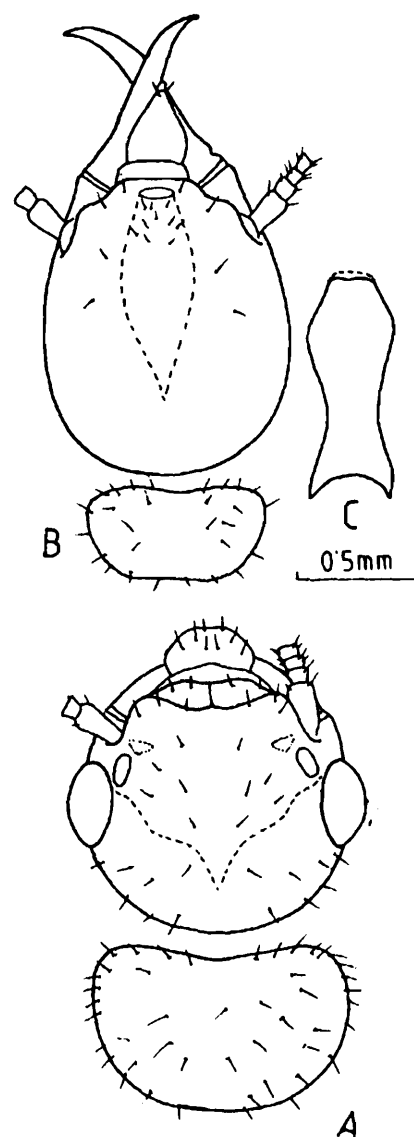


Fig. 51. *Coptotermes vastator* Light A, Imago. A. Head and pronotum, dorsal view; B-C, soldier. B. Head and pronotum, dorsal view; C. postmentum.

58. *Coptotermes xiaoliangensis* Ping

1. *Coptotermes xiaoliangensis* Ping

1956. Ping. Type-locality : Xiaoliang of Dianbai County, Guangdong Province.

Material : The characters are based on the english translation of ping ()

Diagnostic character : (i) IMAGO : (ii) SOLDIER (Fig. 52.A-E) : Body medium size and small. Head pale yellow with scanty hairs, pronotum pale yellow.

Head oval, head index 0.78-0.84, head contraction index 0.57-0.65. Fontanelle opening circular and vertical head in profile slightly raised in meddle slightly sloping downward to fontanelle and posterior margin. Antennae with 14 segments. Labrem subtriangular. Mandibles sabre-shaped, tips slightly incurved, left mandible with crenulations at base. Mandible-head index 0.71-0.77. Postmentum shorter and somewhat club-shaped, broadest in anterior one-third when grandnaln narrowing posteriorly, waist on posterior one-fourth, median length about 3.60 times than width of the waist pronotum flat, emarginate anteriorly and posteriorly, lateral sides gradually recording.

Measurements : Table. 23 (S.).

Types : Holotype and Paratypes S., and workers from type-setues (No. E. 7622) coll. Ping, 8.iv. 1983, ex. living tree, *Acacia confusa*" in Guang dong Inst. Ent. China.

Distribution : ASIA : China : Guangdong Province, Dianbyai county, Xiaoliang.

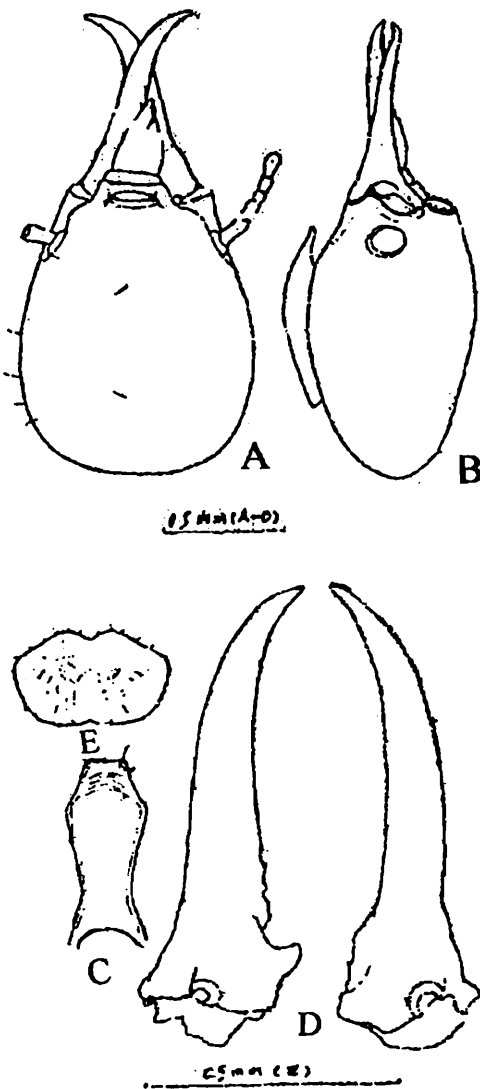


Fig. 52. *Coptotermes xiaoliangensis* Ping; A-E, soldier. A. Head, dorsal view; B. Head, side view; C. Postmentum; D. pronotum, dorsal view; E. Left and Right mandibles (Ping. 1985).

Remarks : The species can easily separated from a well known species, *C. formosamus shiraki* by its much smaller size. The species appears to be a serious pest of some *Eucalyptus* spp. in Xiaoling area especially in the trees of the age group of twenty years.

Table-4 : Measurements (in mm.) etc., of Caste - Imago.

<i>Coptotermes</i> spp.	<i>C. aciacinaciformis</i>	<i>C. elisae</i> (Holmgren, 1911)	<i>C. dreghorni</i>
Total body-length <i>with</i> wings (excluding antennae), ca.	11.50-14.25	16.00-18.00	14.00
Total body-length <i>without</i> wings, (excluding antennae), ca.	6.00-7.50	6.10-7.40	6.25-6.80
Length of head to lateral base of mandibles	0.90-0.95	0.80-0.90	0.95-1.10

Table-4 (Contd)

<i>Coptotermes spp.</i>	<i>C. aciacinaciformis</i>	<i>C. elisae</i> (Holmgren, 1911)	<i>C. dreghorni</i>
Max. width of head (with eyes)	1.28-1.35	1.80-1.90	1.17-1.21
Max. diameter of compound eye (with ocular sclerite)	0.33-0.44		0.31-0.33
Max. diameter of lateral ocellus	0.14-0.18		0.14-0.18
Max. length of pronotum	0.69-0.80	0.60-0.70	0.73
Max. width of pronotum	1.13-1.32	1.80-1.90	1.15-1.19
Length of forewing	8.60-11.00	12.00-14.00	9.50
Number of antennal segments	17-20	21	18-19

Table-5 : Measurements (in mm) etc., of Caste - Imago.

<i>Coptotermes spp.</i>	<i>C. amanni</i>	<i>C. ceylonicus</i>	<i>C. formosanus</i>
Total body-length <i>with</i> wings (excluding antennae), ca.		10.30-14.00	14.00-16.00
Total body-length <i>without</i> wings, (excluding antennae), ca.	5.00-5.10	6.00-7.40	6.50-9.60
Length of head to lateral base of mandibles	1.07-1.08	1.00-1.08	1.20-1.30
Max. width of head (with eyes)	1.30-1.32	1.30-1.53	1.50-1.71
Max. height of head	0.57-0.58	0.55-0.57	0.58-0.60
Max. length of postclypeus	0.05-0.07	0.08-0.09	0.10-0.11
Max. width of postclypeus	0.50-0.52	0.55-0.58	0.57-0.58
Max. length of labrum	0.35-0.37	0.33-0.40	0.38-0.45
Max. width of labrum	0.40-0.41	0.43-0.43	0.50-0.53
Max. diameter of compound eye (with ocular sclerite)	0.35-0.35	0.38-0.43	0.43-0.45
Max. diameter of lateral ocellus	0.125-0.127	0.14-0.15	0.16-0.20
Min. eye-ocellus distance	0.03-0.05	0.012-0.038	0.03-0.05
Min. eye-antennal distance	0.02-0.04	0.03-0.05	0.05
Max. length of pronotum	0.70-0.72	0.68-0.85	0.80-0.93
Max. width of pronotum	1.10-1.11	1.10-1.14	1.30-1.52
Max. width of pronotum	1.10-1.11	1.10-1.14	1.30-1.52
Length of forewing with scale	—	8.50-10.70	11.00-11.63
Length of forewing scale	—	0.90-1.15	1.00-1.28
Length of hindwing with scale	—	8.00-10.20	10.60-11.50
Length of hindwing scale	—	0.55-0.68	0.60-0.80
Number of antennal segments	14	19-23	20-21

Table-6 Measurements (in mm) etc., of Imago of *C. crassus* Snyder

<i>Coptotermes</i> sp.	<i>C. crassus</i> (Snyder)
1. Total body-length <i>with</i> wings (excluding antennae), ca...	14.00
2. Total body-length <i>without</i> wings, (excluding antennae), ca...	7.30-8.30
3. Length of head to lateral base of mandibles	1.15-1.20
4. Maximum width of head (with eyes) ...	1.45-1.53
5. Maximum height of head	0.45
6. Maximum length of postclypeus	0.10-12
7. Maximum width of postclypeus	0.52-0.60
8. Maximum length of labrum	.37-.48
9. Maximum width of labrum	0.40-0.50
10. Maximum diameter of compound eye (without ocular sclerite)	0.36-0.40
Maximum diameter of compound eye (with ocular sclerite)	0.32
11. Maximum diameter of lateral ocellus	0.12-0.14
12. Minimum diameter of lateral ocellus	0.07-0.10
13. Minimum eye-ocellus distance	0.07-0.10
14. Minimum eye-antennal distance	0.05
15. Maximum length of pronotum	.90-1.00
16. Maximum width of pronotum	1.35-1.48
17. Length of forewing with scale	12.00-12.12
18. Length of forewing scale	.87-1.00
19. Length of hind wing with scale	10.45-10.57
20. Length of hind wing scale	0.50
21. Number of antennal segments	16

Table-7 Measurements (in mm) etc., of Caste - Imago

<i>Coptotermes</i> spp.	<i>C. grandiceps</i>	<i>C. acinaciformis</i> <i>raffrayi</i>	<i>C. frenchi</i> (Hill, 1942) gay, 1967
Total body-length <i>with</i> wings (excluding antennae), ca.	13.40-13.60	11.73-14.00	11.00-13.00
Total body-length <i>without</i> wings	7.00-8.00	6.25-8.00	4.50-7.00
Length of head to lateral base of mandibles	1.17-1.19	1.06-1.17	0.91-1.06

Table-7 (Contd.)

<i>Coptotermes</i> spp.	<i>C. grandiceps</i>	<i>C.acinaciformis</i> <i>raffrayi</i>	<i>C.frenchi</i> (Hill, 1942) <i>gay</i> , 1967
Max. width of head (with eyes)	1.46–1.50	1.31–1.43	1.00–1.28
Max. diameter of compound eye (with ocular sclerite)	0.44–0.47	0.29–0.36	0.27–0.40
Max. diameter of lateral ocellus	0.18	0.11–0.16	0.12–0.18
Max. length of pronotum	0.79	0.77–0.84	0.62–0.70
Max. width of pronotum	1.33–1.35	1.32–1.43	0.91–1.13
Length of forewing with scale	—	9.25–9.50	9.00–10.30
Number of antennal segments	19–20	17–20	17–20

Table-8. Measurements (in mm) etc., of Caste - Imago

<i>Coptotermes</i> spp.	<i>C. heimi</i>	<i>C.premrasmii</i>	<i>C.havilandi</i> (Gay, 1967)
Total body-length <i>with</i> wings (excluding antennae), ca.	10.6–12.30		11.00–13.50
Total body-length <i>without</i> wings, (excluding antennae), ca.	5.60–7.00		5.40–8.00
Length of head to lateral base	1.04–1.16	1.05–1.15	0.97–1.03
Max. width of head (with eyes)	1.30–1.40	1.40–1.50	1.31–1.48
Max. length of labrum	0.39–0.41		
Max. width of labrum	0.46–0.47		
Max. diameter of compound eye (with ocular sclerite)	0.37–0.41	0.37–0.42	0.36–0.39
Max. diameter of lateral ocellus	0.16–0.19	0.15–0.17	0.14–0.15
Min. diameter of lateral ocellus		0.10–0.12	0.10–0.13
Min. eye-ocellus distance	0.012–0.037		
Min. eye-antennal distance	0.04–0.05		
Max. length of pronotum	0.72–0.81	0.75–0.80	0.72–0.75
Max. width of pronotum	1.21–1.33	1.32–1.40	1.22–1.26
Length of forewing with scale	8.60–9.75		
Length of forewing scale	0.80–0.97		
Length of hindwing with scale	8.10–9.60		
Length of hindwing scale	0.61–0.70		
Number of antennal segments	20–22	20–23	18–21

Table-9. Measurements (in mm) etc., of Caste - Imago

<i>Coptotermes</i> spp.	<i>C. niger</i>	<i>C. michaelsoni</i>	<i>C. lacteus</i>
Total body-length <i>with</i> wings (excluding antennae), ca.	—	11.90	12.25–16.00
Total body-length <i>without</i> wings, (excluding antennae), ca.	7.80	6.00	5.25–6.60
Length of head to lateral base of mandibles	1.23	0.96	0.88–1.10
Max. width of head (with eyes)	1.46	1.14	1.06–1.32
Max. height of head	0.72	—	—
Max. length of postclypeus	0.11	0.20	0.11
Max. width of postclypeus	0.57	0.57	0.57
Max. length of labrum	0.34	—	—
Max. width of labrum	0.42	—	—
Max. diameter of compound eye (with ocular sclerite)	0.38	0.30	0.25–0.38
Max. diameter of lateral ocellus	0.13	0.13	0.13
Min. diameter of lateral ocellus	0.07	0.08	—
Min. eye-ocellus distance	0.11	0.03	—
Max. length of pronotum	0.88	0.61	0.55–0.70
Max. width of pronotum	1.34	0.96	0.88–1.35
Length of forewing without scale	—	—	9.00–11.40
Length of forewing scale	1.12	0.69	—
Length of hindwing scale	0.56	0.38	—
Number of antennal segments	16	—	19

Table-10. Measurements (in mm) etc., of Caste - Imago

<i>Coptotermes</i> spp.	<i>C. testaceus</i> (Mathews, 1977)	<i>C. sjöstedti</i> (Harris, 1966)
Total body-length <i>with</i> wings (excluding antennae), ca.	13.59–16.00	12.25–16.00
Total body-length <i>without</i> wings, (excluding antennae), ca.	7.94–9.00	—
Max. width of head (with eyes)	1.40–1.45	1.32–1.36
Max. diameter of compound eye (with ocular sclerite)	0.36–0.40	0.38–0.42
Max. diameter of lateral ocellus	0.12–0.14	0.18–0.20
Min. diameter of lateral ocellus	0.09–0.11	0.13

Table-10 (Contd.)

<i>Coptotermes</i> spp.	<i>C. testaceus</i> (Mathews, 1977)	<i>C. sjöstedti</i> (Harris, 1966)
Min. eye-ocellus distance	0.08–0.09	0.03–0.04
Max. length of pronotum	0.99–1.05	
Max. width of pronotum	1.47–1.56	1.09–1.14
Length of forewing with scale	12.00–12.50	12.00–13.00
Number of antennal segments	19–20	

Table-11. Measurements (in mm) etc., of Caste - Imago

<i>Coptotermes</i> spp.	<i>C. travians</i>	<i>C. curvignathus</i>	<i>C. vastator</i>
Total body-length <i>with</i> wings (excluding antennae), ca.	11.50–13.30	15.16	1.00–12.00
Total body-length <i>without</i> wings, (excluding antennae), ca.	6.40–9.00	7.58	6.00–7.00
Length of head to lateral base of mandibles	1.10–1.15	1.82	1.48
Max. width of head (with eyes)	1.18–1.45	1.71–1.75	1.35
Max. length of labrum	0.30–0.38	—	—
Max. width of labrum	0.40–0.43	—	—
Max. diameter of compound eye (with ocular sclerite)	0.35–0.38	—	0.31–0.33
Max. diameter of lateral ocellus	0.175–0.190	—	0.17
Min. diameter of lateral ocellus	0.13–0.15	—	0.075
Min. eye-ocellus distance	0.03–	—	—
Max. length of pronotum	0.61–0.83	0.91–0.95	0.85
Max. width of pronotum	1.06–1.38	1.53–1.63	1.13–1.20
Length of forewing with scale	10.00–10.50	11.12	—
Length of forewing scale	—	—	10.20
Length of hindwing with scale	9.50–10.00	—	—
Number of antennal segments	19–23	20–21	—

Table-12. Measurements (in mm) etc., of Caste - Soldier

<i>Coptotermes</i> spp.	<i>C. acinaciformis</i>	<i>C. frenchi</i>	<i>C. grandiceps</i>
Length of head to lateral base of mandibles	1.54–1.76	1.17–1.35	1.50–1.72
Max. width of head	1.21–1.35	0.66–1.21	1.18–1.41
Width of head at anterior end	0.80–0.9	0.58–0.69	0.77–0.88

Table-12. (Contd.)

<i>Coptotermes</i> spp.	<i>C. acinaciformis</i>	<i>C. frenchi</i>	<i>C. grandiceps</i>
Max. height of heads	0.88		
Head index (width/length)	0.77	0.73	0.78-0.81
Max. length of labrum	0.38	—	0.38
Max. width of labrum	0.30	—	0.32
Length of mandible (upper base of condyle to tip)	1.14	—	1.08
Head-mandibular length Index (mand. -length/head-length)	0.66-0.74	0.50-0.70	—
Min. median length of postmentum	1.00	—	1.00
Max. width of postmentum	0.50	—	0.42
Width of postmentum at waist	0.23-0.29	0.22-0.25	0.20
Max. length of pronotum	0.46-0.57	0.40-0.47	0.44-0.49
Max. width of pronotum	0.84-1.02	0.75-0.84	0.84-0.96
Pronotum index (length/width)	0.54-0.55	0.55	0.51-0.53
Number of antennal segments	15-17	14-15	

Table-13. Measurements (in mm) etc., of Caste - Soldier

<i>Coptotermes</i> spp.	<i>C. amboinensis</i>	<i>C. beckeri</i>	<i>C. sjöstedti</i>
Length of head to lateral base of mandibles	1.09-1.13	1.10-1.13	1.10
Max. width of head	0.90-1.00	0.90-0.98	0.86-1.00
Width of head at anterior end		0.58-0.63	0.50
Max. height of head		0.63-0.65	
Head contraction index (Ant. W./max. width)	—	0.64	0.50
Head index (width/length)	0.82-0.90	0.80-0.87	0.90
Max. length of labrum	—	0.28-0.30	0.21
Max. width of labrum	—	0.23	0.20
Length of mandible (Upper base of condyle to tip)	0.74	0.73-0.78	0.62
Head-mandibular length Index (mand.-length/head-length)	0.66	0.65	0.56
Min. median length of postmentum	0.70	0.75-0.83	0.62

Table-13 (Contd.)

<i>Coptotermes</i> spp.	<i>C. amboinensis</i>	<i>C. beckeri</i>	<i>C. sjöstedti</i>
Max. width of postmentum	0.31	0.35–0.38	0.32
Width of postmentum at waist	0.21	0.20–0.21	0.17–0.20
Max. length of pronotum	0.32	0.33–0.36	0.40
Max. width of pronotum	0.65	0.58–0.63	0.70
Pronotum index (length/width)	0.50	0.58	0.57
Pronotum head index (pronotum width/head-width)	0.68	0.62–0.68	0.70
Number of antennal segments			13

Table-14. Measurements (in mm) etc., of Caste - Soldier

<i>Coptotermes</i> spp.	<i>C. bentongensis</i>	<i>C. sepangensis</i>
Length of head to lateral base of mandibles	1.05–1.08	1.13–1.16
Max. width of head	0.90–0.93	0.98–1.01
Width of head at anterior end	0.50	0.58
Max. height of head	0.68–0.71	0.75–0.79
Head contraction index (Ant. w./max. width)	0.54	0.58
Head index (width/length)	0.85	0.86
Length of mandible (upper base of condyle to tip)	0.60	0.65–0.68
Head-mandibular length Index (mand.-length/head-length)	0.56	0.57
Min. median length of postmentum	0.60–0.67	0.68–0.75
Max. width of postmentum	0.33	0.33–0.38
Width of postmentum at waist	0.18–0.22	0.18–0.23
Max. length of pronotum	0.34–0.37	0.38–0.41
Max. width of pronotum	0.60–0.67	0.71–0.75
Pronotum index (length/width)	0.53	0.54
Pronotum head index (pronotum width/head-width)	0.69	0.73
Number of antennal segments	13	13–14

Table-15. Measurements (in mm) etc., of Caste - Soldier

<i>Coptotermes</i> spp.	<i>C. boetonensis</i>	<i>C. harrisi</i>
Length of head to lateral base of mandibles	1.24-1.31	1.20
Max. width of head	1.07-1.13	0.97
Width of head at anterior end	0.65	0.55
Max. height of head	—	0.59
Head contraction index (Ant. w./max. width)	0.59	.56
Head index (width/length)	0.86	0.80
Max. length of labrum	0.28	0.32
Max. width of labrum	0.28	0.21
Length of mandible (Upper base of condyle to tip)	—	0.65
Head-mandibular length Index (mand.-length/head-length)	0.58	0.53
Min. median length of postmentum	—	0.70
Max. width of postmentum	—	0.32
width of postmentum at waist	—	0.20
Max. length of pronotum	0.27-0.29	0.32
Max. width of pronotum	0.77-0.81	0.72
Pronotum index (length/width)	0.48	0.44
Pronotum head index (pronotum width/head-width)	0.72	0.74
Number of antennal segments	14	

Table-16. Measurements (in mm) etc., of Caste - Soldier

<i>Coptotermes</i> spp.	<i>C. brunneus</i>	<i>C. crassus</i> Snyder
Length of head to lateral base of mandibles	—	0.65
Max. width of head	1.69	1.23
Width of head at anterior end	1.00	0.76
Max. height of head	1.00	0.61
Head contraction index (Ant. W./max. width)	0.61	0.61
Head index (width/length)	0.84	0.82
Max. length of labrum	0.50	0.42

Table-16 (Contd.)

<i>Coptotermes</i> spp.	<i>C. brunneus</i>	<i>C. crassus</i> Snyder
Max. width of labrum	0.45	0.30
Length of mandible (Upper base of condyle to tip)	1.19	0.96
Head-mandibular length index (mand.-length/head-length)	0.60	0.64
Min. median length of postmentum	1.20	0.84
Max. width of postmentum	0.57	0.30
Width of postmentum at waist	0.30	0.19
Max. length of pronotum	0.69	0.53
Max. width of pronotum	1.20	0.92
Pronotum index (length/width)	0.57	0.57
Pronotum head index (pronotum width/head-width)	0.71	0.74
Number of antennal segments	17	14

Table-17. Measurements (in mm) etc., of Caste-Soldier

<i>Coptotermes</i> spp.	<i>C. ceylonicus</i>	<i>C. vastator</i>	<i>C. perigrinator</i>
Length of head to lateral base of mandibles	1.25-1.50	1.38-1.40	1.22-1.35
Max. width of head	1.00-1.20	1.05-1.13	1.04-1.13
Width of head at anterior end	0.63-0.70	0.63	0.67-0.69
Max. height of head	0.65-0.75	—	—
Head contraction index (Ant. w./max. width)	0.60	0.45	0.63
Head index (width/length)	0.82	0.80	0.88
Max. length of labrum	0.30-0.35	0.38	0.25
Max. width of labrum	0.25-0.28	0.30	0.32
Length of mandible (upper base of condyle to tip)	0.80-0.90	0.82	0.75
Head-mandibular length Index (mand.-length/head-length)	0.63	0.51	0.58
Min. median length of postmentum	0.85-1.00	0.74	0.80-0.87
Max. width of postmentum	0.35-0.40	0.36	0.35-0.37

Table-17 (Contd.)

<i>Coptotermes</i> spp.	<i>C. ceylonicus</i>	<i>C. vastator</i>	<i>C. perigrinator</i>
Width of postmentum at waist	0.20–0.25	0.22	0.20–0.21
Max. length of pronotum	0.38–0.45		0.36–0.45
Max. width of pronotum	0.68–0.91		0.67–0.75
Pronotum index (length/width)	0.53	0.57	0.50
Pronotum head index (pronotum width/head-width)	0.58		0.64
Number of antennal segments	13–15	13	14

Table-18. Measurements (in mm) etc., of Caste - Soldier

<i>Coptotermes</i> spp.	<i>C. emersoni</i>	<i>C. remotus</i>
Length of head to lateral base of mandibles	1.05–1.18	1.11–1.13
Max. width of head	0.88–0.96	1.00–1.02
width of head at anterior end	0.63–0.70	0.53–0.57
Max. height of head	0.63	0.65
Head contraction index (Ant. W./max. width)	0.59	0.53
Head index (width/length)	0.82	0.88
Max. length of labrum	0.30	
Max. width of labrum	0.25	
Length of mandible (Upper base of condyle to tip)	0.82	0.65
Head-mandibular length index (mand.-length/head-length)	0.70	0.58
Min. median length of postmentum	0.83	0.57
Max. width of postmentum	0.35	0.30
Width of postmentum at waist	0.13	0.19
Max. length of pronotum	0.28–0.35	0.34–0.36
Max. width of pronotum	0.57–0.65	0.57–0.68
Pronotum index (length/width)	0.53	0.54–0.55
Pronotum head index (pronotum width/head-width)	0.63	0.56

Table-19. Measurements (in mm) etc., of Caste - Soldier

<i>Coptotermes</i> spp.	<i>C. formosanus</i>	<i>C. gestroii</i>
Length of head to lateral base of mandibles	1.43-1.65	1.50-1.53
Max. width of head	1.03-1.30	1.20-1.25
width of head at anterior end	0.70-0.80	0.75-0.78
Max. height of head	0.75-0.93	0.80-0.85
Head contraction index (Ant. W./max. width)	0.61-0.67	0.60-0.62
Head index (width/length)	0.73-0.84	0.80-0.85
Max. length of labrum	0.30-0.38	0.33-0.35
Max. width of labrum	0.25-0.33	0.30-0.34
Length of mandible (Upper base of condyle to tip)	0.95-1.08	0.90-0.98
Head-mandibular length Index (mand.-length/head-length)	0.61-0.65	0.60
Min. median length of postmentum	0.88-1.08	1.00-1.08
Max. width of postmentum	0.40-0.43	0.40-0.45
Width of postmentum at waist	0.23-0.28	0.25-0.28
Max. length of pronotum	0.40-0.53	0.48-0.50
Max. width of pronotum	0.75-0.93	0.90-0.95
Pronotum index (length/width)	0.53-0.61	0.52-0.54
Pronotum head index (pronotum, width/head-width)	0.68-0.75	0.70-0.75

Table-20. Measurements (in mm.) etc., of Caste - Soldier

<i>Coptotermes</i> spp.	<i>C. gaurii</i>	<i>C. kalshoveni</i>
Length of head to lateral base of mandibles	1.03-1.08	1.00-1.15
Max. width of head	0.91-1.03	0.90-0.99
width of head at anterior end	0.48-0.50	0.46-0.52
Max. height of head	0.69-0.77	0.66-0.77
Head contraction index (Ant. W./max. width)	0.49-0.53	0.52-0.59
Head index (width/length)	0.89-0.95	
Max. length of labrum	0.23	0.19
Max. width of labrum	0.17	0.21

Table-20 (Contd.)

<i>Coptotermes</i> spp.	<i>C. gaurii</i>	<i>C. kalshoveni</i>
Length of mandible (Upper base of condyle to tip)	0.57–0.63	0.59–0.68
Head-mandibular length index (mand.-length/head-length)	0.58–0.61	0.57
Min. median length of postmentum	0.51–0.63	0.50–0.68
Max. width of postmentum	0.29–0.34	0.27–0.34
Width of postmentum at waist	0.23–0.29	0.21–0.27
Max. length of pronotum	0.37–0.40	0.27–0.34
Max. width of pronotum	0.57–0.68	0.61–0.72
Pronotum index (length/width)	0.59–0.64	0.40
Pronotum head index (pronotum width/head-width)	0.61–0.67	0.62–0.72
Number of antennal segments	14	13–14

Table-21. Measurements (in mm.) etc., of Caste - Soldier

<i>Coptotermes</i> spp.	<i>C. havilandi</i>	<i>C. niger</i>	<i>C. sinabangensis</i>
Length of head to lateral base of mandibles	1.11–1.36	1.34	1.34–1.45
Max. width of head	1.00–1.15	1.14	1.32
Width of head at anterior end	0.61–0.70	0.69	0.82
Max. height of head			
Head contraction index (Ant. w./max. width)	0.76–0.85 0.63	0.73 0.60	0.61–0.64 0.62
Head index (width/length)	0.76	0.85	0.94
Mx. length of labrum	0.34	0.32	
Max. width of labrum	0.21	0.24	
Length of mandible (Upper base of condyle to tip)	0.75–0.86	0.92	0.81–0.83
Head-mandibular length Index (mand.-length/head-length)	0.65–0.67	0.68	0.57
Min. median length of postmentum	0.84–1.00	0.80	0.82
Max. width of postmentum	0.38–0.45	0.36	0.39
Width of postmentum at waist	0.21–0.25	0.23	0.23
Max. length of pronotum	0.42–0.45	0.44	0.44–0.49
Max. width of pronotum	0.76–0.80	1.00	0.85–0.91
Pronotum index (length/width)	0.55	0.44	0.52
Pronotum head index (pronotum width/head-width)	0.76	0.87	0.66
Number of antennal segments	14	15	15

Table-22. Measurements (in mm) etc., of Caste - Soldier

<i>Coptotermes</i> spp.	<i>C. heimi</i>	<i>C. travians</i>	<i>C. bornensis</i>
Length of head to lateral base of mandibles	1.20-1.45	1.23-1.40	1.18-1.32
Max. width of head	1.00-1.35	1.00-1.18	0.97-1.03
Width of head at anterior end	0.65-0.75	0.68-0.71	0.65-0.67
Max. height of head	0.69-0.83	0.65-0.78	0.70-0.75
Head contraction index (Ant. W./max. width)	0.52-0.66	0.58-0.63	0.58-0.67
Head index (width/length)	0.77-1.04	0.80-0.88	0.77-0.78
Max. length of labrum	0.28-0.35	0.25-0.34	0.30-0.32
Max. width of labrum	0.23-0.30	0.25-0.30	0.25-0.26
Length of mandible	0.70-1.00	0.75-0.88	0.75-0.81
Head-mandibular length Index (mand.-length/head-length)	0.50-0.65	0.57-0.65	0.57-0.65
Min. median length of postmentum	0.75-1.05	0.78-1.00	0.76-0.87
Max. width of postmentum	0.38-0.45	0.34-0.44	0.35-0.36
Width of postmentum at waist	0.25-0.34	0.23-0.29	0.20-0.22
Max. length of pronotum	0.40-0.50	0.35-0.44	0.37-0.42
Max. width of pronotum	0.75-0.95	0.68-0.88	0.72-0.81
Pronotum index (length/width)	0.51-0.59	0.50-0.55	0.51-0.53
Pronotum head index (pronotum width/head-width)	0.63-0.80	0.57-0.75	0.80-0.83
Number of antennal segments	—	—	13-14

Table-23. Measurements (in mm) etc., of Caste - Soldier

<i>Coptotermes</i> spp.	<i>C. intermedius</i>	<i>C. xiaolingensis</i>	<i>C. kishori</i>
Length of head to lateral base of mandibles	1.14-1.32	1.14-1.29	1.13-1.25
Max. width of head	0.95-1.18	0.96-1.08	0.95-1.08
Width of head at anterior end	—	—	.57-0.65
Max. height of head			0.65-0.68
Head contraction index (Ant. w./max. width)	0.54	0.57-0.65	0.59
Head index (width/length)	0.86	0.78-0.84	0.84-0.86
Max. length of labrum	0.27		0.20-0.28
Max. width of labrum	0.27		0.20-0.25

Table-23 (Contd.)

<i>Coptotermes</i> spp.	<i>C. intermedius</i>	<i>C. xiaolingensis</i>	<i>C. kishori</i>
Length of mandible (Upper base of condyle to tip)	0.68	0.82–0.88	0.73–0.83
Head-mandibular length Index (mand.-length/head-length)	0.62	0.71–0.77	0.58–0.66
Min. median length of postmentum	0.70	—	0.770–0.80
Max. width of postmentum	0.37	—	0.35–0.38
Width of postmentum at anter.end	—	—	0.23–0.25
Width of postmentum at waist	0.25–0.25	—	0.18–0.20
Max. length of pronotum	0.40–0.42	—	0.35–0.40
Max. width of pronotum	0.76–0.82	—	0.65–0.73
Pronotum index (length/width)	0.53	—	0.51–0.59
Pronotum head index (pronotum width/head-width)	0.70	—	0.64–0.70
Number of antennal segments	14–15	—	—

Table-24. Measurements (in mm) etc., of Caste - Soldier

<i>Coptotermes</i> spp.	<i>C. lacteus</i>	<i>C. michaelsoni</i>	<i>C. pamuae</i>
Length of head to lateral base of mandibles	1.21–1.46	1.17–1.32	1.10–1.35
Max. width of head	1.06–1.28	0.93–0.99	0.91–1.20
Width of head at anterior end	0.62–0.73	0.58–0.62	0.70
Max. height of head	0.73		
Head contraction index (Ant. w./max. width)	0.59	0.62	0.71
Head index (width/length)	0.92	0.75–0.79	—
Max. length of labrum	0.40	0.26	—
Max. width of labrum	0.25	0.19	—
Length of mandible (Upper base of condyle to tip)	0.66–0.72	0.61–0.69	0.77
Head-mandibular length index (mand.-length/head-length)	—	0.52	0.57
Min. median length of postmentum	0.80	0.73	
Max. width of postmentum	0.40	0.34	

Table-24 (Contd.)

<i>Coptotermes</i> spp.	<i>C. lacteus</i>	<i>C. michaelsoni</i>	<i>C. pamuae</i>
Width of postmentum at waist	0.23–0.29	0.20–0.24	
Max. length of pronotum	0.38–0.48	0.36–0.40	0.45
Max. width of pronotum	0.70–0.96	0.69–0.73	0.75
Pronotum index (length/width)	0.50–0.52	0.52–0.54	0.60
Pronotum head index (pronotum width/head-width)	0.66–0.75	0.73–0.74	0.76
Number of antennal segments	13–16	14	14

Table-25. Measurements (in mm) etc. of Caste - Soldier

<i>Coptotermes</i> spp.	<i>C. premrashmii</i>	<i>C. curvignathus</i>
Length of head to lateral base of mandibles	1.26–1.53	1.34–1.69
Max. width of head	1.23–1.46	1.40–1.63
width of head at anterior end	0.69–0.80	0.84–0.90
Max. height of head	0.90–0.95	0.96–1.11
Head contraction index (Ant. W./max. width)	0.54–0.56	0.56
Head index (width/length)	0.95–0.97	0.91
Max. length of labrum	0.30–0.34	0.36–0.40
Max. width of labrum	0.26–0.30	0.30–0.34
Length of mandible (Upper base of condyle to tip)	0.90	0.96–1.00
Head-mandibular length index (mand.-length/head-length)	0.57	0.61–0.65
Min. median length of postmentum	0.85–0.87	0.84–1.00
Max. width of postmentum	0.26–0.30	0.37–0.45
Width of postmentum at waist	0.26–0.30	0.23–0.26
Max. length of Pronotum	0.46–0.57	0.57–0.65
Max. width of pronotum	0.84–1.00	0.90–1.09
Pronotum index (length/width)	0.54–0.57	0.62
Pronotum head index (pronotum width/head-width)	0.68	0.66
Number of antennal segments	14–15	15–16

Table-26. Measurements (in mm) etc. of Caste - Soldier

<i>Coptotermes</i> spp.	<i>C. reffrayi</i>	<i>C. dreghorni</i>	<i>C. obiratus</i>
Length of head to lateral base of mandibles	1.50-1.79	1.57-1.65	1.55-1.68
Max. width of head	1.24-1.39	1.28-1.32	1.28-1.32
Width of head at anterior end	0.84-0.99	0.73-0.80	0.77-0.80
Max. height of head	0.84	—	0.84
Head contraction index (Ant. w./max. width)	0.67-0.71	0.57-0.60	0.60
Head index (width/length)	0.77-0.79	0.80-0.81	0.78-0.82
Max. length of labrum	0.34	—	0.38
Max. width of labrum	0.30	—	0.30
Length of mandible (Upper base of condyle to tip)	1.03-1.10	0.81-1.10	1.03-1.10
Head-mandibular length index (mand.-length/head-length)	0.61-0.68	0.51-0.66	0.65-0.66
Min. median length of postmentum	1.00	—	0.88
Max. width of postmentum	0.42	—	0.40
Width of postmentum at waist	0.21-0.32	0.25	0.23
Max. length of pronotum	0.48-0.61	0.51-0.55	0.47-0.51
Max. width of pronotum	0.91-1.12	0.95-0.99	0.88-0.95
Pronotum index (length/width)	0.52-0.54	0.51-0.55	
Pronotum head index (Pronotum width/head-width)	0.85	0.74	
Number of antennal segments	16	16	16

Table-27. Measurements (in mm) etc. of Caste - Soldier

<i>Coptotermes</i> spp.	<i>C. testaceus</i>	<i>C. guandongensis</i>	<i>C. eucalyptus</i>
Length of head to lateral base of mandibles	1.40-1.60	1.53-1.55	1.41-1.48
Max. width of head	1.14-1.36	1.33-1.35	1.11-1.22
Width of head at anterior end	0.70-0.80	0.73-0.80	0.77-0.80
Max. height of head	0.80	—	0.84
Head contraction index (Ant. w./max. width)	0.58		
Head index (width/length)	0.80-0.81	0.75-0.77	0.76-0.80
Max. length of labrum	0.26		
Max. width of labrum	0.23		

Table-27 (Contd.)

<i>Coptotermes</i> spp.	<i>C. testaceus</i>	<i>C. guandongensis</i>	<i>C. eucalyptus</i>
Length of mandible (Upper base of condyle to tip)	0.80	1.07	0.82–0.88
Head-mandibular length index (mand.-length/head-length)	0.58	0.69–0.70	0.57–0.61
Min. median length of postmentum	0.84	—	—
Max. width of postmentum	0.34	—	0.40
Width of postmentum at waist	0.19	—	—
Max. length of pronotum	0.46	—	—
Max. width of pronotum	0.80	0.94–0.99	—
Pronotum index (length/width)	0.57	—	—
Pronotum head index (Pronotum width/head-width)	0.70	0.70–0.73	—

Table-28. Measurements (in mm) etc. of Caste - Soldier

<i>Coptotermes</i> spp.	<i>C. truncatus</i>	<i>C. amanni</i>	<i>C. kishori</i>
Length of head to lateral base of mandibles	1.38	1.20–1.25	1.13–1.25
Max. width of head	1.14	1.00–1.02	0.95–1.08
Width of head at anterior end	0.69	0.50	—
Max. height of head	0.73	—	—
Head contraction index (Ant. w./max. width)		0.50–0.51	
Head index (width/length)	0.82	0.83–0.84	0.84–0.86
Max. length of labrum	0.34	0.25–0.27	0.20–0.28
Max. width of labrum	0.23	0.20–0.25	0.20–0.25
Length of mandible (Upper base of condyle to tip)	0.78	0.70–0.73	0.73–0.83
Min. median length of postmentum	0.76	0.70–0.73	0.70–0.80
Max. width of postmentum	0.42	0.37–0.39	0.35–0.38
Width of postmentum at anter.end			
Width of postmentum at waist	0.26	0.25–0.26	0.23–0.25
Max. length of pronotum	0.42	0.40–0.43	0.35–0.40
Max. width of pronotum	0.76	0.75	0.65–0.73
Pronotum index (length/width)	0.55	0.54	0.54
Pronotum head index (Pronotum width/head-width)	0.66	0.73	0.68
Number of antennal segments	15	14	13–14

Subfamily HETEROTERMITINAE

Genus 15. *Heterotermes* Froggatt
(syn. *Leucotermes* Silvestri, *Psalidotermes* Silvestri)1. *Heterotermes* Froggatt

1858. Hagen, *Linn. Enfom.*, 12 : 108, 186.
 1896. Froggatt, *Proc. Linn. Soc. N.S.W.*, 21 : 518, 550.
 1934. Kemner, K. *Sv. Vet. Akad. Handl.*, 13(4) : 67-68.
 1942. Hill, *Termites (Isoptera) Australian Region* : 8, 11, 14, 120.
 1949. Snyder, *Smiths. misc. Colls.*, 112 : 56.
 1953. Rattan Lal and Menon, *Catal. Indian Insects, Part 27, Isoptera* : 29.
 1955. Emerson, *Fieldiana Zool.*, 37 : 472, 473, 477, 478, 479, 483, 490, 493, 499, 509.
 1955. Ahmad, *Biologia*, Lahore, 1 : 219, 220.
 1958. Ahmad, *Biologia*, Lahore, 4: 58, 59, 68-70.
 1961. Harris, *Termites : Recognition and Control* : 46, 89. (2nd Ed. 1971).
 1964. Roonwal and Bose, *Zoologica*, 40 (113) : 8.
 1968. Chatterjee and Thakur, *Indian Forester*, 94 (7) : 562-563.
 1970. Krishna, In *Biology of Termites* (Eds. Krishna and Weesner) Vol. 3 : 137.
 1970. Roonwal, In *Biology of Termites* (Eds. Krishna and Weesner) Vol. 2 : 332-334.
 1971. Emerson, *Bull. Am. Mus. nat. Hist.*, 146 (Art. 3) : 248, 250, 251, 256, 257, 258, 259, 272-274, 298.
 1975. Sen-Sarma, et al., *Wood Destroying Termites of India* (Final Tech. Rep. PL 480 Proj.) : 7, 11.
 1977. Roonwal and Rathore, *Zool. Anz.*, 198 : 299, 308, 311.
 1977. Chhotani, *Proc. 8th int. Cong. Int. Un. Study Social Insects* (Wageningen, Sept. 1977) : 116, 117.
 1977. Mathews, *Studies Termites from Mato Grasso State, Brazil* : 83.
 1979. Roonwal, Verma and Thakur, *Proc. Indian. Nanlie. Sci. Acad.*, (B) 45 (4) : 333, 349.
 1979. Thakur and Sen-Sarma, *Indian For. Rec. (N.S.) Ent.*, 13 (2) : 1-4.
 1980. Chhotani, *Tech. Monog. Zool. Surv. India*, No. 4 : 5, 20.
 1982. Bose and Das, *Rec. zool. Surv. India*, 80 : 199.
 1983. Tsai and Huang, *Acta Ent. Sinica*, 26 : 43.
 1983. Maiti, *Occ. Pap., Rec. zool. Surv. India*, No. 42 : 17, 22.
 1983. Roonwal, *Proc. Indian Nanl. Sci. Acad.*, (B) 49(5) : 363.
 1983. Chhotani, *Oriental Insects*, 17 : 111, 112, 114, 115, 118.
 1984. Bose, *Occ. Pap. Rec. zool. Surv. India*, No. 49 : 77, 78.
 1985. Chhotani, *Z. ang. Ent.*, 100 : 91, 92, 93, 94.
 1986. Grasse *Termitologia*, 3 : 522.
 1989. Thakur, *Indian For. Rec. (N.S.)*, (Ent) : 15 (1) : 14.

2. *Termes* (*Eutermes*) in part

1858. Hagen, *Linn. Ent.*, 12 : 108, 186.

3. *Termes* Linn. (Part)

1897. Froggatt, *Proc. Linn. Soc. N.S.W.*, 22 : 721.
 1898. Haviland, *J. Linn.Soc. London*, 26 (169) : 378, 398. (section with *Termes tenuis* for type).
 1900. Sjostedt, K. *Sv. Vet. Akad. Handl.*, 34(4) : 19-21.

4. *Leucotermes* Silvestri

1901. Silvestri, *Bull. Mus. Zool. Anat. Comp.*, 16 (389) : 3.
 1911. Holmgren, K. *Sv. Vet. Akad. Handl.*, 46 (6) : 62, 69.
 1913. Holmgren, K. *Sv. Vet. Akad. Handl.*, 50(2) : 60, 63.
 1926. Sjostedt, K. *Sv. Vet. Akad. Handl.*, (3) 3(1) : 59.

5. Subgenus *Leucotermes* of *Termes*

1904. Desneux, In Wytman's *Genera Insect.*, Fasc. 25 : 29, 31, 32-33.

6. *Psalidotermes* Silvestri

1909. Silvestri, In Michaelsen's and Hartmeyer's *Die Fauna Siidwest-Austral.* Vol. 2 : 296. Type of genus : *Termes ferox* Froggatt.
 1911. Holmgren, K. *Sv. Vet. Akad. Handl.*, 46(6) : 69, 71.

vide Hill 1942, Snyder 1949 and Thakur and Sen-Sarma 1979 also for synonymy.

Type of genus : *Heterotermes platycephalus* Froggatt.

a. History, Distribution, Composition, etc.

Froggatt (1896) had introduced the generic name *Heterotermes* based on a single species *H. platycephalus* from Kangaroo Island, South Australia. However, Snyder (1949) in his world catalogue designated *H. platycephalus* as the type species of the genus which was relegated to the synonymy of *Heterotermes tenuis* (Hagen). In the recent past, Emerson (1971) had retained *H. platycephalus* as its type genus. It is a well established genus containing about 36. Species occurring predominantly in the major tropical regions of the world.

The genus may have originated in the tropical Oriental Region, but the evidence in support of this is less conclusive. Although, distribution pattern in the southern Hemisphere is indicative of an upper Cretaceous origin, but the time and place of origin of the genus still remain obscure.

The genus is generally found in the humid tropical rainforest as well as in the arid savanna, with extension of few species in the temperate region. It is unknown to day from the true Occanic Island (Emerson, 1971).

Some of the species of *Heterotermes* inhabit in man-made environment, especially in the houses causing considerable damage to structural wood and house-hold articles of cellulosic origin. Pest status of such species is well recognised. Out of 36 species known so far from the entire world, seven species namely, *H. aurius*, *H. maculatus* (Light) from S. America, *H. cardini* (Snyder) from Bahama, *H. crinitus* (Emerson) from Guayana; *H. gaoyaoensis* (Tsai and Chen), *H. gingjiangensis* (Gao and Wang) are not dealt, but former five species have been incorporated in the key for their identity.

General characters : (1) IMAGO : Generally pale yellowish throughout the body and with fairly dense hairs. Head subsquarish, almost as long as broad, posterior margin round, epicranial suture absent. Fontanelle small, placed almost at the middle of head. Eyes oval and distinct, generally bulging out, ocelli, if present, dot-like or absent.

Antennae with 13-19 segments; 2, 3 and 4 variable. Postclypeus chitinised, weakly convex, pilose. Anteclypeus whitish and apilose. Mandibles each with an apical and three marginal teeth. Left with apical finger-like, 1st marginal slightly smaller than apical, 2nd as long as apical, 3rd smaller with long anterior margin. Right with apical finger-like, 1st marginal small, rudimentary, placed at anterior base of 2nd marginal, 2nd triangular, 3rd short, but with a long posterior margin. Pronotum generally narrower than head, anterior margin almost straight or weakly incurved, posterior also with feeble median emargination, sides weakly converging posteriorly. Tibial spur formula 3 : 2 : 2. Tarsi 4-jointed.

Wings fairly light yellow, transparent with papillae and both with asteroid and non-asteroid microasters and hairs, more hairy, sometimes on margins, veins on membrane.

Forewing : Costa (subcosta and radius according to some authors) thick, boarding the anterior margin, radius as thick as costa and running parallel with and close to it, median arising separately from scale with branches in distal half. Cubitus arising independently from scale with 10-11 branches. Hindwing : Costa and radius as in forewing, median separately arising from radius outside the scale, the rest similar to forewing, cubitus with 9-11 branches to posterior margin. Cerci 2-jointed. Styli in male 1-jointed.

(ii) SOLDIER : Soldiers of two types major and minor, in some species only. Variable only in size. Characters of soldier (major) only included here.

Head light yellowish to pale brownish. Head yellowish to pale brownish. Head and pronotum moderately and abdomen fairly densely hairy.

Head subrectangular, longer than broad, sides subparallel, posterior margin round, frons sloping in front. Fontanelle circular and minute with chitinised small tube, placed at most at the anterior third. Eyes and ocelli absent. Antennae with 12-19 segments, 2-4 variable. Labrum

subtriangular with hyaline needle-like pointed apex, not niddle-like in Australian and South American species. Postclypeus flat, pilose. Mandibles long, substraight with weakly incurved apices, left with robust blunt projection at the inner base and with 3-4 crenulations in the basal inner half, right with 1-2 minute crenulations at the basal inner margin. Postmentum elongately club-shaped, widely varied within its regular shape, sometimes bilobed above the widest width, but not in all the species. Pronotum flat, subreniform, generally narrower than head, side narrowing posteriorly, anterior margin weakly or strongly notched at the middle, posterior margin substraight or feebly emarginate medially. Tibial spur formula 3 : 2 : 2. Tarsi 4-jointed. Cerci 2-jointed and styli 1-jointed.

Remarks : Needle-shaped labrum of Australian *Heterotermes* may be like that of *Reticulitermes* as referred to by Tsai and Hwang (1983), which has not been examined and no definite conclusion could be made unless the chinese species are studied. *Reticulitermes* and *Heterotermes* could hardly be separated on the basis of needle-shaped labrum of *Heterotermes*. In imago second marginal tooth is larger than first in *Heterotermes* and second in *Reticulitermes* is equal to first.

C. Key to the species of *Heterotermes*
Froggatt

- 1. Labrum terminating with a distinct short or long needle 2
 - Labrum not terminating with a distinct needle, rather with broadly rounded apex 12
- 2. Pronotum wider in proportion to head-width, pronotum head-width index 0.80-0.83 3
 - Pronotum narrower in proportion to head-width, pronotum head-width index 0.63-0.76 6
- 3. Smaller species, head-length 1.38-1.78 4
 - Larger species, head-length 1.75-1.98 5
- 4. Head feebly diverging anteriorly, larger

- species, head-length 1.50-1.78 head-width 0.97-1.05; mandible shorter, thick and somewhat stout; anterior margin of pronotum with median notch; antennae with 12-17 segments (generally with 14-15)
..... *H. gertrudae* Roonwal
- Head not diverging anteriorly; rather parallel sided; smaller species, head-length 1.38-1.78; mandibles longer, thin and not so stout; anterior margin of pronotum with distinct median notch; antennae with 14-15 segments (generally with 15)
..... *H. wittmeri* Chhotani and Bose
- 5. Soldier dimorphic, mandibles short, only slightly longer than half the head-length, mandible-head index 0.49-0.53; head-length 1.75-1.98 head-width 0.90-0.98 (S.maj).
..... *H. omanae* Chhotani
- Soldier monomorphic; mandibles longer, mandible-head index 0.55-0.70 6
- 6. Antennae generally with 12-14 segments .7
 - Antennae with 14-16 segments 10
- 7. Smaller species, head-length 1.00-1.17 8
 - Larger species, head-length 1.30-1.65 10
- 8. Head not so moderately hairy; head broadly rectangular; mandibles as long as almost two-thirds of head-length; pronotum wider in proportion to head-width, head-pronotum index 0.71-0.73; head-length 1.00-1.10, head-width 0.70-0.75
..... *H. balivanti* Mathur and Chhotani
- Head densely hairy; head elongately rectangular, mandibles as long as slightly longer than half the head-length; pronotum narrower in proportion to head-width, head pronotum index 0.61-0.69 9
- 9. Labrum much longer, reaching three fourth of mandible length, mandibles finely pointed at the apices; pronotum with deep median notch at the anterior margin, head-length 1.27, head-width 0.75-0.85 *H. vagus* Hill

- Labrum shorter reaching two-thirds of mandible length, mandibles not so finely pointed at the apices; pronotum with shallow anterior margin; head-length 1.22–1.20, head-width 0.72–0.86 *H. tenuior* (Haviland)
- 10. Postmentum wider at waist, postmentum waist-width index 0.43–0.53; head less hairy and slightly larger, head-length 1.30–1.69, head-width 0.85–1.00; antennae with 13–14 segments *H. ceylonicus* (Holmgren)
- Postmentum narrower at waist, postmentum waist-width index 0.38–0.43; head more hairy and smaller; head-length 1.23–1.54, head-width 0.77–0.95; antennae with 12–14 segments *H. malabaricus* Snyder
- 11. Head larger, head-length 1.25–1.90, head-width 0.85–1.07; pronotum with appreciable median notch both on anterior and posterior margins; pronotum width 0.65–0.90 ; labrum with more prominent needle tip (0.08–0.10) *H. indicola* (Wasmann)
- Head smaller, head-length 1.10–1.50 12
- 12. Pronotum wider in proportion to head-width, pronotum head width index 0.70; antennae with 15 segments; generally larger species, head-length 1.10–1.50; anterior margin on either sides of median notch of pronotum distinctly outcurved *H. philippinensis* (Light)
- Pronotum narrower in proportion to head-width, pronotum-head width index 0.67 ; antennae with 14 segments ; smaller species, head length 1.09–1.34; anterior margin on either sides of median notch of pronotum not so distinctly out-curved *H. pamatensis* Kemner
- 13. Head long, narrower in proportion to head-width, head-index 0.54–0.62 14
- Head short, wider in proportion to head-width, head index 0.65–0.68 26
- 14. Mandibles shorter in proportion to head-length, mandible-head index 0.56–0.66..... 15
- Mandibles longer in proportion to head-length; mandible-head index 0.70–0.77 24
- 15. Smaller species, head-length 1.40–1.54 16
- Larger species, head-length 1.57–2.20 17
- 16. Antennae with 15 segments, head-length 1.40, head-width 0.78–0.85; head with sparse hairs; dorso-frontal prominence not so distinct; labrum not globose *H. cardini* (Snyder)
- Antennae with 12–14 segments; head-length 1.54, head-width 1.40; head moderately hairy; dorso-frontal prominence distinct; labrum globose *H. perfidus* (Silvestri)
- 17. Head strictly rectangularly elongate, postero-lateral corners of head angularly rounded, generally smaller species, head-length 1.46–1.63 (1.54) 18
- Head elongate, rather somewhat ovoidal, postero-lateral corners of head broadly rounded; larger species, head length 1.80–2.20 21
- 18. Pronotum wider in proportion to head-width, pronotum width 0.80–0.91, pronotum-head width index 0.84–0.85; antennae with 16–18 segments, postmentum waist narrow 0.16–0.18; labrum short *H. paradoxus validus* Hill
- Pronotum not so wide, pronotum width generally 0.52–0.83 19
- 19. Antennae with 17–18 segments; posterior margin of pronotum not so deeply emarginate *H. paradoxus paradoxus* Froggatt
- Antennae with 16–17 segments 20
- 20. Smaller species, head-length 1.65; head-width 0.95–1.00 ; pronotum wider, pronotum width 0.72–0.83; antennae with 16–17 segments; mandible apices much incurved *H. paradoxus intermedius* Hill
- Larger species, head-length 1.98–2.00, head-width 0.75–0.85 ; pronotum width 0.52–0.58;

- antennae with 16 segment; mandible apices not much incurved
..... *H. paradoxus venustrus* Hill
21. Soldier dimorphic; very large species, head elongate with a few hairs, head-length 2.20 (soldier major), head-width 1.00
..... *H. longiceps* (Snyder)
- Soldier monomorphic, smaller species, head-length 1.80–2.05 22
22. Mandible somewhat very thick, uniformly incurved and terminating into fine apices; (head-length 1.79–1.86, head-width 1.10)
..... *H. latilabrum* Tsai and Chen
- Mandibles somewhat straight, abruptly hooked at apices 23
23. Smaller species, head-length 1.80, head sparsely hairy; mandibles not so hooked at apices *H. insularis* Wasmann
- Larger species, head-length 1.83–2.05, head-width 1.14–1.28; head fairly hairy; mandibles substraight with abruptly hooked apices; labrum bluntly terminated
..... *H. teunis* Hagen
24. Anterior margin of pronotum devoid of any distinct median emargination; head-length 1.13–1.54, head-width 0.71–1.00
..... *H. ferox* Froggatt
- Anterior margin of pronotum with deep median emargination 25
25. Smaller species, head capsule fairly hairy, head-length 1.23–1.35, head width 0.70–0.76; mandibles long and slender with substraight apices; labrum broad, devoid of sharp apices
..... *H. sulcatus* Mathews
- Large species, head capsule least hairy, head-length 1.50, head-width 0.90; mandibles somewhat thick with fairly incurved apices; labrum elongate with sharp apex, but devoid of any fine needle
..... *H. aurius* Snyder (Fig. 54A)
26. Smaller species, head-length 1.12–1.20, head-width 0.80; mandibles long and slender with sharply pointed apices; labrum bluntly terminate at the apices postmentum club-shaped; pronotum with deep anterior and shallow posterior emargination
..... *H. canalifrons* Emerson
- Larger species, head-length 1.40–1.52 27
27. Head-length 1.40–1.48, head-width 0.85–0.94; head with sparse hairs, mandibles not so slender and incurved; labrum somewhat blunt; pronotum with antero median notch not so prominent
..... *H. convexinotus* (Snyder)
- Head-length 1.52, head-width 1.02 ; head densely hairy; mandibles long and slender, sharply incurved at the apices; labrum with a sharp point at apex; pronotum with antero-median notch prominent
..... *H. crinitus* (Emerson)

The genus contains 34 species altogether from the entire world, of which three species could not be put in the key. These are *H. maculatus* only known by imagoes and other two Chinese spp., namely, *H. gaoyaoensis* (Tsai and Huang) and *H. gingjiangensis* due to nonavailability of material. However four Chinese species have been put in the key based on Ping and Xu, 1987. These are characterised by the labrum apices not which are pointed or blunt, but with a fairly distinct point (all Chinese species).

Key to the Chinese species based on Ping, and Xu, 1987

1. Labrum translucent and acutely pointed, but not needle-like 2
- Labrum translucent and not acutely pointed (as in *main key*, 12)
2. Body medium or small to medium size; head-width 1.00–1.40 4
- Body large, head-width more than 1.45 3
3. Head strictly rectangularly elongate, mandibles gradually bent towards apices;

labrum angularly outcurved at its maximum width, larger species.....

.....*H. hainanensis* (Tsai and Huang)

- Head not so rectangular, mandibles somewhat straight with feebly hooked at apices; labrum uniformly outcurved at its maximum width, smaller species, head-length 2.00-2.15 and head width, 1.42-1.49.....
.....*H. hunanensis* (Tsai and Peng)

- 4. Head-width generally more than 1.21; mandibles comparatively slender and its tip slightly straight, anterior margin of pronotum twice broaden than posterior margin.....
.....*H. leptomandibularis* Tsia and Huang

- Head-width more wider, mandibles not so slender and its tips incurved
.....*H. aculabialis* (Tasi and Huang)

59. *Heterotermes aculabialis* (Tsai and Huang)

1. *Reticulitermes aculabialis* Tsai and Huang

1977. *Reticulitermes aculabialis* Tsai and Huang.

1987. Gao and Zhu, *Zoo. Res.*, 8 (3) : 305, 307, China.

2. *Heterotermes aculabialis* (Tsai and Huang)

1983. Tsai and Huang, *Acta Ent. Sinica*, 26 (4) : 435, 436, China (comb. nov.)

1986. Gao amd Paul, *Mem. HongKong, nat. Hist. Soc.*, 17 : 82, China

Material : Since no material is available, the salient characters are based on illustrations (Tsai and Huang) 1977.

Diagnostic character : (i) IMAGO : Unknown.

(ii) SOLDIER (Fig. 53.A) : Head subrectangularly elongate, one and a half times as wide as long, lateral sides substraight and posterior margin weakly outcurved. Fontanelle opening very small, placed almost on anterior fourth of head dorsum. Labrum regularly drome-shaped with outcurved margin, maximum width at basal third whence narrowing anteriorly and terminating into a pointed apex (not neddle-shaped) with two bristles. Antennae broader, segment 2 as long as 3 and 4 combined, 3 smallest. Mandibles as long as head-width, very weakly incurved with fairly pointed apices.

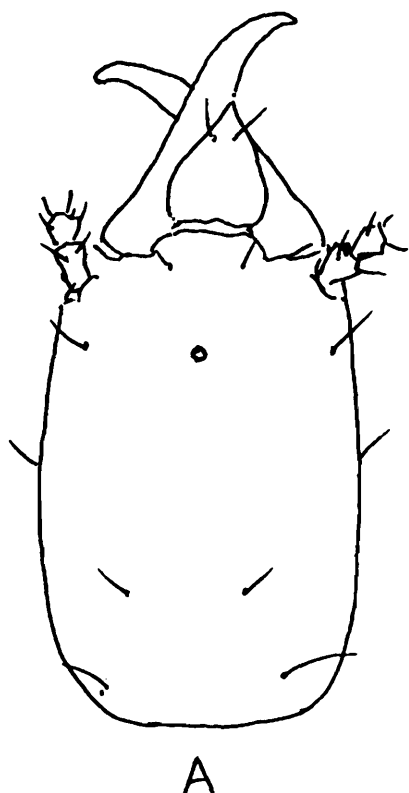


Fig. 53. *Heterotermes aculabialis* (Tsai and Huang) A-B, soldier; A. Head, dorsal view, B. Labnem. (Tsai and Huang, 1977).

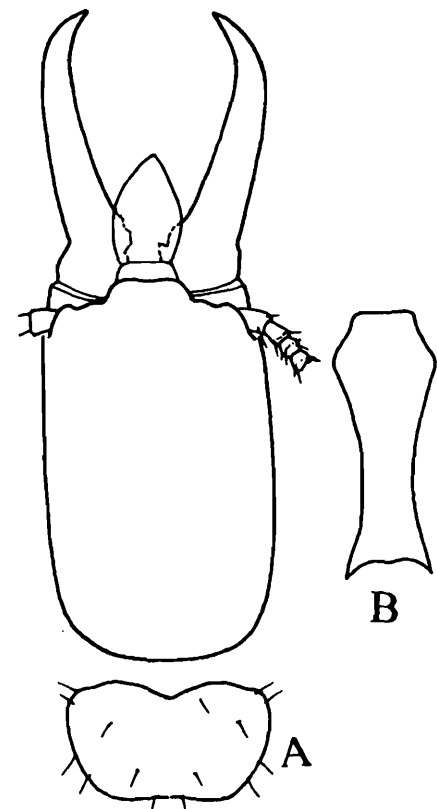


Fig. 54. *Heterotermes aureus* (Snyder); A-B, soldier. A. Head and pronotum, dorsal view; B. postmentum.

60. *Heterotermes balwanti*

Mathur and Chhotani

***Heterotermes balwanti* Mathur and Chhotani**

1969. Mathur and Chhotani, *J. Timber Dev. Assoc. India*, 15 (4) : 4-6, 10. S. W. Type-locality : Balukhand For. Range, near Puri, Orissa, India.
1979. Thakur and Sen-Sarma, *Indian Fr. Rec. (N.S.) Ent.*, 13 (2) : 1, 4, 5-7, 18, 19-20.
1983. Chhotani, *Orient, Insects.*, 17 : 118.
1987. Bose and Das, In *Fauna of Orissa, State Fauna Ser.*, No.1 : 104, 108.
1989. Roonwal and Chhotani, *Fauna of India, Isoptera (Termites)*, 1 : 476-479, Fig. 248 and 249.
1995. Verma, *Fauna of Western Himalaya, Part 1, Uttaranchal*, pp. 47-50, Z. S. I. Publ., Kolkata.

Material : Present in Z.S.I., Kolkata : 1 Paratype S. and 2 Morphotypes W. from Balukhand Forest Range, Puri, Orissa, India.

Diagnostic character : (i) IMAGO : Unknown.

(ii) SOLDIER (Fig. 55.A-B) : Head creamy white to yellowish brown, body whitish and mandibles dark brown. Head and pronotum fairly and abdomen densely hairy. Head subrectangular, sides parallel and posterior margin very weakly outcurved. Frons strongly slopping, dorsal hump prominent and broadly rounded. Fontanelle small, leading into a small brownish tube. Eyes and ocelli absent. Antennae with 12-14 segments, 3 variable. Labrum elongately dome-shaped with pointed hyaline tip and with a pair of bristles. Postclypeus separated from frons by a faint line. Mandibles thin and substraight with very weakly incurved apices. Postmentum club-shaped, maximum width at anterior fourth feeble with bilobed lateral margins above it, waist much below the middle. Pronotum subreniform, anterior margin outcurved with distinct median emargination including a notch at the middle, lateral margins narrowing, posterior margin with faint emargination.

Measurements : Table-33(S)

Types : Holotype S. and Morphotype W. in Ent. Coll., F.R.I., DehraDun. Paratypes and

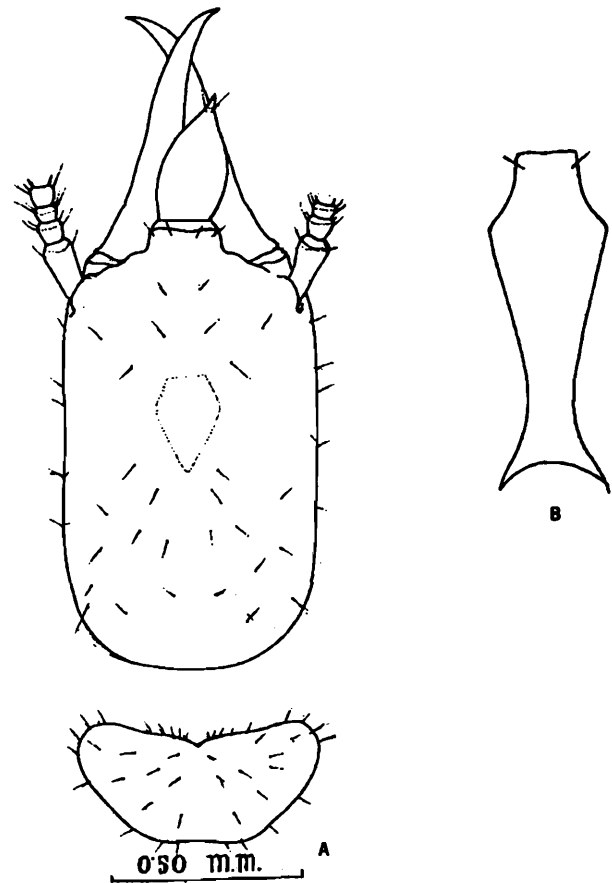


Fig. 55. *Heterotermes balwanti* Mathur and Chhotani A-B, Soldier, A. Head and pronotum, dorsal view; B. postmentum.

Paramorphotypes : (i) 4S. and sev. W. in F.R.I., Dehra Dun ; (ii) 1S. and 2W. in A.M.N.H., New York; (iii) 1S. and 2W. in Z.S.I., Kolkata.

Distribution : ASIA : India : Orissa : Balukhand Forest Range near Puri (Type-locality), Barkūda Island, Puri and Rambha. Karnataka : Dharwar, Goa.

Remarks : The species is mostly found in the plains of India, except its single record in the hilly tracks of the Himalaya made recently by Verma (1995). The species is very close to *H. malabaricus* in morphological characters, but differs in its smaller size and longer mandibles.

61. *Heterotermes canalifrons* (Emerson)**1. *Heterotermes canalifrons* Emerson**

1962. Mathur and Thapa, *Indian Forest Leaflet No. 167, (Ent.)*, p.25 (material only)

Material : Present in F.R.I., Dehra Dun : 1S. and 1W. Paratype from Holotype colony, det. Emerson,

RECIFE, Pernambuco, Brazil, 8.iv.1944, Coll. R. L. Wenzil, Inquilines in the nest of *Nasutitermes bivalens*"

Diagnostic character : (i) *Imago* : Unknown

(ii) **SOLDIER** (Fig. 56. A-B) : Head yellowish brown, other body parts paler except mandibles with deep yellowish colour. Head and pronotum somewhat profusely hairy and abdomen more densely hairy.

Head rectangularly ovoidal, one and a half times as long as broad, sides and posterior margins weakly outcurved, antero-dorsal angles very prominent. Fontanelle minute, placed fairly above the middle with distinctly visible gland below. Postclypeus prominent. Labrum subtriangulr. with slightly hyaline apex, slightly broad above.

Mandibles longer and substraight, much longer than half the head-length, distinctly thinner

apically with abruptly hooked apices. Antennae broken, 2 wider and conical, 3 thinnest and smaller than 2 and subequal to 4. Postmentum club-shaped, widest width slightly below the apical margin and waist slightly above the basal margin and almost half the widest width. Pronotum only slightly narrower than head-width, anterior margin feebly outcurved with deep median notch, convex sides narrowing posteriorly, posterior margin substraight, disc and margins fairly hairy.

Measurements : Table 33 (S.)

Types : In F.R.I., Dehra Dun : Paratypes 1S. and 1W., from *Holotype*-colony, det. Emerson, other data as under material.

Distribution : SOUTH AMERICA : Brazil, Recife.

62. *Heterotermes ceylonicus* (Holmgren)

1. *Leucotermes ceylonicus* Holmgren

1911. Holmgren in Escherich's *Termitenleben auf Ceylon* : 190-191. Im, S. W. Syntypes : in Holmgren Coll., Type-locality : Paradeniya, Sri Lanka.

2. *Heterotermes ceylonicus* (Holmgren)

1933. Snyder, *Proc. U. S. natnl. Mus.*, 82 (Art.16) : 5.

1949. Snyder, *Smiths. misc. Colls.*, 112 : 67.

1958. Ahmad, *Biologia*, Lahore, 4 (1) : 68-70.

1970. Roonwal, In *Biology of Termites* (Eds. Krishna and Weesner), 2 : 333.

1983. Chhotani, *Orient. Insects*, 17 : 118.

1989. Roonwal and Chhotani, *Fauna of India Isoptera (Termites)* 1:

Material : Present in F.R.I., Dehra Dun : 4S. and Sw. W., Hali Ela, Peradeniya, Sri Lanka.

Diagnostic character : (i) **IMAGO** (Fig. 57.A) : Head yellowish brown, other body parts paler. Head and body densely and wings sparsely hairy.

Head subsquarish, lateral sides subparallel and posterior margin round. Fontanelle small and placed slightly below the middle. Eyes round and small. Ocelli small, oval and separated from the

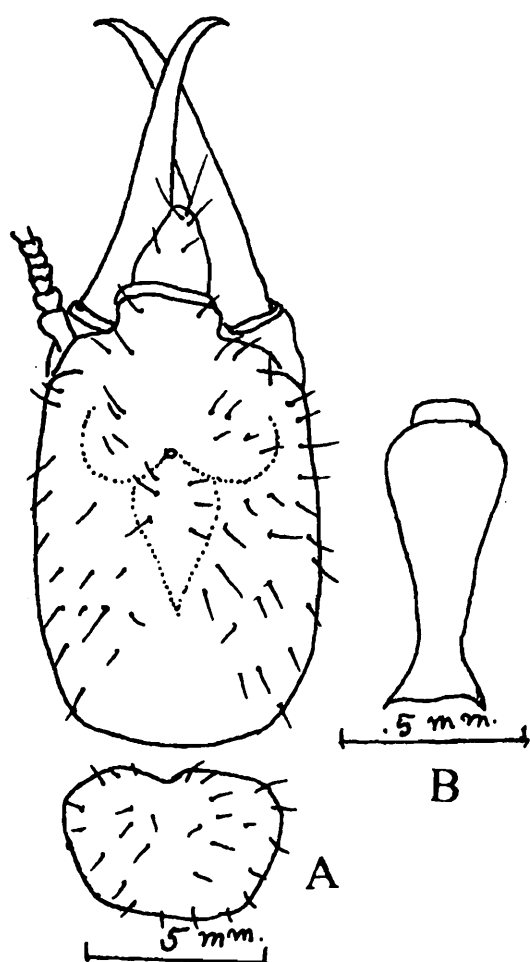


Fig. 56. *Heterotermes canalifrons* (Emerson); A-B, soldier. A. Head and pronotum, in dorsal view; B. Postmentum.

eyes by their long diameter. Postclypeus weakly convex with weak median line. Mandibles typically *Heterotermes*-types. Pronotum only slightly wider than long, anterior and posterior margins both with faint median emarginations.

Forewing with venation as in the genus, cubitus with 10-12 branches to posterior margin. Hindwing with 9-11 branches to posterior margin.

(ii) SOLDIER (Fig. 57.B-C) : Head light to yellowish brown. Head sparsely and body fairly densely hairy. Head elongately subrectangular, with parallel lateral sides and weakly round posterior margin. Fontanelle small, circular, placed at anterior third. Eyes and ocelli absent. Antennae with 14 segments, 3 shortest. Labrum triangular with a hyaline pointed tip with a few hairs below the point. Mandibles thick, almost straight, with thick weakly incurved apices. Postmentum long, club-shaped, waist below the middle. Pronotum slightly narrower than head, anterior margin, wavy and with median emargination and posterior margin with very weak depression.

(iii) SOLDIER (Minor) : Very similar to major soldier, with smaller in body measurements.

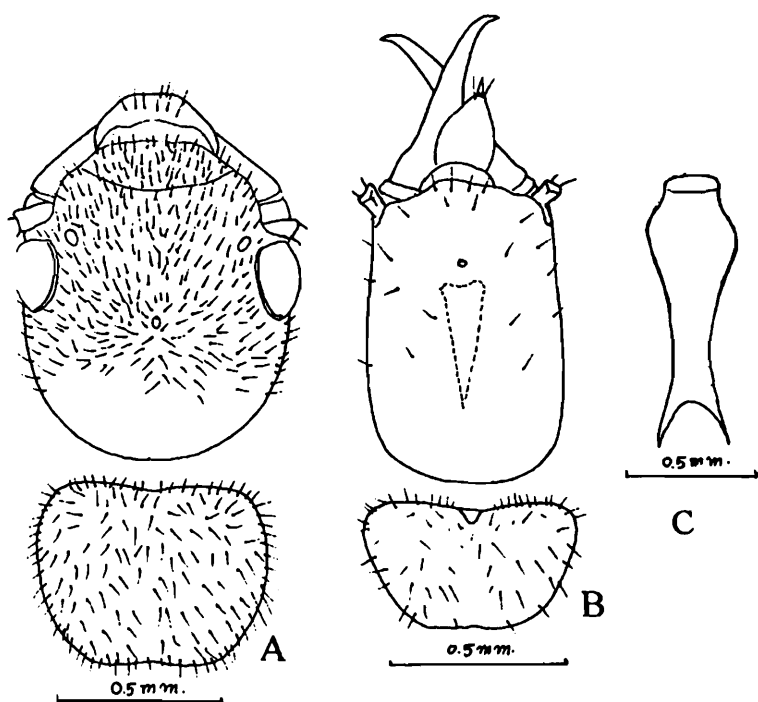


Fig. 57. *Heterotermes ceylonicus* (Holmgren) A, Imago. A. Head and pronotum, dorsal view; B - C, Soldier. B. Head and pronotum, dorsal view; C. postmentum.

Measurements : Table 29 (Im.); 37 (S.)

Types : Syntypes : In Holmgren's collection housed in the Swedish Mus. Nat. Hist., Stockholm (Sweden).

Distribution : ASIA : Sri Lanka : Alutnuware, Uva province, Hali Ela and Paradeniya (type-locality).

Remarks : The species is very similar to *H. indicola* in its characters, but may be distinguished from it by the following features : In Imago, the eyes are separated from the lower margin of head capsule by their short diameter and larger antennal segments. Soldiers are larger in size, more number of antennal segments and pronotum with distinct median notch.

This species attacks stumps (*Grevillia* sp. and other wood) and wood works in houses. At times, it is found in the outer walls of the mounds of *Hypotermes obscuriceps* (Escherich, 1911).

63. *Heterotermes convexinotatus* (Snyder)

1. *Leucotermes convexinotatus* Snyder

1924. Snyder, *Proc. Ent. Soc. Wash.*, 26 (5) : 15-17 Im. and Winged, S. Type-locality : Colon, Panama.

2. *Heterotermes orthognathus* Light

1933. Light, *Calif. Univ. Publ., Ent.*, 6 (5) : 113-114, S. Type-locality : Colima, West Mexico.

1949. Snyder, *Smiths. misc. coll.*, 112 : 67 (syn.)

3. *Heterotermes pallidus* Light

1935. Light, *Proc. Calif. Acad. Sci.*, (4) 21 (20) : 247, Im. and S. Type-locality : Puentarenas Costa Rica.

1949. Snyder, *Smiths. misc. Coll.*, 112 : 67 (syn.)

4. *Heterotermes convexinotus* (Snyder)

1949. Snyder, *Smiths misc. Coll.*, 112 : 67, Im. and S. Panama, Mexico, Costa Rica, West Indies.

1970. Weesner, in : *Biology of Termites*, (Eds. Krishna and Weesner), 2 : 506, distribution only.

Material : No material available, hence snyder's description (1924) has been followed.

Diagnostic character : (i) IMAGO : Known, but not available to study

(ii) SOLDIER (Fig. 58.A) : Head rectangularly elongate with weakly narrowing anterior end, lateral sides substraight, posterior margin convex. Fontanelle minute placed more above the middle. Labrum broadly done shaped with hyaline apex. Mandibles with broad base, but much narrowed anteriorly and with abruptly hooked apices. Antennae broken.

Pronotum only slightly narrower than head, and almost one and a half times as wide as its own length, anterior margin slightly impressed at the middle, antero-lateral corners narrowly round, posterior margin indistinctly invaginated.

Measurements : Table 41 (S.)

Types : Im. (deal) in USN (No.25083), Washington.

Distribution : CENTRAL AMERICA : Panama, Mexico, Guatemala, Honduras Costa Rica and West Indies.

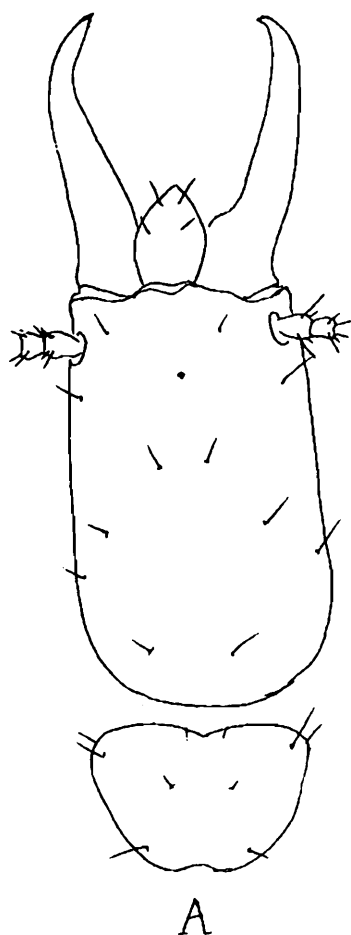


Fig. 58. *Heterotermes convexinotatus* (Snyder) A, Soldier, A. Head and pronotum, dorsal view.

Remarks : This small termite species had been observed feeding on pine stumps in the Stann Creek Valley in Guatemala. In Corozal township, the survey pegs were observed being attacked by the species, in addition to their attack in the building timbor (Harris, 1959).

64. *Heterotermes ferox* (Frogatt)

1. *Termes ferox* Frogatt

1897. Frogatt, *Proc. Linn. Soc. New South Wales*, 22 : 721–758, 1m., S. and W., Thronleigh near Sydney.

2. *Psalidotermes ferox* Silvestri

1909. Silvestri, *Fauna Sudwest-Austral*, 2 (17) : 279–314, Australia.

3. *Leucotermes ferox* Mjoberg

1920. Mjoberg, *Arkiv. Zool.*, 12 (15) : 29.

4. *Heterotermes ferox* Hill

1942. Hill, C.S.I.R., pp.122–125; Im. and s. (detailed syn.)

1949. Snyder, *Smiths. misc. Coll.*, 112 : 67–68, Australia

1970. Gay and Calaby, *In* : *Biology of Termites* (Eds. Krishna and Weesner), pp.409–410, (bibl.)

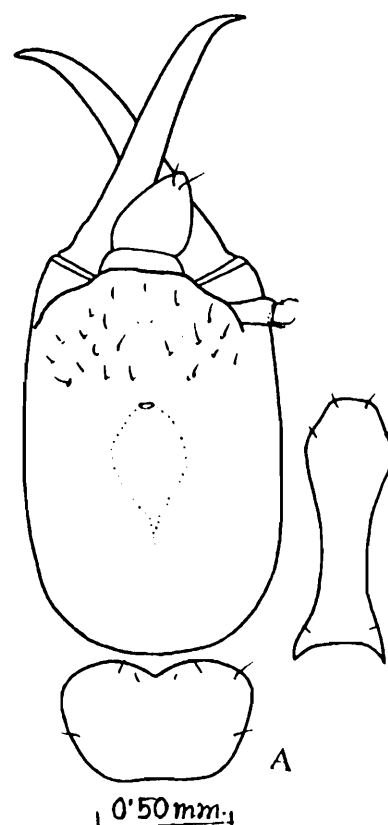


Fig. 59. *Heterotermes crinitus* (Emerson); A–B, Soldier. A. Head and pronotum, dorsal view; B. postmentum.

5. *Leucotermes occiduus*, Hill

1927. Hill, *Mem. nat. Mus.*, No. 7, p.50. Im., S. and W.

Material : Present in F.R.I., Dehra Dun : 3 Adults 3S. and 2W., Australia, New Castle; Don. C.S.I.R.O., Canberra, Australia.

Diagnostic character : (i) IMAGO (Fig.60.A) : Head dark brown, other head parts paler. Head slightly longer than broad, weakly narrowing posteriorly, fontanelle very small, but distinctly placed at the level of slightly below the posterior margin of eyes. Postclypeus strongly convex with indistinct median line. Labrum wider than long with broadly rounded apical margin. Eyes small, placed nearly the lower margin of head. Ocelli small, variable in shape, size and placement from the eyes. Antennae with 15-17 segments, 3 smallest, rarely larger than 4, pronotum strongly convex, anterior with median deep notch and posterior margins with weak emargination, lateral margins narrowing posteriorly. Median vein of

forewing either unbranched or with two branches nearer to cinctus than to the radial sector. Cubitus with 9-11 branches.

(ii) SOLDIER (Fig. 60.B-C) : Head longer than broad, parallel sided, postero-lateral corners round with substraight posterior margin. Fontanelle small, placed above the middle. Postclypeus broader than long. Labrum dome-shaped with finely pointed hyaline margin. Mandibles almost straight with feeble incurved sharply pointed apices. Antennae with 15-17 segments, segments very variable.

Measurements : Table. 30 (Im.); 35 (S).

Types : Holotype Im. and Morpho-lectotype S. and W. in C.S.I.R. Coll., Melbourne.

Distribution : Australia : New South Wales : Castle, New Sydney (type-locality_ and distinct, Woronora, Narrabeen, Mittagong, Appin, Barge, Captaja's Flat, Braidwood, Nowra, Clarence Town, Graffon, Broken Hill, Griffith, Young : Victoria : All over the state, excepting g otway Forest. Australia Capital Territory : At elevations upto about 2600 ft. Queensland : Brisbane, Toowoomba, Yarraman, Benarkin, Aramara, Dalby. South Australia : Adelaide, and district, Kangaroo Island, Reevesby Island. Western Australia : South Western Division, Leonora, Mullewa.

Remarks : The deep dark colour of images keeps it distinct from all other species of the genus in Australia. In the soldiers' character, it is almost indistinguishable from *H. paradexus*. It is one of the most common species in Australia from southern queensland through south-eastern and southern areas of the mainland across to western Australia. It occurs in small colonies in soil, under logs, stones, decaying sapwood of piers, poles and fence posts and in the nests of other termites. Images are found in the nests from October to July and emergence from the it's holes on ground or from infested wood above ground either late afternoon or early evening. The species is not so economically important (Gay and Calaby, 1970).

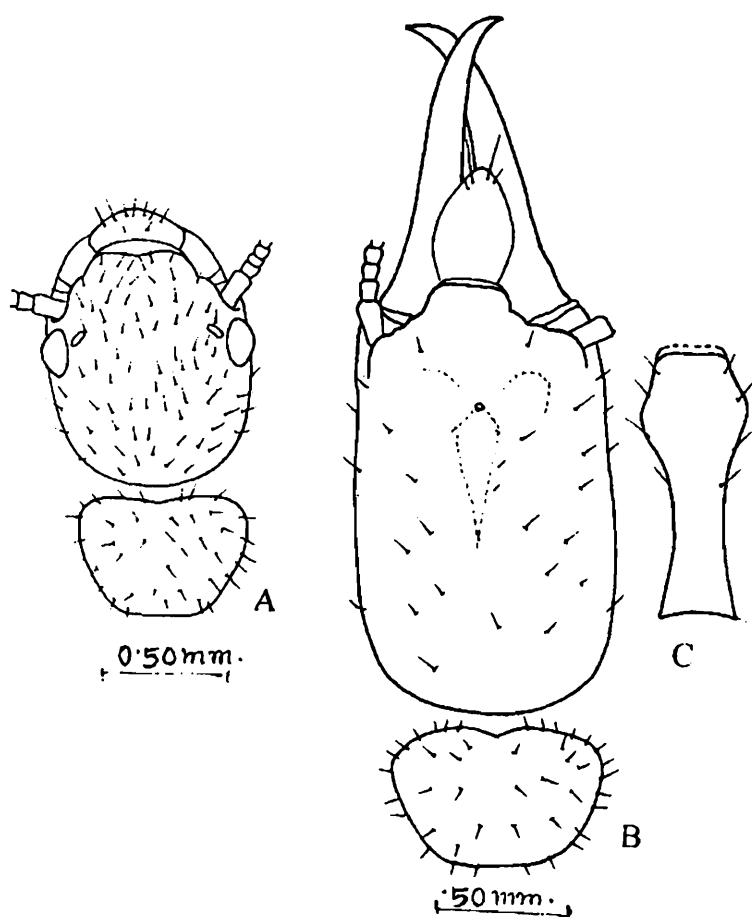


Fig. 60. *Heterotermes ferox* (Froggatt) A, Imago. A. Head and pronotum in dorsal view. B-C, soldier. B. Head pronotum, dorsal view; C. postmentum.

65. *Heterotermes gertrudae* Roonwal

1. *Heterotermes gertrudae* Roonwal

1953. Roonwal, *Indian J. Ent.*, 15 (2) : 115–118. S. W. Type-locality : Almora, Uttaranchal, India.
1976. Verma and Thakur, *Newsl. zool. Surv. India*, 2 (4) : 140.
1979. Roonwal, *Termite Life & Termite Contr., Trop. South Asia* : 7, 51, 79, 117.
1983. Chkotani, *Orient. Insects*, 17 : 118.
1989. Roonwal and Chhotani, *Fauna of India, Isoptera (Termites)* 1 : 483–487, Fig. 252–254.
1995. Verma, *Fauna of Western Himalaya, Part 1, Uttaranchal* pp. 47–50, Z. S. I., Publ., Kolkata.

2. *Heterotermes indicola* (Wassmann). (in part.) wrong identification.

1979. Thakur and Sen-Sarma, *Indian For. Rec. (N.S.) Ent.*, 13 (2) : 10–11. (Treat *tt. gertrudae* as synonym of *H. indicola*).

Material : Present in F.R.I., Dehra Dun : (i) Paratype 4s. from Holotype colony, Almora, Uttaranchal, India ; (ii) presnet in Z.S.I., Kolkata : one paratype S. and 1 worker from Almora. Present in Z.S.I., Kolkata : (i) Sev. Im., S. and W. on the bank of River Ravi, Chamba Dist. Himachal Pradesh, India, G.S.Roonwal coll., 26.5.1970, ex wooden beam in hoof of a house.

Diagnostic character : (i) IMAGO : Head yellowish brown, paler other parts, both head and body fairly densely hairy. Head subcircular, lateral and posterior margins weakly outcurved. Fontanelle minute, placed almost at the middle. Eyes broadly oval, of median size., Ocelli absent. Antennae with 17 segments, 3 smaller than 2, 4 shortest. Postmentum weakly swollen with distinct median line. Labrum broadly tongue-shaped with broadly rounded anterior margin. Mandibles of typical *Heterotermes*-type. Pronotum with broadly rounded posterior margin and anterior with indistinct median emargination. Wing venation as in the genus. In forewing, cubitus with 11 branches. In hindwing, media arising from radius outside the scale, cubitus with 10 branches.

(ii) SOLDIER (Fig. 61.A-B) : Head yellowish brown, other parts paler. Head sparsely and body fairly hairy. Head subrectangular, sides weakly diverging anteriorly. Fontanelle minute leading to a small tube behind labrum, subtriangular with a sharply acuminate distal tip. Mandibles short, stout with very weakly apical tips, right mandible with a few crenulations. Antennae with 12–17 segments (generally 14–15), 2 subequal to 3 and 4, 3 shortest. Postmentum short and club-shaped, anterior half feebly bilobed laterally, widest width one-and-a half times wider than waist at the middle. Pronotum crescentic in shape with weak median emargination both on anterior and posterior margins.

Measurements : Table 29 (Im.); 36 (S.)

Types : Holotype s. in F.R.I., DehraDun

Distribution : Asia : India : Himachal Pradesh : Malha. Uttaranchal : Dehra Dun Dist.; Nainital Dist.; Almora Dist.; Tehri Dist.; Pauri Dist.; Dhikota; Pithoragarh Dist.; Rishikesh; Chamoli; Onbank of R. Ralr, Chamba Dist.

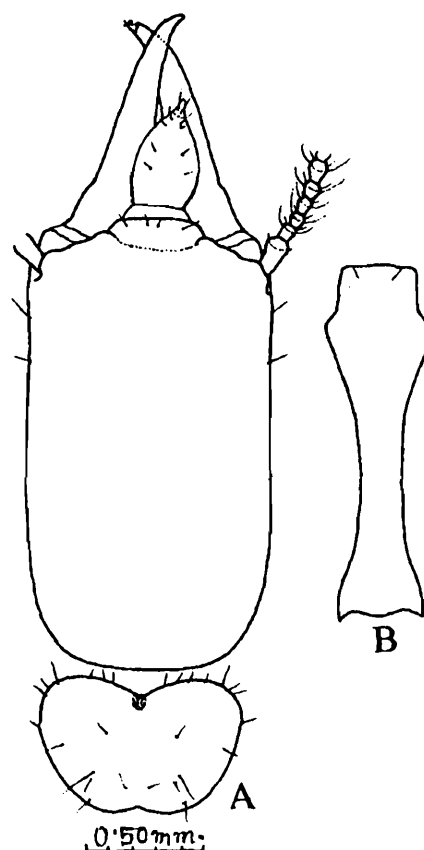


Fig. 61. *Heterotermes gertrudae* Roonwal ; A–B, soldier, A. Head and pronotum in dorsal view; B. postmentum.

Remarks : The species was a valid one since its first description until 1979 when Thakur and Sen-Sarma synonymised it under a very common species *H. indicola*. Later on, Roonwal and Chhotani (1989) had kept the species valid. It attacks mostly wood works in the building in the western part of the Himalaya. Recently, Verma (1995) maintained its valid status.

66. *Heterotermes hainanensis* (Tsai and Huang)

1. *Reticulitermes hainanensis* Tsai and Huang

1977. Tsai and Huang.

2. *Heterotermes hainanensis* (Tsai and Huang).

1983. Tsai and Huang, *Acta Ent. Sinica*, **26** (4) : 433, 436, S. Fig.2. China (Comb. nov.)

1986. Gao and Paul *Mem. Hong Kong nat. Hist. Soc.*, **17** : 82, China.

Material : Diagnostic characters are mainly based on illustrations given by Tsai and Huang, (1983).

Diagnostic character : (i) IMAGO : Unknown.

(ii) SOLDIER (Fig. 62.A) : Head large and strictly rectangular, head length two-thirds of

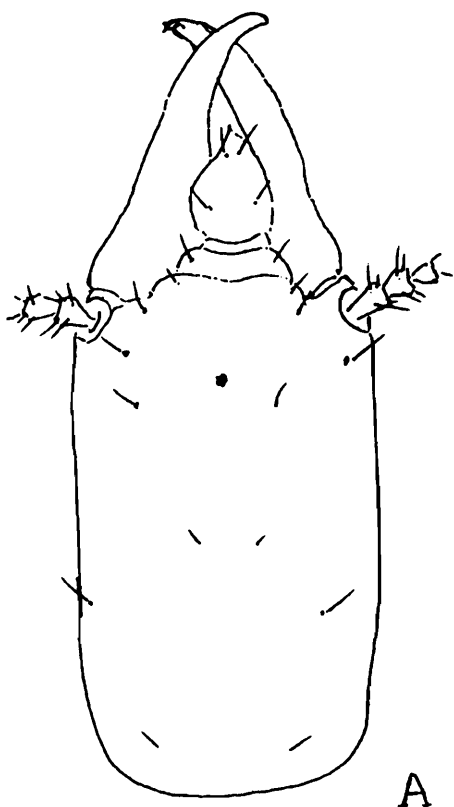


Fig. 62. *Heterotermes hainanensis* (Tsai and Huang) A. Soldier. A. Soldier, view. (Tsai and Huang, 1977).

head-width, lateral sides parallel and posterior margin almost straight. Fontanelle minute, placed almost on anterior fourth of head dorsum antennal segment 2 as long as 3 and 4 combined. Postclypeus distinctly marked. Mandibles slightly shorter than half the head length somewhat sickle-shaped with not so pointed apices.

67. *Heterotermes hunanensis* (Tsai and Peng)

1. *Reticulitermes hainanensis* Tsai and Peng

1980. Tsai and Peng.

2. *Heterotermes hunanensis* (Tsai and Peng).

1983. Tsai and Huang, *Acta Ent. Sinica*, **26** (4) : 435-436. (comb. nov.)

1986. Gao and Paul, *Mem. Hong Kong nat. Hist. Soc.*, **17** : 82, China.

Material : Characters are based on illustrations given by Tsai and Huang (1983).

Diagnostic characters : (i) IMAGO : Unknown

(ii) SOLDIER (Fig. 63. A) : Head rectangularly elongate more than one and a half times as wide

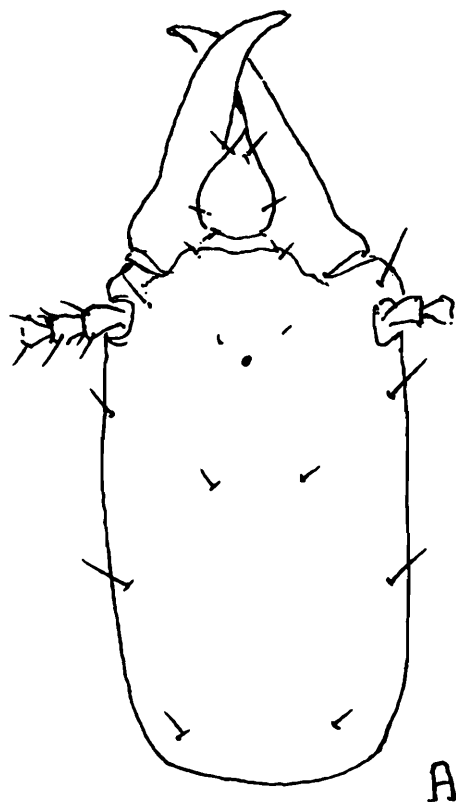


Fig. 63. *Heterotermes hunanensis* (Tsai and Peng) A-B, Soldier. A Head, dorsal view; B. Labrum. (Tsai and Peng, 1980).

as long, lateral sides substraight, posterior margin almost straight. Fontanelle minute, placed slightly below the anterior fourth. Anteclypens distinct. Labrem dome-shaped strongly outcurved lateral margin, maximum width slightly below the posterior third whence sharply converging anteriorly and terminating into a pointed hyaline apex being devoid any bristle. Mandibles very short much less than half the head length, somewhat straight with little incurved apices.

Distribution : ASIA : China.

68. *Heterotermes indicola* (Wasmann)

1. *Leucotermes indicola* Wasmann

1902. Wasmann. *Zool. Jb. (Syst.)*, 17 (1) : 118–119, S.W. Lectotype : S. (designated O.S.B. Chhotani), in *Nat. Hist. Mus.*, Maastricht. *Type-locality* : Bombay, India.

2. *Heterotermes indicola* (Wasmann).

1933. Snyder, *Proc. U. S. natnl. Mus.*, 82 (16) : 5.

1949. Snyder, *Smiths. misc. Colls.*, 112 : 68.

1958. Ahmad, *Biologia*, Lahore, 4 (1) : 68.

1970. Roonwal, in *Biology of Termites* (Eds. Krishna and Weesner, 2 : 333–334.

1979. Roonwal, *Termite Life and Termite Contr. Trop. South Asia* : 16, 38, 43, 45, 51, 52, 53, 56, 58, 61, 62, 117, 134, 143–146.

1980. Sen-Sarma and Thakur, *Indian. For. Rec. (N.S.) Ent.*, 14 (1) : 9–11.

1985. Chhotani, *Z. ang. Ent.*, 100 : 93.

1989. Roonwal and Chhotani, *Fauna of India (Isoptera)*, 1 : 487–491, Fig. 255 and 256.

1995. Verma, *Fauna of Western Himalaya*, Part 1, Uttar Pradesh (Uttaranchal), pp. 47–50, Z.S.I., publ., Kolkata.

Material : (i) In F. R. I., Dehra Dun : S. and W. (long series), Mysore, Pujab and from various States.

(ii) In Z.S.I., Kolkata : Sev. Ims., S. and W. (long series) from various localities.

Diagnost characters : (i) IMAGO (Fig. 64.A-E) : Head and thorax straw yellow to light brown,

other body parts paler. Head and pronotum fairly densely and abdomen more densely hairy. Head subsquarish with posterior and lateral margins. Head subsquarish with posterior and lateral margins weakly outcurved. Fontanelle small, placed slightly below the lower margins of eyes. Eyes of moderate size with moderately bulging out margin. Ocelli small and more separated from the eyes by its long diameter. Postclypeus with distinct median line with fairly hairy. Labrum broad with minute apical margin. Mandibles of typical *Heterotermes*-type. Pronotum flat, somewhat rectangular with broadly concave, anterior margin and with weak median emargination, wings as in the genus.

(ii) SOLDIER (Fig.64. F-G) : Head pale yellow to yellowish brown. Other body parts paler except mandibles. Head and pronotum with sparse hairy and abdomen more hairy. Head weakly diverging

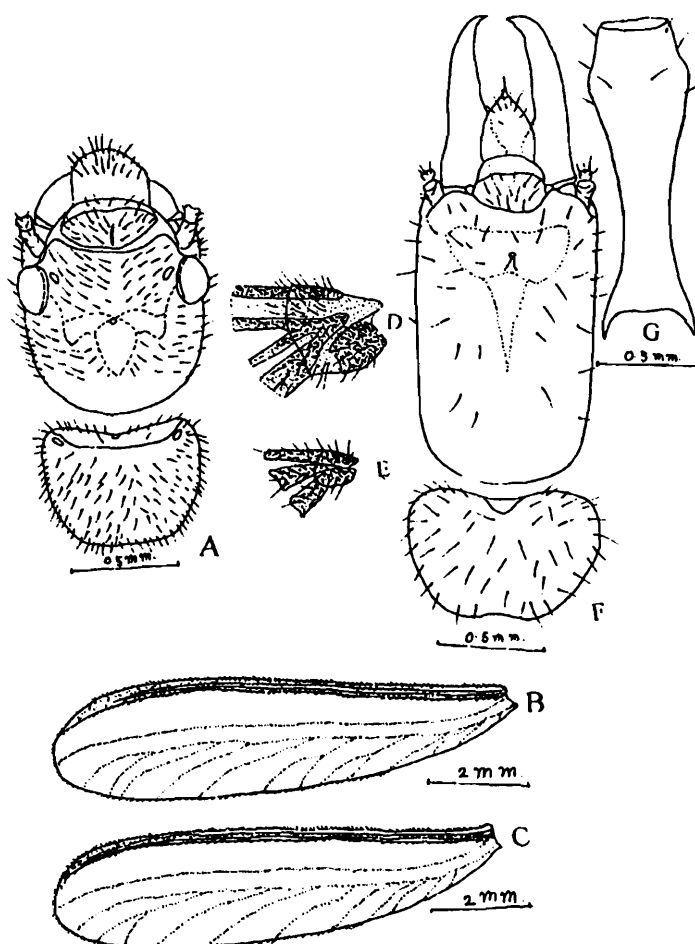


Fig. 64. *Heterotermes indicola* (Wasmann); A-E, Imago. A. Head and pronotum; B. forewing; C. Hindwing; D. Forewing-scale; E. Hindwing-scale; soldier. F-G, Soldier. F. Head and pronotum; G. postmentum.

anteriorly with round posterior margin. Fontanelle minute with distinct gland. Labrum lanceolate in shape with middle like hyaline apex and with a few hairs apically. Mandibles short and stout with loss incurved somewhat pointed apices. Antennae with 14–16 segments (normally with 15), 3 variable, either shorter or longer than 2. Postmentum club-shaped, maximum width on anterior fourth and waist almost at the middle. Pronotum with prominent emargination on anterior margin and feeble so on posterior margin.

Measurements : Table 29 (Im.); 37 (S.)

Types : Wasmann's type collection present in Naturhistorich Museum, Maastricht, Holland.

Distribution : ASIA : it is a very common wood-destroying termite in the Indian subcontinent and is found all over above 20° N latitude and extends upto Pakistan and Afghanistan.

Remarks : The species is reported to cause extensive damage to woodworks in houses as well as anything of cellulosic nature. The infestation in house can be made out from the galleries running on walls and ceiling to reach the wooden structure. The habits and biology of the species have been dealt by Roonwal (1955; 1970a), Mathur and Sen-Sarma (1959), Maiti (1983) and others. In Dehra Dun, it swarms in the middle of July generally when it is raining between 9 and 12 p.m. and it continues for an hour or so (Mathur and Sen-Sarma, 1959).

69. *Heterotermes insularis* (Wasmann)

1. *Leucotermes insularis* Wasmann

1902. Wasmann, *Zool. Jahrb, Abt. Syst.*, 17 (1) : 140, 160., S. *Type-locality* : Cocos Island (between Galapages and Costa Rica).

2. *Termes (Leucotermes) insularis* (Wasmann).

1904. Desneux, *Genera Insectorum*, 25 : 33.

3. *Heterotermes insularis* (Wasmann).

1944. Snyder, *Smiths. misc. Coll.*, 112 : 68 Cocos Isl.

Material : Since no material is available, the diagnostic character of the soldiers is based on Wasmann (1902).

Diagnostic character : (i) IMAGO : Unknown.

(ii) SOLDIER : Head pale rust yellow. Only slightly longer than broad, oval, narrowed anteriorly, fairly flat. Fontanelle opening distinctly marked. Labrum very small, hardly extending beyond mandibles, longer than broad, oval with a rounded apex. Mandibles somewhat straight upto the middle and then narrowly incurved with pointed apices.

Pronotum without any anterior lobe, widening anteriorly, anterior margin not bilobed, on the contrary entire margin shallowly emarginate, but without notch. Mese- and Metanotum slightly narrower than prothorax.

Measurements : Total body length 5.00 mm. Head with mandibles 2.80"

Types : In Wasmann's Coll., in Naturalist Mus. Maastricht, Holland.

Distribution : Cocos Island (between Galapages Isl. and Costa Rica).

Remarks : The species is so far known only from its type-locality.

70. *Heterotermes latilabrum* Tsai and Chen

Heterotermes latilabrum Tsai and Chen

1963. Tsai and Chen, *Acta. Ent. Sinica*, 12 (2) : 12, S. only
Type-locality : China.

Material : Since no material was available, characters were based on Isae and Chen, 1963.

Diagnostic character : (i) Imago : unknown.

(ii) Soldier (Fig. 65. A–B) : Head rectangular, thick and devoid of any antero-dorsal prominence, about one and a half times longer than wide, lateral sides feebly incurved, postero-lateral angles and posterior margins rounded. Fontanelle indistinct. Labrum dome-shaped, widest width slightly above the middle. Mandibles substraight thick at base whence

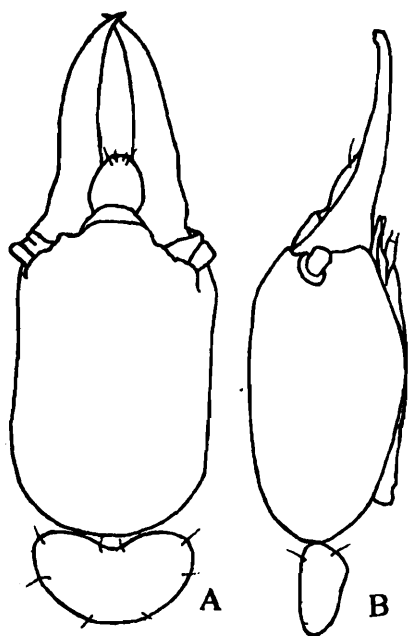


Fig. 65. *Heterotermes latilabrum* Tsai and Chen A-B. Soldier. A. Head and pronotum, dorsal view; B. Head and pronotum, side view (Tsai and Chen).

gradually narrowing apically and terminating into pointed apices. Pronotum kidney shaped, anterior margin weakly incurved, outcurved sides, anterolateral corners narrowly rounded and posterior margin cornex. Postmentum weakly arched.

Measurements :

Head-length	1.79 1.86
Head-width	1.10 1.10
Head height	0.86 0.86
Postmentum width (max.)	0.41 0.44
Postmentu width (min.)	0.15 0.15
Pronotum length	0.41 0.44
Pronotum width	0.90 0.90

Distribution : Asia : China

71. *Heterotermes longiceps* (Snyder)

1. *Leucotermes longiceps* Snyder

1924. Snyder, *Proc. ent. Soc. Wash.* 26 (5) : 20-21, S. Coxipe, Cuba, Brazil, (Type : S. U.S.N.M. No.25689 Silvestri believes the material from S. Ana, vial in Silvestri Coll. from Coxipe not *H. longiceps*).

2. *Heterotermes longicons* (Snyder)

1949. Snyder, *Smiths. misc. Coll.*, 112 : 68, S. Brazil.

1977. Mathews, *Acad. Brasil. Cien.*, Rio de Janeiro, p.14.

Material : Present in FRI, Dehra Deun : Is. and Iw., cotypes from type colony, Ana, Brazil, det. Emerson as '*Leucotermes tenuis*' and Coll. F. Silvestri.

Diagnsotic character : (i) IMAGO : Unknown.

(ii) SOLDIER (Fig.66.A) : Head straw yellow, lighter posteriorly, other body parts paler, except the mandibles with deep yellowish colour. Head and pronotum with very sparse hairs. Head somewhat rectangular, one and a half times longer than wide, sides parallel, posterior margin feebly outcurved. Fontanelle very minute at anterior fourth. Postclypeus transversely rectangular. Labrum somewhat dome-shaped, widest width, at the middle with rounded anterior margin and with a pair of hairs. Mandibles quite broad at base, with a few crenulations straight, abruptly hooked at the apices. Antennae broken.

Pronotum much narrower than head, anterior margin outcurved, but with deeply incised notch at the middle, antero-lateral angles broadly and

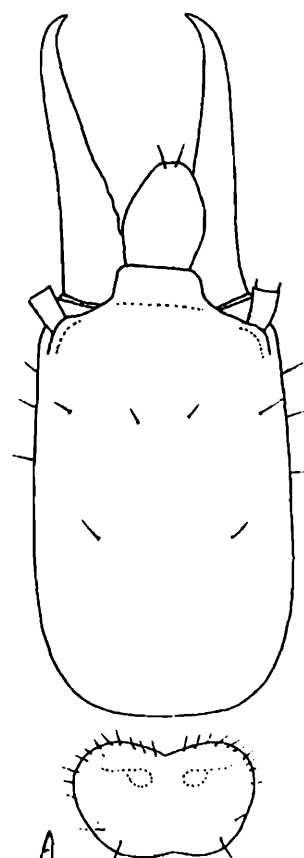


Fig. 66. *Heterotermes longiceps* (Snyder) A. Soldier. A. Head and pronotum, dorsal view.

uniformly rounded, posterior margin with a feeble median emargination.

Measurements : Table 38 (S.)

Types : S. in Usnm (No. 25689), Washington.

Distribution : AFRICA : South Africa. SOUTH AFRICA : Brazil and Argentina.

Remarks : The species had been collected in some occasions from the mounds of *Cornitermes snyderi* Emerson at the Campo/Cerroado margin at the Mato Grosso State, Brazil.

72. *Heterotermes malabaricus* Snyder

1933. Snyder, *Proc. U.S. Nantl. Mus.*, **82** (Art. 16) : 4-6.
Type-locality : Mangalore, Karnataka, India.

1949. Snyder, *Smiths. misc. Colls.*, **112** : 68.

1970. Roonwal, in *Biology of Termites* (Eds. Krishna and Weesner) **2** : 334.

1975. Sen-Sarma *et al.*, *Wood Destroying Termites of India* (Final Tech. Rep. PL.480 proj.) : 11, 24-25, 47, 64.

1964. Bose, *Occ. Pap. Rec. Zool. Surv. India*, No.49 : 79-81.

1989. Roonwal and Chhotani, *Fauna of India. Isoptera* (Termites) **1** : 491-494, Figs. 257.

Material : (i) *Present in Z.S.I., Kolkata* : 2 cotype alates from Mangalore, Karnataka, India. (ii) *Present in F.R.I., Dehra Dun* : 31 Cotype alates and 3 comorphotypes soldiers, South Mangalore, Karnataka, India.

Diagnostic characters : (i) IMAGO (Fig. 67.A) : Head and pronotum yellowish brown, other body parts generally paler. Head and pronotum densely and abdomen densely hairy. Head suboval, almost as long as broad, posterior margin uniformly round. Fontanelle small, almost at the level of posterior margin of ocelli. Y-suture distinct. Eyes uniformly round and fairly bulging out. Ocelli oval, slightly separated from the eyes. Postclypeus pronounced, demarcated by strongly chitinated frontal margin devoid of any median line. Labrum broadly rounded, apically with several hairs. Antennae with 13-16 segments (normally with 14), 3 shorter than 2, longer than 4. Mandibles of typical *Heterotermes* type.

Pronotum slightly narrower than head, anterior margin broadly concave with a feeble median notch, lateral margin uniformly out curved and narrowing posteriorly terminating in curved posterior margin.

Wings smoky with hairy margin and venation as usual like in the genus.

SOLDIER (Fig. 67.B-C) : Head and labrum light yellow to brown, other body parts paler, except mandibles. Head and pronotum fairly hairy and abdomen more hairy.

Head cylindrical, much longer than wide, lateral sides parallel and posterior margin round. Fontanelle minute with a narrow-tube. Antennae with 12-14 segments, 3 shortest. Labrum dome-shaped with a hyaline niddle-like tip with a few basal hairs. Mandibles almost straight with feeble incurved apices. Postmentum club-shaped, waist at posterior third. Pronotum distinctly narrower than head, anterior margin with deep emargination, antero-lateral coners uniformly round, lateral margin outcurved and posterior margin feebly incurved in the middle.

Measurements : Table- 32 (Im.); 37 (s.)

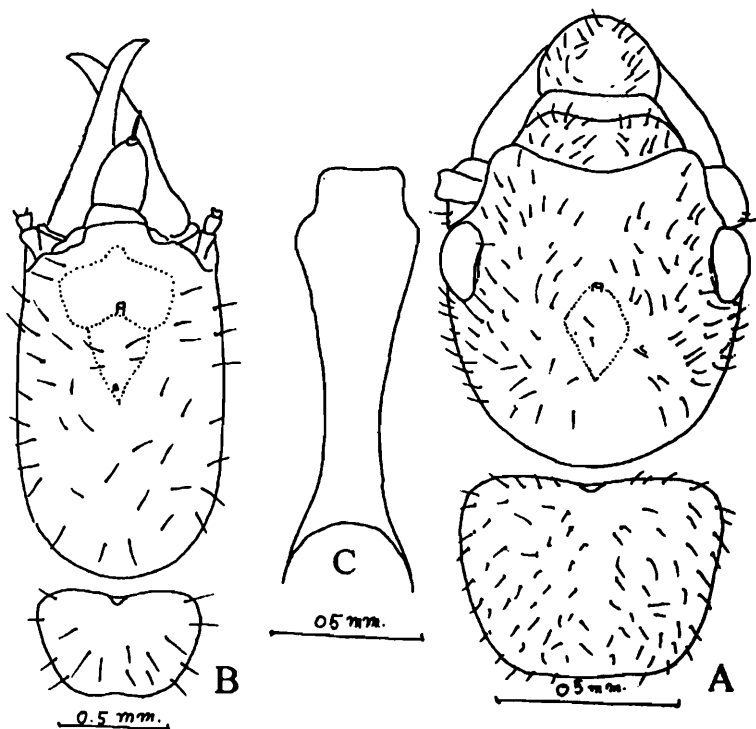


Fig. 67. *Heterotermes malabaricus* Snyder A. Imago; B-C. Soldier.

Type : (1) *Holotype* not selected by the original author. (2) Cotype image and comorphotype soldiers are deposited as follows : (i) In F.R.I., Dehra Dun, Brit. Mus. London and (ii) U.S. Nat. Mus., Washington, (3) One Lectotype S. in F.R.I., Dehra Dun.

Distribution : ASIA : India : The species is fairly wide spread in the Indian subcontinent below 20°N.

Remarks : The species is very close *H. balwanti* Mathur and Chhotani. It is recorded infesting a number of trees and plants, but not as pest of structural timber in house.

73. *Heterotermes omanae* Chhotani

1. *Heterotermes omanae* Chhotani

1988. Chhotani, J. *Oman Studies, Special Report*, No.3, 366–267. *Type-locality* : Bayt al Falaj Compound near Muscat, Oman.

Material : Present in Z.S.I., Kolkata : *paratype* S. from holotype lot. Bayt al Falaj Compound, near Muscat, coll. Md. Gallagher, 11.x.1982, "root stump of dead tree"

Diagnostic character : (i) IMAGO : Unknown [Some imagoes are collected at light in the same locality from where *H. omanae* Chhotani has been collected. Since these are not collected in association with the soldiers, Chhotani (1988, p. 367) has raised some doubt of their taxonomic status and kept as such. 'These imagoes' are darker and have larger eyes and longer wings than *H. wittmeri* Chhotani and Bose from Saudi Arabia.]

(ii) SOLDIER (Major) (Fig. 68.A-C) : Head pale golden yellow; postclypeus, antennae and labrum somewhat darker. Head and body sparsely hairy.

Head rectangular, much longer than wide, lateral margins either subparallel or weakly diverging anteriorly; frons sloping in front at an angle of about 45°, depressed medially and with dark swelling at base on either side. Fontanelle small, circular, situated almost on anterior fourth. Antennae with 15 segments, 2 subequal to 3 and

4 combined. Postclypeus not well marked, but somehow with a few hairs on anterior margin. Labrum triangular, with a transparent thin needle like pointed tip having a pair of bristles at base. Mandibles almost half the head-length, tapering towards weakly incurved apices. Postmentum long and club-shaped, broadest on anterior one-fourth and waist almost half the widest width. Pronotum flat, much wider than length, anterior margin deeply incurved medially and posterior margins substraight.

(iii) SOLDIER (Minor) (Fig. 68. D-E) : Much smaller and paler in colour than soldier major. Mandibles long and thin, longer than head and lateral margins substraight.

Measurements : Table-36 (s.)

Types : *Holotype* S. major and *Morphotype* (=paratype), S. miners and W. in Oman Nat. Hist.

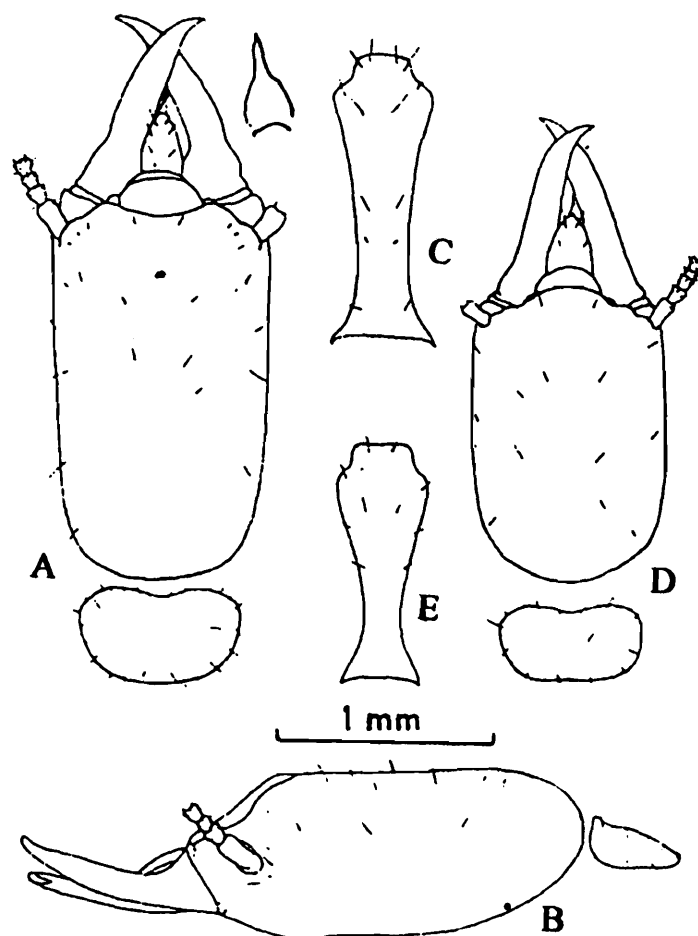


Fig. 68. *Heterotermes omanae* Chhotani, A-E, soldier. A. Head and pronotum; B. soldier and pronotum, lateral view (S. maj.); C. postmentum; D. Soldier and pronotum (S. min.); E. postments.

Mus.; Muscat. *paratypes* from *Holotype*-let in Nat. Zool. Coll., Z. S. I., Kolkata.

Distribution : ASIA : Oman : Bayt al Falaj; Rumays, Batinah; Jabal Akhdhar; Ghubra Bowl; Wade Ghazir, Dhofar; and Madinat Qaboos.

Remarks : The species comes near to *H. wittmeri* Chhotani and Bose from Saudi Arabia, but differs in having curved lateral sides of head, (straight in *wittmeri*), weakly curved head in profile, less acute labrum and less in curved anterior margin of pronotum. These characters are not pronounced in *H. wittmeri*.

74. *Heterotermes pamatensis* Kemner

Heterotermes pamatensis kemner

1934. Kemner, K. *Sven Vet. Akad. Handl.*, (3) 13 (4) 68–69. S. Saleier 1sl, south of Celebes, Indonesia.

1949. Snyder, *Smiths. misc. Coll.*, 112 : 69, S., Sabeir 1sl.

1958. Ahmad, *Biologia*, 4 : 71 (S. key).

Material : Since no material is available, diagnostic characters are based on kemner, (1934) and Ahmad (1958).

Diagnostic character : (i) IMAGO : Unknown.

(ii) SOLDIER : Head yellowish brown, antennal segments brown with yellowish tinge, sparsely hairy.

Head elongate and small, with parallel sides, slightly longer than broad. Labrum long and lanceolate in shape, with two long bristles of the apex. Mandibles moderately long with incurved apices. Antennae with 14 segments, 2 slightly longer than 3 and 4. Pronotum narrower than head width deeply notched anteriorly and slightly emarginate posteriorly.

Measurements : Table 39 (S.)

Types : Not known.

Distribution : ASIA : Indonesia : South Celebes : Sabier Island.

Remarks : The species comes close *H. teniur* Haviland.

75. *Heterotermes paradoxus paradoxus* (Froggatt)

1. *Termes paradoxus* Froggatt

1897. Froggatt, *Proc. Linn. Soc. New South Wales*, 22 : 721–758, Im., S. and W. Type-locality : Queensland : Mackay.

2. *Termes (Eutermes) paradoxus* Desneux

1904. Desneux, *Genera Insectorum*, 25 : 44.

3. *Leucotermes (Leucotermes) paradoxus* Holmgren

1913. Holmgren, K. *Sven. Vet. Akad. Handl.*, 50 (2) : 60.

4. *Leucotermes paradoxus* Hill

1927. Hill, *Mem. Nat. Mus. Melbourne*, No.7, pp. 41–45, Im, S. and W.

5. *Heterotermes paradoxus paradoxus* Hill

1942. Hill, *Australian CSIR*, p.473, Im. S. *Holo-lectotype* : Im; *Morpho-lectotype* : S. and W., C.S.I.R. coll.

1949. Snyder, *Smiths. misc. Coll.*, 112 : 69. Australia.

1970. Gay and Calaby, In : *Biology of Termites* (Eds. Krishna and Weesner), p.410 (Biology).

Material : Since no material is available for study, diagnostic characters are based on Hill, 1942.

Diagnostic character : (i) IMAGO (Fig.69.A) : Head pale yellowish with brownish tinge. Thorax and abdomen still paler.

Head rectangularly oval with dense short and long hairs, lateral sides and posterior margins weakly outcurved, frons depressed and rugose. Fontanelle minute, almost invisible. Postclypeus with a median line. Eyes small and subround, not strongly projecting laterally. Labrum small, distinctly convex, narrowed at base, widest at the middle and anterior margin round. Antennae with 17–18 segments, 3–6 variable, 3 shorterst. Pronotum slightly narrower than head, anterior and posterior margins with deep median notch, lateral sides converging posteriorly. Wings of

typical *Hoeterotermes*-type. Median vein with 1-2 branches, and cubitus with 9-11 branches.

(ii) SOLDIER (Fig.69.B) : Head orange yellow in colour. Head rectangularly elongate with parallel sides, posterior margin substraight or outcurved weakly. Fontanelle minute, placed in slightly depressed rugose area. Labrum short and wide, tapering anteriorly, but not with pointed apex. Antennae with 17-18 segments, 3 shortest. Mandibles weakly hooked with pointed apices. Pronotum with the posterior margin not so deeply emarginate as anterior margin.

Measurements : Table 31(Im.); 40 (5.)

Types : *Holo-lectotype* Im. and *Morpho-loctotype* S. and W. in CSIRO Coll., Melbourne.

Distribution : AUSTRALIA : Queensland : Mackay (type-locality), Townsville, Torrens Creek, Prairie, Millungera, Gordonvale, Brisbane, Cedar, Creek, Ravanshoe, Cairns, Bellenden ker, El. Arish, Utchee Creek, Innisfail, Home Hill, Cunnamulla and Dalby. Northern Territory : New Castle Waters, Barrow Creeks; Torres Strait : Banks Island.

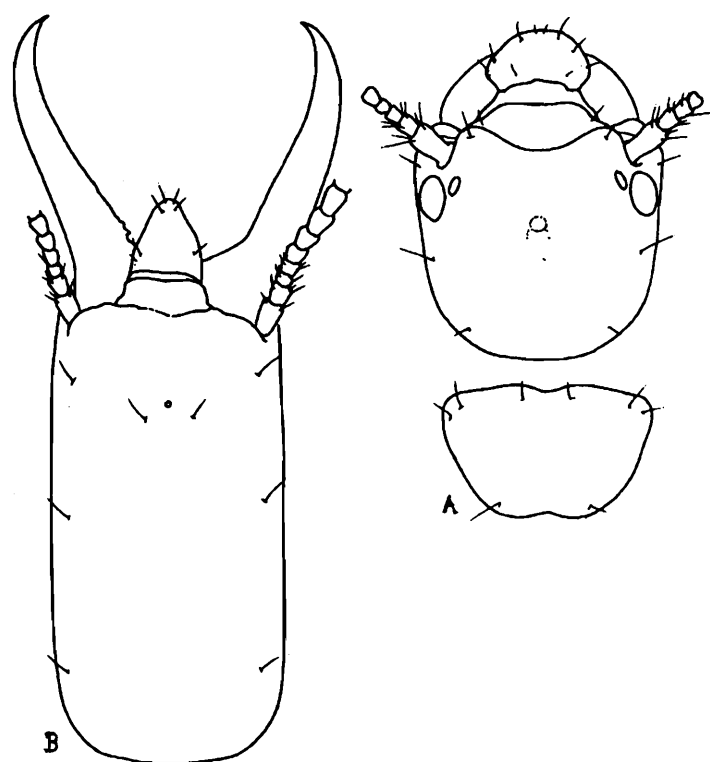


Fig. 69. *Heterotermes paradoxus paradoxus* (Froggatt) A, Imago. A. Head and pronotum, dorsal view; B, soldier. B. Head, dorsal view.

76. *Heterotermes paradoxus intermedius* Hill

1. *Heterotermes intermedius* Hill

1932. Hill, *Proc. Roy. Soc. Victoria* (NS), (2) 41 (7) : 85-96, Im. S. and W. Type-locality : near Kalgoorlie, Western Australia.

2. *Heterotermes paradoxus intermedius* Hill

1942. Hill, *Australian CSIR.*, Im., S. and W., p.128.

1949. Snyder, *Smiths. misc. Coll.*, 112 : 69.

1970. Gay and Calaby, In : *Biology of Termites* (Eds. Krishna and Weesner), 2 : 410 (Biology).

Material : Present in F.R.I., Dehra Dun : 1 Im. and 1S. (paratype) from type colony "*H. paradoxus intermedius*" near Kalgoorlie, Western Australia, 19.3.1928 (Hill coll.)

Diagnostic character : (i) IMAGO (Fig. 70.A) : Very much similar to *H. paradoxus paradoxus*, except the following characters :

Head, eyes and pronotum smaller. Wings

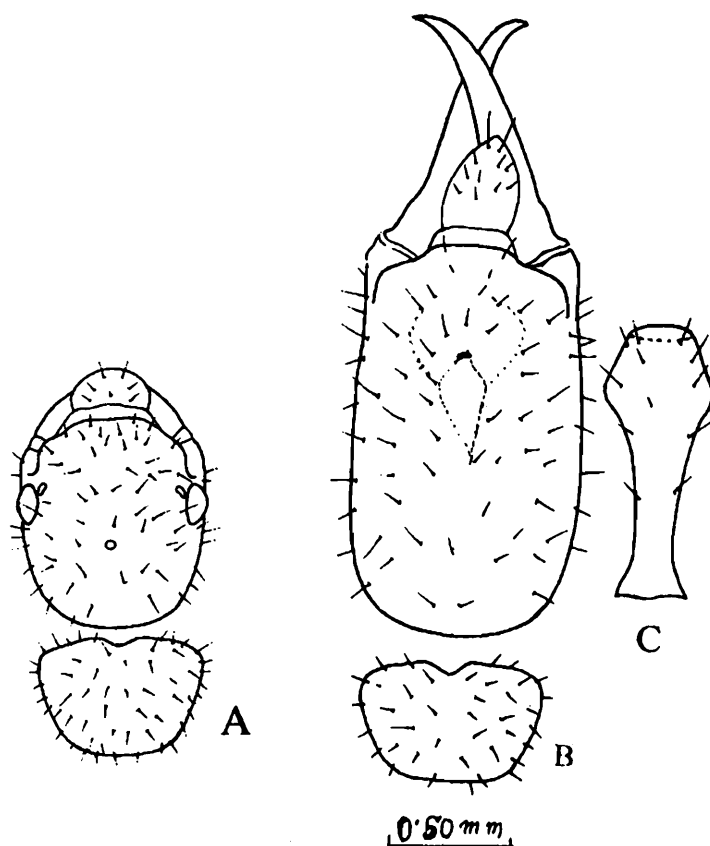


Fig. 70. *Heterotermes paradoxus intermedius* Hill A, Imago. A. Head and pronotum, dorsal view; B-C, Soldier. B. Head and pronotum, dorsal view; C. postmentum.

longer and darker. Ocelli present. Antennae with 16–18 segments.

(ii) SOLDIER (Fig. 70.B-C) : Similar to *H. paradoxus paradoxus* except the following features. Head narrow and cylindrical. Antennae with 16–17 segments.

Measurements : Table 31 (Im.); 40 (S.)

Types : *Holotype* Im. and *Morphotype* S. and W. in CSIR. Coll., Melbourne.

Distribution : AUSTRALIA : Western Australia : near Kalgoorlie (type-locality), Leenora, Tammin, Eradu and Bangulla.

77. *Heterotermes paradoxus validus* Hill

1. *Heterotermes validus* Hill

1932. Hill, *Proc. Linn. Soc. New South Wales*, 40 (1) : 83, Im., S. and W. *Type-locality* Australia : North Territory : Darwin (Koolpinyah).

1927. Hill, *Mem. Nat. Mus. Melbourne*, No.7 : 45

2. *Heterotermes paradoxus validus* Hill

1942. Hill, *Termites (Isoptera) from the Australian region*, Australian CSIR, (June), pp.129–130, Im. and S.

1949. Snyder, *Smiths. misc. Coll.*, 112 : 69.

1970. Gay and Calaby, In : *Biology of Termites* (Eds. Krishna Weesner), 2 : 410 (Biology).

Material : Since no material is available, characters are based on Hill, 1942.

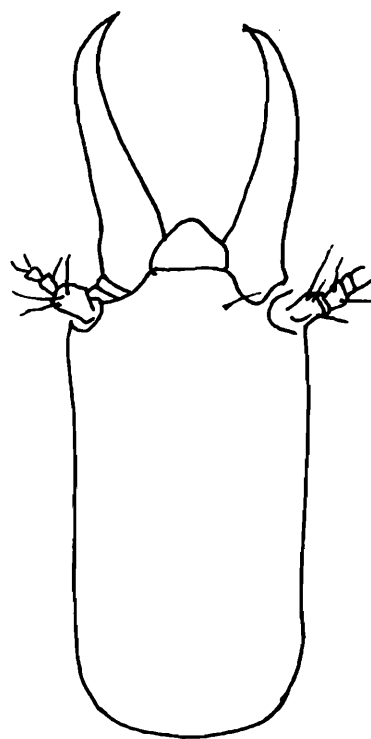
Diagnostic character : (i) IMAGO : very similar to typical *H. paradoxus paradoxus*, except with longer wings and absence of ocelli.

(ii) SOLDIER (Fig. 71.A) : very similar to typical *H. paradoxus paradoxus*, except having larger head and antennae with 16–18 segments.

Measurements : Table 31 (Im.); 40 (S.)

Types : *Holotype* Im. and *Morphotype* S. and W. in Nat. Mus., Melbourne.

Distribution : AUSTRALIA : Northern Territory : Darwin (type-locality), Koolpinyah.



A

Fig. 71. *Heterotermes paradoxus validus* Hill A, soldier. A. Head, dorsal view.

78. *Heterotermes paradoxus venustus* Hill

Leucotermes venustus Hill

1927a. Hill, *Mem. Nat. Mus., Melbourne*, No.7, p.55, Im. S. and W. *Type-locality* : Northern Territory : Stapleton (70 miles S. of Darwin), Australia.

1942. Hill, *Termites (Isoptera) from the Australian region*, 131–132, Im. S. and W. Australian C.S.I.R., June.

1949. Snyder, *Smith. misc. Coll.* 112 : 69.

1970. Gay and Calaby, In : *Biology of Termites*, (Eds. Krishna and Weesner), 2 : 410 (biology)

Material : A. Present in F.R.I., Dehra Dun : 4S. and 5 Im. (Autotype), Australia : Wyndham, Coll. H. J. Willings (Hill Coll.), det. Hill, material from Emerson's collection.

B. Present in ZSI, Kolkata : Im. with same data as above.

Diagnostic character : (i) IMAGO : Head light brown, fairly densely hairy, other body parts paler, except mandibular margin. Fontanelle indistinct. Postclypeus convex, much broader than long. Labrum whitish, hairy, much wider than long with broadly rounded apical margin.

Antennae broken, segment as in *Heterotermes*. 2 and 3 subequal, 4 smallest. Mandibles typically of *Heterotermes*-type. Eyes subround, not distinctly bulging out, placed more than its long diameter from the lateral margins of head. Ocelli not visible. Pronotum slightly narrower than head, anterior margin weakly concave with a feeble median notch, lateral margins converging posteriorly, posterior margin with weak median emargination. Wing as in the genus.

(ii) **SOLDIER** (Fig. 72.A) : Head densely hairy and yellowish in colour, other body parts paler. Very much similar to *H. paradoxus vagus*, except the following characters.

Head densely covered with minute hairs, lateral and posterior margins roundish, otherwise subrectangular in shape. Fontanelle small and round, and placed in shallowly depressed area with fine rinkles around. Labrum wider and shorter with rounded apical margin. Mandibles long and somewhat substraight with gradually narrowing anteriorly and terminating into finely pointed less incurved apices. Antennae with 16 segments, 2 and 3 subequal.

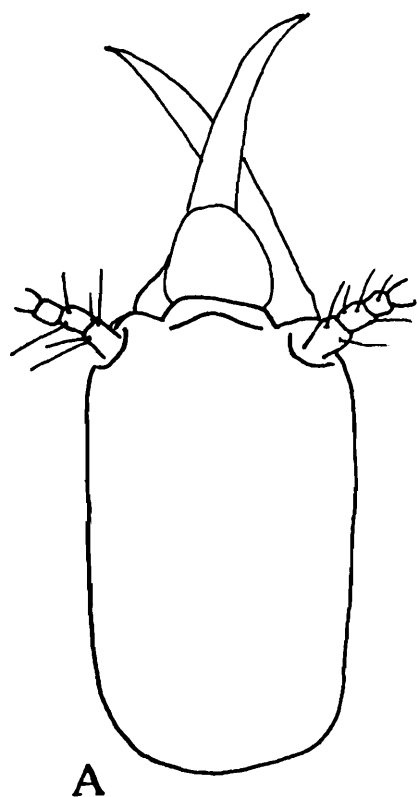


Fig. 72. *Heterotermes paradoxus venustus* Hill A, soldier. A. Head, dorsal view.

Measurements : Table-30 (Im.); 42 (S.)

Types : *Holotype* S. and Im., and *Morphotypes* S. and W. in Nat. Mus., Melbourne.

Distribution : Australia : Northern Territory : Stapleton (type-locality). Western Australia : Wyndham.

79. *Heterotermes perfidus* (Silvestri)

1. *Leucotermes perfidus* Silvestri

1936. Silvestri, *Bull. Soc. Ent. France*, **41** (10) : 203-205, S., St. Helons Isl.

2. *Heterotermes perfidus* (Silvestri)

1949. Snyder, *Smiths. misc. Coll.*, **112** : 70. S., st. Helena Isl.

1967. Gay, *Div. of Ent.*, CSIRO; p.26, Im. (described for the first time from Scotland stn., st. Helona Isl.)

1982. Chhotani and Bose, *Fauna of Saudi Arabia*, **4** : 81.

Material : Since no material is available for study, diagnostic characters are based on Gay (1967) for Im. agos and Silvestri (1936) for soldiers.

Diagnostic character : (i) **IMAGO** : (After Gay's (1967) first description.) Body fairly brown, legs, antennae and postclypeus and wings pale brown. Body densely clad with long hairs. Head slightly longer than wide, posterior margin broadly and uniformly round. Fontanelle indistinct, placed at the level of posterior margin of eyes. Postclypeus convex with a distinct complete median line. Labrum dome-shaped with a few hairs. Eyes triangular. Ocelli small, oval and separated from the eyes by their long diameter. Antennae with 20-21 segments, 3 smallest, 3-6 smaller than the rest. Mandibles of typical *Heterotermes*-type.

Pronotum narrower than head, moderately hairy, anterior margin with distinct median notch, posterior margin weakly concave.

In wings, median closer to cubitus than to radial sector and fairly distinct throughout its length. Radial sector with cross veins to median; cubitus with 7-10 branches.

(ii) SOLDIER (Fig. 73.A) : (Based on Silvestri, 1936 and illustrations by Gay, 1967) Head straw yellow, other parts pale except mandibles with deep brown in colour. Head and pronotum fairly hairy and abdomen more posteriorly densely hairy. Head subrectangular, longer than broad, sides parallel and posterior margin indistinctly outcurved. Fontanelle small placed almost at anterior fifth in depressed area. Antennae with 18 segments, 3 subequal to 2, 4 smallest. Postclypeus prominent with a pair of hairs. Labrum widest at the middle where laterally angularly outcurved, anterior margin substraight with a few hairs. Mandibles stout and strong, straight before fairly incurved apices. Pronotum almost as broad as head or slightly narrowed than head, anterior margin convex, but with angularly notched distinctly at the middle, antero-lateral angles broadly and uniformly round, posterior margin with feeble median emargination, margin with scattered hairs.

Measurement : Table 34 (S.)

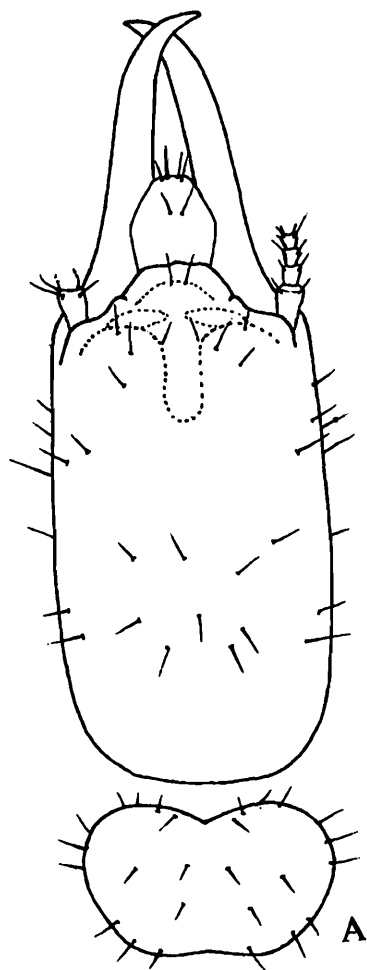


Fig. 73. *Heterotermes perfidus* (Silvestri) A, soldier, A. Soldier and pronotum.

Types : *Morphotype* Im. (Female) in Div. Ent., CSIRO, Canberra; and *Paratype* Im. in BMNH, London and in AMNH, New York.

Distribution : ASIA : Scotland Stn., St. Helena Island.

Remarks : The species was originally described by Silvestri (1936) based on material (Soldiers only) from St. Helena. The status and origin are still not clear, although it is certainly an introduced species in this Island. The imagoes had been described for the first times by Gay (1967).

Primarily, the species had been thought to have come from African coast and close to *H. tenuis* (Hagen) known from Brazil, Guianas and Panama (Emerson, 1936). Now, it is regarded as a good species and is introduced in this Island in the nineteenth century from an unknown source (Gay, 1967). It is now widely distributed in this Island causing extensive damage to houses and furniture, scented geranium plant, etc. (Froggatt, 1915; Harris, 1953) amounting to huge economic loss.

80. *Heterotermes philippinensis* (Light)

Leucotermes philippinensis Light

- 1921. Light, *Philippine J., Sci.*, **19** (1), p.58, S. and W. *Type-locality* : Manila, Philippines.
- 1936. Moutia, *Bull. Mauritius, Deep. Agr. Sci. Ser.*, **21** : 17, Im. and S., Port Louis, Mauritius (introduced).
- 1949. Snyder, *Smiths. misc. Coll.*, **112** : 70, Im. S. and W.
- 1949. Cachan, *Mem. Inst. Sci., Madagascar*, (A) **3** : Madagascar (introduced).
- 1970. Paulian, in : *Biology of Termites* (Eds. Krishna and Weesner), **2**, pp. 282, Madagascar.

Material : Since no material is available, description and illustrations are based on Light (1921), and Moutia (1936).

Diagnostic character : (i) IMAGO : Head light yellow; antennae, labrum and abdomen paler; thorax and legs still paler.

Head moderately hairy, a little longer than broad, widest behind eyes, whence narrowing

posteriorly. Labrum as long as broad, tip bluntly round with 2-3 short bristles. Frons depressed between clypeus and fontanelle. Postclypeus broader than long and convex with a median groove. Eyes small nearly round with distinct facets, placed slightly behind lateral margin of head and separated from lower margin by a distance equal to half diameter of eyes. Ocelli absent. Fontanelle small, placed about midway between clypeal suture and posterior margin of head. antennae with 17 segments, sparsely pulsescent, 2, 4 and 5 subequal, 3 almost half the 2.

Pronotum slightly wider than long, slightly narrower than head, widest anteriorly, anterior margin with median concavity, posterior margin nearly round. Meso- and Metanotum narrower than pronotum.

Wing scales as long as pronotum; wings straw colour. Median running near to middle of wings, but closer to cubitus than to subcosta. Cubitus with 7-8 branches.

Measurements :

Length of wings	9.10
Body length without wings	3.50-4.00
Head with labrum	1.10-1.12
Head length to fontanelle	0.50
Width of head	0.80
Diameter of eyes	0.26
Width of pronotum	0.74
Length of forewing	7.80
Width of forewing	1.90

(ii) SOLDIER (Fig.74.A-B) : Head chestnut brown, labrum, base of mandibles, pronotum paler; mandibles blackish brown. Head and pronotum sparsely hairy, abdomen more hairy.

Head subrectangular, lateral margins feebly outcurved with rounded posterior margin. Fontalle indistinct, placed slightly above the middle, frontal gland transparent and triangular in shape. Labrum lanseolate in shape with hyaline

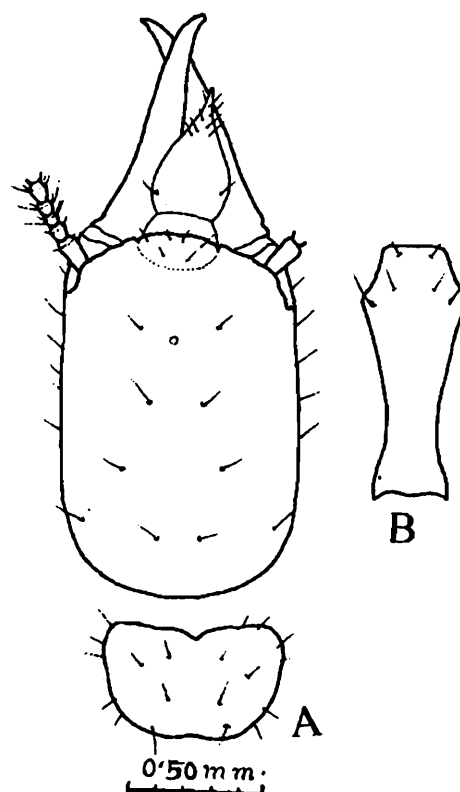


Fig. 74. *Heterotermes philippinensis* (Light) A-B, Soldier, A, Head and pronotum, dorsal view; B, postmentum.

niddle-like projection. Mandibles substraight with very weakly hooked apices. Antennae broken, 3 smallest slightly longer than 2 and 4. Postmentum as long as mandibles, widest width slightly below the apical margin and with distinctly projected lateral corners, waist at posterior third. Pronotum narrower than head, anterior margin convex with distinct median notch, posterior margin weakly outcurved.

Measurements : Table 39(s.)

Types : Repository unknown.

Distribution : ASIA : Philippines : Manila. Madagascar and Mauritius (introduced).

Remarks : The species is well known as a pest attacking timber, buildings, furniture, books in Madagascar (Paulian, 1970).

81. *Heterotermes sulcatus* Mathews

1. *Heterotermes sulcatus* Mathews

1977. Mathews, Acad. Brasil. Ciencis, p.19.

Material : Since no material was available for study, the characters were based on Mathews (1977).

Diagnostic characters : IMAGO (Fig. 75.A) : Head pale yellow with patches of yellowish brown patches on vertex, as postclypeus and antennae yellowish white, pronotum yellowish brown. Wings translucent, subcosta and radius sector pale yellow.

Head, postclypeus and labrum with stout long and fine short setae sloping forward, pronotum with many stout hairs.

Head elongate, sides almost straight, posterior margin semicircular. Eyes less bulging out. Ocelli inconspicuous, broadly oval, very close or almost touching the eyes. Fontanelle small and raised above the vertex. Antennae with 16 segments, 2 longer than 3, 3 and 5 subequal. Pronotum narrower than head, anterior margin indented.

Measurements :

Head-length	0.77–0.80
Head-width across eyes	0.77–0.79
Max. diameter of eye	0.22–0.23
Max. diameter of ocellus	0.05–0.06
Min. diameter of ocellus	0.04–0.05
Eye-ocellus distance	0.00–0.01
Pronotum-width	0.62–0.65
Pronotum-length	0.46–0.48
Length of forewing	8.25–8.50

(ii) SOLDIER (Fig. 75.B) : Head pale yellow, paler posteriorly; frons, postclypeus and antennal sockets and labrum darker yellow. Head with sparse setae anteriorly.

Head with parallel sides and with round posterior margin, sloping in front with bilobed frons, V-shaped furrow in between lobes. Frontal gland opening immediately behind the furrow. Labrum broadest at posterior one-third. Left mandible with 4 rudimentary teeth at base. Postmentum broadest near the front, more than twice as broad as on waist. Pronotum subcordate, broader than long, posterior margin either straight or weakly concave.

Measurements (in mm) :

Head-length	1.23–1.35
Head-width	0.70–0.76
Mandible-length	0.89–0.96
Pronotum length	0.37–0.46
Pronotum width	0.52–0.61

Types : In (i) Mus. de Zoologia, Univ. of Sao Paulo; and (ii) Brit. Mus. Nat. Hist, London (are to be deposited, Methews, 1977)

Distribution : SOUTH AMERICA : Brazil : Mato Grosso state, Cerrado.

Remarks : In its imago character, the species is close to *H. convexinotus* (Snyder), *H. cardini* (Snyder) and *H. aureus* (Snyder), but differs from the former two in having antennae with 16 segments (not 17), longer postclypeus and less eye-ocellus distance. Its soldiers differs from *H. convexinotus* and other neotropical *Heterotermes* in having steeply sloping frons with deeper medial

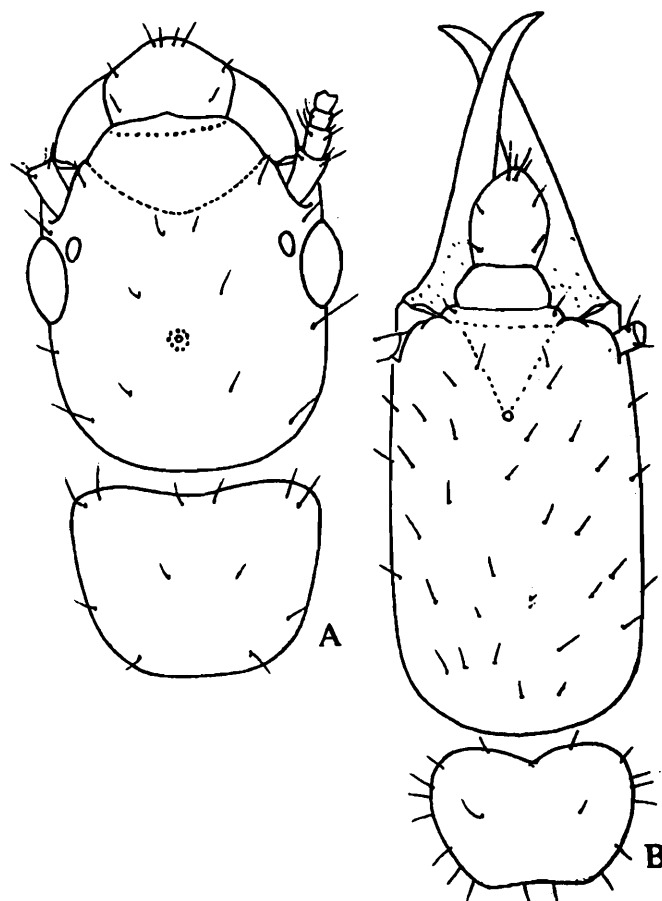


Fig. 75. *Heterotermes sulcatus* Mathur A, Imago. A. head and pronotum dorsal view. B, Soldier. Head and pronotum, venter view.

furrow. The species had been collected from dead trees in its rotten portion and fother logs (Mathews, 1977).

82. *Heterotermes tenuior* (Haviland)

1. *Termes tenuior* Haviland

1913. Holmgren, K. *Sven. Vet. Akad., Handl.*, 50 (2) : 63-64.

2. *Leucotermes (Leucotermes) tenuior* Holmgren

1913. Holmgren, K. *Sven. Vet. Akad., Handl.*, 50 (2) : 63-64.

3. *Heterotermes tenuior* (Haviland)

1949. Snyder, *Smiths. misc. Coll.*, 112 : 70.

1958. Ahmad, *Biologia*, 4 : p.69 Im. and S. (key)

1982. Thapa, *Sabah For. Rec.*, No.12, pp. 71-74 S. and W. Sabah.

Material : Present in F. R. I., Dehra Dun : Sev. S. and W. from Sepilok Forest, Dist. Sandakan South, Coll. R. S. Thapa, 11-VI-1968, ex. "rotten wood".

Diagnostic character : (i) IMAGO : Based on description of Holmgren (1913).

Body brownish yellow, paler on underside, wings whitish, fairly densely hairy. Head rectangularly oval, longer than broad. Fontanelle distinct. Eyes relatively small, somewhat bulging out. Ocelli of medium-size separated from the eyes by their long diameter. Postclypeus very short. Antennae with 15 segments, 3 shorter than 2, 4 longer than 3. Pronotum small, both anterior and posterior margins notched, much longer than its half width. Wings long, relatively slender. Wing membrane, densely punctate and less thickly hairy. Median plain. Cubitus with about 10 widely spread branches.

Measurements :

Length of wings	8.5-9.0 mm.
Body length without wings	4.5-5.0 "
Length of anterior wing	7.5 "
Head length	0.99 "

Head width	0.80 mm.
Width of pronotum	0.61 "
Length of pronotum	0.38 "

(ii) SOLDIER (Fig. 76.A-F) : Head deep yellow with other body-parts paler, except the reddish brown mandibles. Head and pronotum very densely hairy.

Head elongate with feebly outcurved lateral margins posterior margin substraight. Fontanelle minute, placed on anterior fifth. Antennae with 13 segments, 2 one-and-a half times as long as 3, 4 subequal to 3. Postclypeus less than half as long as wide. Labrum lanceolate in shape with hyaline pointed apex and with a pair hairs. Mandibles substraight with weakly incurved apices. Postmentum club-shaped, widest width on anterior fourth, waist at below the middle, and fairly hairy. Pronotum slightly narrower than head, anterior margin outcurved with a distinct notch at the middle, distinctly narrowed posteriorly, posterior margin indistinctly emerginate.

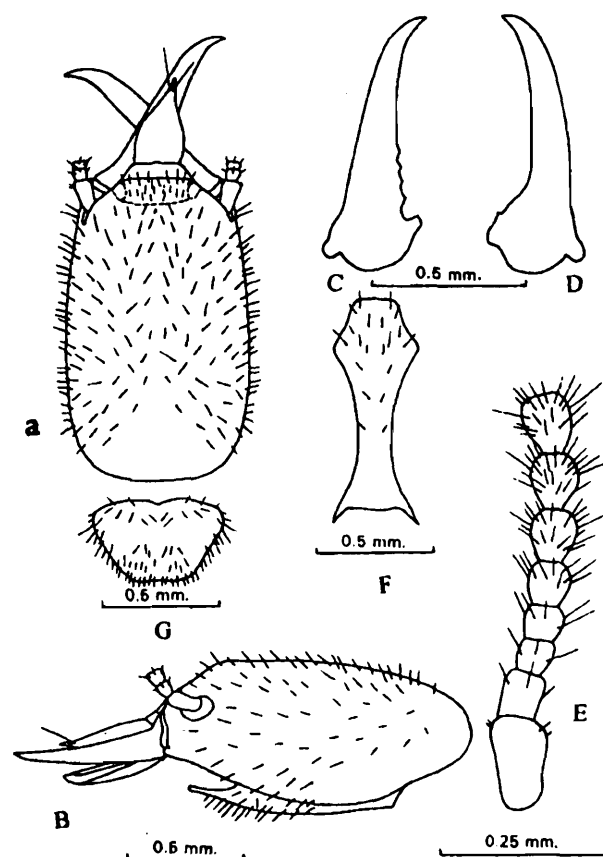


Fig. 76. *Heterotermes tenuior* (Haviland); A-F, soldier. A. soldier and pronotum, dorsal view, B. soldier, lateral view; C-D. Mandibles, E. Antennae, F. Postmentum.

Measurements : Table 33 (S.)

Types : Repository unknown.

Distribution : ASIA : Malayasia : Borneo, Sarawak (type-locality). Sabah : Dist. Kalabakam : Brantian ; Luasong; Umas Umas. Dist. Kunak-Mostya : Kalimpong, dist. Labag : Balat; pin. Dist. Sandakan North : Kolapis, Dist. Sandakan South : Sepilok. Dist. Beaufort. Dist. Kota Kinabalu : Lumat.

Remarks : The species has been collected mostly from rotten wood in Sabah (Thapa, 1982).

83. *Heterotermes tenuis* (Hagen)

1. *Termes tenuis* Hagen

1858. Hagen, *Linn. Entomol.*, 12 : 231, Im., st. Domingo, near port au prince, Colombia, Brazil.

1898. Haviland, *Journ. Linn. Soc. London*, 26 (169) : 399, pls. 22-25 (Read June 6, 1897). Brazil and West Indies.

2. *Leucotermes tenuis* Silvestri

1901. Silvestri, *Boll. Mus. Zool. Anat. Comp. Torino*. 16 (389) : 1-8, Paraguay.

1903. Silvestri, *Redia*, 1 : 38, Portici, Im. S. and W.

1906. Holmgren, *Zool. Jahrb. (Abt. Syst.)* 23 : 540-542, 81 figs., June 16, Im. S. and W. Bolivia, Peru.

1918. Banks, *Amer. Mus. Nat. Hist.*, 38 (17) : 663.

1920. Banks, (and Snyder), *U. S. nat. Mus. Bull.*, No.108, p.76, 70 figs.

1925. Emersen, *Zoologica*, 6 (4), 340-341, 1 pl., 94 figs., Im. and S.

1926. Snyder, *Proc. U. S. nat. Mus.*, 68 (14) : 12.

3. *Heterotermes platycephalus* Froggatt

1896. Froggatt, *Proc. Linn. Soc. New South Wales*, (2) : 10, 550-551, July 31, winged, South Australia, Kangaroo Island.

1942. Hill, *Australian Council Sci. and Indus. Res.*, June, Im., S. and W. 473 pp., 24 pls., 353 figs.

4. *Heterotermes tenuis* (Hagen)

1970. Araujo, In : *Biology of Termites* (Eds. Krishna and Weesner), 2 : 544, Biology.

1977. Mathews, *Acad. Brasil Cien*, Rio de Janeiro, p.85.

Material : Present in F. R. I., Dehra Dun : 6 Adult, 13S. and 5W from Australia : Swan River.

Diagnostic character : (i) IMAGO (Fig. 77A) : (based on Hill, 1942). Head and wings light brown, clypeus and legs paler. Head small, a little longer than broad, widest at the eyes, posterior margin broadly round. Frons sloping anteriorly and depressed. Eyes subtriangular, usually flattened, not projected beyond the sides of head. Ocelli very small, placed from the eyes by its one-half of length. Fontanelle small but distinct. Antennae with 17-19 segments, 3 shorterst. Pronotum subtriangular, anterior margin weakly outcurved with a shallow median notch, lateral sides distinctly converging posteriorly and terminating into a emarginate posterior margin.

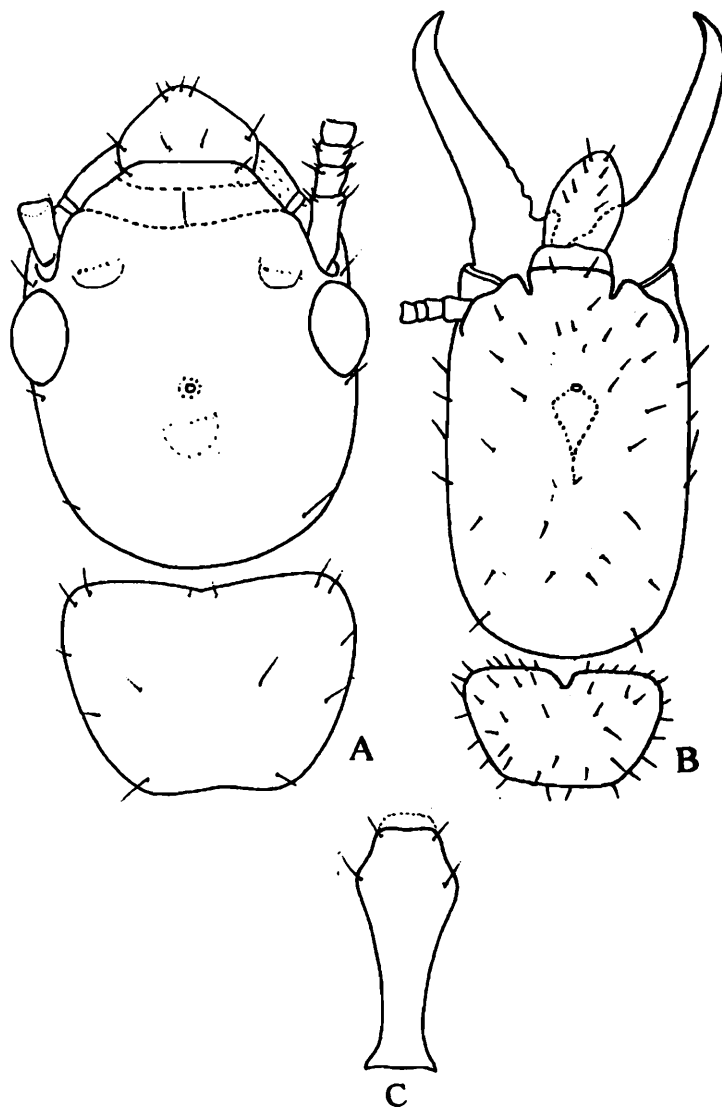


Fig. 77. *Heterotermes tenuis* (Hagen) A. Imago. A. Head and pronotum, dorsal view. B-C, Soldier. B. Head and pronotum, dorsal view; C. postmentum.

Wings : Stumps of forewing almost one-third longer than that of hind-wings, not even reaching the base of hind wings. In forwing, costal border and radial sector stout, median more stout at base, a little closer to cubitus than to radius, becoming indistinct with 2-3 branches. Cubitus with 5-7 distinct branches, other becoming indistinct.

(ii) **SOLDIER** (Fig. 77. B-C) : Head, labrum, antennae and mandibular base bright yellow, thorax pale yellow. Head rectangularly elongate with parallel sides, at times slightly narrowing posteriorly. Fontanelle small placed a little above the middle leading to some what depressed frons, antero-lateral prominence distinct. Postclypeus a little less than four times wider than long. Antennae with 16-18 segments, 3 shortest. Labrum large, conical, as long as its width at base. Pronotum convex in front with deep median notch, sides narrowed posteriorly, posterior margin deeply incised.

Measurements : Table 38 (S.)

Types : Of *H. tenuis* (Hagen) in Vienna Mus., Austria and of *H. platycephalus* Froggatt : *Holoneotype* winged form and *morphoneotype* soldier in C.S.I.R.O, Australia.

Distribution : CENTRAL AND SOUTH AMERICA : Guyana : Oko River. Guatemala. Brazil : Mate Grosso. Bolivia, Peru, Panama, West Indies : Trinidad; Barbados and Santa Helena (Introduced).

Remarks : The species is very common in Brazil being recorded under rotting trunk, under bark, amongst books, papers, and in the gallery of abandoned *Cornitermes* nest. In Trinidad, it is very common and regarded as most destructive species, and in Panama it is found to infest sugarcane. The species is known to swarm in October and November (in Bolivia and Peru) and its winged forms are found in nest in the months of May, June, July, October and November in West Indies (Araujo, 1970, Mathew, 1977). The species is found in the large earthen mounds of *Cornitermes snyderi* Emerson in Brazil (Mathews, 1977).

84. *Heterotermes vagus* (Hill)

1. *Leucotermes vagus* Hill

1927. Hill, *Mem. Nat. Mus. Melbourne*, No. 7, pp. 134-136, S. and W. *Type-locality* : Northern Territory : Darwin, Australia.

2. *Heterotermes vagus* Hill

1942. Hill, *Termites (Isoptera) from the Australian region*, pp. 134-136, Im. and S. Australian C.S.I.R.O. Publ.
1949. Snyder, *Smiths. misc. Coll.*, 112 : 71.
1970. Gay and Calaby, In : *Biology of Termites* (Eds. Krishna and Weesner), 2 : 411 (biology).

Material : Present in F.R.I., Dehra Dun : 2S., 3 Im. and 2W., Books Creek, Northern Territory, Australia, Coll. T. G. Campbell, 6.xii.1931. (Morphotype colony, Metatype and Autotype, det. G. F. Hill), collection from Emerson, U.S.A.

Diagnostic character : (i) **IMAGO** (Fig.78.A) : Head and other body parts of uniform light brown in colour. Head subround, weakly narrowing posteriorly with dense hairs. Fontanelle indistinct. Postclypeus much wider than long with incomplete median line. Anteclypeus whitish. Labrum broadly round with a few erect hairs anteriorly. Eyes large, very feebly bulging out. Ocelli absent. Fontanelle small and distinct. Antennae with 15 segments, 3 generally smallest. Pronotum very little narrower than head, densely hairy, anterior margin concave and posterior margin broadly round, both devoid of median emargination. In forewing, median vein with 1-2 branches, cubitus with 9-11 branches.

(ii) **SOLDIER** (Fig. 78.B-C) : Small yellowish brown, mandibles darker, pronotum and legs paler. Head pilose, longer than broad, widest at the middle, broadly rounded posterior margin. Fontanelle distinct, small, placed much above the middle. Labrum lanceolate in shape with pointed hyaline apex with a few erect hairs. Mandibles straight with weakly incurved pointed apices. Antennae with 12-14 segments, 3 smallest. Pronotum convex, anterior margin notched medially and posterior margin shallowly sinuate.

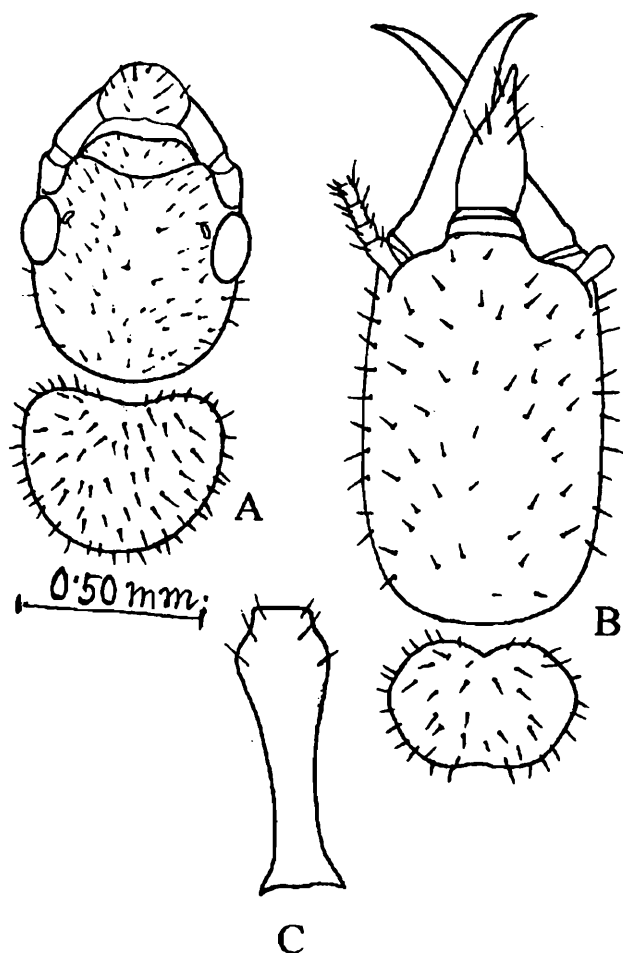


Fig. 78. *Heterotermes vaugs* Hill A, Imago. A. Head and pronotum, dorsal view. B-C, Soldier. B. Head and pronotum, dorsal view; C. postmentum.

Measurements : Table 31 (Im.); 42 (S.)

Types : Holotype S. and Morphotype W., in Nat. Mus., Melbourne; and Morphotype 1m. in C.S.I.R. Coll., Australia.

Distribution : AUSTRALIA : Northern Territory : Darwin (type-locality), Brock's Creek.

85. *Heterotermes wittmeri* Chhotani and Bose

1. *Heterotermes wittmeri* Chhotani and Bose

1982. Chhotani and Bose, *Fauna of Saudi Arabia*, 4 : 78-81. Im., S. and W. Type-locality : Hakimal, Saudi Arabia.

1985. Chhotani and Bose, *Fauna of Saudi Arabia*, 7 : 123, Turaba and Wadi Bani Malek.

Material : Present in Z.S.I., Kolkata : 1 Im. (Morphotype = paratype) and 1S. (paratype).

Diagnostic character : (i) IMAGO (Fig. 79. A-C) : Head pale yellow with pale brownish mark

around the fontanelle area, other parts of the body paler except mandibles. Head and body fairly densely hairy and wings with hairs along margin.

Head subrectangular, side substraight. Y-suture faintly marked. Fontanelle minute and circula, placed at the middle. Eyes broadly oval with anterior margin substraight. Ocelli separated from the eyes by less than shortest diameter of eyes. Antennae with 16 segments, 2 short and cylindrical, 3 shorter than 2, 4 shortest. Postclypeus swollen, median line distinct. Mandibles as in the genus. Pronotum slightly narrower than head, anterior margin with a median distinct notch, margins convex and posterior margin feebly incurved.

Forewing : Scale reaching upto base of hindwing scale; costa and subcosta, and radial sector thick, running parallel and close; median weak running medially and with 2-3 branches near distal end; cubitus with 8-10 branches.

Hindwing : as in forewing except median arising from radial sector.

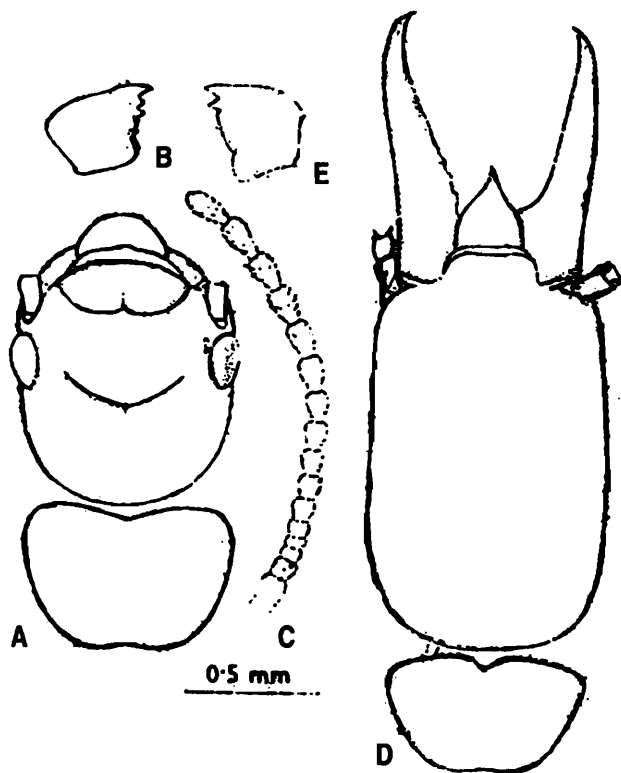


Fig. 79. *Heterotermes wittmeri* Chhotani and Bose A-C. Imago. A. Imago and pronotum, dorsal view; B. mandibles; C. Antennae; D. Soldier and pronotum, dorsal.

(ii) SOLDIER (Fig. 79.D) : Head pale yellow, darker anteriorly. Head sparsely and body fairly pilose.

Head subrectangular, sides substraight, frons inclined in front at an angle of 45° and feebly depressed medially. Fontanelle minute, chitinised, opening leading to a narrow and chitinised tube. Eyes and ocelli absent. Antennae with 15–16 segments, 3 and 4 variable. Postclypeus distinct. Labrum short and triangular with a long hyaline distal tip with a pair of short hairs at anterior margin. Mandibles long, slender, weakly hooked apically, left with 4 and right with 2 crenulations. Postmentum long, waist almost half the maximum width at anterior forth. Pronotum narrower than head, anterior margin convex with a deep notch and posterior margin weakly incurved.

Measurements : Table 32 (Im.); 36 (S.)

Types : Morphotype 1 Im. Paratype 1S. in Z. S. I. coll., Kolkata, India

Distribution : ASIA : Saudi Arabia : Hakimah (type-locality).

Remarks : Species is very close to *H. perfidus*, the soldiers of which are smaller in size and with elongated labrum. It also comes close to the most common Indian species. *H. indicola*, but differs as follows : Imago : Head capsule with brownish mark around fontanelle, presence of Y-sulture which are absent in *H. indicola*. Soldier : Antennae with 14–15 segments in *H. wittmeri* are represented by 16–18 segments in *H. indica*, of course, these are almost equal in size range.

Table-29. Measurements (in mm) etc., of Caste - Imago

<i>Heterotermes</i> spp.	<i>H. ceylonicus</i>	<i>H. gertrudae</i>	<i>H. indicola</i>
Total body-length with wings (excluding antennae), ca.	9.56–10.00	10.00–11.50	10.10–11.40
Total body-length without wings, (excluding antennae), ca.	4.60–5.50	5.50–5.80	5.40–6.10
Length of head to lateral base of mandibles	0.82–0.86	0.89–0.95	0.78–0.98
Max. width of head (with eyes)	0.80–0.87	0.89–0.95	0.80–0.92
Max. height of head		0.53–0.58	
Max. length of labrum		0.16	
Max. width of labrum		0.32–0.37	
Max. diameter of compound eye (with ocular sclerite)	0.22–0.24	0.23	0.24–0.26
Max. diameter of lateral ocellus	0.04–0.09	absent	small
Max. length of pronotum	0.40–0.56	0.47–0.53	0.40–0.48
Max. width of pronotum	0.65–0.66	0.84–0.89	0.75–0.82
Length of forewing without scale	7.69–8.00	8.00–9.00	7.50–8.00
Length of hindwing without scale	7.00–7.14	7.50–8.50	6.40–7.10
Number of antennal segments	15	17	16–18

Table-30. Measurements (in mm) etc., of Caste - Imago

<i>Heterotermes</i> spp.	<i>H. ferox</i> (Hill, 1942)	<i>H. para. venustus</i> (Hill, 1942)
Total body-length <i>with</i> wings (excluding antennae), ca.	10.50–11.50	9.00–9.25
Total body-length <i>without</i> wings, (excluding antennae), ca.	4.00–5.00	4.10–4.50
Length of head to lateral base of mandibles	0.66–0.80	0.73–0.80
Max. width of head (with eyes)	0.73–0.91	0.74–0.80
Max. length of pronotum	0.40–0.50	0.42–0.47
Max. width of pronotum	0.57–0.73	0.62–0.66
Length of forewing	8.50–9.50	7.00–7.80
Number of antennal segments		16–17

Table-31. Measurements (in mm) etc., of Caste - Imago

<i>Heterotermes</i> spp.	<i>H. paradoxus</i> <i>paradoxus</i> (Hill, 1942)	<i>H. paradoxus</i> <i>intermedius</i> (Hill, 1942)	<i>H. paradoxus</i> <i>validus</i> (Hill, 1942)
Total body-length <i>with</i> wings (excluding antennae), ca.	9.25–10.25	10.00–10.50	10.00–11.50
Total body-length <i>without</i> wings, (excluding antennae), ca.	4.25–5.00	4.50–5.50	4.50–5.50
Length of head to lateral base of mandibles	0.80–0.88	0.73–0.79	0.85–0.91
Max. width of head (with eyes)	0.85–0.95	0.80–0.85	0.85–0.91
Max. length of pronotum	0.48–0.55	0.44–0.48	0.51–0.53
Max. width of pronotum	0.73–0.77	0.69	0.74–0.82
Length of forewing	7.50–8.00	8.00–8.75	8.50–9.50
Number of antennal segments	17–18	16–18	

Table-32. Measurements (in mm) etc., of Caste-Imago

<i>Heterotermes</i> spp.	<i>H. wittmeri</i> (Chhotani and Bose 1982)	<i>H. malabaricus</i>	<i>H. vagus</i> (Hill, 1942)
Total body-length <i>with</i> wings (excluding antennae), ca.	8.20–8.80	—	9.75–10.25
Total body-length <i>without</i> wings, (excluding antennae), ca.	4.80–5.80	5.00–5.58	4.50–5.25

Table-32 (Contd.)

<i>Heterotermes</i> spp.	<i>H. wittmeri</i> (Chhotani and Bose 1982)	<i>H. malabaricus</i>	<i>H. vagus</i> (Hill, 1942)
Length of head to lateral base of mandibles	0.83–0.88	0.68–0.88	0.64–0.71
Max. width of head (with eyes)	0.85–0.88	0.75–0.82	0.73–0.77
Max. length of postclypeus	0.18–0.20	—	—
Max. width of postclypeus	0.45–0.48	—	—
Max. length of labrum	0.25–0.33		
Max. width of labrum	0.35–0.38		
Max. diameter of compound eye (with ocular sclerite)	0.19–0.23	0.18–0.22	
Max. diameter of lateral ocellus	0.05–0.06	absent	
Min. diameter of lateral ocellus	0.04–0.04		
Min. eye-ocellus distance	0.02–0.025		
Min. eye-antennal distance	0.13–0.15		
Max. length of pronotum	0.50–0.53	0.40–0.52	0.46–0.51
Max. width of pronotum	0.73–0.75	0.58–0.65	0.69
Length of forewing with scale	6.70–7.20	8.26	7.75–8.00
Length of hindwing with scale	6.40–6.80		
Number of antennal segments	16	13–16	

Table-33. Measurements (in mm) etc., of Caste-Soldier

<i>Heterotermes</i> spp.	<i>H. balwanti</i>	<i>H. canalifrons</i>	<i>H. tenuior</i>
Length of head to lateral base of mandibles	1.00–1.10	1.12–1.20	1.22–1.29
Max. width of head	0.70–0.75	0.80	0.72–0.86
Max. height of head	0.50–0.58		
Head index (width/length)	0.69	0.66	0.57
Max. length of labrum	0.30–0.38		
Max. width of labrum	0.20–0.25		
Length of mandible (Upper base of condyle to tip)	0.73–0.78	0.78–0.87	0.78
Head-mandibular length Index (mand.-length/head-length)	0.70–0.73	0.65	0.62

Table-33 (Contd.)

<i>Heterotermes</i> spp.	<i>H. balwanti</i>	<i>H.canalifrons</i>	<i>H. tenuior</i>
Min. median length of postmentum	0.70–0.88	0.70	
Max. width of postmentum	0.30–0.35	0.30	
Width of postmentum at waist	0.15–0.18	0.12	
Max. length of pronotum	0.30–0.35	0.50	0.30
Max. width of pronotum	0.50–0.55	0.60	0.44–0.53
Pronotum index(length/width)	0.60–0.63	0.77	0.56–0.68
Pronotum head index (pronotum width/head-width)	0.71–0.73	0.75	0.61
Number of antennal segments	12–14		13

Table-34. Measurements (in mm) etc., of Caste - Soldier

<i>Heterotermes</i> spp.	<i>H. cardine</i>	<i>H. perfidus</i>
Length of head to lateral base of mandibles	1.40	2.54
Max. width of head	0.78–0.85	1.40
Head index (width/length)	0.55–0.57	0.55
Length of mandible (Upper base of condyle to tip)	0.87–0.95	1.60
Head-mandibular length Index (mand.-length/head-length)	0.62–0.65	0.63
Max. length of pronotum	0.42	
Max. width of pronotum	0.60	
Pronotum index (length/width)	0.70	
Pronotum head index (pronotum width/head-width)	0.73	
Number of antennal segments	15	

Table-35. Measurements (in mm) etc., of Caste—Soldier

<i>Heterotermes</i> spp.	<i>H. crinitus</i>	<i>H. ferox</i>
Length of head to lateral base of mandibles	1.52	1.13–1.54
Max. width of head	1.02	0.71–1.00
Head index (width/length)	0.67	0.62–0.65
Length of mandible (Upper base of condyle to tip)	1.15	1.06–1.13

Table-35 (Contd.)

<i>Heterotermes</i> spp.	<i>H. crinitus</i>	<i>H. ferox</i>
Head-mandibular length index (mand.-length/head-length)	0.75	0.77
Min. median length of postmentum	0.98	
Max. width of postmentum	0.36	
Width of postmentum at anter. end		
Width of postmentum at waist	0.18	
Max. length of pronotum	0.46	0.33-0.55
Max. width of pronotum	0.72	0.52-0.88
Pronotum index (length/width)	0.63	0.62-0.66
Pronotum head index (pronotum width/head-width)	0.70	0.70-0.88
Number of antennal segments		15-17

Table-36. Measurements (in mm.) etc., of Caste-Soldier

<i>Heterotermes</i> spp.	<i>H. gertrudae</i>	<i>H. omanae</i>	
		S.(maj.)	S.(min)
Length of head to lateral base of mandibles	1.50-1.78	1.75-1.98	1.25-1.65
Max. width of head	0.97-1.05	0.90-0.98	0.88-0.95
Head index (width/length)	0.61-0.64		
Max. length of labrum		0.30-0.43	0.38-0.45
Length of mandible (Upper base of condyle to tip)	0.90-1.05	0.93-0.98	0.90-0.93
Head-mandibular length Index (mand.-length/head-length)	0.58-0.60	0.49-0.53	0.56-0.72
Min. median length of postmentum	1.13-1.50	1.30-1.58	0.90-1.25
Max. width of postmentum	1.30-1.38	0.38-0.43	0.38-0.40
Width of postmentum at waist	0.13-0.19	0.15-0.18	0.13-0.16
Max. length of pronotum		0.43-0.53	0.40-0.45
Max. width of pronotum		0.75-0.80	0.65-0.68
Pronotum index(length/width)		0.57-0.66	0.61-0.66
Pronotum head index (pronotum width/head-width)		0.81-0.83	0.65-0.69
Number of antennal segments		12-17	13-15

Table-37. Measurements (in mm) etc., of Caste—Soldier

<i>Heterotermes</i> spp.	<i>H. indicola</i>	<i>H. ceylonicus</i> S (maj.)	<i>H. malabaricus</i>
Length of head to lateral base of mandibles	1.25–1.90	1.30–1.69	1.23–1.54
Max. width of head	0.85–1.07	0.85–1.00	0.77–0.95
Head contraction index (Ant. W/max. width)			0.62–0.63
Head index (width/length)	0.61	0.63	0.63
Max. length of labrum	(tip 0.08–0.10)	0.35–0.43	0.35–0.45
Max. width of labrum		0.20–0.30	0.25–0.30
Length of mandible	0.85–1.05	0.80–0.85	0.70–0.93
Head-mandibular length Index (mand.-length/head-length)	0.55–0.68	0.51–0.61	0.56–0.60
Min. median length of postmentum	1.00–1.10	0.81–1.25	0.82–1.20
Max. width of postmentum	0.30–0.48	0.35–0.45	0.32–0.43
Width of postmentum at waist	0.15–0.22	0.15–0.20	0.15–0.20
Max. length of pronotum	0.40–0.65	0.38–0.50	0.33–0.50
Max. width of pronotum	0.65–0.90	0.63–0.75	0.53–0.80
Pronotum index (length/width)	0.61–0.72	0.60–0.66	0.62
Pronotum head index (pronotum width/head-width)	0.76	0.73–0.75	0.69–0.84
Number of antennal segments	16–19	13–14	12–14

Table-38. Measurements (in mm) etc., of Caste - Soldier

<i>Heterotermes</i> spp.	<i>H. latilabrum</i>	<i>H. longiceps</i> S (maj.)	<i>H. tenuis</i>
Length of head to lateral base of mandibles	1.79–1.86	2.20	1.83–2.05
Max. width of head	1.10	1.00	1.14–1.28
Max. height of head	0.86	0.45	
Head index (width/length)	0.60		0.62
Length of mandible (upper base of condyle to tip)	1.10–1.14	1.10	
Head-mandibular length index (mand.-length/head-length)	0.61	0.50	0.57

Table-38 (Contd.)

<i>Heterotermes</i> spp.	<i>H. latilabrum</i>	<i>H. longiceps</i> S (maj.)	<i>H. tenuis</i>
Min. median length of postmentum	0.75		
Max. width of postmentum	0.41-0.44		
Width of postmentum at waist			0.18-0.22
Max. length of pronotum	0.41-0.44	0.50	0.53-0.66
Max. width of pronotum	0.90	0.80	0.88-1.17
Pronotum index (length/width)	0.45-0.50	0.62	0.56-0.62
Pronotum head index (pronotum width/head-width)	0.81	0.80	0.77-0.91
Number of antennal segments	12-13	17	16-18

Table-39. Measurements (in mm.) etc., of Caste-Soldier

<i>Heterotermes</i> spp.	<i>H. philippinensis</i>	<i>H. pamatensis</i>
Length of head to lateral base of mandibles	1.10-1.50	1.09-1.30
Max. width of head	0.80-0.93	0.74-0.81
Head index (width/length)	0.62-0.66	0.60-0.62
Length of mandible (Upper base of condyle to tip)	0.82-0.85	
Head-mandibular length Index (mand.-length/head-length)	0.56-0.65	
Min. median length of postmentum	1.00	
Max. width of postmentum	0.73	
Width of postmentum at waist	0.15	
Max. length of pronotum	0.36-0.50	0.34-0.35
Max. width of pronotum	0.59-0.78	0.49-0.56
Pronotum index (length/width)	0.61-0.63	0.62-0.69
Pronotum head index (pronotum width/head-width)	0.73-0.83	0.66-0.69
Number of antennal segments	15	14

Table-40. Measurements (in mm.) etc., of Caste-Soldier

<i>Heterotermes</i> spp.	<i>H. paradoxus paradoxus</i>	<i>H. paradoxus intermedius</i>	<i>H. paradoxus validus</i>
Length of head to lateral base of mandibles	1.46-1.63	1.65	1.57-1.87
Max. width of head	0.91-0.99	0.95-1.00	0.95-1.06
Head index (width/length)	0.60-0.65	0.59	0.56-0.60
Length of mandible (upper base of condyle to tip)	1.12	1.02-1.16	1.14-1.33
Head-mandibular length Index (mand.-length/head-length)	0.62	0.65	0.56
Width of postmentum at waist	0.17-0.22	0.18	0.16-0.18
Max. length of pronotum	0.44-0.57	0.38-0.48	0.47-0.62
Max. width of pronotum	0.66-0.88	0.72-0.83	0.80-0.91
Pronotum index (length/width)	0.66-0.67	0.52-0.57	0.58-0.68
Pronotum head index (pronotum width/head-width)	0.72-0.88	0.73-0.83	0.84-0.85
Number of antennal segments	17-18	16-17	16-18

Table-41. Measurements (in mm) etc., of Caste-Soldier

<i>Heterotermes</i> spp.	<i>H. sulcatus</i>	<i>H. aurius</i>	<i>H. convexinotus</i>
Length of head to lateral base of mandibles	1.23-1.35	1.50	1.40-1.48
Max. width of head	0.70-0.76	0.90	0.85-0.94
Head index (width/length)	0.56	0.60	0.62-0.64
Length of mandible (Upper base of condyle to tip)	0.89-0.97	1.00	0.87-0.95
Head-mandibular length Index (mand.-length/head-length)	0.71-0.72	0.72	0.69-0.71
Min. median length of postmentum		1.00	1.00-1.02
Max. width of postmentum		0.40	0.41
Width of postmentum at waist		0.20	0.17
Max. length of pronotum	0.37-0.46	0.48	0.40-0.44
Max. width of pronotum	0.52-0.61	0.70	0.70-0.73
Pronotum index (length/width)	0.65-0.69	0.60	0.57
Pronotum head index (pronotum width/head-width)	0.74-0.80	0.88	0.77-0.83
Number of antennal segments			15

Table-42. Measurements (in mm) etc., of Caste—Soldier

<i>Heterotermes</i> spp.	<i>H. para. venustrus</i>	<i>H. vagus</i>
Length of head to lateral base of mandibles	1.98–2.00	1.27
Max. width of head	0.75–0.85	0.75–0.85
Head index (width/length)	0.58	0.68
Length of mandible (Upper base of condyle to tip)		0.83–0.85
Head-mandibular length index (mand.-length/head-length)	0.76	0.66
Min. median length of postmentum		0.95
Max. width of postmentum		0.30
Width of postmentum at waist	0.11–0.14	0.11–0.14
Max. length of pronotum	0.35–0.40	0.35–0.40
Max. width of pronotum	0.52–0.58	0.52–0.58
Pronotum index (length/width)	0.67–0.69	0.66–0.68
Pronotum head index (pronotum width/head-width)	0.68–0.70	0.69–0.70
Number of antennal segments	16	

Subfamily TERMITOGETONINAE

Genus *Termitogeton* Desneux1. Subgenus *Termitogeton* (of *Termes*) Desneux1904. Desneux. *Ann. Ent. Belg.*, 48 (10) : 374.1904. Desneux, *Genera Insect*, Fasc. 25 : 29, 32, 46-47.2. Genus *Termitogeton* Desneux1911. Holmgren, *K. Sv. Vet. Akad. Handl.*, 46 (6) : 75-76.1911. Holmgren, in Escherich's *Termitenleben auf Ceylon*, pp. 193-194.1922. Hegh, *Les Termites*, pp. 346-347.1925. John, *Treubia*, 6 (3-4) : 384.1949. Snyder, *Smiths. misc. Colls.*, 112 : 84.1950. Ahmad. *Bull. Am. Mus. nat. Hist.*, 95 (Art. 2) : 54, 56.1953. Rattan Lal and Menon, *Catal. Indian Insects*, Pt. 27, *Isoptera* : 33.1955. Emerson, *Fieldiana : Zool.*, 37 : 509.1955. Weidner. in *Die Termiten* (Ed. Schmidt) : 10, 56.1958. Ahmad. *Biologia*, Lahore, 4 (1&2) : 59, 60, 73.1970. Krishna, In *Biol. of Termites* (Eds. Krishna and Weesner) 2 : 137, 138.1970. Roonwal, in *Biol. of Termites* (Eds. Krishna and Weesner) 2 : 339.1971. Emerson, *Bull. Am. Mus. nat. Hist.*, 146 (Ar. 3) : 248, 251, 256.1974. Sen-Sarma, in *Ecology and Biogeogr. in India* (Ed. M.S. Mani) : 453-454.1975. Emerson and Krishna, *Am. Mus. Novit*, No. 2570 : 16.1979. Roonwal, Verma and Thakur, *Proc. Indian natnl. Sci. Acad.*, (B) 45 (4) : 347.1983. Chhotani, *Orient. Insects*, 17 : 111, 112, 114, 119.1982. Thapa, *Sabah For. Rec.*, No. 12, p.86.1986. Grasse, *Termitologia*, 3 : 527.

3. Genus *Termes* Linn. (part)1860. Hagen, Linn, *Emt.*14 : 1101898. Haviland, J. Linn. Soc. Lond, 26 (169) : 397. (Sect with *Termes planus* for type)Type of genus : *Termes umbilicatus* Hagen.

a. *History, Distribution, composition, etc.* Desneux (1904) named *Termitogeton* as a subgenus under the genus *Termes*, which was given the status of a genus by Holmgren (1911). Since then it stands as a very specialised oriental genus represented by three species. The genus is characterised by the absence or near absence of the radius and median vein in the wing, dorso-ventrally flattened soldier's head with much narrowed anterior end. Structural similarity between *Termitogeton* and *Heterotermes* suggest the origin of the former from a genus close to *Heterotermes*. The genus contains three oriental species which are dealt herewith.

b. *General character of Termitogeton*

i) IMAGO : (Specimen not examined, description based on publication by Bugnion, 1914).

Head rustcoloured, antennae darker, margins of pronotum, legs and abdomen from below paler. Wings ash-grey. Head triangular, strongly depressed and flattened. Eyes of medium size weakly bulging. Ocelli oval, placed more near to eyes. Antennae with 15 segments, 1-3 cylindrical. Pronotum small, narrower than head, anterior margin projected in the middle into pointed, acute tip like navel, sides angles pointed, sides and posterior margins curved and crescent forming.

Wings 3 times as long as wide with fine hairs, scales small. Costa and radius moderately thick, close to each other, remaining veins fine, median indistinct.

(ii) SOLDIER : Head, pronotum and other body parts pale golden to reddish yellow. Head and body densely hairy, head dorso-ventrally flattened, triangular, broad posteriorly and narrowed anteriorly, posterior margin incurved and bulging out medially, sides bow-shaped, epicranial suture distinct. Fontanelle small and

round, and placed almost at the middle. Eyes and ocelli absent. Antennae with 13-15 segments. Clypeus short, divided into ante-and post-clypeus. Labrum somewhat elongately oval-shaped with a small knob-like hyaline tip, with a pair of hairs at the base of tip. Mandibles moderately long with uniformly and weakly incurved apices and both with a small marginal tooth on inner margin near base. Postmentum, elongately club-shaped, widest width very broad on anterior fourth, waist much narrowed, body densely hairy. Pronotum flat, very narrower than head, anterior margin medially projected, anterolateral angles narrow, whence iniformly rounded including posterior margin, body densely hairy. Tibial spur formula 3 : 2 : 2.

C. Key to the species of *Termitogeton* Desneux (Soldier)

1. Smaller species, head-length 0.97–1.35; antennae with 13 segments 2
- Larger species, head-length 1.50–1.55; antennae with 14-15 segments. 3
2. Very smaller species, head-length 0.97-1.12, head-width 0.97–1.16, mandibles longer in portion to head-length, mandible-head index 0.60–0.69 *T. minor* Thapa
- Fairly larger species, head-length 1.17 – 1.35, head-width 1.17–1.40 ; mandibles shorter in proportion to head-length, mandible - head index 0.56–0.58 *T. planus* (Haviland)
3. Postero-lateral corners of head angularly rounded; labrum with uniformly outcurved lateral margins; head-length 1.50–1.55; postmentum very wide, (width 0.43–0.45) *T. umbilicatus* Hagen

86. *Termitogeton minor* Thapa*Termitogeton minor* Thapa1982. Thapa, *Sabah For. Rec.*, No. 12, pp.89–91.1989. Roonwal and Chhotani, *Fauna of India, Isoptera* (Termites), 1 :

Material : Present in F.R.I., Dehra Dun : Few S. and W., Pin, Lamag Dist., Sabah coll. Low Min

Tech, 11.ix.1970, ex. "rotten wood" det. R. S. Thapa.

Diagnostic character : (i) *Imago* : Unknown

(ii) *Soldier* (Fig. 80. A-B) : Head and labrum yellowish brown; head densely hairy. Head suboval, narrowed anteriorly, lateral sides outcurved, posterior margin concave with a median bulge with a concave margin on either side. Fontanelle indistinct. Anteclypeus trapizoid. Postclypeus with straight anterior margin. Antennae with 13 segments, 2 longer than 3; labrum long, double the width with pointed and hyaline tip. Mandibles with incurved apices, slightly more than half the head length, left and right with a reduced marginal tooth at base in each. Postmentum almost thrice as long as its maximum width. Pronotum very narrow, almost one-third as wide as head width.

Measurements : Table 42 a

Types : Types in F. R. I., Dehra Dun.

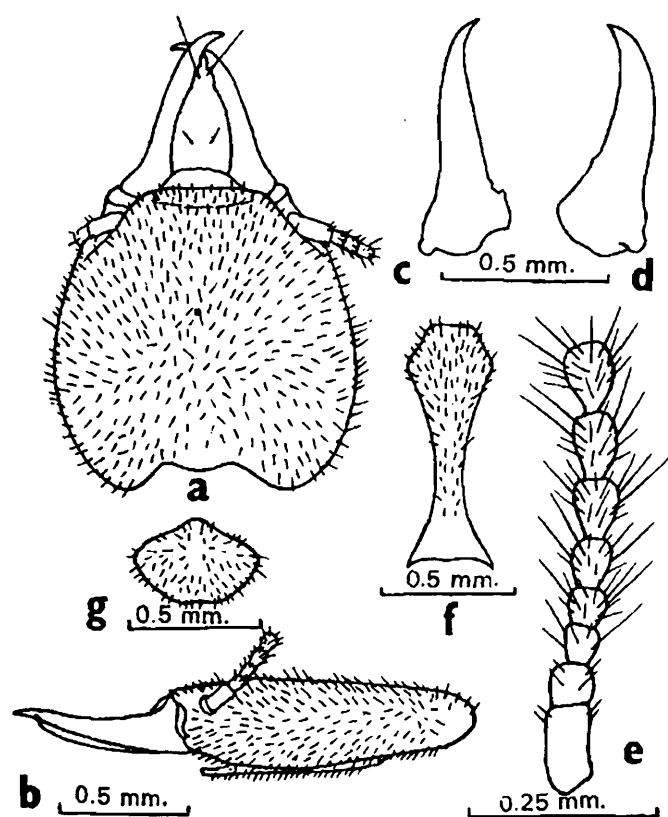


Fig. 80. *Termotogeton minor* Thapa A-G, Soldier. A. Head, dorsal view; B. Head, lateral view; C-D. Mandibles; E. Antennae; F. Postmentum; G. pronotum (After, Thapa, 1982).

Distribution : ASIA : Malaysia, Lamag-Dist., Sabah.

Remarks : The species is only known from its type-locality from rotten long only.

87. *Termitogeton planus* (Hairland)

1. *Termes planus* Hairland

1998. Haviland, J. Linn. Soc. Lond., 26 : 397, Im., Queen, S. and W. Type-locality : Borneo, Sarawak.

2. *Termes (Termitogeton) planus*, Desneux

1904. Desnux, in P. Wytsman *Genera Insectorum*, 25 : 46-47.

3. *Termitogeton planus*, Holmgren

1911. Holmgren, K. *Sev. Vet. Akad. Handl.*, 46 (6) : 75-76.

1913. Holmgren, K. *Sev. Vet. Akad. Handl.*, 50 (2) : 89.

1949. Snyder, *Smiths. misc. Coll.*, 112 : 84.

1958. Ahmad, *Biologia*, 4 (1-2) : 73 (key).

1982. Thapa, *Sabah For. Rec.*, No.12, pp. 86-89.

1989. Roonwal and Chhotani, *Fauna of India Isoptera (Termites)* 1: 514.

Material : Present in F.R.I., Dehra Dun : S. and W., Pin, Lamag Dist. Coll. William Midin, 12.9.70, ex "rottenwood" det. R. S. Thapa.

Diagnostic characters : (After, Holmgren, 1913a) (i) IMAGO : Unknown. (ii) SOLDIER (Fig. 81, A-G) : Head yellowish brown, paler anteriorly, densely hairy, as broad as long, Y-suture distinct. Eyes small, bulging out. Ocelli separated from the eyes by its diameter. Forehead very broad. Postclypeus short, flat. Labrum sloping. Antennae with 15 segments, 3 shorter than 2.

Pronotum very small, flat, almost half the width of head. Wing membrane thin and densely hairy, not reticulate. Subcosta and radius absent. Radial sector plain. Median absent. Cubitus well curved, also with branches to the radial sector.

Length with wings	5.54 mm
Length without wings	3.36 mm
Length of forewing	4.25 mm

Head length	0.76 mm
Head width	0.86 mm
Width of pronotum	0.38 mm
Length of pronotum	0.27 mm

(ii) SOLDIER : Head and labrum yellowish brown, darker anteriorly, head densely hairy; postmentum, pronotum and abdominal tergites densely hairs.

Head as long as its width, dorso-ventrally flattened, lateral margins convex, postero-lateral corners produced, posterior margin produced in the middle with deep concavity on either side. Fontanelle dot shaped. Antennae with 13 segments, 2 slightly longer than 3. Postclypeus short, much less than half as long as wide : Labrum almost thrice as long as broad, sides convex, converging anteriorly into a pointed hyaline tip. Mandibles with weak basal hump with incurved apices, left with a single minute tooth and right with a reduced tooth on basal third. Postmentum almost three times as long as its maximum width. Pronotum small and narrow, almost one-third as wide as head-width.

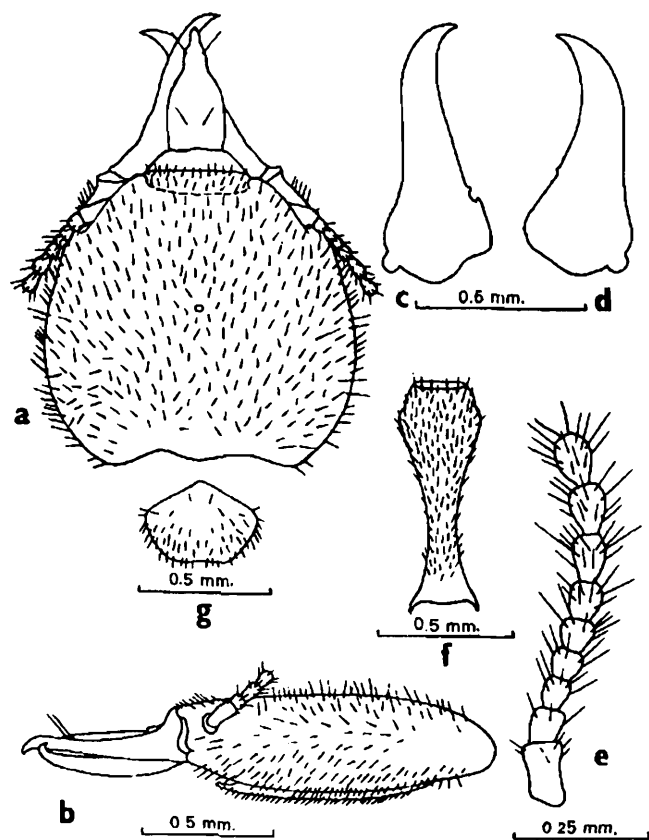


Fig. 81. *Termitogeton planus* (Haviland), A-G, Soldier. A. Head, dorsal view; B. Head lateral view; C-D. Mandibles; E. Antennae; F. postmentum; G. pronotum (Thapa, 1982).

88. *Termitogeton umbilicatus* (Hagen)

1. *Termes umbilicatus* Hagen

1858. Hagen, Zool. Bot. Ver. Wien, 1858 : 472. Im., S., W.
Type-locality : Rambodde, Sri Lanka.

1860. Hagen, Linn. Ent., 14 : 110.

2. *Termes (Termitogeton) umbilicatus* Hagen

1904. Desneus, Genera Insect., 25 : 47.

3. *Termitogeton umbilicatus* (Hagen)

1911. Holmgren, K. Sv. Vet. Akad. Handl., 46 (6) : 75, 76.

1911. Holmgren, In Escherich's *Termiten leben auf. Ceylon* : 193.

1913. Holmgren, K. Sv. Vet. Akad. Handl., 50 (2) : 88, 90-91.

1914. Bugnion, Ann. Soc. Ent. France., 83 (1) : 39-47.

1922. Hegg, Les Termites : 346-347.

1949. Snyder, Smiths. misc. colls., 112 : 85.

1958. Ahmad, Biologia, 4 (1-2) : 73.

1970. Weidner, Handb. d. Zool., 4 (2) : 21.

1970. Roonwal, in *Biology of Termites* (Eds. Krishna and Weesner), 2 : 339-340.

1983. Chhotani, Orient. Insects., 17 : 113, 119.

1986. Grasse, Termitologia, 3 : 526.

1989. Roonwal and Chhotani, Fauna of India, Isoptera (Termites), 1 : 514-517.

Material : Since no material was available, diagnostic characters are based on literature.

Diagnostic character : (i) IMAGO : Rust colour, antennae paler; wings ash grey, margin of veins brown.

Head triangular, strongly depressed and flattened. Eyes of medium size, slightly bulging out. Ocelli oval, situated near eyes. Antennae with 15 segments, slightly longer than head; moderately thick, getting thicker towards tip. Pronotum small, narrower than head; anterior margin projected in middle into pointed acute tip like navel (umbilicate); lateral angles pointed; sides and posterior margin curved, crescent forming. Wings 3 times as long as wide, with fine

hairs, scales very small. Costa and radius moderately thick, close to each other, remaining veins fine, median indistinct.

(ii) **SOLDIER** (Fig. 82, A-B) : Head, pronotum and rest of body light golden to reddish yellow. Head and body densely hairy. Head tiangularly oval, dorso-ventrally very much flattened, widest slightly below the middle, whence strongly narrowing anteriorly lateral sides outbulging, posterior margin distinctly incurved with a median outbulge, postero-lateral angles sharp. Antennae with 14-15 segments, 2 subequal to or longer than 3. Postclypeus hairy anteclypeus hyaline. Labrum leaf-shaped with a hyaline tip, reaching almost tip of the mandible. Mandibles short and strongly incurved at apices, almost half the head length, each with one or two crenulations at basal portion. Postmentum club-shaped, densely hairy, pronotum flat, subtriangular, anterior margin with median angular projection and posterior margin strongly rounded.

Measurements : Table-42a.

Types : Repository of types not known.

Distribution : ASIA : Sri Lanka : Hantana, Rambodde, Peradeniya.

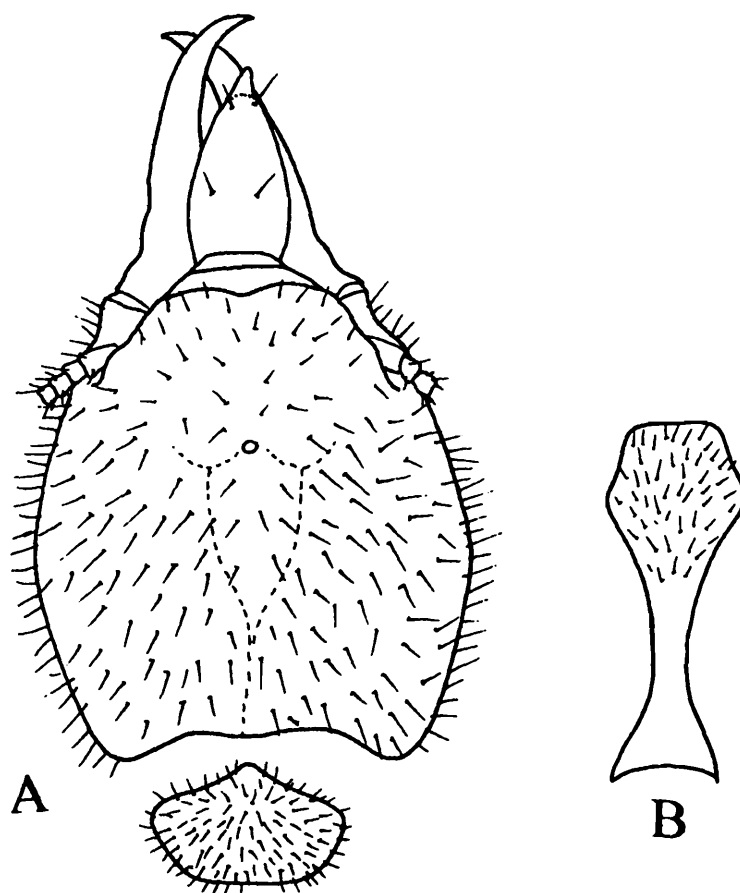


Fig. 82. *Termitogeton umbilicatus* (Hagen) A-B. Soldier. A. Head and pronotum, dorsal view; B. postmentum.

Table-42a. Measurements (in mm) etc., of Caste—Soldier

<i>Termitogeton</i>	<i>T. planus</i>	<i>T. minor</i>	<i>T. umbilicatus</i>
Length of head to lateral base of mandibles	1.17–1.35	0.97–1.32	1.50–1.55
Max. width of head	1.17–1.40	0.97–1.16	1.44–1.55
Head index (width/length)	0.98	1.00	0.97
Max. length of labrum	0.40–0.45	0.40–0.42	0.65
Max. width of labrum	0.21–0.25	0.20–0.22	0.35
Length of mandible (Upper base of condyle to tip)	0.67–0.75	0.67–0.70	0.95–0.98
Head-mandibular length index (mand.-length/head-length)	0.56–0.58	0.60–0.69	0.63
Min. median length of postmentum	0.90–1.00	0.72–0.78	1.25
Max. width of postmentum	0.31–0.32	0.27–0.30	0.43–0.45

Table-42a.(Contd.)

<i>Termitogeton</i>	<i>T. planus</i>	<i>T. minor</i>	<i>T. umbilicatus</i>
Width of postmentum at waist	0.10-0.12	0.10-0.11	0.10-0.13
Max. length of pronotum	0.31-0.35	0.23-0.30	0.40-0.45
Max. width of pronotum	0.42-0.47	0.37-0.40	0.65
Pronotum index (length/width)	0.75	0.66	0.64
Pronotum head index (pronotum width/head-width)	0.34	0.35	0.43
Number of antennal segments	13	13	14-15

Subfamily RHINOTERMITINAE Froggatt

Genus *Prorhinotermes* Silvestri

(Synonyms : *Arrhinotermes* Wasmann,
Procoptotermes Holmgren, *Paratermes* Oshima
and *Termitogetonella* Oshima)

1. Genus *Prorhinotermes* Silvestri

1909. Silvestri, In Michaelen's and Hartmeyer's, *Fauna Sudwest-Austral.* Vol. 2 : 286.
1919. Banks, *Bull. Mus. comp. Zool. Harvard Coll.*, **62** (10) : 479.
1920. Banks and Snyder, *Bull. U. S. natn. Mus.*, No. 108 : 39, 145.
1921. Light, *Philipp., J. Sci.*, **19** (1) : 48.
1949. Snyder, *Smiths. misc. Colls.*, **112** : 85.
1950. Ahmad, *Bull. Am. Mus. nat. Hist.*, **95**(Art. 2) : 53, 54, 56.
1955. Emerson, *Fieldiana : Zool.*, **37** : 471, 478-479, 488, 489, 493, 500, 509.
1955. Weidner, in *Die Termiten* (Ed. Schmidt) : 57, 70.
1958. Ahmad, *Biologia*, Lahore, **4** (1-2) : 59, 60.
1961. Harris, *Termites : Recognition & Control* : 47-48. (2nd edition 1971).
1965. Ahmad, *Bull. Am. Mus. nat. Hist.*, **131** (Art. 1) : 8.
1971. Emerson, *Bull. Am. Mus. nat. Hist.*, **146** (Art. 3) : 248, 250, 251, 257, 258, 259, 260, 262.
1973. Chhotani and Bose, *Zool. Anz.*, **190** (3-4) : 223, 234.
1975. Emerson and Krishna, *Am. Mus. Novit*, No. 2570 : 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22.

1975. Akhtar, *Bull. Dept. Zool. Univ. Panjab. (N.S.) Art.* **7** : 35, 36.
1976. Bose and Maiti, *Newslet. zool. Surv. India*, **2**(1) : 15-16.
1977. Araujo, *Catal. Isoptera Novo Mundo* : 27.
1979. Roonwal, Verma and Thakur, *Proc. Indian natnl. Sci. Acad.*, (B) **45** (4) : 334, 335, 351.
1982. Thapa, *Sabah For. Rec.*, No. **12** : 4, 5.
1983. Roonwal, *Proc. Indian Natnl. Sci. Acad.* (B) **49** (5) : 363.
1983. Chhotani, *Orient. Insects*, **17** : 111, 112, 113, 114, 119.
1984. Bose, *Occ. Pap. Rec. Zool. Surv. India*, No. **49** : 71, 77, 78, 88.
1986. Grassé, *Termitologia* Vol. **3** : 524.
1992. Thakur and Thakur, *Freubia*, **30** (3) : 251.
1994. Maiti and Chakraborty, *Occ. Pap., Rec. zool. Surv. India*, No. 167, p. 9.

2. Subgenus *Rhinotermes* (of *Termes*) Hagen (Part)

1858. Hagen, *Linn. Ent.*, **12** : 107-108, 233.
1858. Hagen, *Catal. Specimens Neuropterous Insects Coll. Brit. Mus. Part I. Termitina* : 16, 33.

3. Genus *Arrhinotermes* Wasmann (Part)

1902. Wasmann, *Zool. Jb.*, **17**(1) : 103, 139, 160.
1911. Holmgren, *Zool. Anz.*, **37**(26) : 548, 549.
1911. Holmgren, K. *Sv. Vet. Akad. Handl.*, **46**(6) : 71-72, 74.
1913. Holmgren, K. *Sv. Vet. Akad. Handl.*, **50**(2) : 66.

4. Subgenus *Arrhinotermes* (of *Termes*) Wasmann

1904. Desneux, *Genera Insect.*, Fasc. 25 : 31, 33-34.

5. Genus *Termes* Linn. (Part)

1904. Sjöstedt, K. *Sv. Vet. Akad. Handl.*, 38(4) : 47.

6. Subgenus *Termes* (of *Termes*) Linn. (Part)

1904. Desneux, *Genera Insect.*, Fasc. 25 : 32, 35-46.

7. Genus *Procoptotermes* Holmgren

1909. Holmgren, K. *Sv. Vet. Akad. Handl.*, 44(3) : 25, 110, 169. (No description).

1911. Holmgren, K. *Sv. Vet. Akad. Handl.*, 46(6) : 73. (No description.)

8. Genus *Paratermes* Oshima

1912. Oshima, *Third Official Rept. Termites* : 69.

9. Genus *Termitogetonella* Oshima

1920. Oshima, *Philipp J. Sci.* 17(5) : 496.

Type of genus : Prorhinotermes inopinatus Silvestri.

a. History. Distribution, Composition, etc.

The genus *Prorhinotermes* Silvestri was established by Silvestri (1909) with its type of genus, *Prorhinotermes inopinatus* Silvestri from Samoa (Ninafoon). This species was later on treated under *Arrhinotermes* by Holmgren in 1911. Subsequently, the genera, *Arrhinotermes* Wasmann, *Procoptotermes* Holmgren, *Paratermes* Oshima and *Termitogetonella* Oshima were treated as the synonymies of *Prorhinotermes*. In the recent past, Quennedey and Deligne (1975) placed the genus under a separate subfamily Prohinotermitinae proposed by them on the characteristic absence of daubing brush' on labrum of soldiers which always present in all other genera of the family Rhinotermitidae. Grassi (1986) has discussed the taxonomic status of the new subfamily and failed to reach any definite conclusion. As such, he has kept the genus in both Rhinotermitidae and Rhinotermitinae. Recently,

Roonwal and Chhotani (1989) maintained its previous assignment under Rhinotermitinae.

The genus is predominantly found in the Oeirtal Region (9 spp.) with its extended distribution to the Papuan (3), Malagasy (1), Neotropical (2) and Nearctic (1) Regions. Out of 17 species known so far, three species, namely, *P. cranicus* (Wasm.) from Cocos Isl., *P. ponapiensis* (Oshima) from Caroline Isl. and *P. xishaensis* Li and Tsai have not been dealt.

Prorhinotermes with its monomorphic soldier is the most primitive genus of the subfamily Rhinotermitinae. The members of the genus are insular in habit and is absent on all continents except in coastal areas of Florida and central America. These are believed to be transported through floating logs and coconut and get established (Emerson, 1955).

b. *General characters* : (i) IMAGO : Head and pronotum moderately and abdomen densely pileose. Head broadly oval to almost circular, moderately swollen. Fontanelle small, placed almost at the middle of head. Postclypeus more chitinised, large and pilose, convex with median line. Antennae with 19-22 segments. Left mandible with 2nd marginal longer than 1st and subequal to 3rd. Right with 1st marginal sharp and longer than 2nd with long posterior margin. Pronotum less wider than head, anterior margin generally substraight or feebly incurved, posterior margin weakly outcurved.

Wings strongly reticulate and moderately hairy. Median of both the wings coming out of cubitus or not separated from cubitus. Tibial spur formula 3 : 2 : 2.

(ii) SOLDIER : Head oval, distinctly narrowed in front, sparsely pilose. Eyes present indistinctly. Fontanelle small with a clear groove running in front upto clypeus, fontanelle gland distinct. Antennae with 16-19 segments. Labrum dome-shaped with moderate hairs. Mandibles substraight with incurved apices with any distinct tooth. Postmentum club-shaped, long and with slender posterior two-thirds, waist almost half the

widest width. Pronotum slightly narrower than head, sometimes transversely oval with rounded lateral margins, both anterior and posterior margins feebly incurved.

C. Key to the species of *Prorhinotermes* Silvestri

1. Mandibles shorter in proportion to head-length; mandibles only slightly longer than half the head-length; mandible-head index 0.52–0.58 2.
- Mandibles much longer in proportion to head length; mandible-head index, 0.60–0.79 4
2. Head elongate, much longer than broad; head index 0.74; small species, head-length 1.65–1.75, head-width 1.11–1.30; mandible length 0.95; postmentum-length 1.05
..... *P. canalifrons* (Sjöstedt) (Fig. 83)
- Head not so elongate, not much longer than broad; head index 0.80–0.84; larger species, head-length 1.85–1.90 3
3. Pronotum length almost half its width, pronotum index (length / width) 0.49–0.50; mandibles half the head-length, smaller species, head-length 1.35–1.50, head-width 1.20–1.33; mandible length 1.00–1.10.
..... *P. panaitanensis* Thakur and Thakur.
- Pronotum length much more than half its width, pronotum index 0.60; larger species, head-length 1.90–1.92; head-width 1.52–1.61 (*S. major*) *P. molinoi* Snyder
4. Pronotum length much less than half its width, pronotum index (length/width) 0.42–0.50 5
- Pronotum length much more than half its width, pronotum index 0.50–0.60 (*P. innopinatus* Silvestri) with pronotum index 0.42–0.54 (may also be included in this group) 8
5. Posterior margin of head not produced; eyes large and distinctly bulging out 6
- Posterior margin of head produced; eyes not so large, rather small and slightly bulging out or not at all 7
6. Antennae with 17–20 segments; monomorphic, head-length 1.56–1.89, head-width 1.37–1.56
..... *P. flavus* Bugnion and Popoff
- Antennae with 16–17 segments, dimorphic, head-length 1.59, head-width 1.48; mandible length 1.05 *P. japonicus* (Holmgren)
7. Antennae with 17–19 segments; lateral margins of head strongly narrowing anteriorly; eyes broadly oval, slightly bulging out; head-length 1.56–1.87, head width 1.32–1.56, mandible length 1.09–1.24
..... *P. tibiaoensisformis* Ahmad
- Antennae with 15–16 segments; lateral margins of head not so narrowing anteriorly; eyes vestigial, not bulging out at all, represented by a vague area; head-length 1.45–1.60, head with 1.25–1.35
..... *P. gracilis* Light
8. Mandibles shorter than the length of postmentum 9
- Mandibles as long as or slightly longer than the length of postmentum 10
9. Postmentum longer than the fontanelle distance from the posterior margin of head, pronotum with deep anteromedian notch; postmentum with incurved antero-lateral margins above the maximum width; head-length 1.68–1.73, head-width 1.43–1.46; mandible length 1.10–1.13; postmentum length 1.13–1.16, maximum width 0.45–0.53
..... *P. ravani* Roonwal and Maiti
- Postmentum as long as the fontanelle distance from the posterior margin of head, pronotum with shallow antero-median notch; postmentum with straight antero-lateral margins above its maximum width; head-

* *P. tibioensis* (Oshima) could hardly be separated from *P. japonicus* (Holmgr) on the basis of measurements and colour (Light, 1921; Ahmed, 1958).

length 1.76–1.78, head width 1.50, mandible length; postmentum length 1.20
..... *P. simplex* (Hagen)

10. Antennae with 13 segments, pronotum much narrower than head-width, index 0.74; smaller species head-length 1.33, head-width 1.14 *P. krakatau* Holmgren

– Antennae with 14 segments, larger species pronotum wider in proportion to head width, pronotum head width index 0.80–0.89 11

11. Mandibles long and thin, strongly incurved at apices, distinct wrinkles around fontanelle opening; head-length 1.59–1.66, head-width 1.34–1.41; mandible length 0.95.
..... *P. rugifer* Kemner

– Mandibles not so long and thick, not so strongly incurved at apices, no such distinct wrinkle around fontanelle opening 12

12. Pronotum width much more than the fontanelle distance from the posterior margin of head; postmentum elongate; head-length 1.30–1.82, head width 1.10–1.50; mandible length 0.82–1.25. *P. innopinatus* Silvestri

– Pronotum width as long as the fontanelle distance from the posterior margin of head; postmentum short; head-length 1.65, head-width 1.38, mandible length 1.14; postmentum-length 1.00
..... *P. oceanicus* (Wasmann)

89. *Prorhinotermes canalifrons* (Sjostedt)

1. *Termes canalifrons* Sjostedt

1904. Sjostedt, K. *Sven. Vet. Akad. Handl.*, 38 (4) : 47, S.
Type-locality : Tamtave, Madagascar.

2. *Termes (Termes) canalifrons* Desneux

1904. Desneux, Im : Isoptera, family Termitidae. P. Wystman, *Genera Insectorum*, 25 : 36.

3. *Procoptotermes canalifrons* Holmgren

1909. Holmgren, K. *Sven. Vet. Akad., Handl.*, 44 (3) : 169.

4. *Arrhinotermes canalifrons* Wasmann

1910. Wasmann, *Wiss. Ergeb.*, 3 (2) : 123, S. and W., Comoren Isl.

1910. Holmgren, *Trans. Linn. Soc. London, Zool.*, (2) 14 : (8) : 148, Seychelles, Mahe.

1911. Holmgren, K. *Sven. Vet. Akad. Handl.*, 46 (6) : 72

5. *Paratermes canalifrons* Oshima

1912. Oshima, the third official report on termites, Taihoku, Madagascar only.

6. *Prorhinotermes canalifrons* (Sjostedt)

1926. Sjostedt, K. *Sven. Vet. Akad. Handl.*, (3) 3 (1) : 55.

1936. Moutia, *Agr. Sci. Severy.*, 21 : 20, Port Luis, Im. and S.

1949. Snyder, *Smiths. misc. coll.*, 112 : 86, Im., neotenic, S. and W., Madagascar and Seychelles group.

1970. Paulian, in : *Biology of Termites* (Eds. Krishna and Weesner).

Material : (i) Present in Z.S.I., Kolkata : 1S. and 1W., Ivoloina, near Tamatave, Madagascar. (ii) Present in F.R.I., Dehra Dun : 2 Adulta, 5 S. and 4 W. from the same locality as above.

(i) IMAGO : Not studied.

(ii) SOLDIER (Fig. 83.A–B) : Head light brown; labrum, postmentum and pronotum paler.

Head sparsely and abdomen densely hairy. Head flat, broadest at posterior third, thence narrowing anteriorly, posterior margin broadly rounded. Fontanelle small and circular with feeble groove upto postclypeus. Mandibles thin and elongated, weakly incurved with pointed apices. Antennae broken, 3 much larger than 4. Labrum as long as wide and almost round. Postmentum as long as mandible, max. width at anterior fourth, waist at posterior third. Pronotum anteriorly raised, anterior margin concave, posterior margin convex with a weak median emargination.

Measurement : Table 47 (S)

Types : Repository not known.

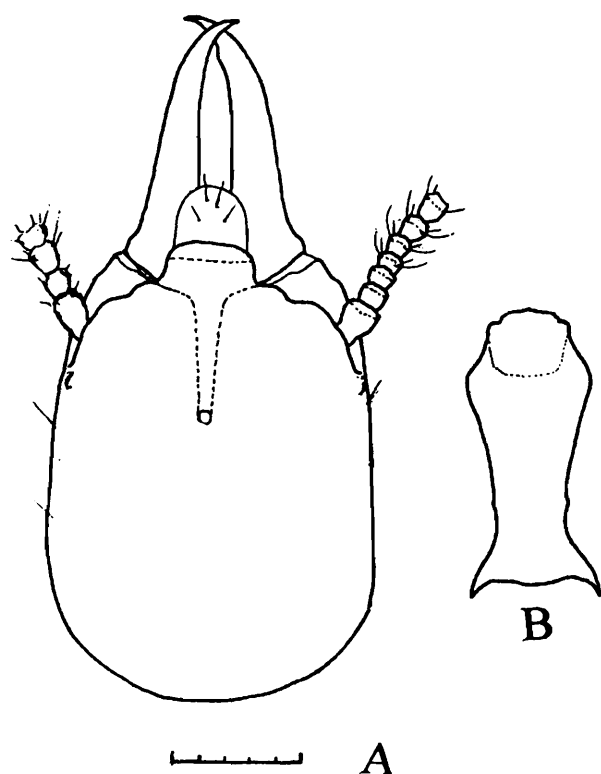


Fig. 83. *Prorhinotermes canalifrons* (Sjostedt) A-B, Soldier.
A. Head and pronotum, dorsal view; B. postmentum.

Distribution : AFRICA : Madagascar : Tamatave (type-locality), Comoros Isl. Seychelles : Mahe, Mauritius and Amirantes.

Remarks : The species is well known to occur in timber in the Western Madagascar and is also found in the comoros, the seychelles, the Amirantes and Mauritius (Paulian, 1970).

90. *Prohinotermes flavus* (Bugnion and propoff)

1. *Coptotermes flavus* Bugnion and Propoff

1910. Bugnion and Popeff, *Mem. Soc. Zool. France*, **23** (No. 8) : 117-120, S. and W., *Type-locality* : of Lake Ambalangoda, Sri Lanka.
1911. Bugnion and Ferriere, *Mem. Soc. Zool. France*, **24** (1-2) : 97-106, Im.

2. *Arrhinotermes flavus* (Bugnion and Popoff)

1911. Holmgren, *Zool. Anz.*, **37**. (26) : 561 (from *Coptotermes*)
1913. Holmgren, K. *Sven. Vet. Akad. Handl.*, **50** (2) : 381 Im. and S., Sri Lanka.
1925. John, *Treubia*, **6** (3-4) : 381, Batavia.

3. *Prorhinotermes flavus* (Bugnion and Popoff)

1949. Snyder, *Smiths. Misc. Coll.*, **112** : 86.
1958. Ahmad, *Biologia*, **4** (1 & 2) : 74, 75 (key)
1970. Roonwal and Bose, *Rec. zool. Surv. India*, **62** (3-4) : 124.
1970. Roonwal, in *Biology of Termites* (Eds. Krishna and Weesner) **2**, p. 340.
1984. Bose, *Occ. Pap., Rec. zool. Surv. India*, No.49, pp 71, 89-90.
1989. Roonwal and Chhotanim, *Fauna of India*, **1** : 119, Andaman Islands.
1994. Maiti and Chakraborti, *Rec. Zool. Surv. India, Occ. pap.* No. 167, pp. 39-42, Im. and S., Andaman and Nicobar Islands.

4. *Prorhinotermes shiva* Roonwal and Thakur

1963. Roonwal and Thakur, *Indian J. agric. Sci.*, **33** : 102-109, S. and W. *Type-locality* : Long Island, Middle Andaman, India.
1966. Roonwal and Maiti, *Treubia*, **27** (1) : 89, 90 (Misplet as *siva*)
1975. Akhtar, *Bull. Dept. Zool. Univ. Panjab (N.S.)*, Art. 7, pp. 49-52.
1977. Chhotani, *Occ., Pap. Rec. Zool., Surv. India*, No. 9 : 30.
1983. Chhotani, *Orient Insects*, **17** : 119.
1989. Roonwal and Chhotani, *Fauna of India*, **1** : 524 (sny. nov.).

Material : 11 vials with Sev. Im., S. and W; and 2 vials with Im. and deal. Great Nicobar Island, P. K. Maiti and party Coll., 1975-1976.

Diagnostic character : (i) IMAGO : Head and pronotum yellowish to reddish brown, body paler, wings hyaline and sparsely pilose. Head and pronotum with scanty hairs.

Head almost round. Fontanelle minute, placed at the level of the middle of eyes, indistinct groove leading upto posterior margin of postclypeus, gland large and transparently visible. Eyes bulging out moderately. Ocelli elongately oval, almost touching or slightly separated from the eyes. Antennae with 19-20 segments, 3 slightly shorter than 2, 4 subequal to 3. Postclypeus moderately convex with a half

median line and chitinised posterior margin. Labrum dome-shaped. Pronotum almost as wide as head, anterior margin indistinctly incurved and posterior margin substraight and weakly outcurved lateral sides.

Wings hyaline, strongly reticulate. Median arising from cubitus at proximal third in forewing and near middle in hindwing. Cubitus with 14–16 branches.

(ii) SOLDIER (Fig. 84.A-C) : Head, postclypeus, labrum bright yellow. Head and pronotum moderately hairy and abdomen densely hairy.

Head elongately oval, longer than broad, narrowing anteriorly. Fontanelle small and circular with a groove running to posterior margin of postclypeus. Eyes translucent and oval. Ocelli absent. Antennae with 16–19 segments, 3 and 4 variable in shape and size. Labrum broad and rounded anteriorly. Mandibles long, slender, weakly incurved with pointed apices, slightly more than half the head-length. Postclypeus with waist at the middle and almost half the maximum

width on anterior third. Pronotum transversely oval, with a feeble median emergination at anterior margin and with almost straight posterior margins.

Measurements : Table 43 (Im.); 44 (S.)

Types : Repository not known.

Distribution : ASIA : Sri Lanka : Ambalangoda, India : Western Coast : Mangalore; Andaman and Nicobar Islands and Bangladesh : Ukhia and Teknaf.

Remarks : This is a highly variable species in morphometry, such as head-length varies between 1.60 and 1.90 in some specimens in Sri Lanka. This is not uncommon in Andamans and is sparsely so in Mangalore, Karnataka in the mainland of India. The population occurring in different islands of Bay Islands shows enormous variation, sometimes leading to erection of even different species. (Maiti and Chakraborti, 1994). It is essentially a rotten wood termite being capable of transportation overseas by floating legs (Mitra and Maiti, 1984).

91. *Prorhinotermes gracilis* Light

1. *Prorhinotermes gracilis* Light

1921. Light, *Philp. J. Sci.*, **19** (1) : 54. Im., S. maj and min. and W. *Type-locality* : Riza Prov. near Rizal-Bulacan boundary on Manila North Road, Philippines.
1949. Snyder, *Smiths. misc. Coll.*, **112** : 86, Im., S. and W.
1958. Ahmad, *Biologia*, **4** : 73 (Im.) and 74 (S.), key.
1960. Snyder and Francis, *Philp. J. Sci.*, **89** (1) : 64, 68, 74. Philippines

Material : Since no material was available, Light's (1921) description has been incorporated.

Diagnostic character : (i) IMAGO : Forewing scales very broad, posterior ends overlapping in the midline and antennae with 16 (?)

(ii) SOLDIER : Head pale yellow, posteriorly slightly darker anteriorly; eyes vestigial, not protruding at all, represented by a vague whitish area. Antennae with 15–16 segments, segment 3 conical, strongly sclerotized. Head length with mandibles 2.30–2.60, without mandibles 1.45–1.60.

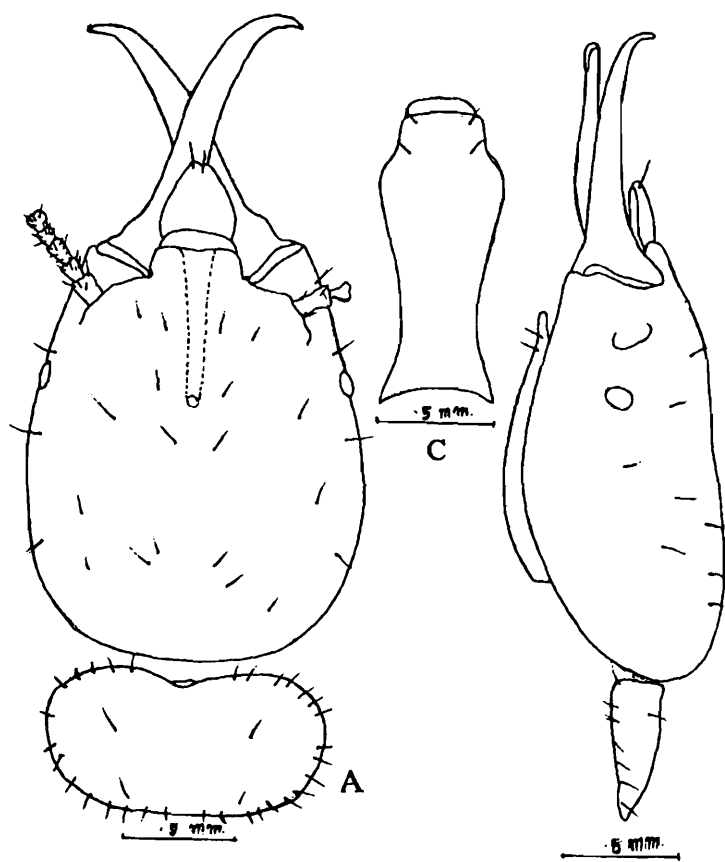


Fig. 84. *Prorhinotermes flavus* (Bugmion and popoff) A–C. Soldier. A. Head and pronotum; B. Head, lateral view; C. postmentum.

Measurements : Table 45 (S.)

Distribution : ASIA : Philippines : Riza Province, Rizal-Bulacan boundary on Manila North Road.

92. *Prorhinotermes innopinatus* (Silvestri)

1. *Prorhinotermes innopinatus* Silvestri

1909. Silvestri, *Fauna Sudwest-Austral*, 2 (17) : 287, Im., S. and W. Type-locality : Samoa : Nimafoon.
1970. Bees, in : *Biology of Termites* (Eds. Krishna and Weesner), 2 : 472.

2. *Arrhinotermes innopinatus* Silvestri

1911. Holmgren, K. *Sven. Vet. Akad. Handl.*, 46 (6), 72

2. *Prorhinotermes innopinatus* Hill

1926. Hill, *Proc. Roy. soc. Victoria*, (N.S.), 38 (10) : 95
1926a. Hill, *Proc. Roy. Soc. Victoria*, (N.S.), 39 (4) : 22 Fiji, Tavenni.
1927. Hill, *Insects of Samoa*, (7) 1 : 15.
1942. Hill, *Termites (Isoptera) from the Australian region*, pp. 38-39, Australian C.S.I.R., June, Im. and S.
1958. Harris and Brown, *Commonw. Inst. Ent.*, pp. 739, 740, 743, Solomon Islands.

3. *Prorhinotermes manni* Snyder

1925. Snyder, *J. Wash. Acad. Sci.*, 15 (17) : 398, S. Type-locality : Santa Cruz Archipelago.
1949. Snyder, *Smiths. misc. Coll.* 112 : 86 (syn.)

4. *Prorhinotermes solomonensis* Snyder

1925. Snyder, *J. Wash. Acad. Sci.*, 15 (17) : 400, S. Type-locality : Solomon Islands.
1949. Snyder, *Smiths. misc. Coll.*, 112 : 86 (syn.)

Material : Present in F.R.I., Dehra Dun : 1S. and 1m. (deal.), Metatype, det. Hill., redet. and Camp. A. E. Emerson; Aleipata, Nuntele Isl. near Upalu Isl., Samoa., coll. Buxton and Hopkins, 9.iv.1924.

Diagnostic characters : (i) IMAGO (Fig. 85.A) : Head and thorax light yellow, wings hyaline with yellowish tinge. Head, thorax and abdomen with few hairs. Head almost round. Fontanelle small,

circular with indistinct rinkles around, with a well defined groove in front leading upto postclypeus. Postclypeus convex, wider than long with a distinct median line. Labrum narrow at the base, widest at the middle with rounded apical margin. Antennae with 19-22 segments, 3 slightly shorter than 2, 4 shortest and narrowest. Pronotum narrower than head, broadly concave in front and posterior margin feebly outcurved. In forewing, median missing, arising from the radial sector in the hind wing. Wing stumps with a few strong hairs on the wings.

(ii) SOLDIER (Fig. 85.B) : Head deep orange, longer than wide, widest width at the base whence narrowing anteriorly. Fontanelle small, circular and placed in the depressed wrinkle area with forwardly running groove reaching upto postclypeus. Eyes hyaline and prominent. Labrum short with anterior rounded narrow margin. Antennae with 19-20 segments, 3 smallest and almost equal to 4. Mandibles almost straight with feebly incurved pointed apices. Pronotum narrower than head, anterior margin deeply notched.

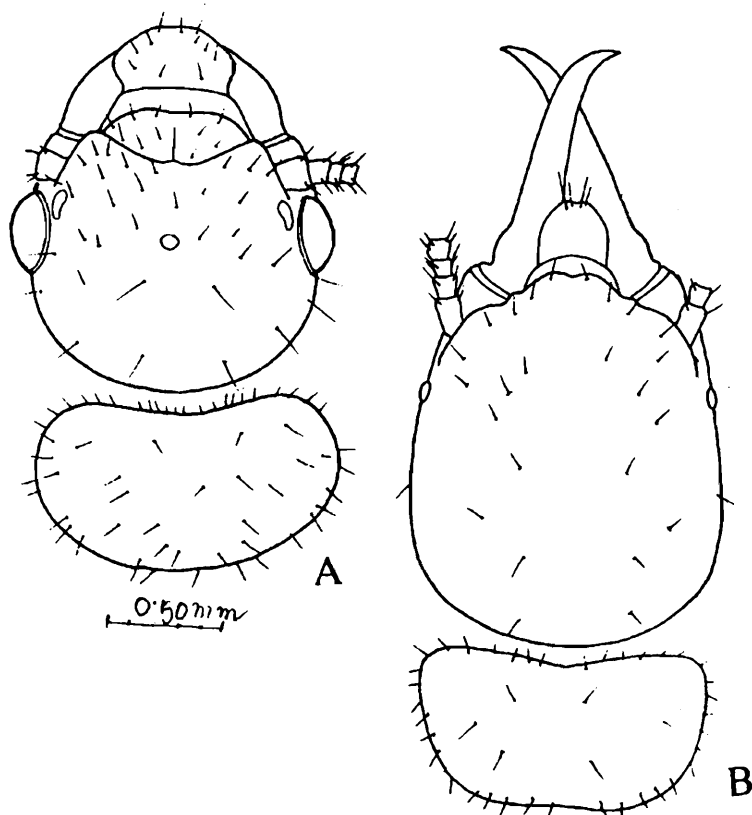


Fig. 85. *Prorhinotermes inopinatus* (Silvestri) A, Imago. A. Head and pronotum, dorsal view. B. Soldier. B. Head and pronotum dorsal view.

Measurements : Table 43(Im.); 45 (S.).

Types : In BMNH, London.

Distribution : ASIA : India. Samoan Islands : Alaipata Nuntele Isl., near upolu Isl., Ninafoon (type-locality); Fiji Islands, Tonga, eltica Islands; Solomon Islands : Malaita Island (*P. solomonensis* recorded by Snyder, 1925), Roonal Island, Lavanggu and Te' unhunggane and Bellona, Santa Cruz Island (*P. manni*, recorded by Snyder), Marianas Islands : Guam (Swezey, 1940; Light, 1946, p. 46, p. 9; Harris, 1957).

Remarks : Snyder (1925) described two new species, namely, *P. solomenensis* from Solemon Isl. and *P. manni* from Santa Cruz Islands, both of which have been synonymised by him (1949) under this species with wider distribution. However, the species has been collected from stems of paw-paw (*Carica papaya*), in rotting log on ground and dead wood (Harris, 1958). The species is widely distributed among the islands of the South Pacific and is generally found in rotten logs, posts, and tree trunk. It has been recorded infesting stored papers in a damp cupboard, where-in several apterus reproductives have also been collected (Bees, 1970).

93. *Prorhinotermes japonicus* (Holmgren)

1. *Prorhinotermes japonicus* Holmgren

1912. Holmgren, *Amet. Zool. Jap.*, **B** : 122, S. only, Type-locality : Taiwan.
1913. Holmgren, *K. Sven. Vet. Akad. Handl.*, **50** (2) : 126 S. and W. Taiwan, Botel-Tobage.
1914. Oshima, *The fourth official report on termites*, 4 pp. 1-5, Taihoku.
1915. Hozawa, *Journ. coll. Sci.*, **35** (7) : 82 (*L. flavipes* not found in Japan).

2. *Paratermes canalifrons* Oshima

1912. Oshima, *Third official report on Termites*, Taihoku, p. 69.
1949. Snyder, *Smiths. misc. Coll.*, **112** : 86, Taiwan.

Material : Present in F.R.I., Dehra Dun : Cotype "*Arrhinotermes*" det. N. Holmgren, Botel-Tobage

Island, 14.vi.1911, 3rd from Queen adn IW. from Emerson coll., AMNH, New York.

Diagnostic characters : (i) IMAGO (Fig. 86.A) : Head subround, feebly narrowing anteriorly, lateral and posterior margins uniformly convex, fairly densely hairy, mid-dorsal spot fairly large, placed on centre of Y-suture. Eyes comparatively smaller and less outbulging. Ocelli small, only slightly separated from the eyes. Antennae broken, segment 3 only slightly longer than 2 and almost double the 4. Postclypeus well-marked and feebly outcurved with a distinct median line. Labrum fairly hairy. Labrum short and much wider than long with almost angularly convex lateral margins and broadly rounded apex with 3 or 4 pairs of hairs. Mandibles of typical *Prorhinotermes*-like. Pronotum distinctly narrower

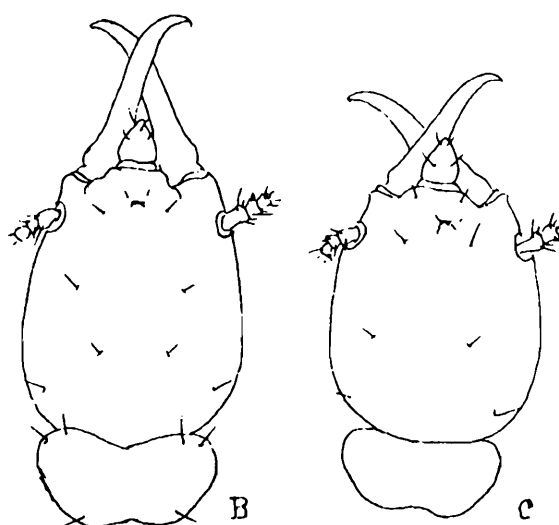
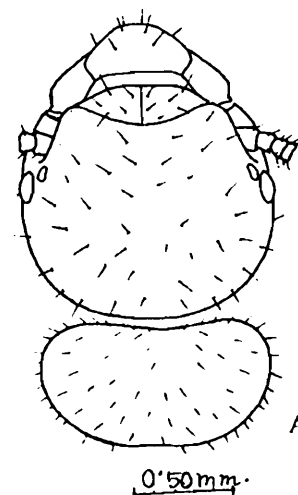


Fig. 86. *Prorhinotermes japonicus* (Holmgren); A. Imago (cotype). A. Head and pronotum. B. Soldier (major). B. Head and pronotum, dorsal view; C. Soldier (Minor). Head and pronotum, dorsal view (after, Holmgren, 1913).

than head-width, laterally ovoid in shape, fairly densely hairy, anterior margin broadly concave, lateral angles and margin uniformly round, posterior margin with very indistinct median emargination.

(ii) SOLDIER (MAJOR) (Fig. 86.B) : (based on Holmgren, 1912 and 1913). Head oval and weakly narrowing anteriorly, lateral sides weakly outcurved and maximum width on almost posterior fourth, posterior end round. Antennae with 17 segments, 3 one and a half times larger than 2 and almost double the 4. Labrum slightly longer than broad with a blunt tip and two bristles. Mandibles long, distinctly incurved with fine apices. Pronotum only slightly narrower than head, anterior margin with a pronounced median notch, lateral margins outcurved and posterior margin with feeble median emargination.

(iii) SOLDIER (Minor) (Fig. 86.C) : Very similar to soldier major, but smaller in size and with some dissimilarity as follows : Head shorter, apparently not so narrowing anteriorly. Antennal segments 3 not so long, rather short. Pronotum somewhat laterally rectangular.

Measurements : Table 43(Im.); 46 (S.)

Types : in Holmgren's Coll.

Distribution : ASIA : Taiwan : Botel-Tobage, Taihoku.

Remarks : The species is almost indistinguishable in colour from other closely related species, namely, *P. flavus* and *P. tibiaoensis* (Ahmad, 1958). However, Light (1921) has already pointed out that they could be none else than one species showing some geographical variations.

94. *Prorhinotermes krakatau* (Holmgren)

1. *Arrhinotermes krakatami* Holmgren

1913. Holmgren, K. *Sven. Vet. Akad. Handl.*, 50 (2) : 126 Im. S. and W. *Type-locality* : Krakatau, Indonesia.

2. *Prorhinotermes krakatau* (Holmgren)

1949. Snyder, *Smiths. misc. Coll.*, 112 : 69.

1958. Ahmad, *Biologia*, 4 : 73-34 (key)

Material : Material could not be studied, hence it is based on Holmgren (1913) and Ahmad (1958).

Diagnostic character : (i) IMAGO : Head length to tip of labrum 1.44; body length without wings 6.20 ; ocelli almost touching the eyes ; head nearly round, light brownish yellow, sparsely hairy; eyes slightly bulging; third antennal article as long as the fourth, somewhat shorter than second; head width 1.37; pronotum length 0.72, width 1.25.

(ii) SOLDIER : Head width 1.14; pronotum width 0.84 ; antennae with 13 articles; head oval fontanelle small, round, situated in the middle of the head; eye indistinct; third antennal article longer than the second, the forth as long as the second but slightly shorter than the third; pronotum almost oval, anterior margin convex, not emarginate posteriorly; head length with mandible 2.24, without mandibles 1.33.

Measurements : Table 45 (S.)

Distribution : ASIA : Indonesia : Krakatau

95. *Prorhinotermes molinoi* Snyder

1. *Prorhinotermes molinoi* Snyder

1924. Snyder, J. *Wash. Acad. Sci.*, 14 (2) : 43-45, Im. and S. *Type-locality* : Large Romo Isl. and Canal. Zone, Panama.

1926. Snyder, J. *Wash. Acad. Sci.*, 16 (1) : 28, S. and W. *Type-locality* : Parisiana Ranch, Costa Rica.

1949. Snyder, *Smiths. misc. Coll.*, 112 : 87

2. *Arrhinotermes wasmanni* Holmgren

1911. Holmgren, K. *Sven. Vet. Acad. Handl.*, 46 (6) : 72 Costa Rica (*nom. nud.*)

1949. Snyder, *Smiths. misc. Coll.*, 112 : 87 (Syn.)

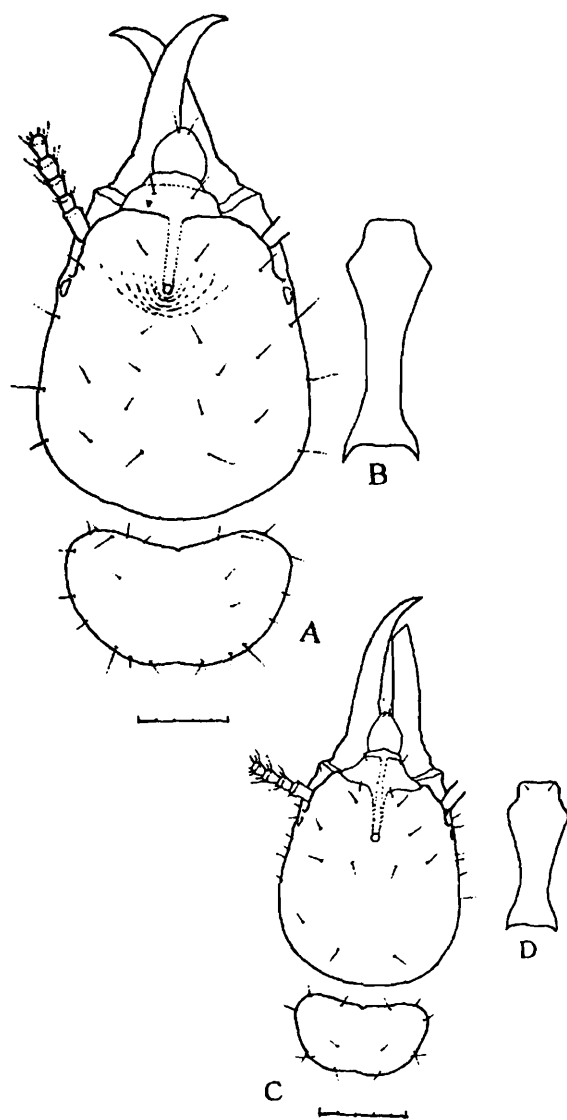
Material : (i) Present in F.R.I., Dehra Dun : 2 deal., 2S. (ii) Present in ZSI., Kolkata, 2S. same locality as above.

(i) IMAGO : Not studied.

(ii) SOLDIER (major) : (Fig. A-B) : Head light brown, other body parts paler. Head, pronotum sparsely and abdomen densely hairy. Head

somewhat triangular in broad sense, maximum width posteriorly, slightly and gradually narrowing anteriorly. Fontanelle distinct with groove. Eyes prominent, placed laterally, much below the antennae. Ocelli absent. Labrum dome-shaped, slightly longer than broad. Mandible comparatively long, substraight with weakly incurved apices. Antennae broken, 2 smaller than 3, 3 and 4 subequal. Postmentum slender with maximum width only slightly below the apical margin, whence gradually narrowing posteriorly to waist almost at posterior third. Pronotum kidney-shaped with broadly concave anterior margin and convex posterior margin.

(ii) SOLDIER (minor) : (Fig. C-D) : Very similar to *S. major*, except having slender head, mandibles and postmentum.



Measurements : Table 48(S.)

Types : 1m. (Male) in U.S.N.M. (No. 26756), Washington.

Distribution : CENTRAL AMERICA : Panama : Canal Zone : Large Island (type-locality) Costa Rica : Parisiana Ranch.

96. *Prorhinotermes oceanicus* (Wasmann)

1. *Arrhinotermes oceanicus* Wasmann

1902. Wasmann, *Zool. Jahrb., Abt. Syst.*, 17 (1) : 123, Im, Cocos Isl., between Galapagos and Costa Rica.

1911. Holmgren, K. *Sven. Akad. Handl.*, 46 (6) : 1-188, Im.

2. *Prorhinotermes oceanicus* (Wasmann)

1949. Snyder, *Smiths. misc. Coll.*, 112 : 87, Im. Material : 2S. and 2W. from Cocos Island, between Galapagos and Costa Rica.

Diagnostic character : (i) IMAGO : Not available for study.

(ii) SOLDIER (Major) (Fig. A-B) : Head sparsely hairy and uniformly oval with slightly narrowing anteriorly, lateral sides outcurved and its maximum width on posterior third, posterior margin round. Fontanelle opening small and circular, placed slightly below the anterior third, fontanelle with a faint groove leading to anterior margin of postclypeus. Eye spot minute but distinctly marked. Labrum with maximum width on anterior third with a rounded anterior margin and a pair of bristles on top. Antennae broken, 3 one and a half times longer than 2 and double the 4. Mandibles abruptly incurved with a fairly pointed apices. Postmentum strictly club-shaped, widest width almost on anterior 4th and more than double the minimum width, with a few hairs anteriorly.

Pronotum almost kidney-shaped, anterior margin with a deep median emargination, antero-lateral angles uniformly round and posterior margin indistinctly outcurved.

(iii) SOLDIER (Minor) : Not studied.

Measurements : Table 48 (S.)

Fig. 87. *Prorhinotermes molinoi* Snyder; A-B, Soldier (major). A. Head and pronotum, dorsal view; B. Postmentum. C-D, Soldier (Minor). C. Head and pronotum, dorsal view. D. Postmentum.

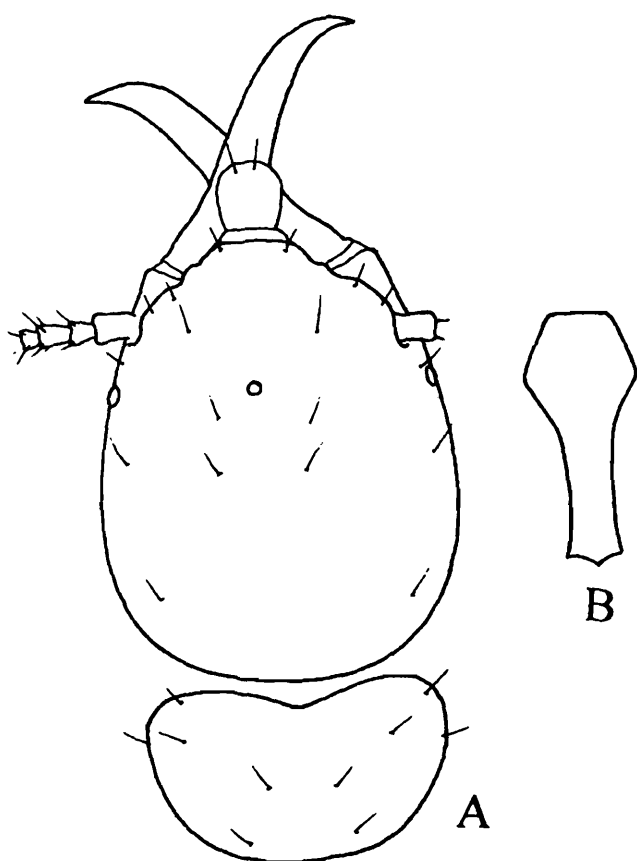


Fig. 88. *Prorhinotermes oceanicus* (Wasmann) ; A-B, soldier (major). A. Head and pronotum, dorsal view; B. postmentum.

Types : Wasman's collection.

Distribution : SOUTH AMERICA : Cocos Island (between Galapagos and Costa Rica).

Remarks : Nothing is known about its biology.

97. *Prorhinotermes panaitanensis* Thakur and Thakur

Prorhinotermes panaitanensis Thakur and Thakur

1992. Thakur and Thakur, *Treubia*, 30 (3) : 251-256 S. and W. Type-locality : Panaitan, Krakatau Islands, Indonesia.

Material : Present in FRI, Dehra Deun : Holotype S. from Panaitan, Krakatau Islands, coll. T. Abe, 10.10.1982.

Diagnostic character : (i) IMAGO : Unknown.

(ii) SOLDIER (Fig.89.A-D) : Head golden yellow, paler near the occiput; front, postclypeus, labrum and basal region of mandibles yellowish brown. Head and pronotum with few scattered hairs.

Head suboval, widest near the posterior third; posterior margin broadly rounded. Fontanelle small and round with groove broadening anteriorly. Eyes translucent and oval. Ocelli absent. Antennae with 18 segmnets, 3 more chitinised slightly longer than 2, 4 shortest. Labrum tongue-shaped, broader than long. Mandibles sabre-shaped with weakly incurved apices, left mandibles with weak crenulation baselly. Postmentum broadest near the apical fourth, waist near the basal third. Pronotum subreniform, anterior margin with a median emargination, lateral margins narrowing posteriorly, posterior margin with a faint median emargination.

Measurements : Table 47 (S.)

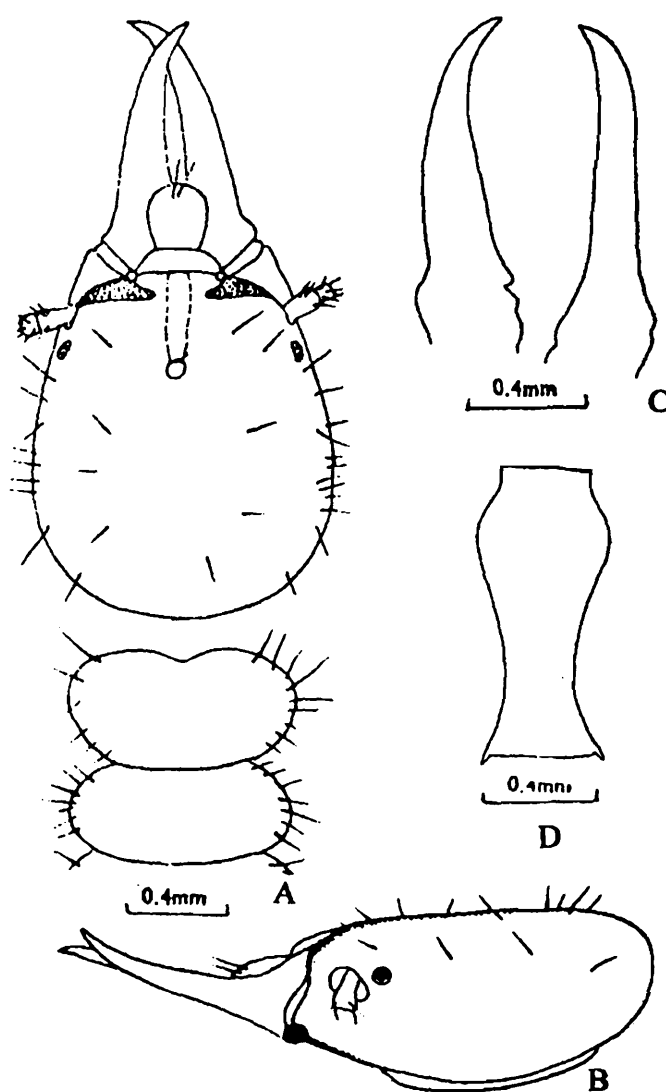


Fig. 89. *Prorhinotermes panaitanensis* Thakur and Thakur A-D, Soldier. A. Head, pronotum and mesonotum, dorsal view; B. Head, lateral view; C. Mandibles; D. postmentum.

Types : Holotype S., Paratype S. and Morphotype W., all with same data as in the Material above in F.R.I., Dehra Dun.

Distribution : ASIA : Indonesia : Krakatau : Panaitan (type-locality).

Remarks : The species is so far known only from its type-locality and comes closest to *P. ravani* Roonwal and Maiti from East Java in having weak crenulations on the left mandibles of soldier caste. However, it differs from the latter by having smaller head (head-length 1.35–1.50 mm vs. 1.68–1.73 in *P. ravani*). Smaller mandibles (1.00–1.10 vs. 1.10–1.13), antennae with 18 segments (vs. 17 segments) and feeble median notch on anterior margin of pronotum (more prominent notch).

98. *Prorhinotermes ravani* Roonwal and Maiti

1. *Prorhinotermes ravani* Roonwal and Maiti

1966. Roonwal and Maiti, *Treubia*, 27 (1) : 84–90, s. and W. Type-locality : Sumber weringin (near Bondowoso), E. Java, alt. 700 m., Indonesia.

Material : (i) Present in Z.S.I., Kolkata : Holotype S. from the type locality.

Diagnostic character : (i) IMAGO : Unknown

SOLDIER (Fig. 90.A-B) : Head pale yellow to golden yellow; antennae, labrum and pronotum pale creamish white. Head and pronotum sparsely and abdomen densely hairy.

Head suboval, broadest at postero-lateral corners; posterior margin broadly outcurved; much longer than broad. Fontanelle distinct, round and translucent; opening leading to a prominent, anteriorly broadening groove reaching upto middle of postclypeus. Eyes small and translucent, ocellae absent. Antennae with 17 segments, 3 longer than 2 and 4. Labrum tongue-shaped with a pair of hairs at the tip. Mandibles sabre-shaped with slightly incurved tips. Postmentum club-shaped, shorter than head-length; broadest at anterior fifth, narrowest at basal fourth. Pronotum subreniform, much

narrower than and much broader than its length; antero-lateral corners rounded; anterior margin substraight with a median wide notch, posterior margin with a median emargination.

Measurements : Table– 44 (s.)

Type : (1) Holotype S. and Paratype S. and W in (i) Z.S.I., Kolkata; (ii) Paratype 2S. and 4W in Mus. Zool. Bogoriense, Bogor, Java and (iii) Paratype 1S and 7W. in AMNH, New York.

Distribution : ASIA : Indonesia : Sumber weringin (near Bondowoso), East Java (alt. 700 m.)

Remarks : The species is so far known from the type-locality only. It is very close to *P. flavus* Bugnion and Popofit and *P. japonicus* (Holmg.), but differs in its characters of the soldiers as indicated in the key. Nothing is known of its biology.

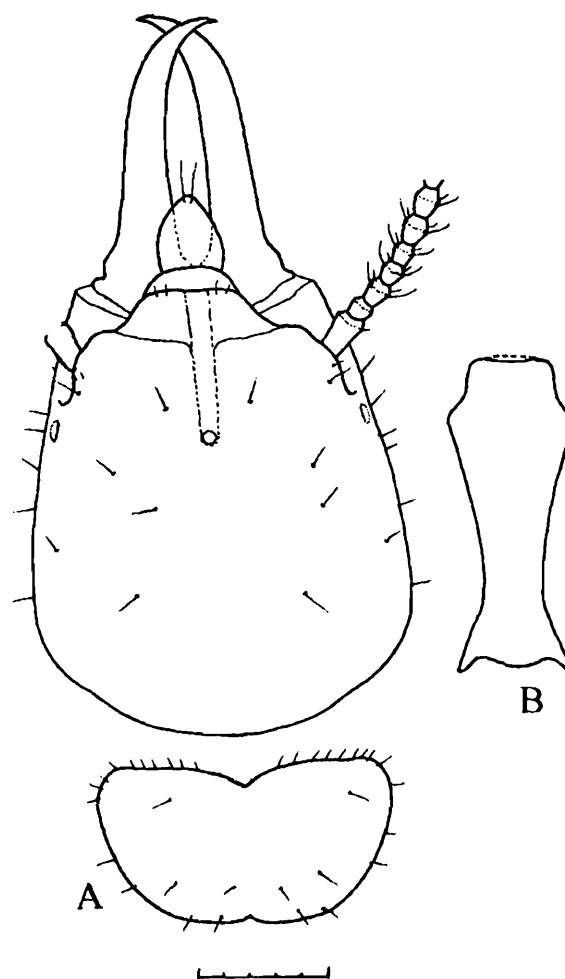


Fig. 90. *Prorhinotermes ravani* Roonwal and Maiti A–B. Soldier. A. Head and pronotum, dorsal view; B. postmentum.

99. *Prorhinotermes rugifer* Kemner

1. *Prorhinotermes rugifer* Kemner

1931. Kemner, *Lunds. Univ. Arsskr.*, 27 (13) : 16-17, 1m.
S. (maj) and S. (min.), *Type-locality* : Amboina Isl.

1970. Bees, in : *Biology of Termites* (Eds. Krishna and Weesner), 2, 472. Oceanic Islands.

Material : No material was available for study

Diagnostic character : (Based on Kemner, 1931)

(i) IMAGO : Not studied.

(ii) SOLDIER (Major) (Fig. 91.A) : Head pale yellow with rustbrown mandibles and sparsely hairy. Head somewhat oval, weakly narrowing anteriorly and only slightly longer than broad, lateral sides most outcurved slightly below the middle, antero-lateral corners very prominent. Fontanelle small and round, situated much below the anterior third, being distinctly wrinkled, a shallow groove running from the opening upto below the frons. Labrum roundish, almost as long as broad with a pair of hairs at the tip. Antennae with 16 segments, 2, 3 and 4 subequal, 3 slightly

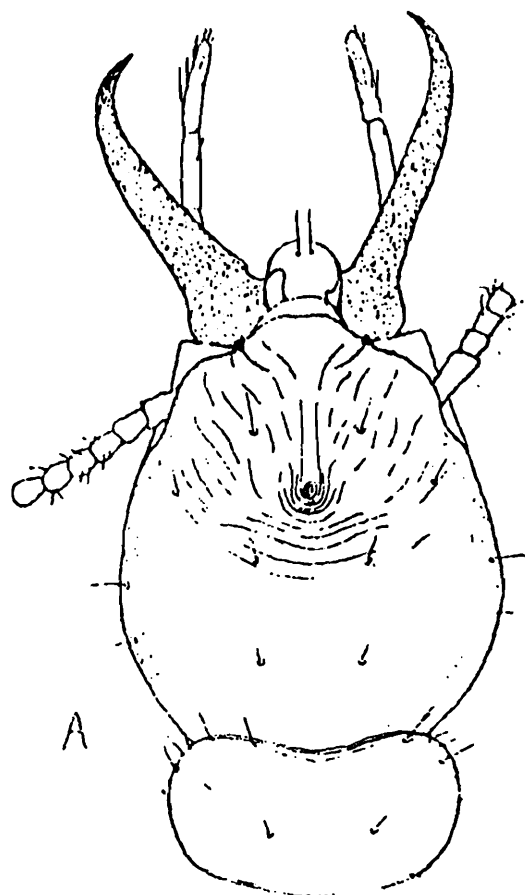


Fig. 91. *Prorhinotermes rugifer* Kemner A. Soldier. A. Head and pronotum, dorsal view (after, Kemner.).

longer. Mandibles more than half the head-length, thin, almost straight, but somewhat strongly hooked with fine apices. Pronotum narrower than head-width, width almost double the length, anterior margin concave and posterior margin convex.

(iii) SOLDIER (Minor) : Very similar to soldier major, but distinctly smaller.

Measurements : Table – 47 (s.)

Types : Kemner's coll.

Distribution : ASIA : Amboina; Oceanic Isl.

Remarks : The species occurs in stumps, logs and tree trunk in moist conditions like other members of the genus in the oceanic Islands (Bees, 1970).

100. *Prorhinotermes simplex* (Hagen)

1. *Termes simplex* Hagen

1858. Hagen, *Linn. Entomol.* 12 : 238, 1m. *Type-locality* : Cuba.

2. *Rhinotermes simplex* Desneux

1904. Desneux, *Genera insecterum*, 25 : 28

3. *Arrhinotermes simplex* (Holmgren)

1911. Holmgren, K. *Sven. Vet. Akad. Handl.*, 46, (6) : 72.

4. *Prorhinotermes simplex* Banks

Banks, *Bull. Mus., Comp. Zool.*, 62 (10) : 480, Cuba, Jamaica, Kingston, Florida.

1920. Banks (and Snyder), *U. S. Nat. Mus. Bull.*, No. 108, pp. 39-42.

1949. Snyder, *Smiths. misc. Coll.*, 112 : 87.

1949. Miller, *Univ. Miami. Press, Florida.*

1942. Miller, *Bull. Univ. Miami*, 15 : 1-27

1943. Hammis, *Entomological News*, 54(8) : 185-186, (key).

1970. Weesner, In : *Biology of Termites* (Eds. Krishna and Weesner), 2 : 506-507, Nearctic Region.

1970. Araujo, In : *Biology of Termites* (Eds. Krishna and Weesner), 2 : 533, Florida.

Material : (i) Present in F.R.I., Dehra Dun : 4 Alates, 7S. and 9W. from Coral Gables & Miami, Florida. (ii) Present in Z. S. I., Kolkata : 1S. and 1W. from Miami.

(i) IMAGO : Not studied

(ii) SOLDIER (Fig. 92.A-B) : Head light brown, paler anteriorly including postclypeus and labrum ; pronotum with brownish tinge. Head, labrum and pronotum very sparsely hairy.

Head wide, almost above the posterior margin, gradually narrowing anteriorly, anterior end only slight broader than half the head width. Fontanelle distinct with a groove running upto end of postclypeus. Labrum elongately oval, anterior margin weakly convex. Mandibles long and slender with weakly incurved and somewhat pointed apices. Antennae with 18 segments, 3 longer than 2 and 4, 4 smallest. Postmentum as long as mandibles, elongate, widest width almost double the waist at posterior third. Pronotum subreniform, anterior margin weakly convex with shallow median notch lateral sides uniformly round and posterior margin convex with a faint median emargination.

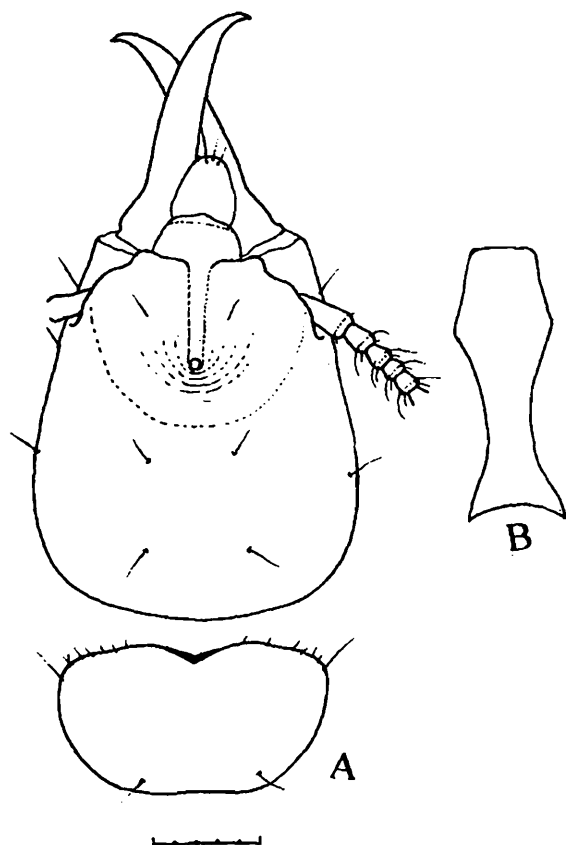


Fig. 92. *Prorhinotermes simplex* (Hagen); A-B, Soldier. A. Head and pronotum, dorsal view; B. Postmentum.

Measurements : Table 48 (S.)

Types : Im. in Hof Mus., Vienna, Austria.

Distribution : America : United States : Florida. Cuba, West Indies : Jamaica. Puerto Rico.

Remarks : The species is one of the distinctive species in Florida fauna, inhabiting moist wood partly buried in the soil, lying upon soil or entirely removed from soil. It is found in mangrove swamps on the coast and in pale forest areas in the lower overglades at Homestead (Weesner, 1970). In Florida, it has been collected sparsely south-eastern keys and on the mainland in Dado country. It is of fairly economic importance in the area of its occurrence. Swarming has been reported from Cuba in October (Banks and Snyder, 1920), while from Florida from October to January during 6.00–9.00 p.m. (Miller, 1949).

101. *Prorhinotermes tibiaoensisformis* Ahmad

1. *Prorhinotermes tibiaoensisformis* Ahmad

1965. Ahmed, *Bull. Amer. Mus. Nat. Hist.*, 131(1) : 23-24, S. and W. Type-locality : Wang Nok, An, Thailand.
1973. Morimoto, *Bull. Govt. For. Exp. Stn.*, No. 257, p. 77, Thailand.

Material : (i) Since no material is available, characters are based on Ahmed (1965)

(i) IMAGO : Unknown.

(ii) SOLDIER (Fig. 93.A) : Head, labrum and antennae yellowish brown. Head, postclypeus and pronotum with few scattered hairs. Head oval, narrowed anteriorly, widest in basal third, posterior margin weakly produced at the middle. Fontanelle small and circular, with groove running in front. Eyes distinct, broadly oval, slightly bulging. Labrum small and subround. Antennae with 17-19 segments, 2 slightly shorter than 3 (in 18 segmented). Mandibles thin, only slightly incurved. Postmentum two a half times as long as broad at its widest point, waist almost at the middle. Pronotum with anterior margin convex and notched at the middle, posterior margin substraight.

Measurement : Table 46(S).

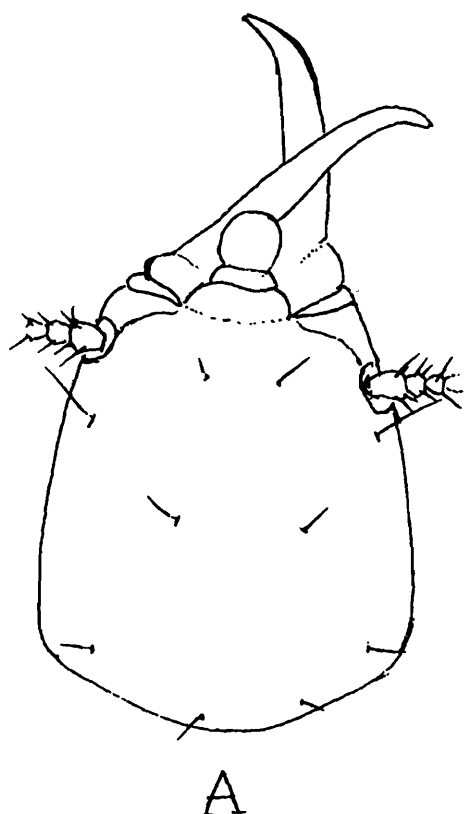


Fig. 93. *Prorhinotermes tibiaoensisformis* Ahmad A. Soldier.
A. Head, dorsal view.

Types : Holotype in Ahmad's coll. Dept. Zool., Unjv. Panjab, Lahore, Pakistan; and *Paratypes* in A.M.N.H., New York.

Distribution : ASIA : Thailand, Wang Nok

Remarks : The species is very close to *P. tibiaoensis* (Oshima), but different from the latter in having mandibles with less strong incurved apices, head more narrowed anteriorly and narrower pronotum. It is also somehow similar to *P. flavus*. Bugnien and Popoff, *P. krakataui* (Haviland), *P. graciles* Light and *P. japonicus* (Helmgren), but can be distinguished from them by the characters as given in the key.

102. *Prorhinotermes tibiaoensis* (Oshima)

1. *Termitonella tibiaoensis* Oshima

1920. Oshima, *Philip. J. Sci.*, 17 (5) : 495, Im. only *Type-locality* : Tibiae, Antique Province, Panay, Philippines.

2. *Prohinotermes luzonensis* Light

1921. Light, *Philp. J. Sci.*, 19 (1) : 49, Im., S. major and minor and W. *Type-locality* : Rizal-Bulacan, boundary on Manila, North Road, Philippines.
1949. Snyder, *Smiths. misc. Coll.*, 112 : 88 (sys.)

3. *Prorhinotermes tibiaoensis* (Oshima)

1949. Snyder, *Smiths. misc. Coll.*, 112 : 88
1958. Ahmad, *Biologia*, 4 (1-2) : 73-74 (Im.) and 75 (S.), key.
1960. Snyder and Francia, *Philip. J. Sci.*, 89 (1) 64, 48, 74 (key)
1970. Roonwal, In : *Biology of Termites* (Eds. Krishna and Weesner), 2 : 340.
1983. Thapa, *Sabah For. Rec.*, No.12 : 92-95, S. only, Sabah, Malaysia.

Material : Present in F.R.I., Dehra Dun : one vial with sev. S. and W., Koyah 11, Dist. Lamag, Coll. Low Min. Tech, 16.xi.1970, ex. "rotten wood"

Diagnostic characters : (i) IMAGO : (Based on Oshimas, 1920) : Head chestnut brown, postclypeus and antennae yellowish. Head round, fontanelle small and distinct; postclypeus swollen; labrum tongue-shaped; antennae with 17 segments (with 18-21 joints, by Light 1921), segment 2 longer than 3, 4 shorter than 3 eyes distinct Ocelli oval and almost touching the eyes. Pronotum sub-reneform, anterior margin bilobed, posterior margin substraight and sides rounded. Wings hyaline, costa and radius yellowish brown; radius near and parallel to costa with no branch in forewing; median vein of hindwing originating from radius and running nearer to cubitus than to radius.

Measurements (in mm) :

Length of body with wings	11.00
Length of body without wings	6.50
Length of Head	1.25
Width of head	1.38
Width of pronotum	1.44
Length of pronotum	0.94
Length of anterior wing	8.50

(ii) SOLDIER (Major) (Fig. 94.A-G) : Head, antennae and labrum deep yellow. Head and pronotum with scattered long and short hairs. Head longer than broad, gradually narrowing anteriorly, lateral margin weakly outcurved and

posterior margin produced medially. Fontanelle circular with groove in front upto postclypeus. Eyes fairly large. Antennae with 19-20 segments, 3 longer than 2, 4 shorter than 2 (in 19 segmented antenna). Labrum tongue-shaped, lateral margins outcurved with a pair of erect hairs near margin. Mandibles with finely pointed incurved apices. Postmentum vash-shaped and arched, widest width almost near the apical fourth and waist near the middle, anterior half with a few scattered hairs. Pronotum subreniform, anterior margin with deep median emargination and posterior margin outcurved with feeble median depression.

Measurements : Table 46 (S.).

Types : Repository unknown.

Distribution : ASIA : Philippines : Panay : Tibiao (Antique Province) (type-locality); Rizal-bulacan boundary on Manila, North Road, Culsasi, Malaysia : Sabah : Dist. Lamag : Koyah II, Dist. Sandakan South : Sepilok.

Remarks : Ahmad (1965) had described a species *P. tibiaoensisformis* from Thailand which had derived its name from *P. tibiaoensis* from Philippines and Malaysia due to its closeness (*Vide*, under that species).

However, the species mostly lives in damp and decaying wood, devoid of water source, the species could hardly survive (Light, 1934 as *P. luzonensis* ; Roonwal, 1970). However, the species are frequently found in decaying wood of standing trees, specially in the hollows. It is

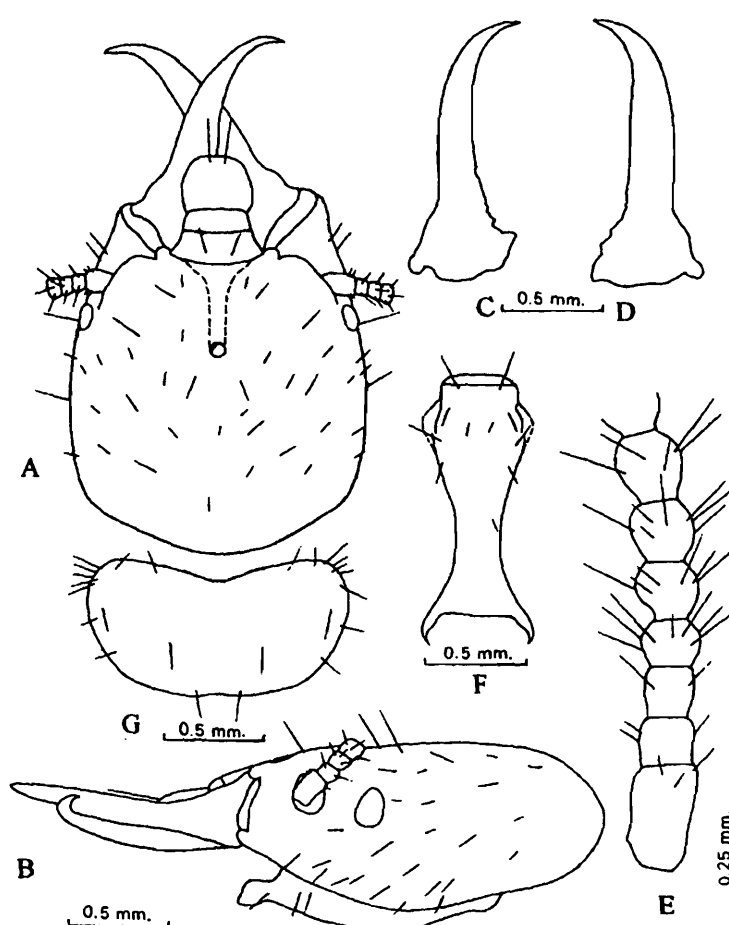


Fig. 94. *Prorhinotermes tibiaoensis* (Oshima); A-G. Soldier. A. Head, dorsal view; B. Head, lateral view; C-D. Mandibles; E. Antennae; F. postmentum; G. pronotum (After, Thapa, 1982).

common in the hollow of bagtikan (*Parashorea plicata*) tree and is known to swarm in November and December in the Philippines (Snyder and Francis, 1960).

Ahmad (1958) remarked *P. flavus*, *P. japonicus* and *tibiaoensis* are difficult to isolate on the basis of colour only.

Table-43. Measurements (in mm) etc., of Caste—Imago

<i>Prorhinotermes</i> spp.	<i>P. flavus</i>	<i>S.inopinatus</i>	<i>S. japonicus</i>
Length of head to lateral base of mandibles	1.04-1.09	1.10	1.09
Max. width of head (with eyes)	1.38	1.40	1.30
Max. length of postclypeus	0.19-0.22	0.25	0.20
Max. width of postclypeus	0.63-0.65	0.65	0.68
Max. length of labrum	0.40-0.43	0.30	0.28
Max. width of labrum	0.50-0.58	0.55	0.54

Table-43 (Contd.)

<i>Prorhinotermes</i> spp.	<i>P. flavus</i>	<i>S.inopinatus</i>	<i>S. japonicus</i>
Max. diameter of compound eye (with ocular sclerite)	0.34-0.36	0.32	0.18
Max. diameter of lateral ocellus	0.14-0.16	0.15	0.10
Min. diameter of lateral ocellus	0.09-0.11	0.08	0.05
Min. eye-ocellus distance	0.02	0.02	touching
Max. length of pronotum	0.75-0.78	0.75	0.62
Max. width of pronotum	1.24-1.29	1.35	1.18
Length of forewing with scale	8.48-8.57	—	—
Length of forewing scale	1.00-1.04	—	—
Length of hindwing with scale	7.43-7.81	—	—
Length of hindwing scale	0.58-0.63	—	—
Number of antennal segments	17-19	19-22	

Table-44. Measurements (in mm) etc., of Caste-Soldier

<i>Prorhinotermes</i> spp.	<i>P. flavus</i>	<i>P. ravanii</i>
Length of head to lateral base of mandibles	1.56-1.80	1.68-1.73
Max. width of head	1.37-1.56	1.43-1.46
Width of head at anterior end	—	0.95-0.98
Head contraction index (Ant. W./max. width)		0.65-0.67
Head index (width/length)	0.87-0.89	—
Max. length of labrum	0.28-0.32	0.20-0.22
Max. width of labrum	0.26-0.34	0.26-0.28
Length of mandible (Upper base of condyle to tip)	1.03-1.16	1.10-1.13
Head-mandibular length Index (mand.-length/head-length)	0.66-0.73	0.64-0.67
Min. median length of postmentum	1.09-1.19	1.13-1.16
Max. width of postmentum	0.41-0.52	0.45-0.53
Width of postmentum at waist	0.20-0.26	0.20-0.23
Max. length of pronotum	0.46-0.59	0.58-0.63
Max. width of pronotum	1.09-1.30	1.10-1.16
Pronotum index (length/width)	0.42-0.43	0.53-0.55
Pronotum head index (pronotum width/head-width)	0.79-0.83	0.77-0.79
Number of antennal segments	18-20	17

Table-45. Measurements (in mm) etc., of Caste-Imago

<i>Prorhinotermes</i> spp.	<i>P. gracilis</i>	<i>P. krakatau</i>	<i>P. inopinatus</i>
Length of head to lateral base of mandibles	1.45-1.60	1.33	1.30-1.82
Max. width of head	1.25-1.35	1.14	1.10-1.50
Width of head at anterior end	0.90-0.95		
Head contraction index (Ant. W./max. width)	0.70-0.72		
Head index (width/length)	0.84-0.85	0.86	0.84-0.90
Length of mandible (Upper base of condyle to tip)		0.88	0.82-1.25
Head-mandibular length Index (mand.-length/head-length)		0.68	0.63-1.79
Max. length of pronotum	0.45-0.50		0.40-0.58
Max. width of pronotum	1.00-1.05	0.84	0.95-1.25
Pronotum index (length/width)	0.44-0.47		0.42-0.54
Pronotum head index (Pronotum width/head-width)	0.77-0.80	0.74	0.86-0.87
Number of antennal segments	15-16	13 (broken)	

Table-46 Measurements (in mm) etc., of Caste-Imago

<i>Prorhinotermes</i> spp.	<i>P. japonicus</i> (S. maj)	<i>P. tibiaoensis</i>	<i>P. tibionensi formis</i>
Length of head to lateral base of mandibles	1.59	1.60-1.97	1.56-1.87
Max. width of head	1.48	1.40-1.65	1.32-1.56
Width of head at anterior end		0.87-1.00	
Head index (width/length)	0.82	0.76-0.78	0.81-0.84
Max. length of labrum		0.30-0.32	
Max. width of labrum		6.31-0.32	
Length of mandible (upper base of condyle to tip)	0.88-1.05	1.12-1.27	1.09-1.24
Head-mandibular length Index (mand.-length/head-length)	0.67	0.63-0.70	0.66-0.69
Min. median length of postmentum		1.06-1.25	1.04-1.26
Max. width of postmentum		0.47-0.55	0.46-0.52

Table-46 (Contd.)

<i>Prorhinotermes</i> spp.	<i>P. japonicus</i> (<i>S. maj</i>)	<i>P. tibiaoensis</i>	<i>P. tibionensi</i> <i>formis</i>
Width of postmentum at waist			0.23–0.26
Max. length of pronotum	0.53–0.57	0.69–0.72	0.48–0.56
Max. width of pronotum	1.05–1.18	1.15–1.29	1.04–1.24
Pronotum index (length/width)	0.49–0.50	0.55–0.60	0.45–0.46
Pronotum head index (pronotum width/head-width)	0.72–0.80	0.79	0.79
Number of antennal segments	17	17–20	17–19

Table-47. Measurements (in mm) etc., of Caste-Soldier

<i>Prorhinotermes</i> spp.	<i>P. rugifer</i> (<i>S. maj.</i>)	<i>P. canalifrons</i>	<i>P. panaitanensis</i>
Length of head to lateral base of mandibles	1.59–1.66	1.65–1.75	1.35–1.50
Max. width of head	1.34–1.41	1.11–1.30	1.20–1.33
Width of head at anterior end			0.80–0.88
Head contraction index (Ant. W./max. width)			0.63–0.67
Head index (width/length)	0.84	0.74	0.85–0.89
Max. length of labrum		0.19	
Max. width of labrum		0.21	
Length of mandible (Upper base of condyle to tip)	0.95	0.95	1.00–1.10
Head-mandibular length index (mand.-length/head-length)	0.60	0.54	0.89–0.96
Min. median length of postmentum		0.84–1.05	1.00–1.10
Max. width of postmentum		0.46	0.43–0.48
Width of postmentum at waist		0.26	0.23–0.25
Max. length of pronotum	0.59	0.57	0.50–0.58
Max. width of pronotum	1.09–1.13	1.15	0.93–1.05
Pronotum index (length/width)	0.53–0.54	0.49	0.51–0.56
Pronotum head index (Pronotum width/head-width)	0.80–0.89	0.88	0.70–0.72

Table-48. Measurements (in mm) etc., of Caste-Soldier

<i>Prorhinotermes</i> spp.	<i>P. simplex</i>	<i>P. molinoi</i>		<i>P. oceanicus</i>
		<i>S.maj</i>	<i>S.min</i>	
Length of head to lateral	1.76–1.78	1.90–1.92	1.19	1.65
Max. width of head	1.50	1.52–1.61	1.07	1.38
Width of head at anterior end	0.92	1.00	0.75	0.88
Head index (width/length)	0.84	0.80		0.83
Max. length of labrum	0.21	0.26	0.19	0.23
Max width of labrum	0.23	0.23	0.15	0.28
Length of mandible (upper base of condyle to tip)	1.13–1.15	1.26	1.07	1.14
Head-mandible length index (mand. -length/head-length)	0.61	0.52		0.68
Min. median length of postmentum	0.38	0.48–0.54	0.34	0.46
Width of postmentum at waist	0.19	0.15	0.15	0.23
Max. length of pronotum	0.61–0.70	0.75–0.96	0.50	0.63
Max. width of pronotum	0.19–1.22	1.25–1.34	0.73	1.11
Pronotum index (length/width)	0.57	0.60	0.68	0.56
Pronotum head index (pronotum width/head-width)	0.81	0.83	0.68	0.83

Genus *Parrhinotermes* Holmgren1. Genus *Parrhinotermes* Holmgren

1910. Holmgren, *Zool. Anz.*, 35 : 285. (No description)
1911. Holmgren, K. Sv. Vet. Akad. Handl. 46(6) : 77, 78.
- 1913-14. Holmgren, *Zool. Jb. (Syst)*, 36 (2-3) : 237.
1962. Roonwal and Chhotani, *Proc. natnl. Inst. Sci, India*, (B) 28 (4) : 294.
1942. Hill, *Termites (Isoptera) from Australian Region* : 172.
1949. Synder, *Smiths. misc. Colls.* 112 : 85.
1950. Ahmad, *Bull. Am. Mus. nat. Hist.* 95 (Art.2) : 54, 56.
1955. Emerson, *Fieldiana* : Zool, 37 : 500, 509.
1955. Weidner, in *Die Termiten* (Ed. Schmidt) : 57.
1958. Ahmad, *Biologia*, 4 (1 & 2) : 59, 60.
1961. Harris, *Termites : Recognition and Control*; P.48 (2nd Ed. 1971).
1970. Krishna, In *Biology of Termites* (Eds. Krishna and Weesner) : vol. 2 : 137, 139.
1970. Roonwal, in *Biology of Termites* (Eds. Krishna and Weesner) : Vol. 2 : 340-341.
1970. Weidner, *Handb. d. zool.*, 4 (2) : 21.
1971. Emerson, *Bull. Am. Mus. nat. Hist.*, 146 (Art. 3) : 248, 251, 256.
1973. Chhotani and Bose, *Zool. Anz.*, 190 (3/4) : 233, 234.
1982. Thapa, *Sabah For. Rec.*, No. 12 : 5.
1982. Tsai and Huang, *Acta Ent. Sinica*, 25 : 306–310.
1983. Chhotani, *Orient. Insects*, 17 : 111, 112, 113, 114, 115, 119.
1985. Chhotani, *Z. ang. Ent.*, 100 : 91, 93, 94.
1986. Grasse, *Termitologia*, 3 : 529.
1992. Bose, *Occ. pap., Rec. Zool Surv. India*, No. 171, p. 53

History, Distribution, Composition, etc. : The genus *Parrhinotermes* was erected by Holmgren

(1910) based on the type-species of the genus, *Termes aequalis* Haviland from Borneo. Since then it is a good genus containing 11 species from the Oriental (10) and Australian (one). The genus is closely related to *Prorhinotermes* in having monomorphic soldier caste in addition to other characters. The subspecies, *P. khasu ruiliensis* Tsai and Huang has not been included in the study.

b. *General character* : (i) IMAGO : Head and pronotum yellowish brown and sparsely hairy, abdomen paler and more hairy.

Head subcircular and considerable flat. Fontanelle placed forwardly with a distinct groove, running anteriorly upto postclypeus. Eyes large bulging out. Ocelli absent, if present, thin oval and placed close to eyes. Antennae with 16-17 segments, 2-4 variable. Postclypeus weakly convex with a median line. Labrum short and round apically. Left mandible with finger-like apical teeth, 1st marginal subequal to apical, 2nd short and subequal to 3. Right mandible with apical as in left, 1st marginal rudimentary, placed at base of 2nd marginal being subequal to apical, 3rd short with long posterior margin being subequal to molar plate. Pronotum flat, narrower than head. Apical tibial spur 3 : 2 : 2 or 2 : 2 : 2. Cerci 2-jointed. Styli absent.

(ii) SOLDIER : Head ovoid, flat and narrowed in front. Fontanelle placed almost near the clypeus, opening round to oval, groove running to apex of labrum. Postclypeus flat. Eyes and ocelli absent. Antennae with 13 segments, 2-4 variable. Labrum tongue-shaped, longer than broad, anterior margin hyaline with a fringe of hairs like a brush.

Mandibles long, narrow, fairly broad at base. Left with a thin and finely pointed incurved apex. 1st marginal forwardly directed with fine apex, 2nd somewhat blunt, its posterior margin smooth and terminate into a notch, below of which serrated allthrough.

Right mandible with finely pointed apical and very small, adpressed to 1st marginal tooth with long posterior margin and serrated below. Postmentum

club-shaped, widest at anterior third and waist almost on posterior third, in some species covering with minute hairs, specially on anterior half, otherwise with sparse hairs. Pronotum narrower than head, both anterior and posterior margins shallowly concave.

E. Key to the species of *Parrhinotermes* Holmgren

1. Marginal tooth of right mandible in the middle 2
 - Marginal tooth of right mandible at the anterior third 6
2. Marginal tooth of right mandible very small, not extending beyond the curvature of inner cutting edge of apical tooth 3
 - Marginal tooth of right mandible distinctly long, much extending beyond the curvature of inner cutting edge of apical tooth 5
3. Inner cutting margin of apical tooth and right mandible concave; head length 1.32–1.44, head-width 1.18–1.19; postmentum width 0.28, waist 0.15 *P. inaequalis* (Haviland)
 - Inner cutting margin of apical tooth on right mandible not concave, rather outcurved like parrot's beak 4
4. Larger species, head-length 1.35–1.46, head-width 1.20–1.27 ; postmentum length 1.05–1.07 ; pronotum length 0.35–0.36, pronotum width 0.66–0.70. ... *P. microdentiformis* Thapa
 - Smaller species, head-length 1.15–1.20, head width 0.98–1.07; postmentum length 0.87–0.95; pronotum-length 0.30–0.31, width 0.52–0.57. *P. microdentiformisoides* Thapa
5. Smaller species, head-length 0.77–0.85, head width 0.70–0.72; 3rd antennal segment subequal to 4th ; 1st marginal tooth of left mandible not so pointed *P. minor* Thapa
 - Larger species, head-length 0.98–1.17, head width 0.87–1.07 ; 3rd antennal segment longer than 4th; 1st marginal tooth of left mandible somewhat pointed *P. aequalis* (Haviland)

6. Smaller species, head-length 0.87–1.18 7
 – Larger species, head length 1.18–1.32 10
7. Mandibles very short in proportion to head length, mandible head index 0.51 : (Head-length 0.87–0.93, head-width 0.80–0.85; postmentum length 0.65–0.70, postmentum waist 0.15 ; pronotum-length 0.25–0.27, pronotum-width 0.47–0.50)
 *P. pygmaeus* John
- Mandible long in proportion to head-length, mandible head index 0.60–0.66 8
8. Labrum very long, almost reaching the tip of the mandibles; postmentum-waist placed much above the basal margin (head-length 0.95–0.98, head-width 0.85–0.90; length of left mandible 0.63; postmentum width 0.28, postmentum waist 0.18; pronotum width 0.50–0.53 *P. shamimi* Bose
- Labrum short, not reaching the tip of the mandibles, postmentum waist placed near the basal margin. 9
9. First marginal tooth on right mandible placed more towards apex; smaller species, head length 0.88–1.13, head-width 0.84–1.02; labrum length 0.35, labrum-width 0.30; length of left mandible 0.60 ; postmentum width 0.34, postmentum-waist 0.19.
 *P. queenslandicus* Mjoberg
- First marginal tooth on right mandible placed further below the apex ; larger species, head-length 1.07–1.18, head-width 1.00–1.08; labrum length 0.35–0.40, labrum width 0.30–0.32; length of left mandible 0.65–0.67; postmentum width 0.30–0.32, postmentum waist 0.15–0.17
 *P. buttel-reepeni* Holmgren
10. Mandibles thinner and less incurved at apices; inner cutting edge of the apical tooth of right mandible feebly incurved; head-length 1.18–1.32, head-width 1.00–1.14; mandible length 0.65–0.78; postmentum width 0.30–0.36, postmentum waist 0.18; pronotum length 0.36–0.38, pronotum width 0.66–0.72
 *P. khasii khasii* Roonwal and Sen Sarma*
- 103. *Parrhinotermes aequalis* (Haviland)**
- 1. *Parrhinotermes aequalis* Haviland**
1898. Haviland, J. Linn. Soc. Lond., 26 : 395, queen S. and W. Type-locality : Sarawak, Indonesia. Zool. Anz., 35 : 285. (No description)
- 2. *Parrhinotermes aequalis* (Haviland)**
1911. Holmgren, K. Sven. Vet. Akad. Handl., 46 (6) : 78, S.
1913. Holmgren, K. Sven. Vet. Akad. Handl., 50 (2) : 80, S. and W.
1914. Holmgren, Zool. Jahrb., Abt. Syst., 36 (2-3) : 237–238, Im.
1925. John, Treubia, 6 (3-4) : 382.
1949. Snyder, Smiths. Misc. Coll., 112 : 88.
1959. Ahmad, Biology, 4 (1-2) : 76 (key, Im and S.)
1983. Thapa, Sabah For. Rec., No.12, pp. 96–99. S. Sabah
- Material* : One vial with S. and W., Brantian, Dist. Kalabakan, Coll. W. Midin, 6.vii.1970, ex "rotton Wood"
- Diagnostic character* : (i) IMAGO : Based on Holmgren's (1914) description in German language.
- Head light brown with yellowish tinge; clypeus, antennae, mouth parts and pronotum rust yellow. Head and thorax with sparse bristles and abdominal tergites with hairs on posterior margins. Head circular and with medium sized eyes, Ocelli separated from the eyes by much less than their diameter. Fontanelle at the middle of head. Antennal spot very distinct and pale. Mandibular condyles considerably small. Clypeus short. Antennae with 17 segments, 3 longer than 2 (two).
- Pronotum kidney-shaped, narrower than head, weakly notched at the posterior margin.
- *All the species of the genus have been dealt in key, except *P. khasii ruiliensis* of which no material was available for study

(ii) SOLDIER (Fig. 95.A-D) : Head and labrum yellowish brown and with scattered hairs, other parts somewhat paler. Head and postmentum more hairy than pronotum.

Head slightly longer than broad, ovoid and very less narrowing anteriorly, lateral margins outcurved, posterior margin with median outbulge either side of which with feeble emargination. Fontanelle circular with forwardly running groove upto below the margin of labrum. Labrum slightly longer than broad with hyaline apex, fringed with microhairs. Antennae with 13 segments, 2, 3 and 4 subequal. Mandibles strongly bent inward almost at the middle with long pointed apical teeth, inner margin feebly convex; left with two unequal, very much pointed broad base large teeth and right with broad base single marginal teeth. Postmentum vash-shaped with widest width at the anterior fourth and almost double the waist at posterior fourth. Pronotum almost pentagonal with produced anterior margin and substraight posterior margin.

Measurements : Table 49 (S.)

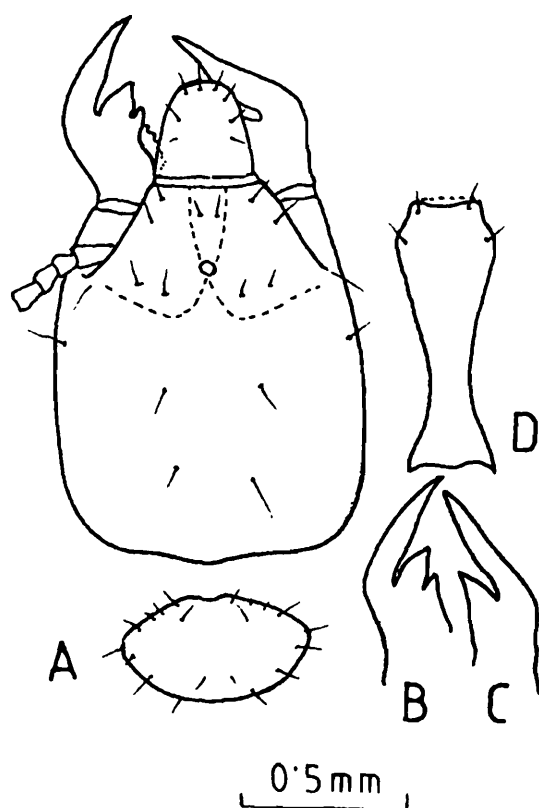


Fig. 95. *Parrhinotermes acualis* (Haviland); A-D, Soldier. A. Head and pronotum, dorsal view; B-C. Mandibles; D. postmentum.

Types : In Haviland's coll.

Distribution : ASIA : Malaysia : Malacca : Selanger, Gap (2500 ft. alt.); Taiping, Maxwell's Hill (3400 ft. alt.). Borneo : Sarawak. Sabah : Dist. Kalabakan, : Brantian. Dist. Kota Kinabalu : Lumat. Dist. Keningau : Biah. Dist. Kunak - Mostya : Kalimpong. Dist. Lamag : Balat.

Remarks : In sabah, the species has been recorded mostly from rotten wood in many occasions.

104. *Parrhinotermes buttel-reopeni* Holmgren

1. *Parrhinotermes buttel-repeni* Holmgren

1913. Holmgren, K. *Sven. Vet. Akad. Handl.*, 50 (2) : 79, S. Type-locality : Malacca, Indonesia.

1913-1914. Holmgren, *Zool. Jahrb., Abt. Syst.*, 36 (2-3) : 238-240, Queen and S.

1949. Snyder, *Smiths. misc. Coll.*, 122 : 88, Im. and S. Malacca.

1958. Ahmad, *Biologia*, 4 (1-2) : 77, (keys.)

1983. Thapa, *Sabah For. Rec.*, No. 12, pp. 100-103, Sabah.

Material : Present in F.R.I., Dehra Dun/Sev. S. and W., Vergin Jungle Reserve, Tambunan, Dist. Keningau, coll. S. B. Gimpin, 15, vii, 1970, ex. 'rotten wood'

Diagnostic character : (i) IMAGO : (Based on Holmgren (1914) description in German language of a Apteris Queen.

Head of queen and workers very similar, fontanelle gland and eyes small Ocelli absent. Antennae with 13 segments in male and 14 in female, 3 longer than 2 (male) and 2 longer than 3 (female). Pronotum with median notch at the anterior margin.

Measurements : (in mm) :

	Male	Female
Body length	3.5	9.5
Head width	0.99	—
Width of pronotum	0.65	—
Width of abdomen	—	2.28

(ii) SOLDIER (Fig. 96.A-D) : Head and labrum yellowish brown, other parts lighter than these. Head pronotum and postmentum equally fairly densely pilose.

Head slightly narrowing anteriorly, lateral sides feebly outcurved, posterior margin almost straight with indistinct median outbulge.

Fontanelle moderately large and circular with forwardly directed as usual groove. Antennae with 13 segments, 2 subequal to 3 as well as 4. Labrum longer than broad with median groove, lateral margins outcurved anterior margin hyaline and round with fringe of microhairs. Mandibles less broader than other species, bent inwards at the anterior third with weakly outcurved inner margin of apical teeth, left with almost subequal two and right with more pointed one marginal teeth. Postmentum club-shaped with widest width, almost double the waist at posterior fifth. Pronotum narrow, anterior margin weakly outcurved and posterior margin feebly incurved.

Measurements : 49 (S.)

Types : Holmgren's coll.

Distribution : ASIA : Indonesia : Malacca, Central Sumatra.

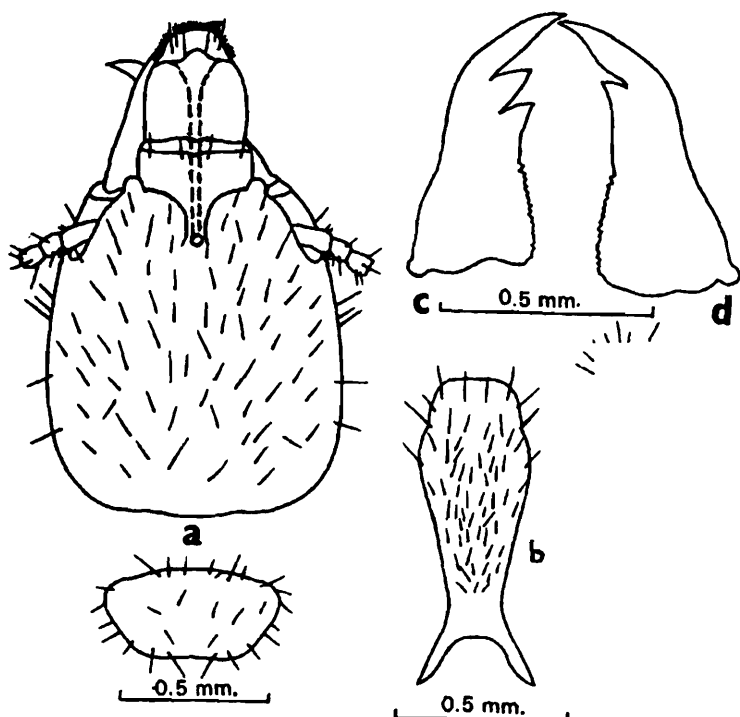


Fig. 96. *Parrhinotermes buttel-reepom* Holmgren; A-D, soldier. A. Head and pronotum, dorsal view; B. postmentum; C-D. Mandibles (After, Thapa 1982).

105. *Parrhinotermes inaequalis* (Haviland)

1. *Termes inaequalis* Haviland

1898. Haviland, Linn. Soc. London, 26 (169) : 396, S. and W. Type-locality : Borneo, Sarawak.

2. *Parrhinotermes inaequalis* Holmgren

1911. Holmgren, K. Sven. Vet. Akad. Handl, 46 (6) : 78.

1913. Holmgren, K. Sven. vet. Akad. Handl., 50(2) : 79-80, S. and W.

1914. Oshima, Annot. Zool., Jap., 8; 61-62.

1925. John, Treubia, 6 (3-4); 382.

3. *Parrhinotermes inaequalis* (Haviland)

1949. Snyder, Smiths. misc. Coll., 112 : 88.

Material : Cotype 1S. from Borneo, Saranak present in F.R.I., Dehra Dun.

Diagnostic character : (i) IMAGO : Unknown.

(ii) SOLDIER (Fig. 97.A-D) : Head somewhat oval with outcurved lateral sides and weakly converging anteriorly; sparsely hairy, more so posteriorly; fontanelle opening very small, placed towards at anterior fifth. Postclypeus hardly separated from frons, anteclypeus transverse stripe like with a very weak median notch. Mandibles with broad base and shorter; left mandible incurved with triangular 1st marginal and the rest with serrated margins; right mandible not so hooked, 1st marginal very small and placed almost at the middle. Postmentum club-shaped, apical 3rd densely hairy, widest width almost double the waist. Pronotum much narrower in proportion to head-width, fairly densely hairy lateral angles narrowly rounded.

Measurements : Table 50 (S.)

Types : Cotype S. in FRI, DehraDun

Distribution : ASIA : Malaysia : Borneo, Sarawak.

Remarks : The species is very close to *P. aequalis* (Haviland).

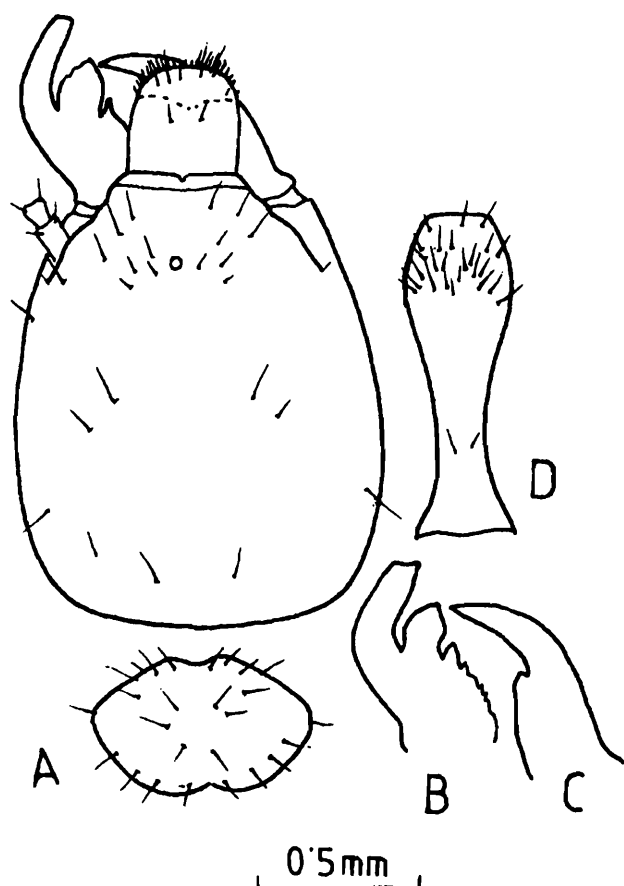


Fig. 97. *Parrhinotermes inaequalis* (Haviland); A-D, Soldier. A. Head and pronotum; B-C. Mandibles; D. postmentum.

106. *Parrhinotermes khasii khasii* Roonwal and Sen-Sarma

1. *Parrhinotermes khasii* Roonwal and Sen-Sarma

1956. Roonwal and Sen-Sarma, *Indian, J., Agric., Sci.*, 26 (1) : 5, 6-11, S. and W. Holotype : S. in ZSI. Type-locality : collecting Station No. 14, Bank of Nong-Priang Stream, Khasi Hills, Meghalaya, India.
1962. Roonwal and Chhotani, *Proc. nat. Inst., Sci., India*, (B) 28 (4) : 288, 31-3
1977. Lahiri, Ghosh and Biswas, *Bull., Meghalaya Sci. Soc.*, 2 : 36.
1983. Chhotani, *Orient. Insects*, 17 : 119.
1983. Maiti, *Rec. zool. Surv. India, Occ. Pap.*, 42 : 17, 54-55, West Bengal.
1993. Maiti and Saha, *State Fauna Series 3 : Fauna of West Bengal, Part 4*, p. 512, Kalimpong, West Bengal.

2. *Parrhinotermes khasii khasii* Roonwal and Sen-Sarma

1982. Tsai and Huang, *Acta. etc. Sinica*, 25 : 306-310, China

1989. Roonwal and Chhotani, *Fauna of India, Isoptera*, 1 : 529-532.

1999. Bose, *Rec. Zool. Surv. India, Occ. Pap. No. 171* : 54-56, Arunachal Pradesh

Material : Present in F.R.I., Dehra Dun : 1 Paratype S. and 3 Paramorphotype W., from Assam, Bank of Non-Priang stream (1200 ft.), Khasi Hills.

Diagnostic character : (i) IMAGO : Unknown.

(ii) SOLDIER (Fig. 98.A-c) : Head yellowish brown with long and short hairs. Other body parts paler. Head, pronotum and abdomen fairly pilose.

Head subsquarishly oval, longer than broad, broadest in the middle with substraight posterior margin. Fontanelle small, placed nearer to postclypeus, narrow groove running from fontanelle opening to almost hyaline tip of labrum. Postclypeus small. Antennae with 13 segments, 2 shortest, 3 and 4 subequal. Eyes and ocelli absent. Labrum elongate, almost reaching the tip, mandible-tip hyaline and with fringe of hairs along with a few long bristles at the base of

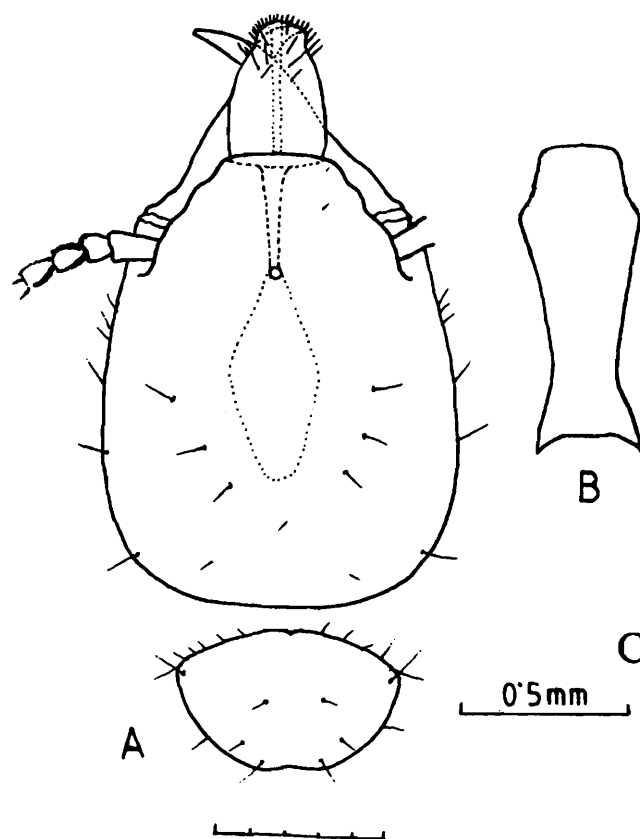


Fig. 98. *Parrhinotermes khasii khasii* Roonwal and Sen-Sarma A-C. soldier. A. Head and pronotum; B. Postmentum; C. Right mandible.

hyaline portion. Mandibles sabre-shaped with pointed apices. Postmentum fairly pilose and club-shaped, widest width at the anterior third and waist on posterior third. Pronotum sparsely pilose, broader than long, anterior margin convex with a median notch and posterior margin with a feeble median emargination.

Measurements : Table 50 (S.)

Types : *Holotype* S. in Z.S.I., Kolkata.

Distribution : ASIA : India : Meghalaya, Khasi Hills, Bank of Nong-Priang Stream, Arunachal Pradesh : Rahung Vill., Bank of Digien River (1800 m.), Kameng Dist., Rupa, E. Kameng Dist; Naba and Damin, Upper Subansiri Dist. West Bengal : Kalimpong.

Remarks : The species is very close to *P. khasi ruiliensis* - a subspecies recently described from Ruili Xian, China by Tsai and Huang (1982). Biology of the species is not known, except its record from 'log' in the Kalimpong, West Bengal (Maiti, 1983).

107. *Parrhinotermes microdentiformis* Thapa

1. *Parrhinotermes microdentiformis* Thapa

1982. Thapa, *Sabah For Rec.*, No. 12, pp. 103-106, S. and W. *Type-locality* : Lumat, Dist. Kota Kinabalu, Sabah, E. Malaysia.

Material : Present in F.R.I., Dehra Dun : *Holotype* and *Paratypes* S., Swamp Forest, Lumat, Dist. Kota Kanabalu, coll. S. B. Gimpin, 8.Viii.1979, 'rotten wood'

Diagnostic character : (i) IMAGO : Unknown.

(ii) SOLDIER (Fig. 99.A-E) : Head and labrum brownish yellow, other body parts generally paler, except mandible with reddish brown colour.

Head flattened with scattered hairs slightly longer than broad, widest at posterior fourth whence gradually slightly narrowing anteriorly, posterior margin weakly produced medially with a feeble emargination on either side. Fontanelle small with forwardly running groove reaching

almost anterior margin of labrum. Labrum broader than long with a hyaline densely pilose rounded apical margin. Antennae with 13 segments, 3 one-and-a half times as long as 2 and subequal to 4. Mandibles with broad base and strongly incurved with sharply pointed apices, left with two unequal and right with one small teeth. Postmentum slightly less than twice as wide anteriorly at broadest point as at waist. Pronotum narrower than head-width, anterior margin produced medially and posterior margin with weak median emargination.

Measurement : Table 50 (S.)

Types : *Holotype* S. in F.R.I., Dehra Dun; and *Paratype* and *Morphotypes* W. in F.R.C., Sandakan, E. Malaysia.

Distribution : ASIA : Malaysia : Sabah Dist. Kalabakan : Luasvng. Dist. Kota Kinabalu : Lumat. Dist. Lamag : Pin.

Remarks : The species comes close to *P. aequalis* (Haviland), but differs in having large head size, smaller subtriangular teeth not extending beyond

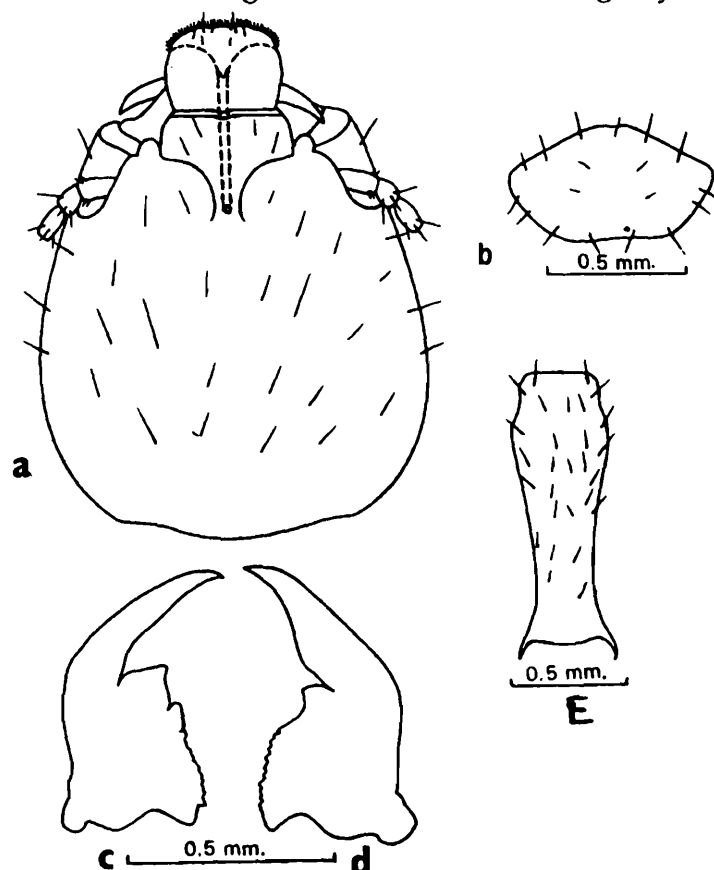


Fig. 99. *Parrhinotermes microdentiformis* Thapa A-E. soldier. A. Head, dorsal view; B. Pronotum; C-D. Mandibles; E. postmentum (After, Thapa, 1982).

the curvature of inner cutting edge, less hairy postmentum and broader labrum. However, *P. buttel-reepeni* Holmg., *P. inaequalis* (Havil.) and *P. pygmaeus* John are also close to this species, but can be distinguished as shown in the key. The species is so far recorded from rotten wood in Sabah.

108. *Parrhinotermes microdentiformisoides* Thapa

1. *Parrhinotermes microdentiformisoides* Thapa

1982. Thapa, *Sabah for Rec.*, No. 12, pp. 106–108, *Type-locality* : Beauort, Dist. Beaufort, Sabah, E. Malaysia.

Material : Present in F. R. I., Dehra Dun : *Holotype* S. from vergin jungle reserve, Beaufort, Dist. Beaufort, coll. R. O. T Dingkj, 27.vii.1970, ex. "rotten wood"

Diagnostic characters : (i) IMAGO : Unknown.

(ii) SOLDIER (Fig. 100. A–E) : In all esestial characters, the species is very similar to that of *P. microdentiformis* Thapa, except its smaller size.

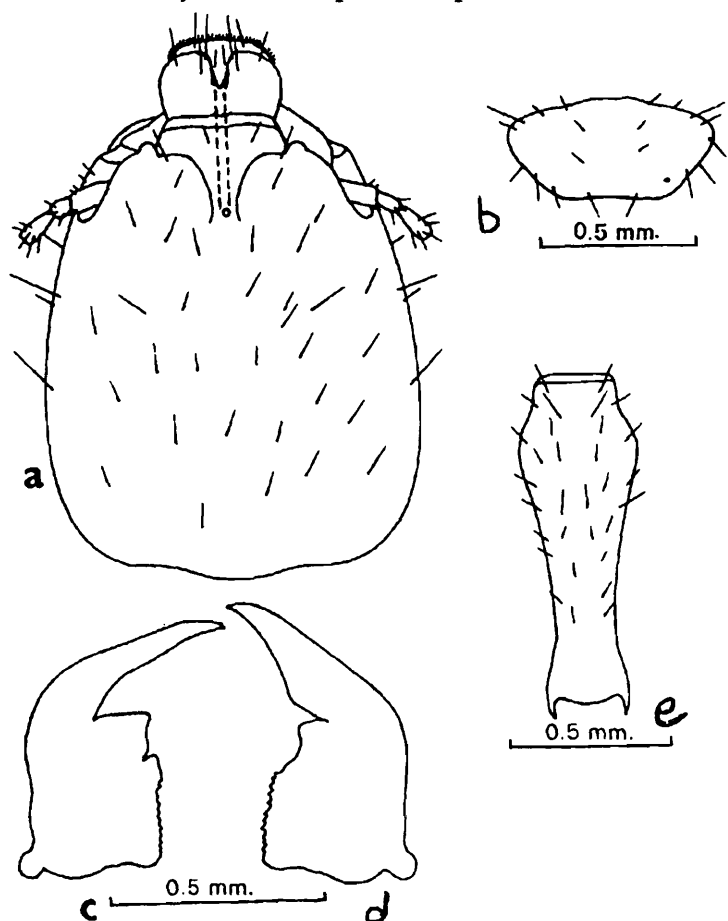


Fig. 100. *Parrhinotermes microdentiformisoides* Thapa A–E, Soldier. A. Head, dorsal view; B. pronotum; C–D. Mandibles; E. postmentum (Africa, Thapa, 1982)

Measurements : Table 49 (S.)

Types : *Holotype* S. in F.R.I., Dehra Dun; and *Paratype* S. and *Morphotype* W. in F.R.C., Sandakan, E. Malaysia.

Distribution : ASIA : *Malaysia* : Sabah : Dist. Beaufort : Beaufort type-locality : Dist. Kalabakan : Brantian.

Remarks : The species closely resembles to *P. microdentiformis* Thapa from Sabah, but differs in having smaller size in all the morphological characters. Like other members of the genus in Sabah, it is also collected from rotten wood.

109. *Parrhinotermes minor* Thapa

1. *Parrhinotermes minor* Thapa

1981. Thapa, *Sabah For Rec.*, No. 12, pp. 110–111, S. and W. *Type-locality* : Kalumpang, Dist. Kunak-Mostyn, Sabah, East Malaysia *Types* : In F.R.I., Dehra Dun : and F.R.C., Sandakan.

Material : Present in F.R.I., Dehra Dun : *Holotype* S. and *Paratypes* S., Kalumpang, Dist. Kunak-Mostyn, coll. L. M. Tech, 24.VII.1970, ex. 'rotting wood'

Diagnostic character : (i) IMAGO : Unknown

(ii) SOLDIER (Fig. 101.A–E) : Head and labrum brownish yellow to brown and other body parts paler. Head and abdomen densely and pronotum sparsely hairy. Head evoid, but not so narrowed anterior lateral sides. Outcurved and posterior margin medially produced with weak emargination on either side. Fontanlle as in other species. Labrum somewhat rectangular with hyaline, convex apical margin with microhairs and with a few bristle little below. Antenne with 13 segments, 3 shorter than 2 and subequal to 4. Mandibles strongly bent almost at the middle and terminating into incurved pointed apices with outcurved inner margin. Left mandible with unequal two and right with a single broad base marginal teeth. Postmentum fairly bilobed anteriorly, widest width almost double the waist, body densely pilese throughout. Pronotum much narrower than head, anterior margin produced medially and posterior margin weakly emarginate.

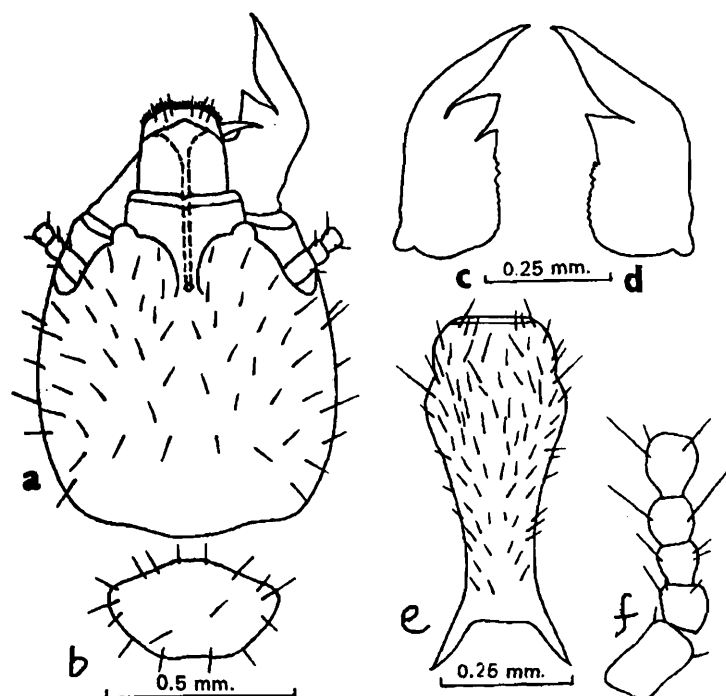


Fig. 101. *Parrhinotermes minor* Thapa; A-F. Soldier. A. Head, dorsal view; B. Pronotum; C-D. Mandibles; E. Postmentum; F. Antennae (After, Thapa, 1982).

Measurements : Table 51 (S.)

Types : In F.R.I., Dehra Dun; and F.R.C., Sandakan, Sabah.

Distribution : Asia : Malaysia : Sabah, Kalumpang, Dist. Kunak-Mestyn.

Remarks : The species is very close to *P. aequalis* (Haviland), but differs in having smaller size and longer 2nd antennal segments of soldiers. It is recorded from rotten wood in its only place of ty-locality in sabah.

110. *Parrhinotermes pygmaeus* John

Parrhinotermes pygmaeus John

1925. John, *Treubia*, 6 (3-4) : 382-384, S. and Queen : Type-locality : Siak, East Sumatra, Indonesia.

1949. Snyder, *Smiths. misc. Coll.*, 112 : 382-384.

1975. Roonwal, *Treubia*, 28 (4) : 136-140, 141 (key), S. neotenic king and Queen.

1983. Thapa, *Sabah For. Rec.*, No.12, 111-115, Sabah.

Material : One vial with sev. S. and W., Swamp Forest, Lumat, Dist. Kota Kamabalu, Coll. R.O.T. Dingki, 1970, ex. "rottenwood"

Diagnostic characters : (i) IMAGO (Based on John, 1925, Neotenic Queen).

Head brownish yellow, thorax pale yellow, wing sheath yellow, abdominal tergites light brownish and with white lateral spot on each side. Head thorax and abdomen fairly densely hairy.

Head narrowing anteriorly with indistinct suture, Eyes medium sized. Ocelli absent. Fontanelle fairly distinct. Antennae with 17 segments, 3 shorter than 4. Mandibles of typical *Parrhinotermes* type. Pronotum narrower than head, width double the length.

Measurements (in mm) :

Body length	8.00
Width of head	1.03
Width of pronotum	0.87

Measurements : Table (S.) (ii) SOLDIER (Fig.102. A-E) : Not studied.

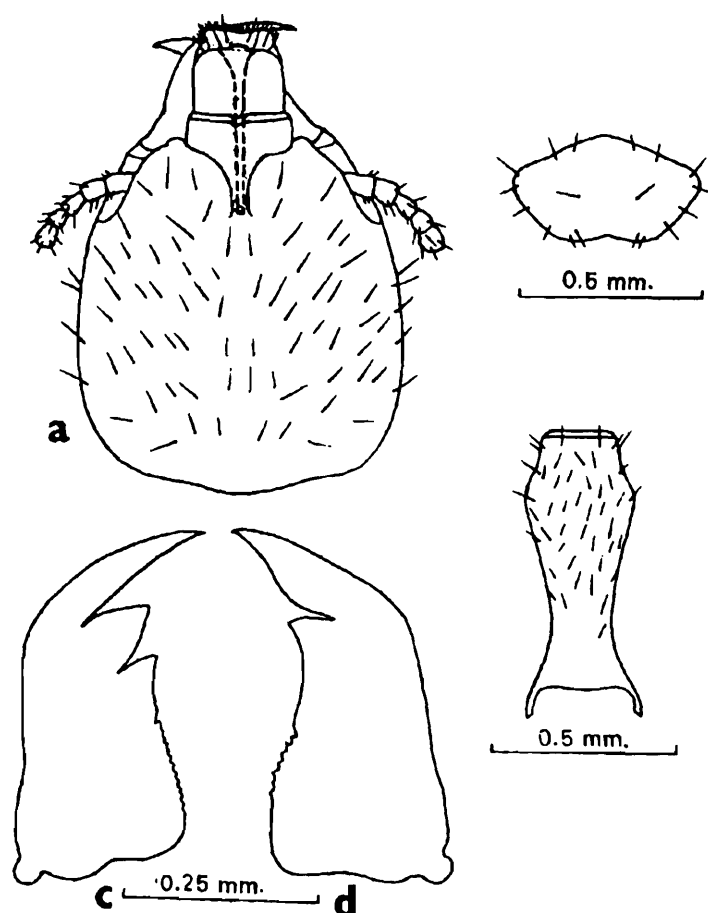


Fig. 102. *Parrhinotermes pygmaeus* John; A-E, Soldier. A. Head, dorsal view; B. Pronotum; C-D. Mandibles; E. Postmentum (after, Thapa, 1982).

Distribution : Asia : *Indonesia* : East sumatra, Siak; *Malaysia* : Kuala Lumpur; Kajang; Sabah, Dist. Kota Kinabalu : Lumat.

Remarks : Species is known to occur in rotten wood in Sabah.

111. *Parrhinotermes queenslandicus* Mjoberg

1. *Parrhinotermes queenslandicus* Mjoberg

1920. Mjoberg, *Arkiv Zool.*, 12 (15) : 31, Im. 124. *Type-locality* : North Queensland, Austrania.

1942. Hill, *Termites (Isopiera) from the Australian Region*, CSIRO, p.172.

1949. Snyder, *Smiths. misc. Coll.*, 112 : 89

2. *Parrhinotermes australicus* Mjöberg

1920. Mjoberg, *Arkiv. Zool.*, 12 (15) : 109.

2. *Parrhinotermes australicus* Hill

1921. Hill, *Proc. Linn. Soc. New South Wales*, 46 (4) : 449.

Material : Cotypes 2S. and 3W., Malanda, Queensland, Australia.

Diagnostic character : (i) IMAGO (After Hill, 1942) : Head light brown and with few hairs, paler in front; labnum, legs and under parts dull yellow; pronotum and forewing stump a little darker than legs. Eyes very large (0.36 x 0.36m) ocelli fairly larger (0.14 long), broadly oval. Fontanelle small and spherical, a shallow groove extending from the fontanelle to the postclypeus. Postclypeus, a little more than one-third as long as wide. Antennae with segment 2 less than half as long as 1st, very little longer than 3rd. Pronotum flat, narrower than head, much wider than long, arcuate in front, antero-lateral angles and sides rounded; posterior margins of meso and metandtum widely arcuate.

Measurements :

Head to apex of labnum	1.06
Head to clypeofrontal suture	0.80
Head-width	1.10
Pronotum length	0.47
Pronotum-width	0.88

(ii) SOLDIER (Fig. 103 A-B.) : Head straw coloured, longer than wide, slightly rounded at sides and slightly narrowing anteriorly, widest width midway between fontanelle and the posterior margin. Labnum nearly one-fourth longer than its width, at the base, barely reaching the tip of mandibles Fontanelle small, circular very distinct; Antennae with 13 segments, 2 shorter than either 3 or 4. Mandibles with apical tooth in the left mandible opposite the tooth in the right mandible. Pronotum with anterior margin convex and slightly emarginate medially, posterior margin less convex and devoid of any median emargination. Head and thorax with sparse long hairs.

Measurements : Table 51(S).

Types : *Holo-lectotype* S, *Morpho-lectotype* W. and *Morphotype* dealated adult in C.S.I.R. collection, Melbourne.

Distribution : AUSTRALIA : North Queensland : Malanda, Herberton, Bellenden ker, Ravenshoe, Gadgarra, Lake Barrine, Innisfail and Gordonvale.

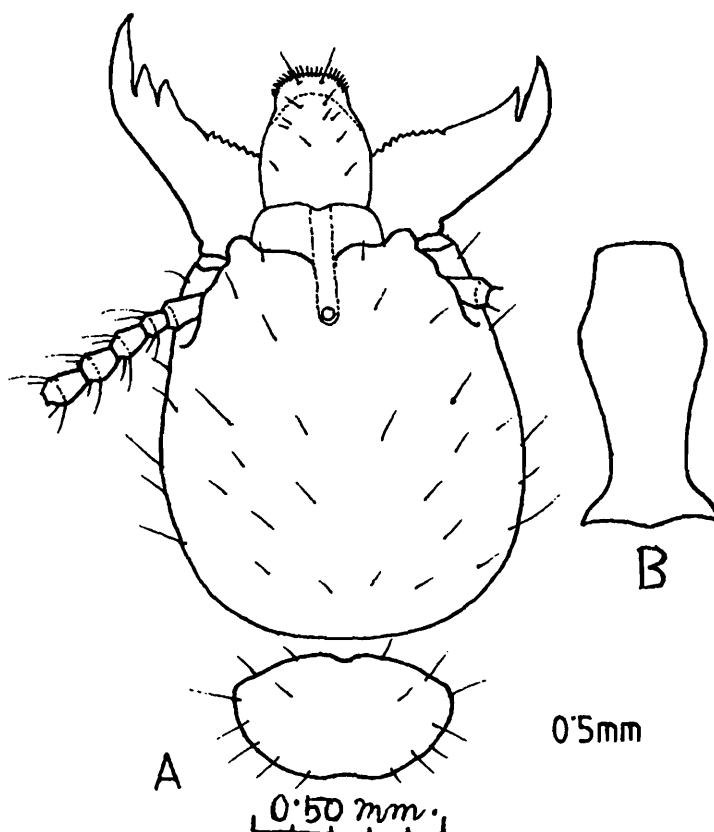


Fig. 103. *Parrhinotermes queenslandicus* Mjoberg; A-B, Soldier. A. Head and pronotum, dorsal view; B. Postmentum.

Biology : The species is so far known to infest rotten wood of *Eucalyptus* plant, avoiding mostly sound wood. The species generally occurs in association with *Rhinotermes seclusus*, *Coptotermes acinaciformis*, *Stolotermes queenslandicus* in long (Hill, 1942).

112. *Parrhinotermes shamimi* Bose

1. *Parrhinotermes shamimi* Bose

1999. Bose, *Rec. Zool. Surv. India*, Occ. paper, No. 171, pp. 56–58, S. type-locality : Itanagar, (natural forest, C. 1km from Lake Ganga), Arunachal Pradesh, India.

Material : Holotype S. and Paratype 1S. in National Zool. Coll., Z. S. I., Kolkata.

Diagnostic character : (i) IMAGO : Unknown

(ii) SOLDIER (Fig. 104. A–E) : Head pale yellow, paler anteriorly; head and thorax sparsely and abdomen densely hairy.

Head subrectangularly oval, longer than broad; sides weakly converging anteriorly. Fontanelle small, placed of anterior 5th, where a groove running upto tip of labrum. Eyes and ocelli absent. Antennae with 12 segments, 3 longer than 2. Postclypeus not defferentiated from frons. Mandibles sabre-shaped, sharply pointed at tip; left with 2 marginal both pointed and right with one marginal tooth. Placed at anterior third. Labrum tongue-shaped, longer than broad, reaching almost tip of closed mandibles, tip hyaline and fringed with hairs. Postmentum vase-shaped, broadest at anterior third and waist near base, profusely hairy.

Pronotum sparsely pilose, somewhat trapezoidal, anterior margin convex with a feeble

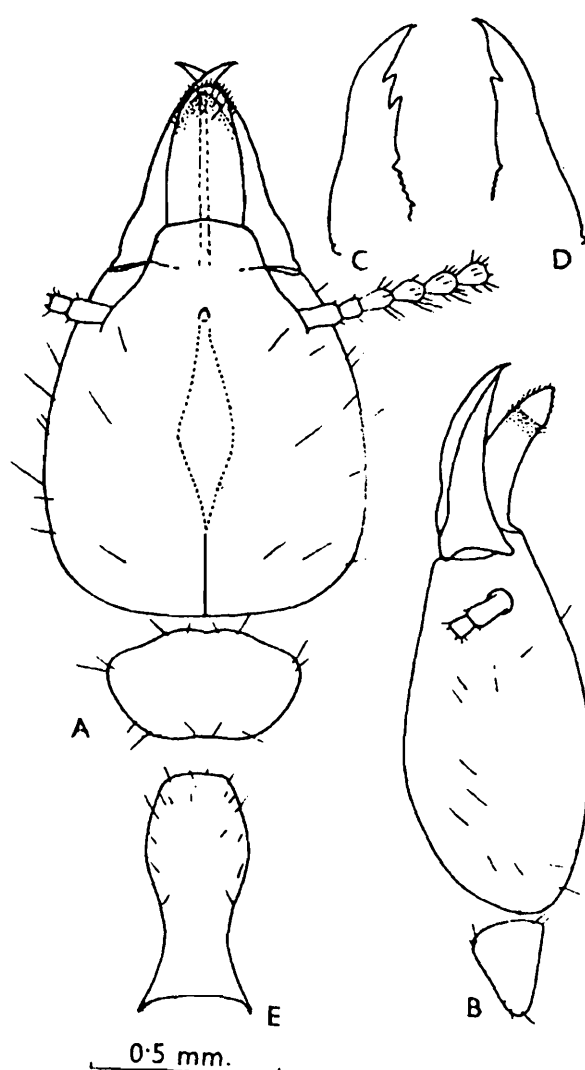


Fig. 104. *Parrhinotermes shamimi* Bose; A–E, Soldier. A. Head and pronotum, dorsal view; B. Head and pronotum, lateral view; C–D. Mandibles; E. Postmentum (Bose, 1999).

median notch and posterior margin feebly incurved.

Measurements : Table 52 (S.).

Types : In Z.S.I., Kolkata.

Distribution : Asia : India : Arunachal Pradesh.

Remarks : The species is recorded from stump of wood from Arunachal Pradesh, India.

Table-49. Measurements (in mm) etc., of Caste-Soldier

<i>Parrhinotermes</i> spp.	<i>P. buttel-reepeni</i>	<i>P. microden-tiformisoides</i>	<i>P. aequalis</i>
Length of head to lateral base of mandibles	1.07–1.18	1.15–1.20	0.98–1.17
Max. width of head	1.00–1.08	0.98–1.07	0.87–1.07
Head index (width/length)	0.91–0.93	0.85–0.89	0.88–0.91

Table-49 (Contd.)

<i>Parrhinotermes</i> spp.	<i>P. buttel-reepeni</i>	<i>P. microden-tiformisoides</i>	<i>P. aequalis</i>
Max. length of labrum	0.35-0.40	0.25-0.27	0.30-0.33
Max. width of labrum	0.30-0.32	0.32-0.35	0.30-0.32
Length of mandible (upper base of condyle to tip)	0.65-0.67	0.62-0.65	0.50-0.55
Head-mandibular length Index (mand.-length/head-length)	0.56-0.60	0.52-0.54	0.51
Min. median length of postmentum	0.72-0.82	0.87-0.95	0.80-0.90
Max. width of postmentum	0.30-0.32	0.30-0.32	0.27-0.32
Width of postmentum at waist	0.15-0.17	0.17	0.12-0.17
Max. length of pronotum	0.32-0.36	0.30-0.31	0.28-0.33
Max. width of pronotum	0.57-0.62	0.52-0.57	0.52-0.60
Pronotum index (length/width)	0.56-0.58	0.54-0.57	0.53-0.55
Pronotum head index (pronotum width/head-width)	0.57	0.53	0.53-0.56
Number of antennal segments	13		13

Table-50. Measurements (in mm) etc., of Caste-Soldier

<i>Parrhinotermes</i> spp.	<i>P. microdentiformis</i>	<i>P. inaequalis</i>	<i>P. khasii khasii</i>
Length of head to lateral base of mandibles	1.35-1.46	1.32-1.44	1.18-1.32
Max. width of head	1.20-1.27	1.18-1.19	1.00-1.14
Head index (width/length)	0.86-0.88	0.82-0.88	0.86-0.90
Max. length of labrum	0.26-0.30		0.48
Max. width of labrum	0.37-0.38		0.30-0.36
Length of mandible (Upper base of condyle to tip)	0.37	—	0.65-0.78
Head-mandibular length Index (mand.-length/head-length)			0.61
Min. median length of postmentum	1.05-1.07	0.80	0.90-1.08
Max. width of postmentum	0.33-0.35	0.28	0.30-0.36
Width of postmentum at waist	0.17-0.20	0.15	0.18

Table-50 (Contd.)

<i>Parrhinotermes</i> spp.	<i>P. microdentiformis</i>	<i>P. inaequalis</i>	<i>P. khasii khasii</i>
Max. length of pronotum	0.35–0.36	0.38–0.39	0.36–0.38
Max. width of pronotum	0.66–0.70	0.67–0.68	0.66–0.72
Pronotum index (length/width)	0.51–0.53	0.56–0.57	0.52–0.54
Pronotum head index (pronotum width/head-width)	0.55	0.56–0.57	0.63–0.66
Number of antennal segments	13		13

Table-51. Measurements (in mm) etc., of Caste—Soldier

<i>Parrhinotermes</i> spp.	<i>P. minor</i>	<i>P. pygmaeus</i>	<i>P. queenslandicus</i>
Length of head to lateral base of mandibles	0.77–0.85	0.87–0.93	0.88–1.13
Max. width of head	0.70–0.72	0.80–0.85	0.84–1.02
Head index (width/length)	0.87	0.91–0.92	0.95
Max. length of labrum	0.23–0.26	0.23–0.27	0.35
Max. width of labrum	0.22–0.25	0.20–0.25	0.30
Length of mandible (Upper base of condyle to tip)	0.43–0.45	0.45–0.47	0.60
Head-mandibular length Index (mand.-length/head length)	0.54	0.51	0.60
Min. median length of postmentum	0.57–0.61	0.65–0.70	0.75
Max. width of postmentum	0.23–0.25	0.25–0.27	0.34
Width of postmentum at waist	0.11–0.12	0.15	0.19
Max. length of pronotum	0.22–0.23	0.25–0.27	0.24–0.33
Max. width of pronotum	0.41–0.42	0.47–0.50	0.46–0.58
Pronotum index (length/width)	0.53–0.54	0.53–0.54	0.52–0.56
Pronotum head index (Pronotum width/head-width)	0.58	0.58	0.54–0.56
Number of antennal segments	13	13	13

Table-52. Measurements (in mm.) etc., of Caste-Soldier

<i>Parrhinotermes</i> sp.	<i>P. shamimi</i>
Length of head to lateral of mandibles	0.95-0.98
Width of head	0.85-0.98
Index (width/length)	0.81-0.89
Length of labrum	0.38-0.40
Width of labrum	0.25-0.28
width of mandible (Upper base of condyle to tip)	0.63
Head-mandibular length index (mand.-length/head-length)	0.64-0.66
Min.median length of postmentum	0.63-0.65
Max. width of postmentum	0.28
width of postmentum at waist	0.18
Max. length of pronotum	0.28
Max. width of pronotum	0.50-0.53
Pronotum index (length/width)	0.52-0.54
Pronotum head index (pronotum width/head-width)	0.58
Number of antennal segments	12

Genus *Macrorhinotermes* Emerson*Schedorhinotermes* (*Macrorhinotermes*)
Holmgren1. Subgenus *Macrorhinotermes* Holmgren

1913. Holmgren, K. *Sven. Vet. Akad. Handl.*, 50 (2) : 81.
 1942. Hill, *Termites of the Australian Region*, C.S.I.R.O., P. 175.
 1949. Snyder, *Smiths. misc. Coll.*, 112 : 94.

2. *Macrorhinotermes* Emerson

1989. Roonwal and Chhotani, *Fauna of India : Isoptera* (Termites) : 1 : 520.
 1970. Krishna, In : *Biology of Termites*, (Eds. Krishna and Weesner) : p.139.
 1971. Emerson, *Bull. Amer. Mus. nat. Hist.*, 146 (3) : 248.

Type of Genus *Macrorhinotermes maximus* (Holmgren)

Holmgren (1913) divided the genus *Schedorhinotermes* into two subgenera, *Schedorhinotermes* and *Rhinotermes* s. str., Subsequently, the same author (1913, p. 81) had added the subgenus *Macrorhinotermes* for a species *M. maximus* (Holmgren) so far known by the imagos only from Borneo (Kalimantan), Indonesia. However, the species has not been dealt due to non-availability of material for study.

113. *Macrorhinotermes maximus* (Holmgren)Genus *Schedorhinotermes* Silvestri1. Subgenus *Schedorhinotermes* (of *Rhinotermes*)
Silvestri

1909. Silvestri, in Michaelsen's and Hartmeyer's *Die Fauna Sudwest-Australia* 2 : 289.
 1911. Holmgren, K. *Sv. Vet. Akad. Handl.*, 46(6) : 77, 79.
 1913. Holmgren, K. *Sv. Vet. Akad. Handl.*, 50(2) : 81, 82.
 1942. Hill, *Termites (Isoptera) of Australian Region* : 176.

2. Genus *Schedorhinotermes* Silvestri

1949. Snyder, *Smiths. misc. Colls.*, 112 : 89.
 1950. Ahmad *Bull. Amer. Mus. nat. Hist.*, 95 (Art. 2) : 54, 56.
 1955. Emerson, *Fieldiana : Zool.*, 37 : 469, 479, 484, 500, 509.
 1955. Weidner, In *Die Termiten* (Ed. Schmidt) : 57.
 1958. Ahmad, *Biologia*, Lahore, 4 (1 & 2) : 59, 60.
 1961. Harris, *Termites : Recognition and Control* : pp. 27, 48, 55. (2nd Ed. 1971).
 1970. Krishna, In *Biology of Termites* (Eds. Krishna and Weesner) Vol. 2 : 137, 139.
 1970. Bouillon, In *Biology of Termites* (Eds. Krishna and Weesner) Vol. 2 : 162.
 1970. Roonwal, In *Biology of Termites* (Eds. Krishna and Weesner) Vol. 2 : 341.
 1970. Gay and Calaby, In *Biology of Termites* (Eds. Krishna and Weesner) Vol. 2 : 406-407.
 1970. Weidner, *Handb. d. Zoologie*, 4 (2) : 22.
 1971. Emerson, *Bull. Am. Mus. nat. Hist.*, 146 (Art. 3) : 248, 250, 251, 256.

1973. Chhotani and Bose, *Zool. Anz.*, 190 (3/4) : 233, 234.
 1979. Roonwal, *Termite Life and Termite Control Trop. South Asia* : 4, 22, 80.
 1982. Thapa, *Sabah For. Rec.*, No. 12 : 5.
 1983. Chhotani, *Orient. Insects*, 17 : 111, 112, 113, 114, 119-120.
 1985. Chhotani, *Z. ang. Ent.*, 100 : 91, 93, 94.
 1986. Grasse, *Termitologia*, 3 : 529.
 1992. Thakur and Thakur, *Treubia*, 30 (3) : 257.

3. Genus *Rhinotermes* Hagen :

1898. Haviland, *J. Linn. Soc. Lond.*, 26 (169) : 392.

Type of genus : *Rhinotermes intermedius* Brauer.

a. History, Distribution, Composition etc.

Silvestri (1909) was the first author to name *Schedorhinotermes* as the subgenus of *Rhinotermes* with its type-species *R. intermedius* Brauer from Australia. It continued to remain as a subgenus (Holmgren, 1911, 1913; Hill, 1942) until Snyder (1949) gave it as a status of genus. Since then as many as 42 species have been described from the Oriental (25), Papuan (9), Australian (6) and Ethiopian (2) Regions. However nine species, namely, *S. butteli* Holmg., *S. celebensis* Holmg., *S. dimorphus robustior* Silv., *S. fortignathus* Xia and He, *S. holmgreni* Emerson, *S. leopoldi* kemner, *S. leiboensis* Gao and Xia, *S. magnificus* and *S. maximus* Holmg. have not been dealt. Further, two species, *S. sanctae crucis* (Snyder) and *S. umbraticus* Hill have not been included in the key also.

It is suggested that the center of origin of the genus was Oriental Region with Cretaceous dispersal eastward to Papuan and southward to Australian Region. The westward dispersal to the Ethiopian Region must occurred during Post-Eocene, after isolation of Madagascar from Africa, since the genus was absent in the Malagasy Region (Emerson, 1955; 1971)

b. General characters :

1. IMAGO : Head subcircular or subrectangular. Frontal opening forwardly

placed with a groove leading to postclypeus. Eyes subcircular, bulging out or flat. Ocelli translucent and medium size, always separated from the eyes. Antennae with 20 segments, 2-4 variable. Postclypeus strongly swollen, with complete or incomplete median line and pilose, and projecting in front medially. Mandible each with an apical and 3 marginal teeth. Left with finger-like apical, 1st marginal equal to apical, 2nd smaller than 1st, 3rd almost as long as 1st, but with a long anterior margin being subequal to molar plate. Pronotum flat, both anterior and posterior margins weakly to strongly emarginate. Tibial spur formula 3 : 2 : 2; tarsi 4-jointed.

Wings normally transparent, reticulate and hairy. Forewing scale overlapping basal portion of hindwing scale, costa and radius thickly chitinated, median thin and running medially with 3-4 branches and cubitus with 10-16 branches. In hindwing, all veins originating separately from scale, except median being originated from radius outside scale.

2. SOLDIER (MAJOR) : Soldier fairly large, head and pronotum sparsely and abdomen somewhat densely hairy. Head as wide as long or either slightly smaller or larger than long, subrectangular to slightly narrower anteriorly. Fontanelle of varied size, forwardly placed with a distinct groove running upto tip of labrum. Eyes and ocelli absent. Antennae with 16-17 segments, 2-4 varied in relative shape and size. Labrum of varied shape, broadest at base to almost at the middle with anterior margin weakly sinuate and with fringed of hairs. Mandibles long and robust, sickle shaped, strongly bent from the middle and terminating into incurved somewhat pointed apices. Left with 2 marginal teeth, and right with a single marginal teeth. Postmentum club-shaped, but varies in shape. Pronotum flat, narrower than head, projected in front and weakly emarginate medially on posterior margin. Tibial spur formula 3 : 2 : 2; tarsi 4-jointed. Cerci 2-jointed, styli single jointed.

SOLDIER (MINOR) : Very similar to major soldier, except the following characters : Body

much smaller, slender and thin. Head at times pentagonal, mandibles very thin with very sharp apices and fine teeth. Labrum very long almost reaching tips of mandibles with bisinuate apex fringed with minute hairs. Postmentum short, more broad at waist than soldier major Pronotum almost pentagonal with medially emarginate posterior margin.

**C. Key to the species of *Schedorhinotermes*
(Soldier, major)**

1. Head slightly wider than long, head index (width/length) more than 1.00 2
 - Head as long as or only slightly longer than wide, head index than 1.00, generally 0.88-0.99..... 7
2. Head not so narrowed anteriorly, head smaller, head-length 1.50-1.68 mm; mandibles much more than half the head-length; mandible-head index 0.62-0.63 3
 - Head larger, head distinctly narrowed anteriorly, head-length 1.98-2.00 mm; mandibles only slightly longer than half the head-length, mandible-head index 0.52-0.57 4
3. Posterior margin of head with a median bulge, 3rd antennal segment almost double the 4th, mandibles less robust with first marginal tooth placed more than one-third distance from the tip of mandibles; head-length 1.50, head-width 1.50 mm..... *S. solomonensis* (Snyder)
 - Posterior margin of head without any median bulge, 3rd antennal segment almost equal to 2nd; mandibles robust with first marginal tooth placed not more than one-third of the distance from the tip of mandibles; head-length 1.68, head-width 1.60 mm..... *S. marjoriae* (Snyder)
4. Head distinctly narrowed anteriorly 5
 - Head not narrowed anterior, mandible robust, head-length 1.53-2.00 head-width 1.64-1.92 *S. magnus* Tsai and Chen
5. Posterior bulge of head feeble with weak emargination on either side of the bulge, head-length 2.28-2.52, head-width 2.00-2.64 *S. sarawakensis* (Holmgren)
6. Smaller species, head-length 1.00-1.56 mm. 7
 - Larger species, head-length, 1.57-2.00 or more 15
7. Mandibles almost half or slightly more than half the head-length, mandible-head index 0.53-0.59 (Indo-Malayan spp.)..... 8
 - Mandibles distinctly longer than half the head-length, mandible-head index 0.62-0.66 13
8. Posterior margin of head narrowly rounded medially, mandibles somewhat strongly hooked at the apices; 3rd antennal segment longer than 2nd; head-length 1.45-1.61, head-width 1.40-1.60 *S. medioobscurus* (Holmgren)
 - Posterior margin of head broadly rounded, devoid of any medial bulge 9
9. Head somewhat rectangular, less narrowed anteriorly, head-contraction index (min-width / max-width) 0.70-0.75 10
 - Head distinctly narrowed anteriorly, visibly contracted anteriorly, head contraction-index less than 0.70 11
10. Lateral sides of pronotum angularly rounded, postmentum waist wider; head length 1.34-1.52, head-width 1.38-1.50. *S. makassarensis* Kemner
 - Lateral sides of pronotum not so angularly rounded; postmentum waist narrower; head-length 1.30-1.43, head-width 1.14-1.24. *S. rectangularis* Ahmad
11. Pronotum comparatively wider with anterior margin not so outcurved; postmentum at widest width angularly projected laterally; head-length 1.43-1.52, head-width 1.46-1.50; postmentum narrower at the waist; labrum

- slightly longer than half the mandibles.....
..... *S. javanicus* Kemner
- Pronotum not so wider with anterior margin rounded; postmentum at widest width devoid of any angular projection; head-length 1.40 - 1.54, head-width 1.33-1.44.
..... *S. longirostris* (Brauer)
12. Smaller species, head-length 1.00 - 1.04 mm., (head-width 0.91, mandible length 0.64; head somewhat ovoid; labrum elongate not reaching to the tip of mandibles but with a dome-shaped apex fringed with dense hairs; pronotum small, more or less oval with anterior and posterior margins emarginate) *S. browni* Harris
- Larger species, head-length 1.30-1.50 mm. 13
13. Head ovoid, almost as long as broad, head index (W/L) 1.00, comparatively smaller species, head-length 1.34-1.36, head-width 1.31-1.35; posterior margin of head subround; pronotum much narrower than head-width, pronotum-head index 0.52 *S. brachyiceps* Kemner
- Head subrectangular, slightly longer than broad, head index 0.91-0.97 14
14. Antennae with 15 segments; head-length 1.38 mm., head-width 1.30-1.34 mm.
..... *S. dimorphus dimorphus* (Desneux)
- Antennae with 16 segments; head-length 1.44, head-width 1.40 mm.
..... *S. dimorphus robustus* Silvestri
15. Mandibles shorter almost half or slightly longer than half the head-length, mandible-head index 0.50-0.59 16
- Mandibles longer, much more than half the head-length, mandible-head index 0.60 - 0.68 (Chinese species with small lateral projection at widest width of postmentum) 28
16. Head strongly narrowed anteriorly, head-width at the anterior end almost half the maximum head-width, head contraction index 0.51 (Ethiopian species) 17
- Head not so strongly narrowed anteriorly, head-width at the anterior end much more than half the maximum width, head contraction index 0.60-0.74 18
17. Maximum head-width almost at posterior third, dorsal sclerites of thorax and abdomen with dark bristles along the margins; pronotum somewhat oval; generally smaller and darker species, head-length 1.64-2.09, head-width 1.64-2.09
..... *S. putorius* (Sjostedt)*
- Maximum head-width almost at the middle; dorsal scarites of thorax without dark bristles; pronotum more rectangular; generally larger and paler species; head-length 1.82-2.23, head-width 1.72-2.13
..... *S. lamanianus* (Sjostedt)**
18. Head moderately narrowed anteriorly, head-contraction index 0.60-0.66 (Oriental species) 19
- Head less narrowed anterior, head contraction index 0.68-0.75 (Australian species) 25
19. Postmentum-waist almost half the maximum width of postmentum, postmentum contraction index 0.49-0.50; larger species, head-length 1.98-2.08 20
- Postmentum-waist much more than half the maximum-width of postmentum, postmentum contraction index 0.57-0.67; smaller species, head-length 1.60-1.90 mm 21
20. Head subrectangular, labrum distinctly bilobed, pronotum comparatively wider (1.30 mm.); pronotum-head index (pronotum-width / head-width) 0.66; head-length 2.00, head-width 1.96 *S. bidentatus* (Oshima)

* *S. putorius* contains a subspecies, *S.p. insularis* Sjosledt which had been synonymised under *S. putorius* (Harris, 1968, p. 106)

** There are three varieties under *S. lamanianus* *lamanianus* (Sjostedt), namely *S.l. angulatus* (Emerson), *S.l. australis* (Fuller) and *S.l. bequaertianus* (Sjostedt) from the Ethiopian Region which had been synonymised under *S. lamanianus* (Harris, 1968, p. 108-109)

- Head subsquarish, feebly narrowing anteriorly, labrum feebly bilobed; pronotum narrower (1.14 mm); head-length 1.98-2.08, head-width 1.98-2.08 *S. nancowriensis* Maiti and Chakraborty
- 21. Head somewhat squarish, head-length 1.68 - 1.85, head-width 1.60-1.68 *S. tiwarii* Roonwal and Bose
- Head somewhat ovoid, narrowing anteriorly, head-length 1.28-1.42; head-width 1.21-1.35 *S. tarakensis* (Oshima)
- 22. Mandibles more robust, left mandibular apex distinctly hooked; head-length 1.60 - 1.88, head-width 1.60 - 1.84; 3rd antennal segment much longer than 2nd *S. translucens* (Haviland)**
- Mandibles not so robust, left mandibular apex not distinctly hooked; head-length 1.69-1.90, head-width 1.61-1.74 *S. bravialatus* (Haviland)
- 23. Head almost as wide as long, head index 0.97- 0.99 24
- Head distinctly longer than wide, head index 0.86-0.88 26
- 24. Mandibles shorter, right mandible with one marginal tooth; antennae with 16 segments, generally smaller species; head-length 1.88, head-width 1.84 *S. reticulatus* (Froggatt)
- Mandibles longer, right mandible with two marginal teeth; antennae with 18 segments; larger species, head-length 1.69-2.20 25
- 25. Pronotum wider in proportion to head-width; head-length 1.69 - 2.08, head-width 1.65 - 1.85 *S. intermedius intermedius* (Brauer)
- Pronotum narrower in relation to head-width, head-length 2.20, head-width 2.20 *S. intermedius dorsus* (Hill)
- 26. Right mandible with one marginal tooth; antennae with 17 segments; generally smaller species, head-length 1.61-1.68, head-width 1.31-1.40 *S. intermedius brenli* (Hill)
- Right mandible with two marginal teeth; antennae with 18 segments; generally larger species, head-length 2.00-2.20 27
- 27. Head generally rectangular; pronotum wider in proportion to head-width, pronotum head-width index 0.71; head-length 2.00-2.14; head-width 1.77-1.88 *S. intermedius actuosus* (Hill)
- Head not rectangular, rather narrowed anteriorly; pronotum narrow in proportion to head-width; pronotum head-width index 0.60; head-length 2.00; head-width 2.00 *S. intermedius seclusus* (Hill)
- 28. Smaller species, head-length 1.59-1.70; head subsquarish, mandibles strongly hooked at apices; postmentum waist narrower 29
- Larger species, head-length 2.20-2.42; head somewhat ovoidal; mandibles less strongly hooked; postmentum waist broader 30
- 29. Waist of postmentum placed almost near the base; head-length 1.62-1.70; head-width 1.45-1.55; postmentum waist 0.27-0.30 *S. fortignathus* Xia and He
- Waist of postmentum placed much above the base; head-length 1.57-1.60, head-width 1.45; postmentum waist 0.30 *S. ganlanbaensis* Xia and He
- 30. Very large species, head length 2.25-2.42 31
- Fairly elarge species, head length 2.20-2.25 32
- 31. Head pyriform in shape, more narrowed anteriorly; larger species, head-length 2.25-2.42, head-width 2.25-2.45; postmentum waist broader, width 0.32-0.36; pronotum distinctly broader than meso-and meta-notum *S. pyricephalus* Xia and He
- Head not pyriform, rather broad as usual, head-length 2.20-2.34, head-width 2.04-2.34;

*** Identification of *S. translucens* and *S. bravialatus* is very difficult based on soldier characters.

postmentum waist narrower, width 0.28;
pronotum narrower than meso- and meta-
notum *S. malaccensis* (Holmgren)

32. Head-length 2.20-2.25; head-width 2.07-2.10
postmentum waist 0.27-0.30
..... *S. insolitus* Xia and He

114. *Schedorhinotermes bidentatus* (Oshima)

1. *Rhinotermes* (*Schedorhinotermes*) *bidentatus* Oshima

1920. Oshima, *Philipp. J. Sci.*, 17 (5) : 494, S. (maj.) and S. (min.). Type-locality : Philippines : Panay, Culasi (Antique Province).
1921. Light, *Philipp. J. Sci.*, 18 (3) : 250, Philippine.
1949. Snyder, *Smiths. Misc. Coll.*, 112 : 89.
1960. Snyder and Francia, *Philipp. J. Sci.*, 89 (1) : 64, 69, 74.

Material : Since no material is available, the diagnostic characters are based on (Ahmad 1958; Snyder and Francia, 1960).

Diagnostic character : (i) IMAGO : Unknown.
(ii) SOLDIER MAJOR : Head dark yellow and rectangular, only slightly longer than wide. Labrum bilobed anteriorly, right mandibles with two and left with single (or two) marginal teeth, both the mandibles short. Antennae with 16 segments, 3 nearly twice as long as 2. Postmentum twice as wide anteriorly as in below the middle at waist. Pronotum not emarginate anteriorly and emarginate posteriorly. (iii) SOLDIER MINOR : Similar to soldier major, but very small in size, except labrum extending almost upto tip of mandibles, antennae with 16 segments, 2 as long as 3, 4 shortest.

Measurements :

	S. (maj.)	S. (min.)
Head length	2.05	1.08
Head width	1.96	1.04
Length of mandible	0.73	—
Widest width of postmentum	0.52	—

Narrowest width of post mentum	0.26	—
Pronotum length	0.68	0.43
Pronotum width	1.30	0.79

Distribution : ASIA : Philippines : Panay, Culasi (Antique Prov.).

Remarks : The species is of moderate size. It builds nests in the soil and infests felled logs, dead stumps, bamboo and rotten wood. Its infestation in wood work of buildings and flight period are still unknown.

115. *Schedorhinotermes brachyiceps* Kemner

1. *Schedorhinotermes brachyiceps* Kemner

1931. Kemner, *Lund.Univ. Arsskr.*, N.F. Avd. 2, 27 (13) : Fysiogr., Sallsk. Handl., N.F., 42 (13) : 23-25, S. (maj.) and S. (Min.). Type-locality : Ambom., Amboina.
1949. Snyder, *Smiths. misc. Coll.*, 112 : 89.

2. *Schedorhinotermes amboinensis* Kemner :

1934. Kemner, *K. Sven. Vet. Akad. Handl.*, (3) 13 (4) : 24. S. (maj.) and S. (min.), Type-locality : Ambon, Amboina.
1949. Snyder, *Smiths. misc. Coll.*, 112 : 89. (Syn.).

Material : Since no materials available, diagnostic characters are based on Kemner (1931).

Diagnostic character : (i) IMAGO : Unknown.
(ii) SOLDIER MAJOR (Fig.105. A-B) : Head yellowish to yellowish brown, devoid of hairs, almost as long as based or slightly broader than long. Fontanelle distinct, circular with anterior groove reaching to tip of labrum. Labrum broad base with narrowed and bilobed apical margin with minute hairs, a few erect hairs below the margin. Mandibles short and stout, left with two blunt and right with one somewhat pointed teeth. Antennae with 16 segments, 3 slightly longer than 2, 4 shorter. Pronotum narrower than head-width, anterior margin outcurved and posterior margin with median emargination. (iii) SOLDIER (MINOR) : Head yellowish with darker mandibles, slightly longer than broad, mandibles

thin and elongate with pointed apical teeth. Antennae with 15 segments, 2 longer than 3, otherwise very similar to major soldier, except smaller in size.

Measurements : (After, Kemner 1931)

	S. (maj.)	S. (min.)
Body length	4.80–5.00	3.50–3.65
Head with mandibles	2.10–2.12	1.31–1.34
Head without mandible	1.31–1.34	0.77–0.81
Head width	1.34–1.38	0.70
Pronotum width	0.74	0.48
Pronotum length	0.42	0.38

Types : Kemner's Coll.

Distribution : ASIA : Amboina.

Remarks : The species was described from Amboina to which *S. amboinensis* had been synonymised. Nothing is known about its biology.

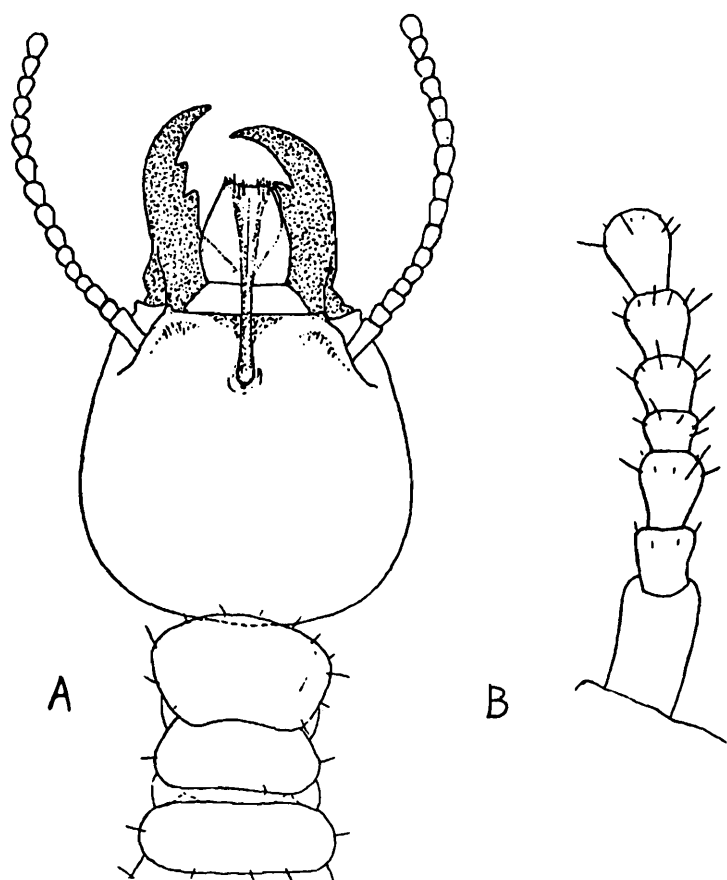


Fig. 105. *Schedorhinotermes brachyceps* Kemner A–B. Soldier. A. Head and thorax, dorsal view; B. Antennae.

116. *Schedorhinotermes brevialatus* (Haviland)

1. *Termes brevialatus* Haviland :

1898. Haviland, Jour. Lin. Soc. London, **26** (169) : 393, Im, S. and W. Type-locality : Borneo, Sarawak.

2. *Rhinotermes brevialatus* Holmgren

1913. Holmgren, K. Sven. Vet. Akad. Handl., **50** (2) : 85, Im, S.W.
 1913-14. Holmgren, Zool. Jahrb., Abt. Syst., **36** (2-3) : 240-241, Im.
 1904. Desneux, Genera insectorum, Fasc. 25, p.28
 1912. Holmgren, K.Sven. Vet. Akad. Handl., **48** (4) : 19, fig. 3.

3. *Schedormes brevialatus* Holmgren

1949. Snyder, Smiths. misc. Coll., **112** : 89.
 1958. Ahmad, Biologia, **4** (1-2) : 77, 80.
 1966. Roonwal and Maiti, Trebuia, **27** (1) : 90-91
 1982. Thapa, Sabah For. Rec., No. 12, pp. 116-123, Sabah.

4. *Rhinotermes (Schedorhinotermes) longirostris* or *translucens* Holmgren

- 1913-14. Holmgren, Zool. Jahrb., Abt. Syst., **36** (2-3) : 240-241, Im.

Material : In FRI, Dehra Dun : 1A., 5S. 5W. and 1Nym. (Metatype), Borneo : Sarawak.

Diagnostic Character : (i) Imago : Head deep brown with reddish tinge, paler anteriorly, rest yellowish brown. Head with scattered hairs. Labrum with long and short bristles, abdomen with dense hairs.

Head wider than long, slightly narrowed anteriorly, frons slightly elevated. Y-suture indistinct. Fontanelle small. Eye moderately large, separated from the lower margin of head by nearly half of their short diameter. Ocelli small separated from the eyes by more than its maximum diameter. Antennae with 20 segments, 2 and 4 sub equal, 3 longer than both. Postclypeus with a median line and produced antero-medially as well as overhanging anteclypeus. Labrum dome-shaped with anterior margin rounded.

Mandibles of typical *Schedorhinotermes*-type. Pronotum narrower than head, anterior margin almost substraight and posterior margin shallowly incurved.

(ii) **SOLDIER (MAJOR)** (Fig. 106. A-B) : Head reddish brown, other head parts paler with yellowish tinge, head and pronotum with a few scattered bristles and pronotal margin with more hairs. Abdomen densely hairy.

Head as long as broad, widest at posterior third, lateral margin slightly depressed below antennal carinae, posterior margin medially outbulging with indistinct concavity on either side. Fontanelle round with a forward by running groove. Antennae with 17 segments, 2 slightly longer than 3, 3 sub equal to 4. Labrum bilobed, hyaline and fringe with fine hairs. Left mandible with inner margin from tip to teeth incurved, and with two blunt teeth and right with a single teeth. Postmentum club-shaped with broad waist. Pronotum narrow, anterior margin medially produced and posterior margin emarginate.

(iii) **SOLDIER (Minor)** (Fig. 106. C-D) : Head longer than wide, slightly wider below the antennal carinae, posterior margin out curved.

Fontanelle small with forwardly running groove. Antennae with 16 segments, 2 subequal to 3, 4 shorter than 3. Labrum bilobed, fringed with microhairs, very long extending beyond the tip of mandibles. Mandibles thin elongate, left with two sharply pointed teeth and right with single pointed tooth. Postmentum arched, anterior widest width slightly more than narrowest width. Pronotum with medially produced anterior margin and with emarginate posterior margin.

Measurements : (After Thapa 1982). – Table 58 (Im); and 74 (S. maj : and S. min).

Types : Not traceable.

Distribution : ASIA : Malaysia : Sabah : Dist. Beaufort : Beaufort. Dist. Kalabakan : Umas Umas and Brantian. Dist. Keningau : Mile 39, Tambunan. Dist. Kota Kinabalu : Lumat. Dist. Kunak-Mostyn : Kalumpang; Kunak. Dist. Lahad Datu : Silam. Dist. Lamag : Balat, Pin and Tenegang Besar. Dist. Sandakan North : Mile 43, Labuk Road. Sarawak Indonesia : Java : Buitenzorg and Tjogrek, Borneo.

Remarks : The wider pronotum in relation to head-width and measurements, etc., bring the species very close to *S. translucens*, but differs in having less hooked mandibular apices of the soldier caste. Hence, their identity needs caution. The species occurs frequently in the rotten wood in the margin jungle reserve in sabah (Thapa, 1982).

117. *Schedorhinotermes browni* Harris

1. *Schedorhinotermes browni* Harris

1958. Harris, *Proc. R. ent. Soc. Lond.*, (B) 27 (3-4) : 59-60. S and W. **Type-locality** : Solomon Island.

1958. Harris and Brown, *Common. Agric. Bureaux, Lond.*, p. 737, 742.

Material : Since no material was available, the description and measurements are based on Harris (1958).

Diagnostic Character : (i) **IMAGO** : Unknow. (ii) **SOLDIER (MAJOR)** (Fig. 107.A) : Head dull yellow with a defused brown area immediately

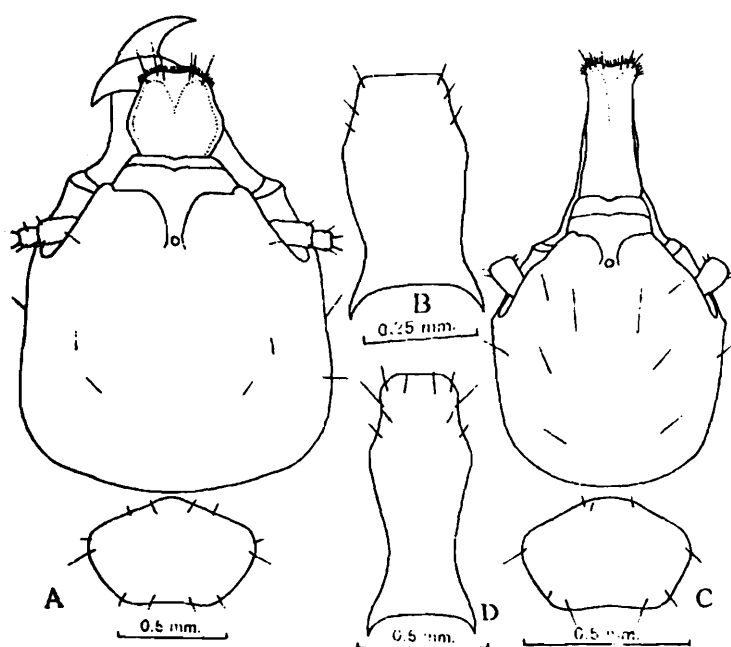


Fig. 106. *Schedorhinotermes braviolatus* (Haviland); A-B, Soldier (maj). A. Head and pronotum, dorsal view; B. Postmentum. C-D, Soldier (min.). C. Head and pronotum, dorsal view; D. Postmentum.

posterior to the fontanelle; labrum and mandibles brown; thorax, abdomen and legs pale yellow with numerous brownish-yellow bristles.

Head ovoid with weakly curved lateral sides, converging anteriorly and posterior margin rounded. Fontanelle distinct with groove running anteriorly upto tip of labrum through frons. Mandibles robust with pointed incurved tips, left with two marginal teeth and right with one. Pronotum somewhat oval, with anterior and posterior margins slightly emarginate.

Measurements :

Length of head	1.00	1.04
Width of head		0.91
Length of left mandible		0.64
Width of pronotum	0.50	0.54
Length of pronotum	0.27	0.32
Length of hind tibia	0.73	0.77

Types : Holotype S. in BMNH., London.

Distribution : ASIA : Solomon Isl., Guadalcanal, Gold Ridge (type-locality)

Remarks : The species is so far known only from its type-locality represented by monomorphic soldier caste which serves its most diagnostic character along with 13 segmented

antennae. Harris and Brown (1958) reported the species to occur under dying bark on trunk of alive and standing forest tree at an altitude of about 1800 ft. on the mountain slope away from the cultivated area in the solomon Island.

118. *Schedorhinotermes dimorphus dimorphus* (Desneux)

1. *Rhinotermes dimorphus* Desneux

1905. Desneux, *Ann. Mus. nat. Hungarici*, 3 (1) : 368, S. W., Type-locality : Fridrich Wilhelms-hafen, New Guinea.

2. *Rhinotermes (Schedorhinotermes) dimorphus* Desneux

1911a. Holmgren, *Mitt. Zool. Mus. Berlin*, 3 (3) : 458.

1911b. Holmgren, *K.Sev. Vet. Akad. Handl.*, 46 (6) : 79.

1942. Hill, *Termites (Isoptera) from the Australian Region*, Aus. C.S.T.R., 177 p., Im. New Guinea only.

3. *Rhinotermes dimorphus* Desneux

1949. Snyder, *Smiths. Misc. Coll.*, 112 : 90.

Material : Present in FRI., Dehra Dun : Metatype 1 S. maj. and 1 S. min. from Koror Isl., Palau Islands, Coll. H.S. Dybas, 30.xi.1947, ex. "tree fern", det. and comp. A.E. Emerson.

Diagnostic character : (i) IMAGO : Unknown. (ii) SOLDIER (MAJOR) (Fig. 108, A-C) : Head sub-quadrate and broad, reddish brown. Fontanelle small with a fontanelle groove running upto the apex of labrum. Labrum large, oblong, reaching beyond the middle of mandibles; lateral sides outcurved with a median incurved apex. Mandibles with strongly incurved piercing-tip, left with two similar and right with one strong triangular marginal tooth. Antennae with 15 segments, 3 slightly longer or subequal to 2. Pronotum almost flat, anterior margin convex with a few median minute hairs antero-lateral corners somewhat round with feebly convex lateral sides converging posteriorly; posterior margin with median invagination. (iii) SOLDIER (Minor) (Fig. 108. D) : Head much smaller and

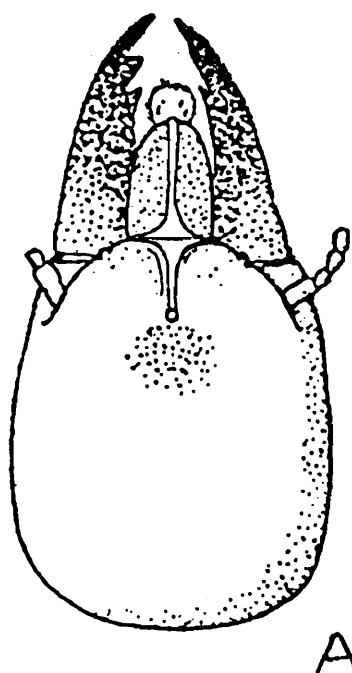


Fig. 107. *Schedorhinotermes browni* Harris A, soldier (maj.).
A. Head, dorsal view.

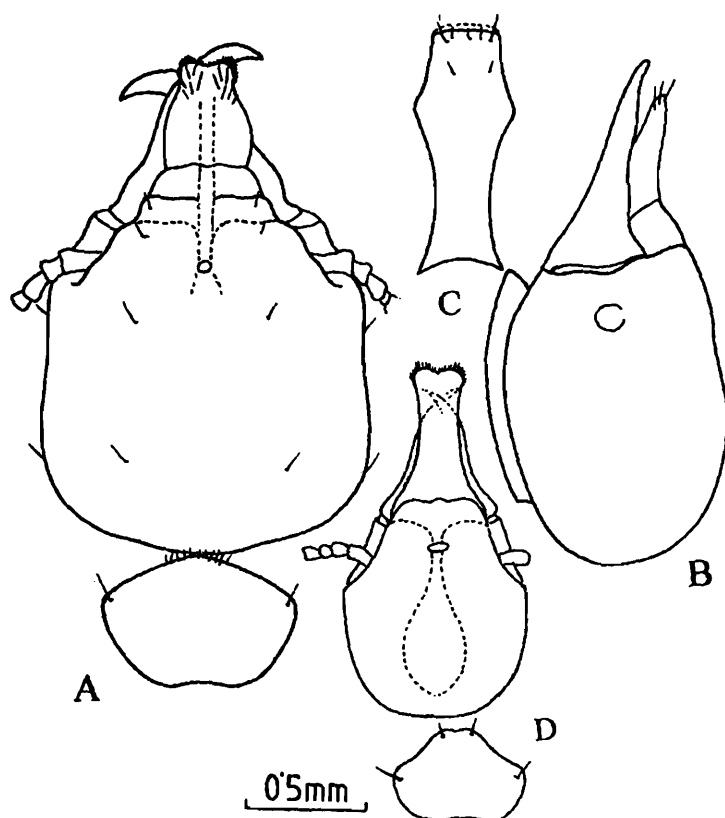


Fig. 108. *Schedorhinotermes dimorphus dimorphus* Desneux A-C, Soldier (maj.). A. Head and pronotum; dorsal view; B. Head, lateral view; C. Postmentum; D. Soldier (min.). D. Head and pronotum, dorsal view.

ovate, ochreous. Posterior margin uniformly round. Labrum long and slender, exceeding the mandibles with two rounded lobes at the apex and fringed with minute hairs. Fontanelle distinct with a groove running to apex of labrum. Antennae with 15 segments, 2 longer and broader than 3. Mandibles slightly incurved at apices. Pronotum smaller, anterior margin projecting anteriorly with a median notch, posterior margin incurved.

Measurements : Table 59 (S. maj and S. min.)

Types : Types in A.M.N.H., New York and *Metatype* S. maj. and min. in F.R.I., Dehra Dun.

Distribution : ASIA : New Guinea; Palau Islands : Koror Isl., (type-locality) and New Britain.

Remarks : The species is very close to *S. javanicus* which is much larger and stouter species than this.

119. *Schedorhinotermes eleanorae* Roonwal and Bose

1. *Schedorhinotermes eleanorae* Roonwal and Bose

1970. Roonwal and Bose, *Rec. zool. Surv. India*, 62 (304) : 125-132, Im., S. (minor) *Type-locality* : Bedeabduly, 19 km. south of Tojkoibuea, Little Andaman, India.
1980. Bose, *Rec. zool. Surv. India*, 77 (1-4) : 100.
1983. Chhotani, *Oriental Insects*, 17 : 120.
1989. Roonwal and Chhotani, *Fauna of India, Isoptera (termites) I*, pp. 537-540.
1994. Maiti and Chakraborti, *Occ. Pap. Rec. zool. Surv. India*, No. 167 : 42-43.

Material : Holotype S. (min.), Im. and W. Bedeabduly, 19 km. South of Tojkoibuea, Little Andaman Island, India.

Diagnostic Characters : (i) IMAGO (DEALATE) (Fig. 109. A-F) : Head, pronotum and wing scales deep brown, thorax and abdomen paler.

Head subround, sparsely pilose and broader than long. Fontanelle circular placed at the middle of head. Eyes subround and large, ocelli small and suboval, separated from the eyes by its short diameter. Antennae with 14 segments, 2 subequal to 3, 4 shortest. Postclypeus weakly convex, projected medially anteriorly. Pronotum flat, broader than long and shorter than head-with, margins with more hairs, anterior and posterior margins feebly incurved. (ii) SOLDIER (MAJOR) : Unknown. (iii) SOLDIER (MINOR) : Head yellowish white, other body parts still paler, head and pronotum sparsely hairy. Head with maximum width at the base of antennal foveolae whence weakly narrowing posteriorly with round posterior margin. Fontanelle distinct with a forwardly running groove upto tip of labrum. Antennae with 14 segments, 2 subequal to 3 and 4 shortest.

Labrum elongate with bilobed hyaline and pilose apical margins. Mandibles long finely pointed and less hooked, left with two sharply and right with more sharply tooth. Postmentum broad and short with sparse hair on anterior

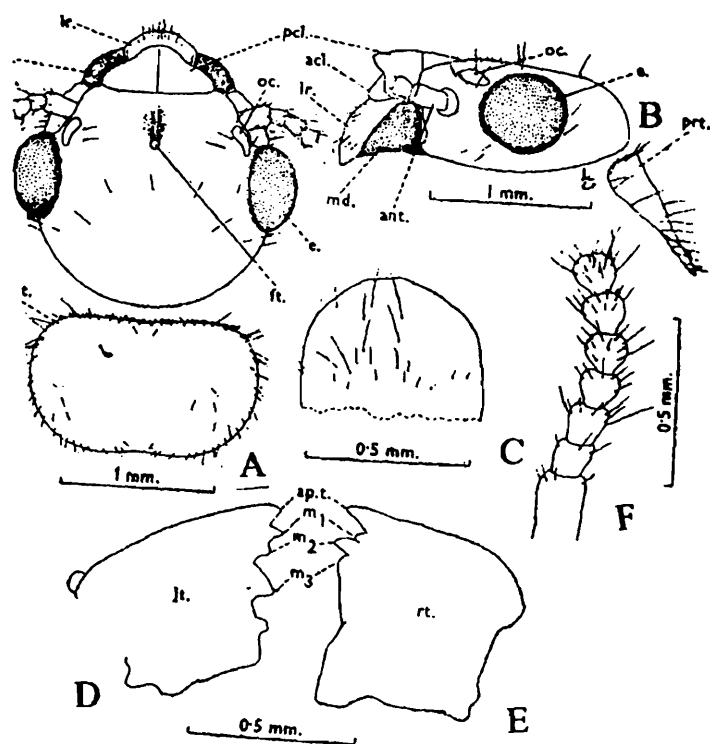


Fig. 109. *Schedorhinotermes eleanorae* Roonwal and Bose A–F. Imago. A. Head and pronotum, dorsal view; B. Head, lateral view; C. Labrum; D. E. Mandibles; F. Antenna.

portion above the maximum width, waist less narrowed. Pronotum with anterior margin round and posterior margin weakly emarginate.

Measurements : Table 53 (Im.); 68 (S. min.).

Types *Holotype* : S (min.) in Z.S.I., Kolkata.

Distribution : ASIA : India, Andaman Island, Little Andaman : Bedealedulu, 19 km. South of Toikoibuea. Neil Isl. Reserve Forest (South Andamans).

Remarks : The major soldiers of the species is still unknown, since its discovery in 1970. Nothing is known about its biology.

120. *Schedorhinotermes fortignathus*

Xia and He

1. *Schedorhinotermes fortignathus* Xia and He

1980. Xia and He, *Contr. Shanghai Inst. Entom.*, 177-179, 181. Fig. 17-20 (S. Maj.); 21-24 (S. min.). *Type-locality* : Yunnan Province, China.

Material : Since no material is available, description and illustrations are based on Xia and He, (1980).

Diagnostic Character : (i) IMAGO : Unknown. (ii) SOLDIER (MAJOR) (Fig. 110. A–D) : Head almost apilose, subrectangular below the antennal incision, sides nearly parallel-sided with weak depression at the middle, posterior margin broadly rounded. Fontanelle distinct, circular with forwardly running groove reaching to hyaline, bilobed apices fringed with minute hairs. Postclypeus both broader and longer than anteclypeus. Mandibles strong with almost hooked apices, both left and right mandibles with two shape marginal teeth. Postmentum club-shaped, widest at anterior third with sharply projected lateral sides on either side, waist only slightly narrower than widest width and placed more towards base. Pronotum narrower than head, anterior margin produced medially, lateral sides converging and posterior margin with

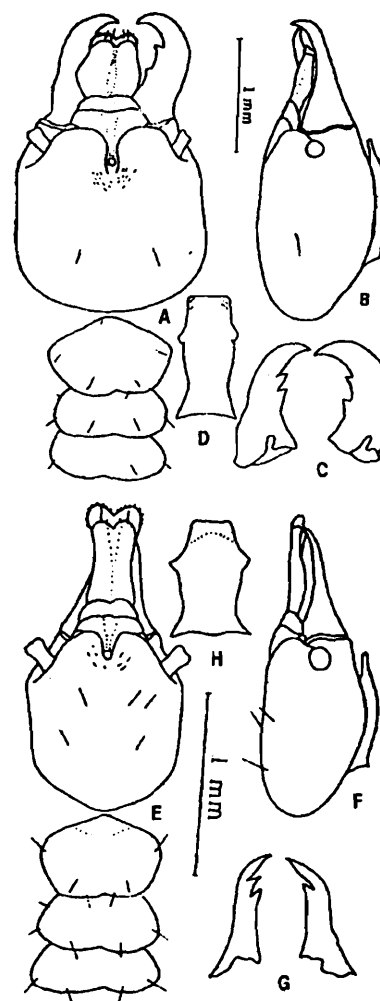


Fig. 110. *Schedorhinotermes fortignathus* Xia and He A–D, Soldier (maj.). A. Head and thorax, dorsal view; B. Head, lateral view; C. Mandibles; D. Postmentum. E–H, soldier (min.). E. Head and thorax, dorsal view; F. Head, lateral view; G. Mandibles; H. Postmentum.

distinct median emargination. (iii) SOLDIER MINOR (Fig. 110. E-H)—Head smaller, somewhat pentagonal in shape with a very few scattered hairs, lateral margins nearly parallel sided, posterior margin medially produced angularly. Fontanelle circular and distinct with forwardly running groove reaching to tip of labrum. Labrum long, medially grooved with hyaline bilobed apical margins, fringed with minute hairs extending a little beyond the tip of mandibles. Postclypeus broader and longer than anteclypeus with median notch. Antennae with 16 segments. Postmentum short and stumpy, widest width at anterior third with small lateral out bulge on either side, waist more towards base. Pronotum pentagonal in shape with medially produced anterior margin and posterior margin with median emargination.

Measurement : Table - 60 (S. major).

Types : In Sanghai Inst. of Ent., Academic Sinica, China.

Distribution : ASIA : China : Yunnan Province.

Remarks : The species is closely similar to *S. magnus* Tsai and Chen, but differs from it by its rectangular head with almost parallel lateral sides, strongly built mandibles; postmentum with waist placed nearer to base than to broadest point (Xia and He, 1980).

121. *Schedorhinotermes ganlanbaensis*

Xia and He

1. *Schedorhinotermes ganlanbaensis* Xia and He

1980. Xia and He, *Contr. Shanghai Inst. Entom.*, pp. 179-180, 181. *S. (Maj.)* and *S. (Min.)*, *Type-locality* : Yunnan Province, China.

Material : Diagnostic characters are based on description and illustrations of Xia and He, since no material was available for study.

Diagnostic Character : (i) IMAGO : Unknown. (ii) SOLDIER (MAJOR) (Fig. 111. A-D) : Head rectangular, almost as long as broad, lateral sides parallel, medially weakly depressed, posterior

margin broadly rounded. Fontanelle distinct with groove running to almost tip of the labrum. Mandibles strongly hooked, left with two sharply pointed and right with single comparatively blunt marginal teeth. Labrum only slightly longer than broad, with broad base, apical margin bilobed, hyaline and fringed with minute hairs. Postmentum club-shaped, widest width with two small lateral projections, waist not so narrow. Pronotum somewhat pentagonal with anterior margin roundedly produced, posterior margin

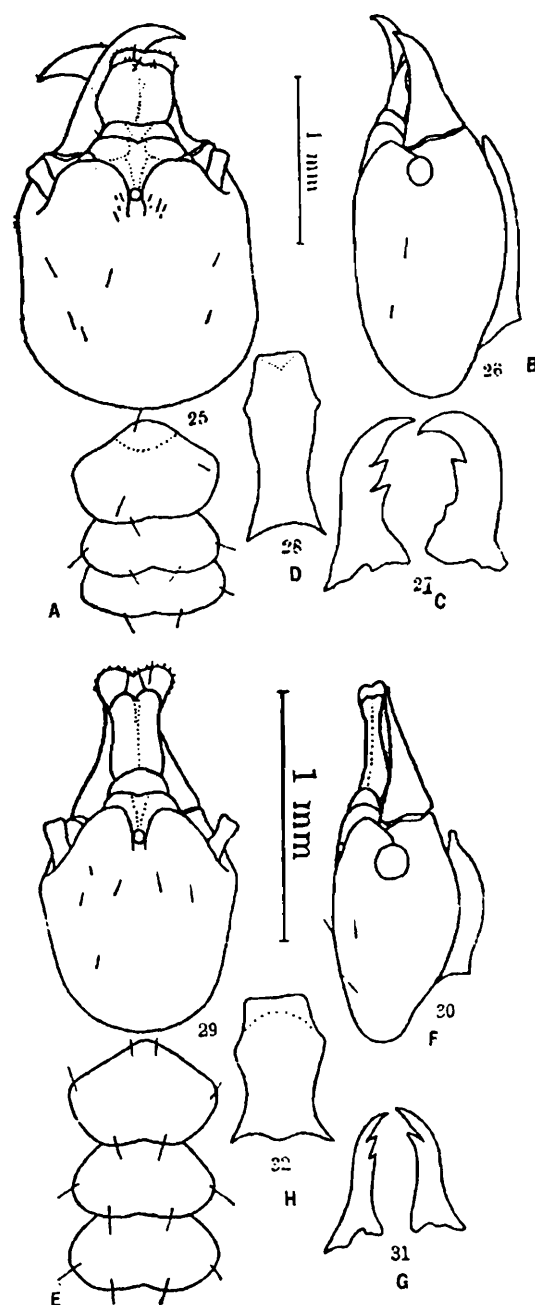


Fig. 111. *Schedorhinotermes ganlanbaensis* Xia and He A-D, Soldier (major). A. Head and thorax, dorsal view; B. Head, side view; C. Mandibles; D. Postmentum. E-H, Soldier (minor). E. Head and thorax, dorsal view; F. Head, side view; G. Mandibles; H. Postmentum (After, Xia and He).

with weak median emargination. (iii) SOLDIER (MINOR) (Fig. 111. E-H) : Head and pronotum with a few scattered hairs. Head with lateral margins diverging anteriorly upto antennal incision, posterior margin round. Fontanelle circular with indistinct groove. Labrum with hyaline, bilobed apical margins fringed with minute hairs just extending upto tips of mandibles. Mandible small thin with pointed apices, left with two small and sharpe, and right with a single moderately pointed marginal tooth. Postmentum arched, short and stumpy; with widest width at the anterior third and narrowest width at posterior third. Pronotum slightly narrower than head width, anterior margin medially produced and posterior margin with median emargination.

Measurements : Table – 60 (*S. major*).

Types : In Shanhai Inst. Ent., Acad. Sinica, China.

Distribution : ASIA : China : Yunnan Province.

Remarks : The species apparently similar to *S. rectangularis* Ahmad, but differs from it, in having following features. Soldier (Major) : Larger in size,

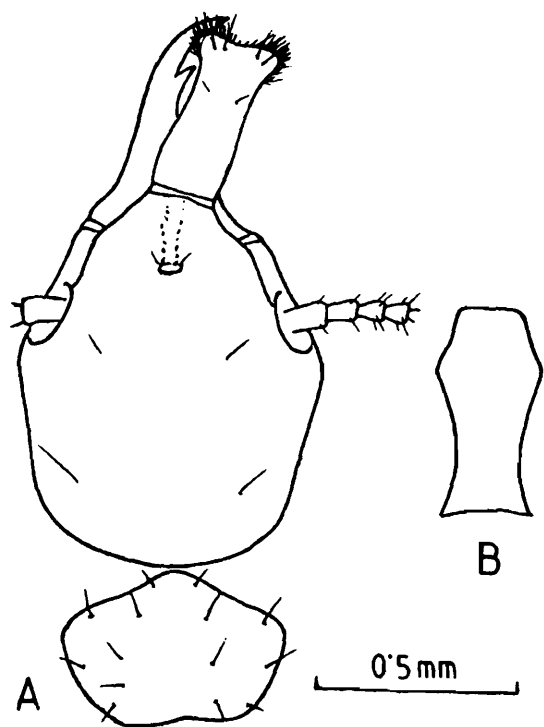


Fig. 112. *Schedorhinotermes holmgreni* Emerson A-B, Soldier (minor). A. Head and pronotum, dorsal view; B. Postmentum.

waist of postmentum slightly broader, 1st marginal teeth of both the mandibles placed at some level. Soldier (Minor) : Labrum short, just reaching to the tip of mandibles.

122. *Schedorhinotermes insolitus* Xia and He

1. *Schedorhinotermes insolitus* Xia and He

1980. Xia and He, *Contr. Shanghai Inst. Ent.*, 175-177.

Type-locality : Yunnan Province, China.

Material : Since no material is available, the diagnostic characters are based on Xia and He (1980).

Diagnostic Character : (i) IMAGO : Unknown. (ii) SOLDIER (MAJOR) (Fig. 113. A-D) : Head somewhat ovoid with a few scattered hairs, devoid of any distinct postero-median bulge. Fontanelle small and circular with forwardly running groove. Labrum slightly longer than broad, widest at basal fourth, apical margin hyaline, bilobed fringed with hairs. Mandibles with pointed hooked apical teeth, left with two pointed and right with more pointed one tooth. Postmentum at widest width with two small projection on either side, moderately narrowed waist at posterior third. Pronotum with anterior margin medially outcurved and posterior margin with feeble median emargination. (iii) SOLDIER (MINOR) (Fig. 113. E-H) : Very similar to *S. (maj.)*, but differs as follows : Head small, uniformly rounded behind. Labrum much longer than broad with hyaline bilobed, hairy apices. Mandibles short, stumpy and not very hooked apices, left with two sharply pointed and right with still pointed one marginal tooth. Postmentum short with less narrowed waist. Pronotum antero-medially produced and posterior margin with weak emargination.

Measurements : Table – 69 (*S. major*).

Types : In S.I.E., Academia Sinica, China.

Distribution : ASIA : China : Yunnan Province.

Remarks : This is a very close species to *S. pyricephalus* Xia and He from China, but differs in some other characters (vide, under that species).

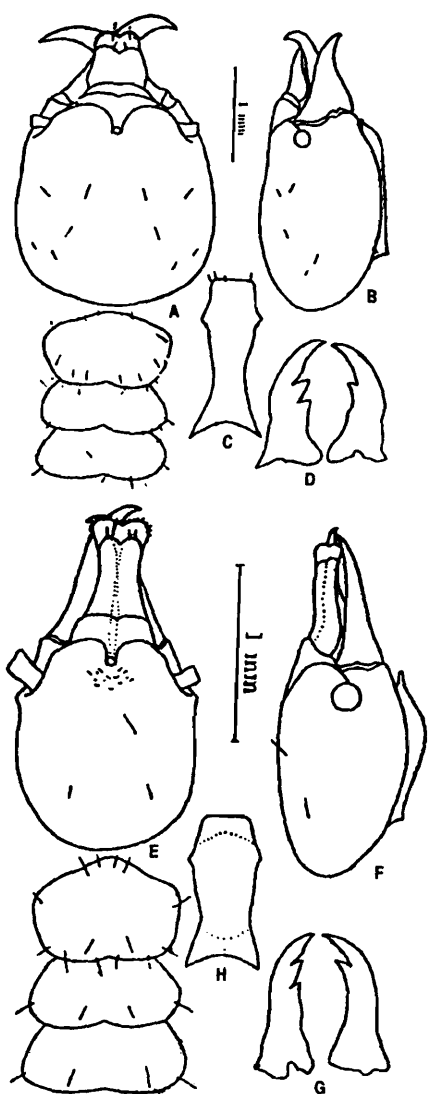


Fig. 113. *Schedorhinotermes insolitus* Xia and He A-D, Soldier (major). A. Head and pronotum, dorsal view; B. Head, lateral view; C. postmentum; D. Mandibles. E-H, soldier (minor). E. Head and thorax, dorsal view; F. Head, lateral view; G. Mandibles; H. Postmentum (After, Xia and He, 1980)

123. *Schedorhinotermes intermedius actuosus* (Hill)

1. *Rhinotermes reticulatus* Hill

1915. Hill, *Proc. Linn. Soc. N.S.W.*, 40 (1) : 109, Material from Northern Territory only.

2. *Rhinotermes intermedius* Froggatt

1896. nec. Froggatt, *Proc. Linn. Soc., N.S.W.*, 21 (4) : 504.

3. *Rhinotermes intermedius actuosus* Hill

1933. Hill, *Proc. Roy. Soc. Vict.*, 45 (1) : 7. Im. and S. Northern Territory.

4. *Rhinotermes (Schedorhinotermes) intermedius actuosus* Hill

1942. Hill, *Australian C.S.I.R.*, p. 183-185.

5. *Schedorhinotermes intermedius actuosus* (Hill)

1949. Snyder, *Smiths misc Coll.*, 112 : 91. Queensland and Northern Territory.

1970. Gay and Calaby, in *Biology of Termites*, (Eds. Krishna and Weesner), 2 : 407 (biology).

Material : Present in Z.S.I., Kolkata : 3 Im., 5S, and 3W., (Z.S.I. Reg. No. 2770/H8), Australia : Newcastle Waler N.I., S.Y.C. Smith, 31.vi.1935, Don. C.S.I.R.O., Australia.

Diagnostic character : (i) IMAGO : Similar to typical forms of *S. intermedius seclusus* (Hill), but smaller. (ii) SOLDIER (MAJOR) (Fig. 114. A-B) : Head more or less quadrate, sides substraight, only narrowing above the antennal incision, posterior margin weakly produced medially. Fontanelle circular with indiacreate groove running to tip of labrum. Labrum almost as long as broad with bilobed apical margin. Postclypeus distinctly wider than long. Antennae with 18 segments, 3 equal to or slightly longer than 2. Mandible fairly stout with moderately, but finely incurved apical teeth left with two unequal, blunt and right with two distantly placed unequal marginal teeth. Pronotum with convex anterior and concave posterior margins. (iii) SOLDIER (MINOR) : Very similar to typical *S. intermedius intermedius*, except only slightly smaller in size.

Measurements : 57 (Im.); 65 (S. maj. min.) (Hill, 1942 and Present Author).

Types : Holotype S. (maj.) and Morphotype Im., S. (min.) and W. in the *Nat. Mus.*, Melbourne.

Distribution : AUSTRALIA : Northern territory : Darwin (Type-locality), Point Charles, Batchelor, Stepleton, Brock's Creek, Doyle's Ridge, Dunmara, Station, New Castle Waters. Mt. Peake Station, Alice Springs. Western Australia : Wyndham, Bamboo Springs Wynangoo, Mullews, Queensland : Mareeba, Herberton, Tolga Mareeba road, Cairna, Meringa, Yeppoon, Gordonvale

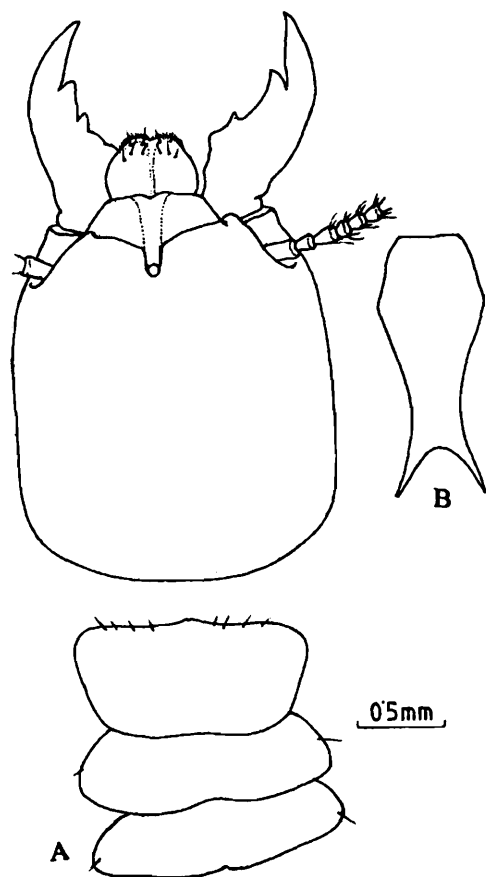


Fig. 114. *Schedorhinotermes intermedius actuosus* (Hill) A-B, Soldier (major). A. Head and thorax, dorsal view; B. Postmentum.

Charters Towers Housestead, Cunnamulla, Morven, Augathella, Charleville (Hill, 1942).

Remarks : The biological habit of this subspecies is very similar to *S. inter. breinle*, but more destructive wood-eating termite of Australia with arid climate. It is a night flyer from end of November to end of May in its place of occurrence. (Hill, 1942 and Gay and Calaby, 1970).

124. *Schedorhinotermes intermedius breinli* (Hill)

1. *Rhinotermes intermedius* Hill

1915. Hill, *Proc. Linn. Soc.N.S.W.*, 40 (1) : 111, Northern Territory (nec. Brauer 1865).

2. *Rhinotermes breinli* Hill

1921. Hill, *Proc. Linn. Soc.N.S.W.*, 46 (4) : 449, Im., S. and W. Type-locality : Rellingatone, Queensland and North Territory.

3. *Rhinotermes intermedius breinli* Hill

1933. Hill, *Proc. Roy. Soc. Vict.*, 50 (1) : 10.

4. *Schedorhinotermes intermedius breinli* Hill

1949. Snyder, *Smiths.misc.Coll.*, 112 : 91.

1970. Gay and Calaby, in *Biology of Termites*, (Ed. Krishna and Weesner), 2 : 407-408 (Biology).

Material : 4 Im., 4S, and 3W., (Z.S.I. Reg. No. 2774/H8) from Australia : New castle Water N.1, S.Y.C. Smith Coll., 6.iii.1935, Don. C.S.I.R.O., Australia.

Diagnostic character : (i) IMAGO (Fig. 115. A-B) : Very similar to typical *S. int. inter.*, but smaller than *S. actuosus* and *S. seclusus*, but same in size as *S. int. derosus*. (ii) SOLDIER (MAJOR) : Most closely related to *S. inter. actuosus* in having quadrate head, from which the species can easily be separated by its smaller size, absence of smaller teeth below the 1st marginal of the right mandible. Besides, head is very densely hairy and antennae with 17-18 segments. (iii) SOLDIER (MINOR) (Fig. 115. C-D) : Head is smaller than that of other subspecies and lateral sides are more distinctly diverging anteriorly. Antennae with 16 segment, 2 and 3 of equal length, 4 shortest.

Measurements : Table – 54 (Im.); 61 (Soldier, maj. & min.) (Hill, 1942 and Present Author).

Types : *Holotype* S. (maj.) and *Morphotype* Im. and worker in *Natt.Mus.*, Melbourne.

Distribution : AUSTRALIA : Queensland : Rollingatone, Towns ville, Magnatic Island, Honestead, Mareeba, Herberton, Meringa, Caieens, Home Hill, Yarwun (near Gladstone), Inverleigh Station, Northern Territory : Roper River, Darwin, Daly River, Johnston's Lagoon (45 miles north of New Castle Waters) and Groote Eylandt.

Remarks : The subspecies is very similar to typical *S. intermedius intermedius*, but differs in having extremely fine apices of mandibles of both soldier major and minor.

It is abundant in arid inland districts and low rainfall areas near the coast in Australia. This is commonly found in the nests of other termites, under stone, animal dung and in the tree trunk.

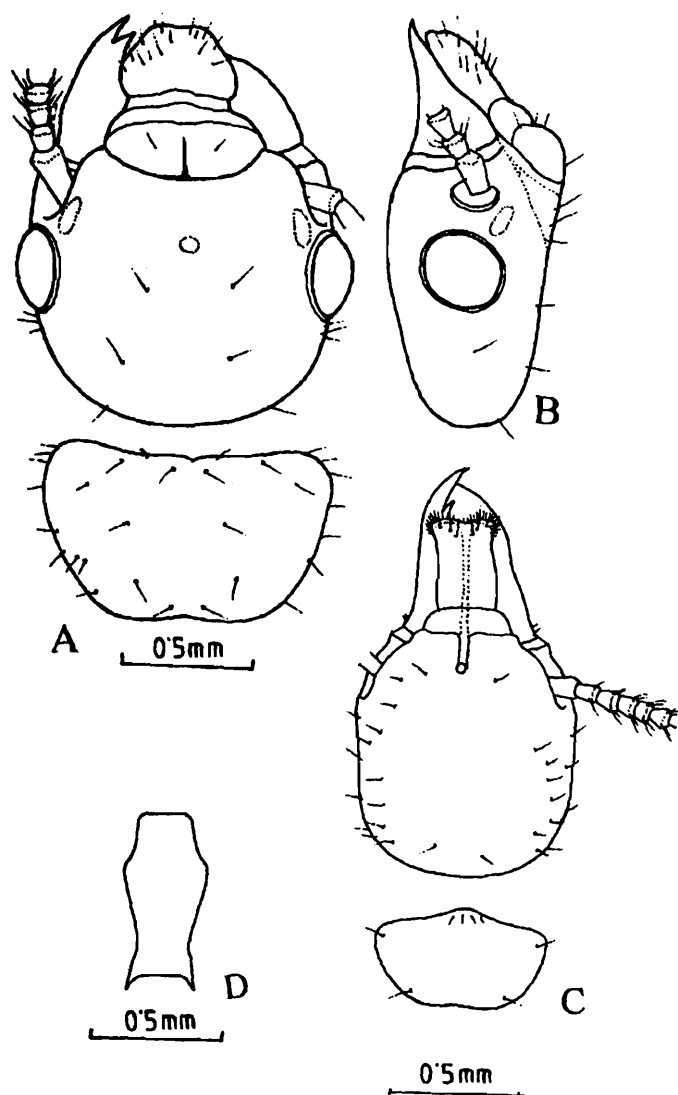


Fig. 115. *Schedorhinotermes intermedius breinli* (Hill) A-B, Imago. A. Head and pronotum, dorsal view; B. Head, lateral view. C-D, soldier (min). C. Head and pronotum, dorsal view; D. postmentum.

Swarming takes place mostly in the evening in the months of February to April. In some areas, the sub species inflicts damage to wooden buildings and fence post (Hill, 1942; Gay and Calaby, 1970).

125. *Schedorhinotermes intermedius derosus* (Hill)

1. *Rhinotermes intermedius derosus* Hill

1933. Hill, *Proc. Roy. Soc. Vict.*, 40 (1) : 8, Im. and S. Type-locality : Western Australia : Derby.

2. *Rhinotermes* (*Schedorhinotermes*) *intermedius derosus* Hill

1942. Hill, *Australian CSIRO*, pp. 188-189. Im., S. maj. and S. min., Western Australia.

3. *Schedorhinotermes intermedius derosus* (Hill)

1949. Snyder, *Smiths. misc. Coll.*, 112 : 91.

Material : Present in FRI, Dehra Dun : 2S., 4W., Paratypes from type-colony, Australia : Derby.

Diagnostic character : (i) IMAGO : Very similar to *S. intermedius actuosus*, but only smaller in size. (ii) SOLDIER (MAJOR) : Similar to *S. intermedius actuosus*, but differs as follows : Head wider posteriorly, antennal segments generally a little longer including 3 longest. (iii) SOLDIER (MINOR) : Very similar to *S. intermedius actuosus*, but slightly larger in size, antennal segments generally longer; a rudimentary tooth between 1st marginal tooth and base of right mandible.

Measurements : Table-54 (Im.); 62 (Soldier, maj. and min.).

Types : Holotype S. (maj.) and Morphotype Im. and S. (min.) in Nat.Mus., Melbourne.

Distribution : AUSTRALIA : Western Australia : Derby, Upper Liverynga, Yeeda, Jigalong and Wallal.

Remarks : It is a smaller species than *S. intermedius actuosus*, otherwise very similar to this species in morphological characters. Biologically, the species is quite unknown.

126. *Schedorhinotermes intermedius intermedius* (Brauer)

1. *Rhinotermes intermedius* Brauer

1865. Brauer, *Verh. Zool. Bot. Ges. Wien*, 15 : 977. Im. Type-locality : New South Wales.

1866. Brauer, *Reise. der. Novara. Zool. Theil*, 2 : 49. Im.

1905. Froggatt, *Agric. Gaz. N.S.W.*, 16 : 654.

1920. Mioberg, *Arkiv. for. Zoologi*, 12 (15) : 30.

2. *Schedorhinotermes intermedius* (Brauer)

1909. Silvestri, *Fauna Sudwest Australiens*, 2 (17) : 290. Im. S. and W.

3. *Rhinotermes intermedius intermedius* Brauer

1933. Hill, *Proc. Roy. Soc. Vict.*, 45 (1) : Im. and S. (biology).

4. *Rhinotermes (Schedorhinotermes)*
intermedius intermedius Brauer

1942. Hill, *Australian CSTR*, p. 179-182. Im., S. 1-2.

5. *Schedorhinotermes intermedius intermedius*
Brauer

1949. Snyder, *Smiths. misc. Coll.*, **112** : 91, Im. (maj. and min.) and W., New South Wales.

1970. Gay and Calaby, In. : *Biology of Termites* (Eds. Krishna and Weesner), p. 407, Biology.

Material : Present in FRI., Dehra Dun : One vial with 4 alates, 6S. and 2W; Australia; Sydney, New South Wales :

Diagnostic character : (i) IMAGO (Fig. 116. A) : Head, postclypeus and labrum yellowish brown, posterior portion of head, pronotum and the other parts still paler. Head, pronotum sparsely and abdomen densely hairy.

Head round, slightly narrowed anterior, posterior margin uniformly round. Fontanelle circular, distinct with brownish margin. Postclypeus outbulge, with incomplete median line. Labrum dome-shaped with round apical margin and with a few hairs. Antennae with 20 segments, 3 longer than 2 and 4. Eyes round, fairly large, devoid of ocular sclarite apparently. Ocelli oval, longer than wide, separated from eyes by its small diameter. Pronotum somewhat rectangular, anterior margin medially outcurved, antero-lateral corners narrowly rounded, posterior margin with very indistinct median emargination. Wings very translucent, very similar to other related species. (ii) SOLDIER (MAJOR) (Fig. 116. D) : Head and postclypeus yellowish brown; labrum, pronotum and other parts still paler; head and pronotum sparsely and abdomen densely hairy.

Head subsequare, slightly narrowing anteriorly, lateral sides feebly outcurved, posterior margin outcurved. Fontanelle circular, fairly distinct with a forwardly running groove, almost reaching to anterior margin. Labrum longer than broad, weakly narrowing anteriorly with a hyaline bilobed apical margin fringed with micro

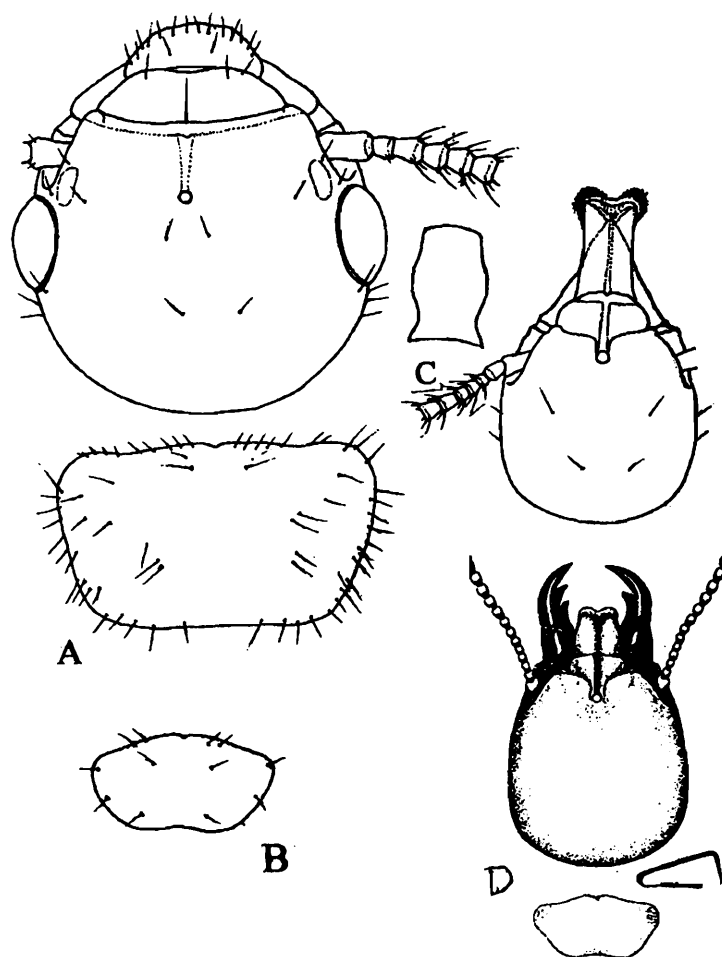


Fig. 116. *Schedorhinotermes intermedius intermedius* Hill A, Imago. A. Head and pronotum. B-C, Soldier (min.). B. Head and pronotum; C. postmentum; D, Soldier maj. D. Head and pronotum (After, Hill, 1942).

hairs. Antennae with 17 segments, 3 slightly longer than 2 and 4. Mandibles sickle-shaped with strongly incurved apical teeth, left with two pointed and right with one pointed marginal teeth. Postmentum club-shaped, widest width slightly broader than waist.

Pronotum narrower than head, weakly saddle-shaped, anterior margin medially produced with feeble median notch, antero-lateral corners narrow, lateral margins weakly incurved, posterior margin substraight. (iii) SOLDIER (MINOR) (Fig. 116. B-C) : Head and pronotum sparsely hairy and yellowish in color, Very smaller than Soldier major, except smaller in size. However, labrum narrow and strongly bilobed, elongate, reaching slightly below the tip of mandibular apices being finely pointed. Antennae with 16 segments unlike major Soldiers having 17-18 segments.

Measurements : Table-54 (Im.); 61 (Soldier, maj. & min.).

Types : *Holotype* Im. in Vienna Mus. and *Morphotypes* S. and W. in CSTR Coll., Melbourne.

Distribution : AUSTRALIA : New South Wales : coastal and near coastal districts from Nowra to Casino; Queensland, Brisbane, Mt. Tambourine, Candamine, Toowoomba, Benerkin and Aramara.

Remarks : The species is found in and under rotten logs, trunk of living and dead trees, base of fence poles and posts, in wooden flooring, etc. Pine posts and poles are susceptible to attack. Winged forms are taken from nests in November and December. The species remains responsible for causing extensive damage to wooden buildings in outer metropolitan areas of Sydney (Hill, 1942; Gay and Calaby, 1970).

127. *Schedorhinotermes intermedius seclusus*
(Hill)

1. *Rhinotermes intermedius seclusus* (Hill)

1933. Hill, *Proc. Ray. Soc. Vict.*, 45 (1) : 5, Im. and S. *Type-locality* : Queensland, Babina.

**2. *Rhinotermes* (*Schedorhinotermes*)
*intermedius seclusus*** (Hill)

1942. Hill, *Australians*, CSTR, pp. 189-191.

3. *Schedorhinotermes intermedius seclusus* (Hill)

1949. Snyder, *Smiths. misc. Coll.*, 112 : 92, Queensland.

Material : 9S. and 4W. from Australia : Atherton, Coll. Atti Wetterly, 1.viii.1951. Don. CSIRO, Australia (Z.S.I. Reg. No. 2772/H8).

Diagnostic character : (i) IMAGO : Smaller than that of typical *S. intermedius intermedius* with larger head, thorax and ocelli. (ii) SOLDIER (MAJOR) (Fig. 117. A) : Head yellowish brown, other body parts paler. Head and pronotum sparsely hairy, abdomen more profusely hairy.

Head rectangular, only narrowed above the antennal fave-olae, lateral sides subparallel, posterior margin weakly outcurved. Fontanelle

circular, distinct, with a forwardly running groove up to apical margin of bilobed labnum with fringed of hairs at the apex. Labnum wider than long with broad base. Antennae with 18 segments, 3 longest and 4 shortest. Mandibles sickle-shaped with less incurved apices, left with two sharply pointed and right with one marginal teeth. Pronotum length almost double the width. Postmentum elongately club-shaped with two small tubercle-like processes on either side of maximum width, waist almost half the widest width. (iii) SOLDIER (MINOR) : No reliable characters are observed for the separation of this species from other species.

Measurements : Table-55 (Im.); 62 (Soldier, maj. & min.).

Types : *Holotype* S. maj and *Morphotypes* Im., S. min. and W. in Nat. Mus., Melbourne.

Distribution : AUSTRALIA : Queensland, Babina, Innisfail, El. Arish, Meringa, Cairns, Ravenshoe, Evelyn Tableland, Atherton Tableland, Dunk Island, Palm Island, Bowen, Imbil, Brisbane Dist., Mt. Tambourine, Toowoomba; New South Wales : Richmond River, Maclean and Taree (Hill, 1942).

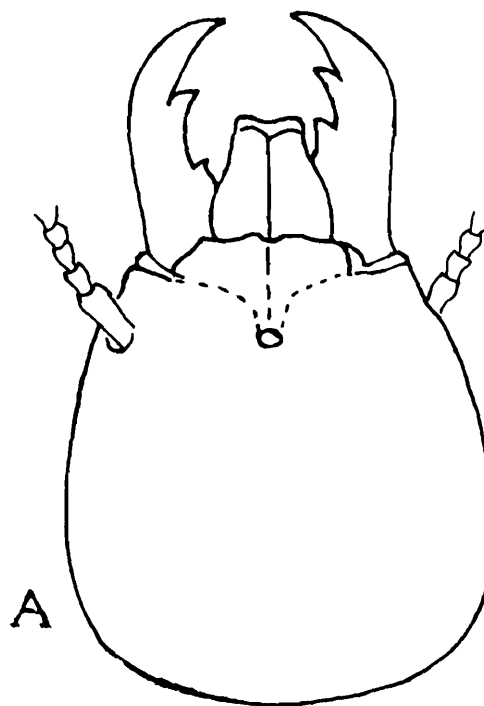


Fig. 117. *Schedorhinotermes intermedius seclusus* Hill A, Soldier (major). A. Head, dorsal view.

Remarks : The species generally occurs in rotten log, but also is known to inflict damage to construction timber in building, commercial trees of both softwood and hardwood. All times, it attacks the crops like potatoes and sugar cane. Imagoes occur in the colonies from October until February (Gay and Calaby, 1970).

128. *Schedorhinotermes javanicus* Kemner

1. *Schedorhinotermes javanicus* Kemner :

1934. Kemner, K. *Sven. Vet. Akad. Handl.*, (3), 13 (4) : 51-54, Im. and S. *Type-locality* : Java, Indonesia.
1949. Snyder, *Smiths. misc. colls.*, 112 : 92 Indonesia.
1958. Ahmad, *Biologia*, 4 (1-2) : 78, 81, 83 (key).
1966. Roonwal and Maiti, *Treubia*, 27 (1) : 90-91, measurements, distribution, Indonesia : Bogor.
1994. Maiti and Chakraborti, *Rec. zool. Surv. India, Occ. Paper*, No. 167, pp. 43-46, Im and S. Great Nicobar and Nancowry.
1982. Thapa, *Sabah For Rec.*, No. 12, 123-129. Sabah.
1992. Thakur and Thakur, *Treubia*, 30 (3) : 257-265.

2. *Rhinotermes* (*Schedorhinotermes*) *brevialatus*

2. *Rhinotermes longirostris, translucens* Holmgren

1914. Holmgren, *Zool. Jahrb., Abt. Syst.*, 36 (2-3) : 240, Java records only.

3. *Rhinotermes* (*Schedorhinotermes*) *translucens* Hill

1942. Hill, *Australian Counc. Sci. & Indus. Res.*, pp.8, 12, 199; Java only.

Material : Present in Z.S.I., Kolkata : (i) One vial with sev. S (mij. and min.) and W. Campbell Bay, Gt. Nicobar, P.K. Maiti and S.K. Chakraborti coll., 21. 1975, ex "dead stump" (ii) One vial with sev. Im., 1S. (maj.) and 5S. (min.) and W. from Nancowry, T.N. Khan and party coll. 4.viii.1280 (F.C.No. K2/4880) ex "dead jungli Bamboo" det. P.K. Maiti and S.K. Chakraborty.

Diagnostic character : (i) IMAGO (Fig. 118. E) : Head yellowish brown, paler posteriorly; labrum, antennae and pronotum yellowish brown; wings hyaline.

Head subrectangular, broader than long. Fontanelle small, circular and situated at the level of anterior ends of ocelli with a shallow groove extending up to the middle of postclypeus. Eyes circular, distinctly bulging out. Ocelli broadly oval, separated from the eyes by one fourth of their minimum diameter. Postclypeus produced anteriorly. Labrum broader than long. Antennae with 20 segments, 3 longer, and 2 and 4 subequal. Mandibles of typical *Schedorhinotermes* - type.

Pronotum flat, subrectangular, narrower than head-width, anterior margin, concave and posterior margin weakly emarginate. Wings long, hyaline, sparsely hairy. Forewing longer

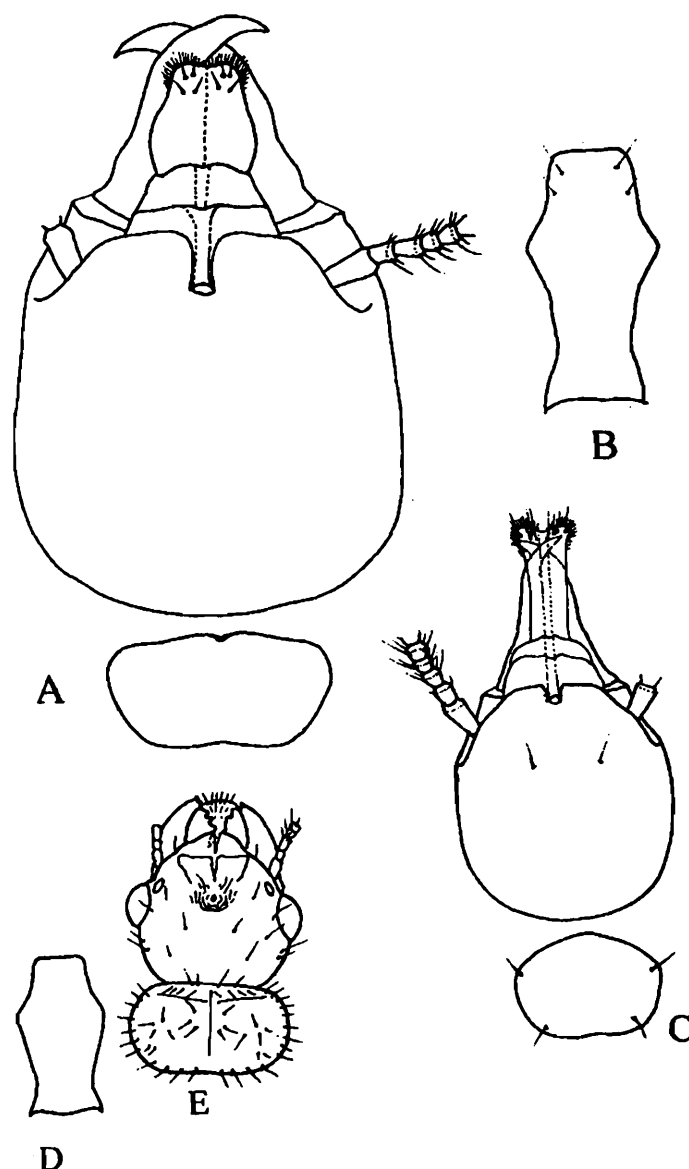


Fig. 118. *Schedorhinotermes javanicus* Kemner A-B, soldier (maj.). A. Head and pronotum, dorsal view; B. Postmentum. C-D. Soldier (min.). C. Head and pronotum, B. postmentum. E. Imago and pronotum.

than hindwing. Forewing scale also longer than that of hindwing. (ii) SOLDIER (MAJOR) (Fig. 118. A-B) : Head yellow with reddish yellow to reddish brown tinge with few scattered hairs, labrum and antennae paler, pronotum with a few long and short hairs along margins, abdomen more profusely hairy.

Head squarish, much narrowed anteriorly beyond antennal faveolae, postero-median outbulge prominent with depressed margin on either side. Fontanelle round with a groove running in front. Antennae with 16 segments, 3 slightly longer than 2, 4 nearly half as long as 3. Mandibles sickle-shaped, left mandible with two sharply pointed tooth. Postmentum widest at the anterior third and waist on posterior third. (iii) SOLDIER (MINOR) (Fig. 118. C-D) : Head yellow with reddish brown tinge and with a few scattered hairs, anteclypeus, labrum and antennae yellowish.

Head longer than wide, widest across postero-lateral ends of antennal carinae. Antennae with 15 segments, 2 one and a half times as long as 3, 4 longer than 3. Labrum elongate, bilobed with fringe of fine hairs with median groove. Mandibles long with fine apical pointed tip, left with two fine and right with one fine tooth. Postmentum arched, broad, anterior widest point slightly more than waist. Pronotum with a median emargination on anterior margin.

Measurements : Table-58 (Im.); 63 (Soldier, maj. & min.).

Types : Not traceable.

Distribution : ASIA : India : Great Nicobar : Campbell Bay : Malaysia : Sabah : Dist. Beaufort : Beaufort. Dist. Kalabakan : Umas Umas; Brantian. Dist. Kota Kinabalu : Lumat. Dist. Keningau : Mile 6, Biah. Dist. Kunak-Mostyn : Kalumpang; Kunak. Dist. Lamag : Balat Keyah II and Pin. Dist. Sandakan South : Sepilok. Indonesia : Java : Buitenzorg; Vada (Tjandjeer); Tjidaho (Buitenzorg), Depot (West Java), Bogor (Roonwal and Maiti, 1966), Kranatau Isl., Rakata

Besar; Rakata Kacil and Sertung (Thakur and Thakur, 1992).

Remarks : The species belongs to the species group possessing smaller mandibles in the genus and comes close to *S. longirostris* in the characters of the major soldier, but differs in having comparatively wider pronotum and an angular small projection on either lateral margin at widest point of postmentum.

The species is quite common in Java and occurs in most tree trunk, beneath logs, under bark, covered runways, etc. It is recorded from about 1000 m. in the forest areas. Dense swarming takes place generally between 6.30 and 10.00 P.M. from October to March. A physogastric termite-ophileus beetles, *Schizelythron javanicus* Kamner (Staplylinidae) is found in association with the species (Kemner, 1934; Kalshoven, 1950a). In Nicobar Island (India), the species generally occurs in dead and decaying wood, bamboo, and images are taken in the month of August (Maiti and Chakraborty, 1994).

129. *Schedorhinotermes lamanianus* *lamanianus* (Sjostedt)

1. *Schedorhinotermes lamanianus* Sjostedt

- 1911. Sjostedt, *Ent. Tidskr.*, 32 (3-4) : 141, Im. S. *Type-locality* : Congo : Mukimbungu.
- 1914a. Sjostedt, *Arkiv. Zool.*, 8 (28) : 1
- 1914b. Sjostedt, *Termiten. Wissenschaftliche ergebnisse der Deutschen Zentral-Africa Expedition, (2d.)*, 1910-11, 1 : 90
- 1915. Sjostedt, *Insectes Pseudonevropteres. I Termitidae*. Coyage Ch. Alluad et. R. Teannel en Afrique Orientale, 1911-12, p. 8.

2. *Schedorhinotermes lamanianus* (Sjostedt.) :

- 1926. Sjostedt, *K. Sven. Vet. Akad. Handl.*, (3) 3 (1) : 53-54.
- 1949. Snyder, *Smiths. misc. coll.*, 112 : 92
- 1968. Harris, *Proc. R. ent. Soc. Lond.*, B 37 : 108-113.
- 1972. Coaton and Sheasby, *Cimbasia. Mem. No. 2*, p. 59
- 1973. Coaton and Sheasby, *Cimbasia*, (A) 3 (2) : 10-17

3. *Rhinotermes* (*Schedorhinotermes*)
lamanianus (Sjostedt)

1928. Emerson, *Bull. Amer. Mus. Nat. Hist.*, 57 (7) : 427-428, fig. 4, S.

4. *Rhinotermes* (*Schedorhinotermes*)
lamanianus (Sjostedt.)
var. angulatus Emerson

1928. Emerson, *Bull. Am. Mus. nat. Hist.*, 57 : 429-430. S. from Congo's Malela.
1949. Snyder, *Smiths, misc. coll.*, 112 : 92.

5. *Rhinotermes* (*Schedorhinotermes*) *puterius*
(Sjostedt.)

1913. Holmgren, *Ent. Tidskr.*, 34 : 324.

6. *Schedorhinotermes puterius* (Sjostedt.)
subsp. *australis* Fuller

1921. Fuller, *S. Afr. J. nat. Hist.*, 3 : 51-52. (Mocambique).
1949. Fuller, *Smiths. misc. coll.* 112 : 6

7. *Rhinotermes bequaertianus* Sjostedt

1913. Sjostedt, *Rev. Zool. Bot. afr.*, 2 : 357, S. from Congo, Elizabethville (Syn.)

8. *Schedorhinotermes bequaertianus* (Sjostedt.)

1926. Sjostedt, *K. Svensk. Vet. Acad. Handl.*, (3) 3 : 54.

9. *Rhinotermes* (*Schedorhinotermes*)
lamanianus Sjostedt
var. bequaertianus Sjostedt

1928. Emerson, *Bull. Am. Mus. nat. Hist.*, 57 : 425

10. *Schedorhinotermes lamanianus* (Sjostedt)
var. bequaertianus (Sjostedt)

1949. Snyder, *Smiths. misc. coll.*, 112 : 93.

11. *Schedorhinotermes provisorius* Grasse

1937. Grasse, *Annls. Soc. ent. Fr.*, 106 : 20-23, Ivory Coast (Syn.).

Material : Present in F.R.I., Dehra Dun : 1S. (maj.), 1S. (min.), 1W., Zululand, South Africa, *Rhinotermes putorius*, det. N. Holmgren, redet. A.E. Emerson.

Diagnostic character : (i) IMAGO : Known, but not available for study. (ii) SOLDIER (MAJOR) (Fig. 119. A-B) : Head yellowish brown; labrum, pronotum and postmentum paler. Head and pronotum sparsely and abdomen densely hairy.

Head suboval, weakly narrowing beyond antennal insertion, lateral sides and posterior margin weakly convex. Fontanelle small, fontanelle gland well marked with forwardly running groove reaching almost to the anterior margin of labrum. Labrum with bilobed anterior margin fringed with minute hairs. Mandibles short, almost half the head length, apical teeth moderately hooked with pointed apices, left with two unequal and right with one sharply pointed tooth. Antennae broken, 3 longer than 2 and 4. Postmentum widest at anterior third and waist almost half at the posterior third. Pronotum narrower than head, anterior margin produced with median feeble notch, posterior margin with median weak emargination. (iii) SOLDIER

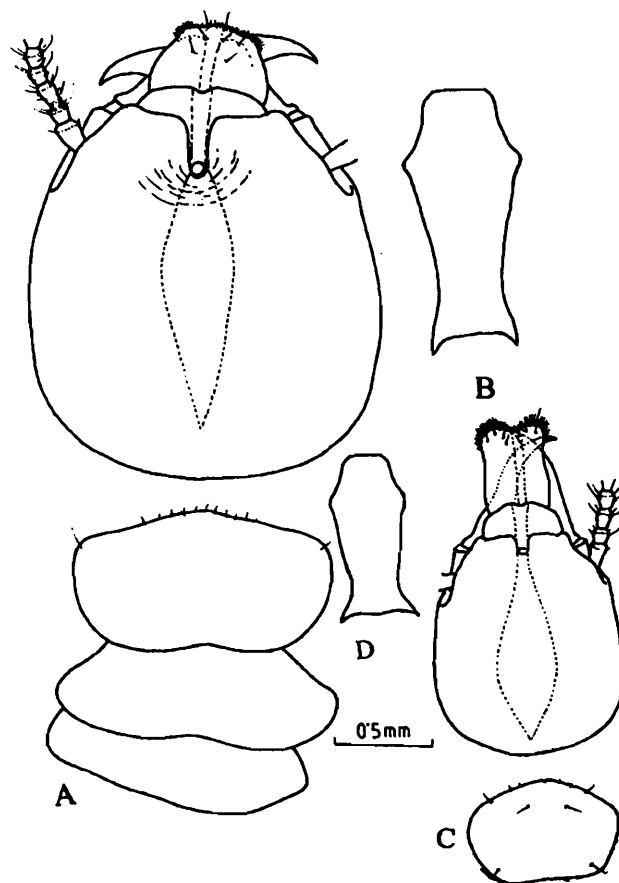


Fig. 119. *Schedorhinotermes lamanianus lamanianus* Sjostedt A-B, Soldier (major). A. Head and thorax, dorsal view; B. Postmentum. C-D, soldier (minor). C. Head and pronotum.

(MINOR) (Fig. 119. C-D) : Head deep brown; labrum, pronotum and antennae pale brown. Head and pronotum sparsely and abdomen densely hairy.

Head subrectangular with narrowed anterior part, lateral and posterior sides weakly convexed. Fontanelle small with forwardly running groove. Labrum longer than broad with bisinuate apical margin fringed with minute hairs, apical third narrowed and posterior third wider. Mandibles long and thin with less incurved apices. Antennae broken, 3 longest and 4 shortest. Postmentum with anterior fourth widest weakly produced on either side like a minute projection, waist two-third of widest width. Pronotum subrectangular, anterior margin produced with a feeble notch and posterior margin with weak emargination.

Measurements : Table-56 (Im.); 64 (Soldier, maj. & min.) (Harris, 1968; and author)

Types : Not traceable.

Distribution : AFRICA : Batswana, Mezambique, Malawi, Kenya, Tanzania, South Africa, Swaziland, Uganda, Zambia and Zimbabwe (Harris, 1968 and Coaton and Sheasby, 1973).

Remarks : The species is widely distributed almost throughout Africa. The shape and size of different population do vary based on which as many as species, subspecies and variety had described in the past. The examination of series of material of different species had resulted into synonymy under this species (Harris, 1968; Coaton and Sheasby 1973).

Two African species, namely, *S. lamanianus* and *S. putorius* appear to be mutually exclusive in their choice of habitats between them. They cover a wide range of vegetation types and where suitable condition exist side by side both may be found in close proximity (Harris, 1968). *S. pulatius* is limited to moist forest at low and medium altitude (Keay, 1959) whereas *S. lamanianus* ranges through forest savana mosaic and, woodlands and Savanna.

The species builds dark carton nest mostly

adpated to tree trunk, buttresses, inside rotten tree stumps or dead branches. In north-east Tanzania, swarming was observed at 03.00 hours in damp foggy night in March (Kemp, 1955). Many termitophilous insects in nests and protozoa in their gut have been recognised.

130. *Schedorhinotermes longirostris* (Brauer)

1. *Termes* sp.

1865. Brauer, *Verh. zool. bot. Ges. Wien.*, 15 : 977, S., Nicobar Island.

2. *Termes longirostris* Brauer

1866. Brauer, *Reise der Fregatte 'Novara' (Zool. Theil)*, Vienna, Bd. 2 (Abth. 1, Art. 4), pp. 47-48, S., W. and Ny. *Type-locality* : Kondul Isl., Nicobar Isl.

3. *Rhinotermes* (*Schedorhinotermes*) *longirostris* (Brauer)

1913. Holmgren, K. *Sv. Vet. Akad. Handl.*, 50 (2) : 86, S., W., India : Nicobar Isl. Indonesia : Java and Malacca.

4. *Schedorhinotermes longirostris* (Brauer) :

1949. Snyder, *Smiths. misc. coll.*, 112 : 93
 1958. Ahmad, *Biology*, 4 : 81 (Key)
 1960. Snyder, and Francia, *Philip. J. Sci.*, 89 (1) : 68 : 74 Philippines, (Key, biology)
 1970. Roonwal and Bose, *Rec. zool. Surv. India*, 62 (3-4) : 132-138, Kondul Isl.
 1980. Bose, *Rec. zool. Surv. India*, 77 (1-4) : 100, Great Nicobar.
 1989. Roonwal and Chhotani, *Fauna of India, Isoptera (Termites)*, I, pp. 540-544.
 1994. Maiti and Chakraborti, *Occ. Pap. Rec. zool. Surv. India*, No. 167, 46-47.

Material : Present in Z.S.I., Kolkata : (i) 3S. (maj.) and Sev. S. (min.) and Neil Island, T.N. Khan and party coll., 21. vi. 1980, ex. 'log' (ii) 1S. (maj.) sev. S. (min.) and sev. W. Laksman Beach, T.N. Khan and party coll., 13. viii. 1980, F.C.No. K.f./13.8.80, ex. "sap wood of an unknown log"

Diagnostic character : (i) IMAGO : unknown. (ii) SOLDIER (MAJOR) (Fig. 120. A-E) : Head

yellowish, other body parts paler. Head and pronotum sparsely and abdomen densely pilose.

Head subquadrate, slightly narrowed anteriorly and more so above antennal faveolae with a few scattered hairs, posterior margin outcurved more so medially. Fontanelle circular with a forwardly running groove reaching up to hyaline, bilobed, pilose and apical margins of labrum. Labrum with broad base. Antennae with 16 segments, 2 shorter than 3, 4 shortest. Mandibles short, finely hooked, left with two somewhat blunt and right with more pointed marginal teeth. Postmentum with few hairs on anterior third beyond the point of maximum width, waist less narrow. Pronotum pentagonal with anterior margin produced and posterior margin weakly emarginate. (iii) SOLDIER (MINOR) (Fig. 120. F-I) : Very similar to Soldier

major, except the smaller size and the following features. Head and pronotum sparsely and abdomen densely hairy.

Head smaller, elongately oval, narrowed above the antennal faveolae. Fontanelle circular with a frontal groove running anteriorly up to the tip of labrum. Labrum elongate with a hyaline, bilobed apical margin fringed with microhairs. Antennae with 15-16 segments. Mandibles long and pointed, thin; left with two and right with single forwardly directed sharp teeth. Postmentum short and broad, widest width not very wide than at waist. Pronotum small, pentagonal in shape with anterior margin produced and posterior margin with feeble emargination.

Measurements : Table-63 (Soldier, maj. & min.).

Types : Repository unknown.

Distribution : ASIA : India, South Andaman : Neil Island. Great Nicobar : Galathea Bay, Gala Bay, Campbell Bay, Laksman Beach. Nicobar Isl. : Kendul Island (Type-locality) Indonesia : Java and Malacca. Philippines.

Remarks : The species seems to be distributed mostly in the Islands. The labrum of soldier (major) is so long as to almost reaching the tip of the mandibles which keep the species distinct.

However, it is very close to *S. javanicus*, but differs in having devoid of any angular projection on lateral sides of widest point of postmentum which is present in the latter species. The species builds nests in the soil and attacks logs, dead stumps, bamboo, etc. in the Philippines (Snyder and Francia, 1960).

131. *Schedorhinotermes magnus* Tsai and Chen

1. *Schedorhinotermes magnus* Tsai and Chen

1963. Tsai and Chen, *Acta Ent. Sinica*, 12 (2) : 174-175, Figs. 8 & 9. S. (maj. & min.). *Type-locality* : China

Material : Since no materials is available for study, description and illustrations by Tsai and Chen (1963) have been followed.

Diagnostic character : (i) IMAGO : Unknown.

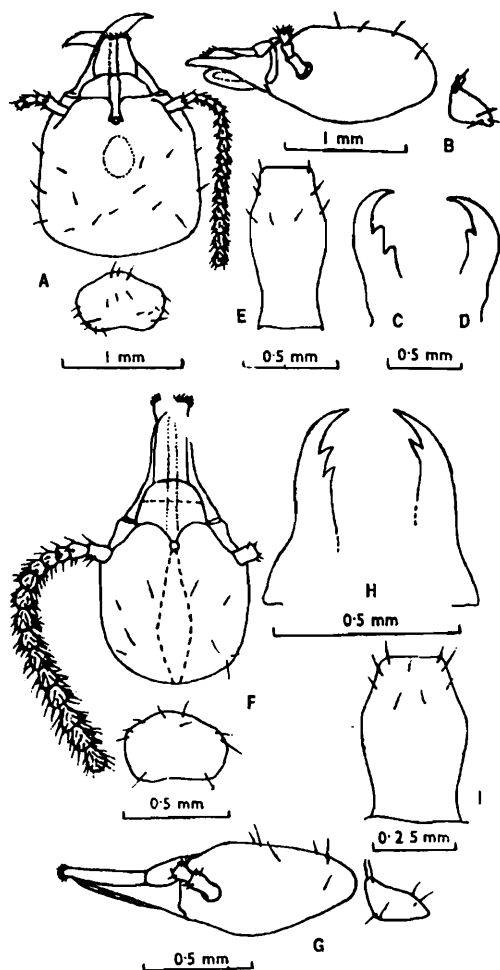


Fig. 120. *Schedorhinotermes longirostris* (Brauer) A-E, Soldier (major). A. Head and pronotum, dorsal view ; B. Head and pronotum, side view; C-D. Mandibles; E. Postmentum. F-I. Soldier (min.). F. Head and pronotum, dorsal view; G. Head, lateral view; H. Mandibles; I. Postmentum.

(ii) SOLDIER MAJOR (Fig. 121. A) : Head robust, almost as long as broad, lateral and posterior margins weakly outcurved. Fontanelle circular and small, placed at the level of antennae. Mandibles thick, with incurved apices, left with two and right with a single marginal tooth. Postmentum broader than long with subround and anterior margin. Labrum slightly longer than broad with bilobed apical margins fringed with minute hairs. Postmentum elongate, maximum width at the anterior third and minimum width at the posterior third. Pronotum much narrower than head, anterior margin out curved with median indistinct notch, posterior margin with median emargination. (iii) SOLDIER (MINOR) (Fig. 121. B) : Head slightly longer than broad, lateral margins slightly converging posteriorly with a rounded posterior margin. Fontanelle circular, small with indistinct forwardly running groove. Postclypeus broader than long. Labrum elongate with bilobed anterior margins fringed with minute hairs. Mandibles thin, slender with fine apices, left with two sharply and right with single still sharply pointed marginal teeth.

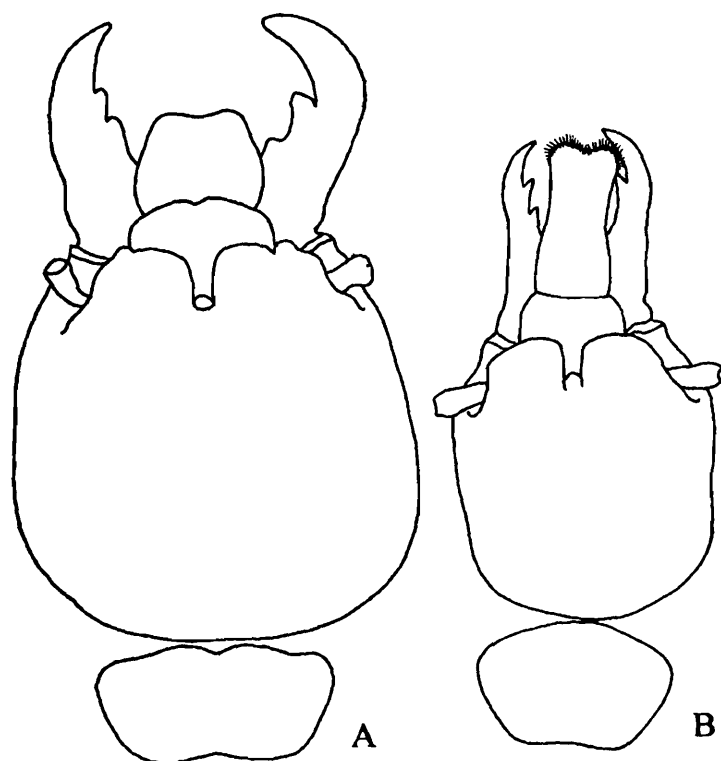


Fig. 121. *Schedorhinotermes magnus* Tsai and Chen A, Soldier (major). A. Head and pronotum, dorsal view; B. soldier (minor). B. Head and pronotum, dorsal view (After, Tsai and Chen, 1963).

Pronotum roundish, anterior margin outcurved and posterior margin with median emargination.

Measurements : Table-66 (S. maj.)

Distribution : ASIA : China.

Remarks : The species is very large and distinctive in its head being wider than long.

132. *Schedorhinotermes makassarensis* Kemner

1. *Schedorhinotermes makassarensis* Kemner

1934. Kemner, K. *Sven. Vet. Akad. Handl.*, (3) 13 (4) : 54-56., *Type-locality* : Makassar, Celebes.

1949. Snyder, *Smiths Misc. Coll.*, 112 : 93

1958. Ahmad, *Biologia*, 4 : 81 (Im.) and 83 (S) (Key).

2. *Rhinotermes* (*Schedorhinotermes*) *longirostris* Oshima

1914. Oshima, *Annot. Zool. Tap.*, 8 : 562, S. Celebes : Maros

1921. Light, *Philippine J. Sci.*, 18 (3) : 250 (Syn.)

3. *Rhinotermes* (*Schedorhinotermes*) *translucens* Holmgren

1913. Holmgren, K. *Sven. Vet. Akad. Handl.*, 50 (2) : 83 Macassar only

1942. Hill, *Australian CSIR*, p. 199., Macassar only.

Material : Since no materials are available, diagnostic characters are based on Kemner (1934) and Ahmad (1965).

Diagnostic Character : (i) IMAGO (Fig. 122. A) : Head very sparsely hairy, brownish in colour, round in shape. Fontanelle round, prominent placed in a rinkle area with forwardly running groove. Postclypeus triangular, basally strongly chitinised and round anteriorly. Labrum dome-shaped with erect hairs. Antennal segment 3 longer than 2, 4 shortest. Eyes strongly bulging out. Ocelli small, oval separated from the eyes, more than its long diameter. Pronotum almost as wide as long, both anterior and posterior margins feebly outcurved, corners somewhat round.

Measurements : (after, kemner, 1934)

Head length to tip of labnum	1.00-1.04
Head length to tip of clypeus	1.60
Head width	1.71-1.80
Long diameter of eye	0.42
Short diameter of eye	0.39
Ocellus length	0.137
Ocellus width	0.120
Eye-ocellus distance	0.10
Pronotum length	0.78-0.88
Pronotum width	1.40-1.46

(ii) SOLDIER (MAJOR) (Fig. 122. B-C) : Head light brown and almost devoid of hairs, nearly as long as broad, lateral margins feebly outcurved and posterior margin broadly round. Fontanelle circular with groove reaching to tip of labrum. Labrum broad basally and narrowing anteriorly terminating into bilobed, apices margined by minute hairs with a few erect hairs below the margins. Mandibles short and stout, left with two sharply pointed and right with a single more pointed marginal teeth. Antennal segments 3 longer than 2, 4 shortest. Postmentum not much

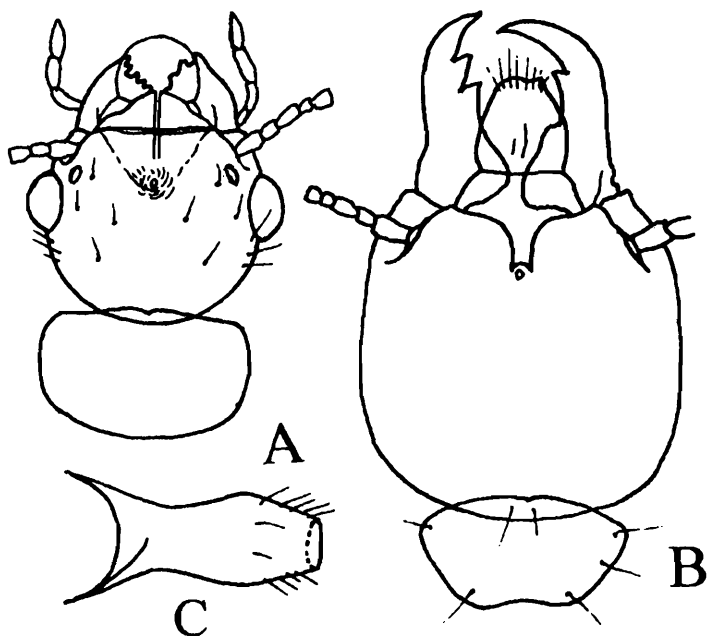


Fig. 122. *Schedorhinotermes makassarensis* Kemner : A. Imago; A. Head and pronotum, dorsal view; B-C. Soldier (maj.) B. Head and pronotum, dorsal view; C. Postmentum.

wider than waist. Pronotum narrower than head, anterior margin outcurved and posterior margin with median emargination. (iii) SOLDIER (MINOR) : Similar to *S. major*, but smaller in size.

Measurements : Table-67 (*S. maj.*, min.).

Types : Repository not known.

Distribution : ASIA : Indonesia : Celebes, Macassar.

Remarks : The species is distinguished from other species in having angularly rounded lateral margins at the widest width which is much wider than the anterior tip of the postmentum of major soldier. However, the species is very similar to *S. javanicus* at least in their morphometry.

133. *Schedorhinotermes malaccensis* (Holmgren)

1. *Rhinotermes* (*Schedorhinotermes*) *malaccensis* Holmgren

1913. Holmgren, K. *Sven. Vet. Akad. Handl.*, 50 (2) : 86, pl. 2, fig. 12, S., fig. 19, S., S., W. Type-locality : Malacca, Indonesia.

1913-14. Holmgren, *Zool. Jahrb., Abt. Syst.*, 36 (2-3) : 242, Malacca : Taiping, Maxwell Hill (2000 ft.), distribution only.

2. *Schedorhinotermes malaccensis* (Holmgren)

1949. Snyder, *Smiths. Misc. Coll.*, 112 : 93.

1957. Harris, *Malayan Nat. J.*, 12 : 23, 28, Malaysia.

1958. Ahmad, *Biologia*, 4 : 79 (Key).

3. *Rhinotermes* (*Schedorhinotermes*) *sarawakensis* (Holmgren)

1925. John, *Truebia*, 6 (3-4) : 384.

Material : Present in F.R.I., Dehra Dun : Metatype 1S. (maj.) Kuala Lumpur, Malaysia, Coll., G.H. Corbett (No. 3667), 20.i.1927, from Emerson Coll. (M.C./19202/2), det. and comp. A.E. Emerson.

Diagnostic Character : (i) IMAGO : Unknown. (ii) SOLDIER (MAJOR) (Fig. 123. A-B) : Head reddish brown, others parts paler. Head and

pronotum very sparsely and abdomen more densely hairy.

Head roundish with narrowed anterior end, almost as long as broad, widest below the middle, lateral margins distinctly outcurved. Fontanelle opening small, with a forwardly running groove running up to apical margin of postclypeus. Labrum broader than long, much outcurved laterally and narrowed anteriorly with weak bilobed apical margin fringed with micro hairs. Mandibles distinctly short and incurved with fine apices. Antennae with 16 segments, 3 almost double the 2.

Pronotum much narrower than head-width, anterior margin convex with a median indistinct notch, antero-lateral corners broadly rounded and posterior margin with deep median emargination. Postmentum club-shaped, widest width one and a half times wider than narrowest width. (iii) SOLDIER (MINOR) : Similar to major soldier in colour and hairiness, but smaller in size in all body parts. Labrum short and not reaching the tip of the mandibles.

Antennae with 15-16 segments, 2 either as long

as or slightly longer than 3, pronotum indistinctly emarginate posteriorly.

Measurements : Table 68 (S. maj., and S. min.)

Types : Types in AMNH, New York; and *Metatype* S. (maj.) in F.R.I., Dehra Dun.

Distribution : ASIA : Indonesia : Malacca; Malaysia : Kuala Lumpur.

Remarks : Biologically, the species is quite unknown.

134. *Schedorhinotermes marjoriae* (Snyder)

1. *Rhinotermes* (*Schedorhinotermes*) *marjoriae* Snyder

1925. Snyder, J. Wash. Acad. Sci., 15 (17) : 404-405, Im. and S. *Type-locality* : Ugi. Isl., Solomon Isls.

1942. Hill, Australian CSIR, pp. 191-192.

2. *Schedorhinotermes marjoriae*

1949. Snyder, *Smiths misc. coll.*, 112 : 94.

1958. Harris and Brown, *Commonw. Agric. Bureaux*, pp. 737, 738, 743. Guadal canal.

Material : Since no material was available for study, the morphological characters are based on Snyder (1925).

Diagnostic character : (i) IMAGO : Head yellowish brown, area of frontal gland distinct; sides parallel and posterior margin round. Fontanelle round, placed at the level of posterior margin of ocelli, with forwardly running groove up to tip of labrum. Postclypeus convex, produced and overhanging labrum. Labrum yellowish, almost as long as broad. Eyes suboval, placed close to lateral margin of head. Ocelli suboval, separated from the eyes by its long diameter. Antennae with 19-20 segments, 3 longer than 2 and 4, 4 shorter than 2. Pronotum twice as broad as long, sides narrowing posteriorly with long hairs on body.

Wings yellow, costal veins slightly darker, membrane coarsely reticulate. Forewing : median free, closer to cubitus than to subcosta, branches to apex of the wing with 4-7 branches or sub-

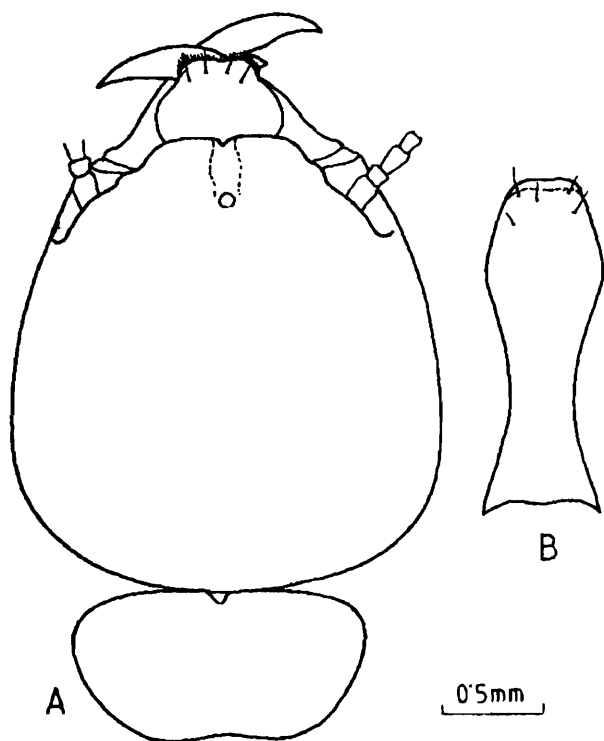


Fig. 123. *Schedorhinotermes malaccensis* (Holmgren) A-B, Soldier (major). A. Head and pronotum; B. Postmentum.

branches, Cubitus with 12-16 branches. (ii) SOLDIER (MAJOR) (Fig. 124, A-B) : Head yellowish brown with scattered hairs; Antennae with 16 segments, 3 longer than 2 or 4, 4 shorter than 2. (iii) SOLDIER (Minor) (Fig. 124, C-D) : Head yellowish brown with transverse rows of long hairs. Mandibles with less incurved apex. Antennae with 15 segments, 3 shorter than 2 or 4.

Measurements : Table-55 (Im.); 70 (S. maj., min.)

Types — *Holotype* : S. (maj.) Cat. No. 15290 in Mus. Comp. Zool., Cambridge, Mass; *Morphotypes* S. (min.) and winged adults; and *Paratypes* in U.S.N.M., Washington.

Distribution : ASIA : Solomon Islands : Ugi island, off San Cristobal. Guadal canal : Rua Vatu, Aruligo, Mamara. Western Group : Rendova.

Remarks : The species in it morphological character of soldier major is very close S. *solomonensis* but differs in having more robust mandibles than in the latter species. However, it

is also somewhat similar to S. *translucens*, but differs in having less hooked mandibular apices.

The species is quite common is Guadalcanal infesting roots of coconut, under creeper (*Epipremnum pinnatum*) (L) on coconut trunk, mound nests on coconut plants, etc. Mostly, it is associated with coconut plants, except in a single occasion, it is recorded from a wooden pillar of an old house at Ilu. A mound nest on roots of one palm, about 6 inches from the trunk, was soft, black, fairly smooth externally and dome-shaped about 9 inches in diameter (Harris and Brown, 1958).

135. *Schedorhinotermes medioobscurus* (Holmgren)

1. *Rhinotermes* (*Schedorhinotermes*) *brevialatus* f. *medioobscurus* Holmgren

1913-14. Holmgren, *Zool. Tahrh., Abt. Syst.*, 36 (2-3) : 241, Im. *Type-locality* : Trong in Taiping, Malacca, Malaysia.

2. *Schedorhinotermes medioobscurus* Holmgren

1949. Snyder, *Smiths misc. coll.*, 112 : 94, Malacca.
1957. Harris, *Malayan Nat. J.*, 12 : 28 Malaysia.
1965. Ahmad, *Amer. mus. nat. Hist.*, 131 (1) : 24-27, Im. and S. (maj. & min.), Thailand.
1968. Harris, *Opusc. Ent.*, 33 (1-2) : 145, Vietnam and Cambodia.
1970. Roonwal and Bose, *Rec. zool. Surv. India*, 62 (3-4) : 138-140, South Andamans.
1973. Morimoto, *Bull. Govt. For. Exp. Stn.*, No. 257, p. 61 Thailand.
1980. Bose, *Rec. zool. Surv. India*, 77 (1-4) : 100, Middle and South Andamans.
1989. Roonwal and Chhotani, *Fauna of India, Isoptera (Termites)*, 1 : 544-549, Andamans.
1994. Maiti and Chakraborti, *Rec. zool. Surv., India, Occ. Pap.*, No. 167 : 48-49, Andamans.

Material : Present in Z.S.I, Calcutta : One vial with 25 Ims. 4S. (maj.), 11S. (min.) and 6W.; 1½ km. W. of RR.O.Colony, Hut Bay, Little

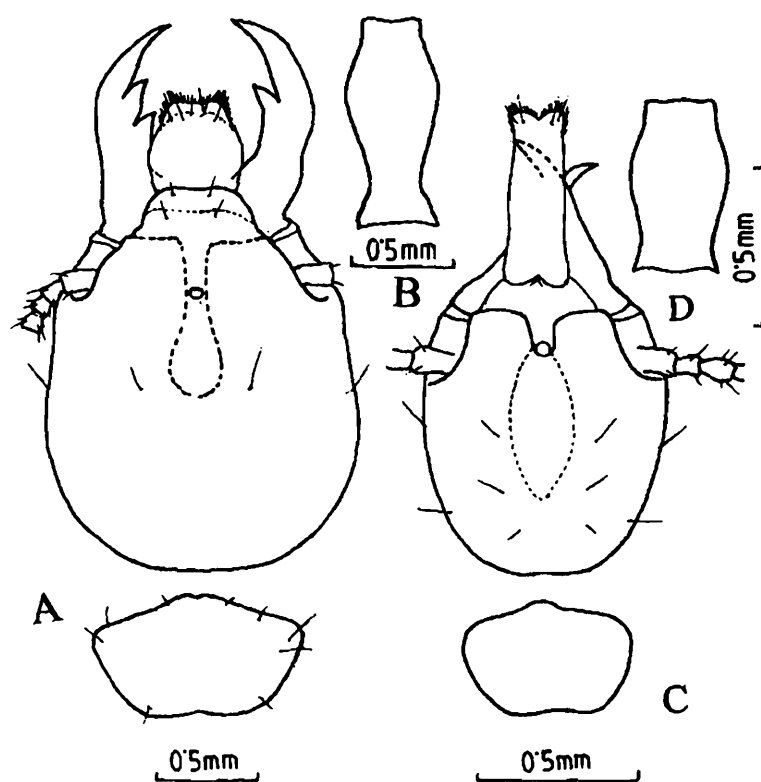


Fig. 124. *Schedorhinotermes marjoriae* (Snyder); A-B, Soldier (major). A. Head and pronotum, dorsal view; B. postmentum; C-D, Soldier (minor). C. Head and pronotum, dorsal view; D. Postmentum (After, Snyder, 1925)

Andamans, B. Mitra and party coll., 22.vi.1982, F.C. No. B 7/22. 7.82, ex. under bark and sapwood of unknown log.

Diagnostic Characters : (i) IMAGO : Head reddish yellow, slightly paler posteriorly, postclypeus light reddish yellow, with a median line, labrum and antennae light yellow brown.

Head round with scattered erect hairs. Fontanelle small, situated at a level of posterior margin of ocelli. Eyes large, circular, separated from lower margin of head by one-fourth of their diameter. Ocelli broadly oval, separated from eye by slightly less than its short diameter. Postclypeus somewhat conical and convex. Labrum broad, dome-shaped. Antennae with 20 segments, 3 longer than 2. Pronotum with anterior margin slightly convex in middle, not emarginate; posterior margin substraight. (ii) SOLDIER (MAJOR) (Fig. 125. A-B) : Head reddish yellow with a few scattered hairs other parts generally paler; postmentum with a few erect hairs on anterior third, pronotum also with a few hairs particularly on margin.

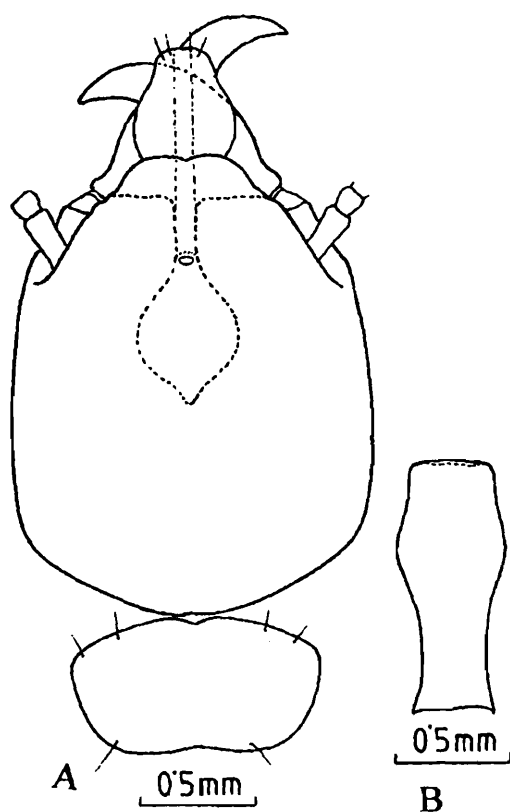


Fig. 125. *Schedorhinotermes medioobscurus* (Holmgren) A-B, soldier maj. A. Head and pronotum, dorsal view; B. Postmentum.

Head subquarish, widest at posterior one-third, posterior margin medially produced with weak concavity on either side. Fontanelle small with a groove running anteriorly. Antennae with 16 segments, 3 longer than 2 and two as long as 4. Labrum as long as broad with hyaline weakly bilobed apical margin with fringe of small hairs. Mandibles sickleshaped, left mandible with two fairly sharp teeth and inner margin of apical tooth weakly outcurved, right with one sharply forwardly directed tooth. Postmentum one and a half times as wide at widest point as waist. Pronotum with anteriorly produced anterior margin and weakly emarginate posterior margin. (iii) SOLDIER (MINOR) : Head yellow with brownish fringe with few scattered hairs, other body parts still paler, pronotum with some erect hairs on margins.

Head subsqarish, lateral margins very weakly diverging anteriorly up to antennal faveolae whence converging anteriorly. Fontanelle small and circular with a anteriorly running groove. Antennae with 16 segments, 3 longer than 2 and almost double the 4. Mandibles thin, finely pointed, inner margin almost straight; left mandible with 2 and right with one sharply forward pointed tooth. Postmentum fairly broad with a pair of hairs on anterior third. Pronotum pentagonal in shape with produced anterior margin and weakly with emarginate posterior margin.

Measurements : Table-56 (Im.); 72 S. (maj., min.).

Types : Respository not traceable.

Distribution : ASIA : India : South Andaman : Monglutan, Bidnabad, Jerwa creek (Maiti and Chakraborti, 1944) Choudari and Mount Harriet (Roonwal and Bose, 1970), Middle Andaman : Bakultala : Little Andaman : Hut Bay, Ramkrishnapur : Malaysia, Kualalumpur. Singapore, Thailand : Kan Tang, Ka-Chong, Chantaburi, Makham one Tung Sa-Lang Luang (Ahmad, 1965), Doi Suthep, Khao Yai, Khao Chong (Morimota, 1973). Cambodia and Vietnam.

Remarks : The species differs from others

known from the Bay Islands by its very thick mandibular apices, almost squarish and paralleled sided head and distinctly narrower pronotum (Maiti and Chakraborti, 1944). In the Andamans, it occurs in stumps, decaying wood, galleries on tree trunk, etc. The habits and biology of the species are almost similar to that of *S. malaccensis* (Harris, 1957; Roonwal, 1970).

136. *Schedorhinotermes nancowriensis* Maiti and Chakraborty

1. *Schedorhinotermes nancowriensis* Maiti and Chakraborty

1994. Maiti and Chakraborty, *Occ. Paper, Rec. zool. Surv. India*, No. 167, pp. 49-56. Figs. 3 and 4. *Type-locality* : Nancowry, Nicobar Island, India.

Material : One vial with 4S. (maj.) and SW. S. (min.) and W. Magar Nallaha, Campbell Bay, Gt. Nicobar, P.K. Maiti and party coll., 27. xii. 1975, F.C.No. 5 ex "stump"

Diagnostic Character : (i) IMAGO : Unknown. (ii) SOLDIER (MAJOR) (Fig. 126. A-C) : Head, postclypeus and thorax yellowish brown, frons paler. Head and thorax sparsely and abdomen densely hairy.

Head squarish, lateral margin substraight, posterolateral angles and posterior margin broadly rounded. Fontanelle round with groove extending up to tip of labrum. Eyes and ocelli absent. Antennae with 16 segments, 3 long and conical, one and a half times as long as either 2 or 4. Labrum broad with feebly bilobed anterior margin fringed with minute hairs and with 4 erect hairs below the margin. Mandibles strongly built with moderately hooked apices, left with two sharp and right with one marginal teeth. Postmentum shorter than head, maximum width at anterior third at most double the waist at posterior third. Pronotum flat, anterior margin weakly raised with a median feeble emargination at the middle, posterior margin indistinctly incised. (iii) SOLDIER MINOR (Fig. 126. D-F) : Head and its different parts pale yellow except mandibles with backish brown color. Head and pronotum with scattered hairs on margin, abdomen more hairy.

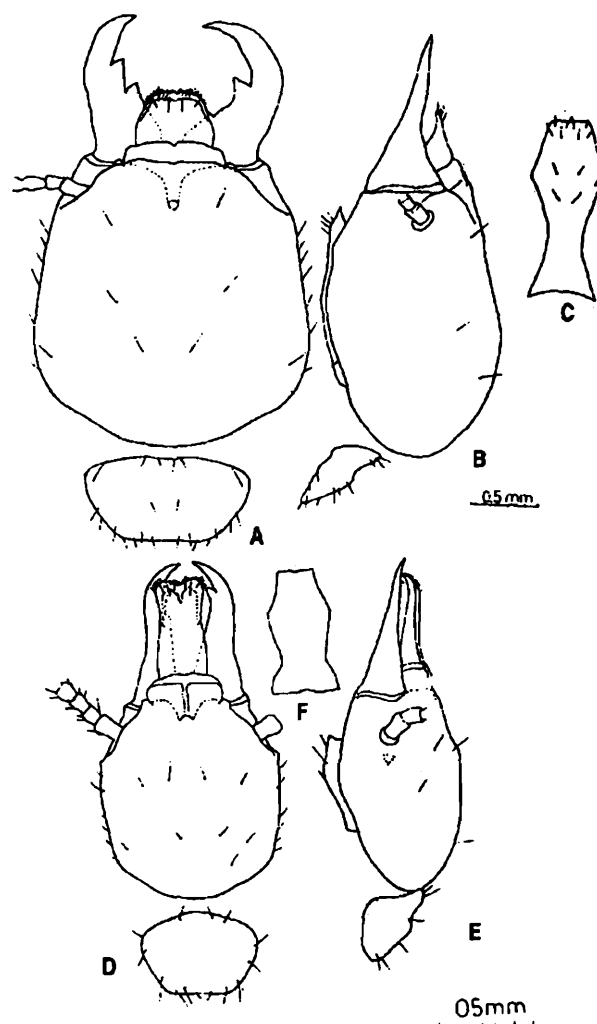


Fig. 126. *Schedorhinotermes nancowriensis* Maiti and Chakraborti A-C, Soldier (major). A. Head and pronotum, side view; C. Postmentum; D-F. Soldier (minor). D. Head and pronotum, dorsal view; E. Head and pronotum, lateral view; F. Postmentum.

Head roughly hexagonal in shape, maximum width at below the antennal incertion, posterior margin weakly medially produced. Fontanelle small and circular with a groove clearly visible up to postclypeus. Antennae with 16 segments, 2 subequal to 3, 4 shortest. Labrum elongate, but not reaching the tips of mandibles with distinct bilobed anterior margin, fringed with minute hairs. Mandibles moderately thin with sharply incurved apices. Postmentum short, maximum width one and a half times broader than at waist at posterior fourth.

Measurement : Table - 70 S. (maj., min.).

Types : Holotype in Z.S.I. Paratypes (6S, 3 maj. and 3 min.) and Paramorphotypes 4 workers in ZSI, Kolkata.

Distribution : ASIA : India : Nicobar Isl. Nancowri, Great Nicobar, Campbell Bay, Magar Nallaha.

Remarks : In morphological characters, the soldiers are very similar to *S. bidentatus* : but differs in having subsquarish head (*vs.* subrectangular in *S. bidentatus*), feebly bilobed labrum (*vs.* distinctly lobed) and narrower pronotum, width 1.14 mm. (*vs.* broader pronotum 1.30 mm) The species is so far recorded from the plastered galleries on stumps in the Nicobar Island.

137. *Schedorhinotermes putorius* (Sjostedt.)

1. *Termes putorius* Sjostedt

1896. Sjostedt, *Ent. Tidskr.* 17 (4) : 298, Im. Type-locality : Camerun : Kitta.

2. *Rhinotermes putorius* (Sjostedt)

1900. Sjostedt, *K. Sven. Vet. Akad. Handl.*, 34 (4) : 50-54, S. maj. from Gabon and S. min. from Cameroun.

1911. Wasmann, *Rev. zool. African*, 1 (1-2) : 171, Neoteinic queens.

3. *Rhinotermes (Schedorhinotermes) putorius* Holmgren

1911. Holmgren, *K. Sven. Vet. Akad. Handl.*, 46 (6) : 79, Im.

1913. Holmgren, *Ent. Tidskr.* 34 : 324.

1928. Emerson, *Bull. Amer. Mus. nat. Hist.*, 57 (7) : 426-427, S.

4. *Schedorhinotermes putorius* Silvestri

1912. Silvestri, *Ann. Mus. Civ. Stor. Nat. Genova*, (3) 5 : 220, Substitute Queen.

1926. Sjostedt, *K. Sven. Vet. Akad. Handl.*, (3) 3 (1) : 52-53, fig. 17, (Sya).

1937. Grasse, *Ann. Soc. Ent. France*, 106 (1) : 20

1949. Snyder, *Smiths. Misc. Coll.*, 112 : 94.

1956. Weedner, *Publ. cult. comp. Diamantes Angola*, 29 : 62

1958. Harris, *Proc. R. ent. Soc. Lond.*, (B) 37 : 106-107

Material : Present in F.R.I., Dehra Dun : 2 Im.,

2S. (min.) and 4W, from longji, Cameroun, det. and Comp. A.E. Emerson, Metatype agrees perfectly with Kitta Cotype Im. and S. (min.).

Diagnostic Character : (i) IMAGO : (127, A)

Measurements : Table-56 (Im.); 64 (S, maj., min.)

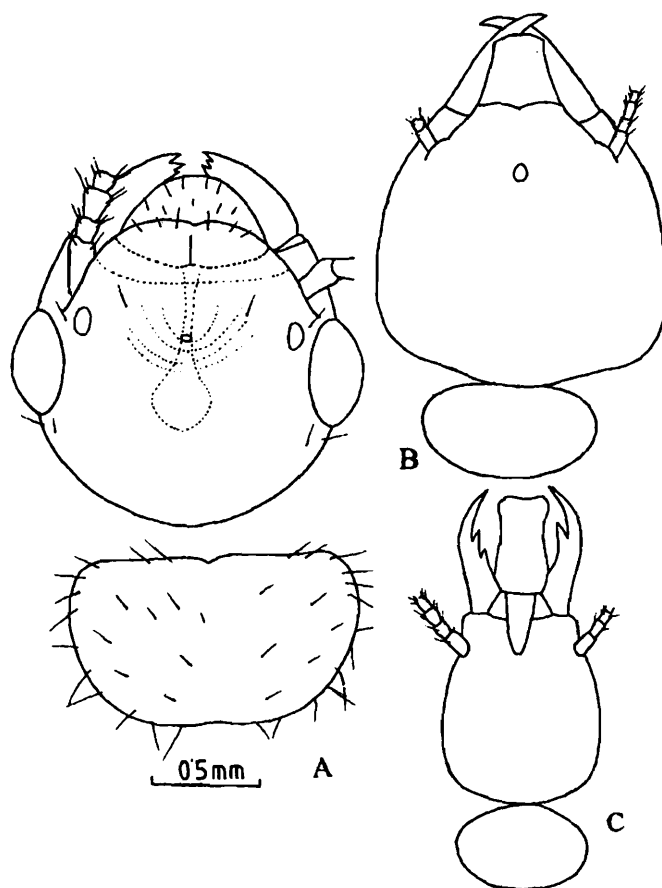


Fig. 127. *Schedorhinotermes putorius* (Sjostedt) A, Imago. A. Head and pronotum; B. Soldier (major). B. Head and pronotum; C. soldier (minor). C. Head and pronotum.

138. *Schedorhinotermes pyricephalus* Xia and He

1. *Schedorhinotermes pyricephalus* Xia and He

1980. Xia and He, *Contr. Shanghai Inst. Ent.*, p.181. Type-locality : China : Yunnan Province.

Material : Diagnostic characters are based on the description and illustrations of Xia and He (1980), since no material was available for study.

Diagnostic Character : (i) IMAGO : Unknown. (ii) SOLDIER (MAJOR) (Fig. 128. A-D) : Head pyriform with a few scattered hairs; much narrowed anteriorly, maximum width at posterior

forth, posterior margin medially weakly produced with two feeble notches on either side of it. Fontanelle circular with forwardly running groove. Labrum broadest almost above the base whence narrowing anteriorly terminating into a weakly bilobed hyaline apices with micro hairs. Mandibles sickle-shaped, left with two forwardly directed and right with laterally directed teeth. Postmentum with feeble tubercle-like projections at the widest width whence narrowing posteriorly to the waist of moderate width, few hairs on anterior third. Pronotum with outcurved anterior margin, but with indistinct median notch, posterior margin with median emargination (Xia and He, 1980, based on illustrations). (iii)

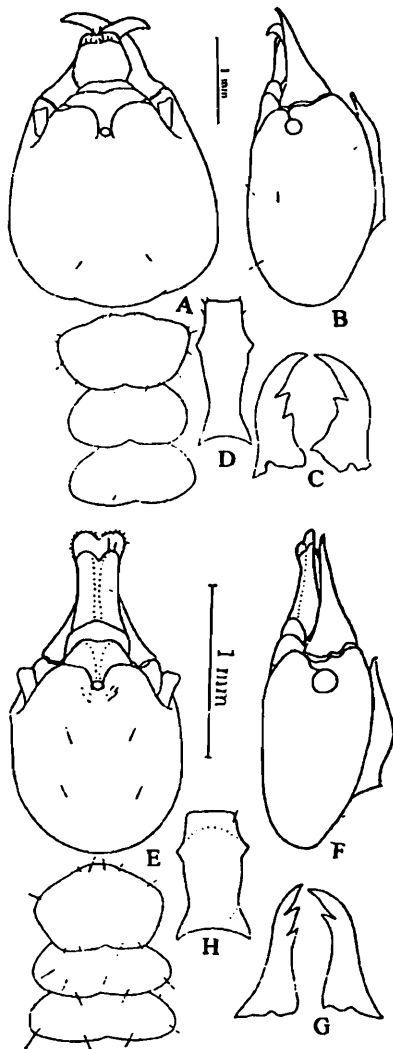


Fig. 128. *Schedorhinotermes pyricephalus* Xia and He ; A-D, soldier (major). A. Head and thorax, dorsal view; B. Head, lateral view; C. Left and right mandibles; D. Postmentum. E-H, Soldier (minor). E. Head and thorax, dorsal view; F. Head, lateral view; G. Left and right mandibles; H. Postmentum (After, Xia and He, 1980).

SOLDIER (MINOR) (Fig. 128. E-H) : Similar to Soldier (major), except in the following characters : Head small, suboval, posterior margin uniformly round. Labrum much elongate with hyaline bilobed apices with more densely hairy margin. Postmentum stumpy and short with broad waist.

Measurements : Table – 69 (S. major).

Types : In Sanghai Inst. Ent., Academic Sinica, China.

Distribution : ASIA : China : Yunnan Province.

Remarks : This species is characterised by large head with more narrowed anterior end and pronotum distinctly broader than meso- and metanotum of soldier major. In these characters, the species differs from its closest on *S. insolitus* from China.

139. *Schedorhinotermes rectangularis* Ahmad

1. *Schedorhinotermes rectangularis* Ahmad

1965. Ahmad, *Bull. Amer. Mus. nat. Hist.*, 131 : 27-29, fig. 21 (S. maj.), fig. 22 (S. min.) *Type-locality* : Cantaburi, Thailand.

1973. Morimoto, *Bull. Govt. For. Exp. Stn.*, No. 257, p. 62, Thailand.

Diagnostic character : (i) IMAGO : Unknown. (ii) SOLDIER (MAJOR) (Fig. 129. A-C) : Head and labrum reddish yellow, other head parts paler, head apilose, pronotum with a few minute hairs on anterior margin. Head somewhat rectangularish with almost parallel margins. Fontanelle circular with a short frontal groove running up to postclypeus with median groove. Labrum with hyaline, bilobed apical margin set with microhairs, Mandibles stout, left with two and right with one sharply pointed marginal teeth. Antennae with 16 segments, 2 slightly longer than 3, 4 smallest. Postmentum slightly arched, one and a half times as broad anteriorly as posteriorly at waist. Pronotum with produced anterior margin, lateral lobes rounded and posterior margin weakly emarginate. (iii) SOLDIER (MINOR) : Head yellow with reddish tinge with a scattered hairs, other head parts still paler.

Head nearly parallel sided up to posterior ends of antennal carinae. Fontanelle circular. Labrum long, but not reaching the tip of the mandible, with hyaline and bilobed apical margin. Mandibles slender, left with two and right with one sharply pointed teeth. Antennae with 16 segments, 2 slightly longer than 3, 4 shorter than 3. Postmentum strongly arched with indistinct narrowed waist. Pronotum with produced anterior margin with a few hairs and feeble emarginate posterior margin.

Measurements : Table – 67 (S. maj., min.).

Types : *Holotype* S. in Ahmad's coll., in the Deptt. of Zoology Univ. of Panjab, Lahore, Pakistan and *Paratypes* S. in AMNH, New York.

Distribution : ASIA : Thailand : Cantaburi (Ahmad, 1965) and Kor Hong Rubber Exp. Station (Morimoto, 1973).

Remarks : The species can easily be distinguished by its strictly rectangular head-caprue. However, it has some similarity to that of *S. maccassarensis*.

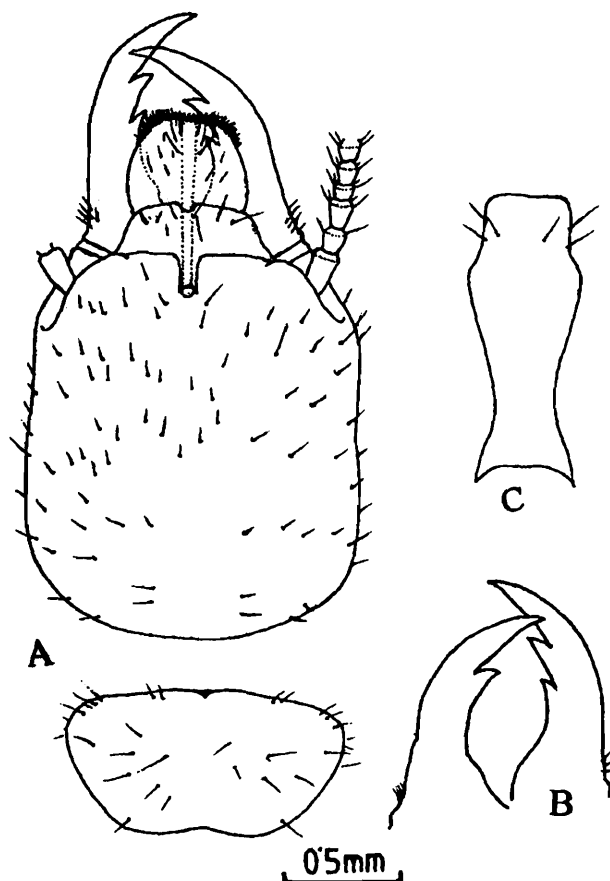


Fig. 129. *Schedorhinotermes rectangularis* Ahmad; A–C, Soldier (major). A. Head and pronotum, dorsal view; B. Mandibles; C. Postmentum.

140. *Schedorhinotermes reticulatus* (Froggatt)

Rhinotermes reticulatus Froggatt

1896. Froggatt, *Proc. Linn. Soc. New South Wales*, 22 : 540, wing, S. W. *Type-locality* : W. Australia (Kalgoorlie) Queensland.
1904. Desneux, *Isoptera, family Termitidae*. P. Wytsman, *Genera insectorum*, 25 : 28.
1920. Mjoberg, *Arkiv Zool.*, 12 (15) : 30.
1933. Hill, *Proc. Roy. Soc. Victoria (N.S.)*, 44 : 12, pl. 4, figs. 11-12.

Schedorhinotermes reticulatus Silvestri

1909. Silvestri, *Isoptera*. In Michaelsen, W., and Hartmeyer, R., *Die Fauna Südwest-Austral.*, 2 (17) : 291, pl. 18, figs. 88-93, minor S. W.

Rhinotermes (Schedorhinotermes) reticulatus Holmgren

1911. Holmgren, K. *Sven. Vet. Akad. Handl.*, 46 (6) : 79
1942. Hill, *Australian CSIR*, p. 193-196 Im., S (maj.) and S (min.).
1944. Hill, *Australian CSIR*, pp. 193-196.
1949. Snyder, *Smiths. misc. coll.*, 112 : 95.

Material : Present in Z.S.I., Kolkata : 5S. and 3W. (ZSI Reg. No. 2773/H8), Australia : 5 miles SW. of Inglewood, Queensland, coll. I. Greaves, 1 xii. 1949, Don. CSIRO, Australia.

Material : Since no material is available, description is based on Hill, 1942.

Diagnostic character : (i) IMAGO (Fig. 130. A.) : Head amber brown, other body parts paler than head.

Head subcircular, broader than long, posterior margin uniformly round. Fontanelle very minute, placed at anterior fourth; Antennae with 20 segments, 3 darker from others and slightly smaller than 2 and larger than 4, 4 smallest. Eyes medium size and subround. Ocelli small and oval, separated from eyes by its long diameter. Postclypeus swollen and with an incomplete median line, much broader than long. Labrum subround, broader than long. (ii) SOLDIER

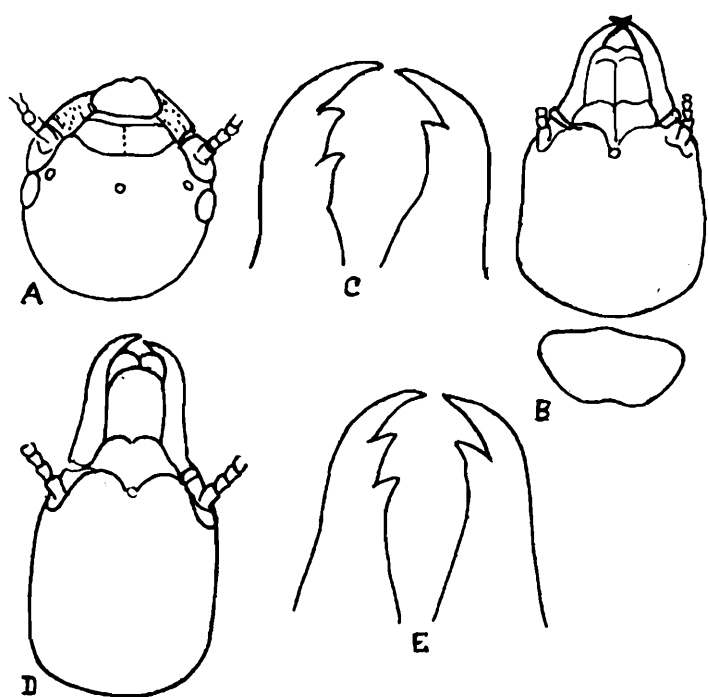


Fig. 130. *Schedorhinotermes reticulatus* (Froggatt) A, Imago. A. Head, dorsal view; B-C, Soldier (major), B. Head and pronotum, dorsal view; C. Mandibles. D-E, Soldier (minor). D. Head, dorsal view; E. Mandibles.

(MAJOR) (Fig. 130. B-C) : Head subrectangular slightly narrowing anteriorly, most as broad as long, posterior end round. Fontanelle small, placed slightly below the level of antennal faveolae, a groove running anteriorly and terminating at the tip of labrum. Postclypeus prominent, anterior margin substraight. Labrum much longer than broad. Mandibles of typical *Schedorhinotermes*-type. (iii) SOLDIER (MINOR) (Fig. 130. D-E) : Head parallel on sides and broadly rounded behind. Mandibles relatively stout, the tooth on the right mandible sometimes with a supplementary point, as in the large soldier. Antennae with 16 segments, segments as in soldier major.

Measurements : Table - 57 (Im.); 73 (Soldier, maj. & min.) (Hill, 1942 and Present Author).

Types : Cotype S. maj. in Nat. Mus, Melbourne; CSIR collection and in Emerson's Collection.

Distribution : AUSTRALIA : Western Australia : Kalgoorlie (type-locality), Ghooli, Hovea, Tammin, Mullewa, Merredin, Wongan Hills, Goomalling, Bruce Rock, Northam, National Park, Three springs, Dowerin; Queensland : Condamine.

Remarks : The species had been recorded frequently in fence posts of different *Eucalyptus* species including a single record from *Casuarina* stump wing adults had been collected in Western Australia on two occasions in March and in January and February in Queensland.

141. *Schedorhinotermes sanctae-crucis* (Snyder)

1. *Rhinotermes* (*Schedorhinotermes*) *sanctae-crucis* Snyder

1925. Snyder, J. *Washington Acad. Sci.*, 15 (17) : 405-406, S. fig. 3b, *Type locality* : Santa Cruz Arch. : Graciosa Bay.

1942. Hill, *Australian C.S.I.R.O.*, pp. 196-197, Santa Cruz Archip.

2. *Schedorhinotermes sanctae-crucis* (Snyder) :

1949. Snyder, *Smiths. Misc. Coll.*, 112 : 95, Santa Cruz. Archep.

Material : Based on Snyder's (1925) description, since no material is available for study.

Diagnostic character : (i) IMAGO : Unknown. (ii) SOLDIER (MAJOR) : Head yellowish brown with scattered numerous hairs. Mandibles slender, less incurved at apices and marginal teeth further from apex. Antennae with 16-17 segments, 3 longer than 2 or 4, 4 shorter than 2. Pronotum broader than head-width. (iii) SOLDIER (MINOR) : Head yellowish brown, smaller from with dense long hairs. Mandibles with apices more elongate and less incurved between tip and marginal teeth. Antennae with 11+, 3 slightly smaller than 2 or 4. Abdomen densely hairy.

Measurements : Table-70 (Soldier, maj. & min.).

Types : S. (maj.) and Morphotype S. (min.) in M.C.Z., Cambridge, Mass.

Distribution : ASIA : Solomon Isl. : Santa Cruz Arch., Graciosa Bay.

Remarks : The species is so far known from its type-locality only. It is a very close species to *S. solomonensis*, but differs in having larger head elongate mandibles with less incurved apices of both soldier major and minor (Hill, 1942). Nothing is known of its field biology.

142. *Schedorhinotermes sarawakensis*
(Holmgren)

1. *Rhinotermes (Schedorhinotermes)*
***sarawakensis* Holmgren**

1913. Holmgren, K. *Sven. Vet. Akad. Handl.*, 50(2) : 87, p.l. 2, fig. 13, 18, S. *Type locality* : Borneo : Sarawak, Malaysia.

1913-14. Holmgren, *Zool. Tahrbr., Abt. Syst.*, 36 (2-3) : 242, S, W.

1925. John, *Treubia*, 6(3-4) : 384.

2. *Schedorhinotermes sarawakensis* Snyder :

1949. Snyder, *Smiths. Misc. Coll.*, 112 : 95.

1958. Ahmad, *Biologia*, 4 (1-2) : 79-80 (major soldier), p.81 (minor soldier) (key).

1965. Ahmad, *Bull. Amer. Mus. nat. Hist.*, 131 (1) : 29-30, S 1-29.

1968. Harris, *Opusc. Ent.*, 33 (1-2) : 145, Vietnam and Cambodia.

1973. Murimoto, *Bull. Govt. For. exp. Sta.*, No. 257, p. 62, Thailand.

1982. Thapa, *Sabah For. Rec.*, No. 12 : 135-142. Sabah

Material : Present in FRI., Dehra Dun : (i) Auto-type-Metatypes 2S. from Selangor Gap; (ii) Sev. S. and W. from Biah Forest, Keningau A. *Simbut coll.*, 8.9.70, ex "rotten wood"

Diagnostic character : (i) IMAGO : Head wider than long, posterior margin below the eyes uniformly circular, frons elevated. Fontanelle small, placed at the level of posterior margin of antennal carinae. Eyes large, placed from lower margin of head by less than one-fourth of their long diameter. Ocelli broadly oval, separated from the eyes by half of their long diameter. Antennae with 20 segments, 3 conical and longer, one-and-a half times longer than 2 and 4. Labrum dome-shaped with markedly hairy and with round apical margin. Postclypeus with a distinct incomplete median line over hanging the anteclypeus. Mandibles of *Schedorhinotermes*-type. Pronotum with substraight anterior margin and with median emarginate posterior margin.

Forewing : Costa and subcosta boarding the

anterior margin; radius joining costal boarder just outside the wing sature at short distance; radial sector running close and parallel with costal border, cross veins between coastal border and radial sector at distant end; median unsclerotized, running mid-way between radial sector and cubitus in proximal half with 3-4 branches, cubitus running in middle of wing with 14-16 branches. Hindwing : Costa, subcosta, radius and radial sector as in forewing; median unchitinized, arising from radial sector outside the suture with 3-4 branches; cubitus running in middle of wing with 14-16 branches. (ii) SOLDIER (MAJOR) (Fig. 131. A-B) : Head light reddish yellow with sparse scattered hairs, other parts on head still paler. Pronotum and abdomen sparsely and somewhat densely hairy respectively. Head wider than long, widest at posterior fourth, whence gradually narrowing anteriorly with convex lateral margins. Posterior margin outcurved with weak concavity on either side of median bulging. Fontanelle circular, small with forward running groove. Antennae with 17-18 segments, sometimes with 17 segment also; 3 longer than 2 and subequal to 4. Postclypeus grooved medially. Labrum grooved medially with a hyaline, weakly bilobed apical margin fringed with microhairs. Mandible sickle-shaped; left mandible with pointed outcurved margin on apical tooth, in addition two other moderately pointed marginal teeth, right with a comparatively sharp teeth. Postmentum vash shaped with broad base and very narrow waist, scattered hairs on the body, particularly on anterior third. Pronotum with anteriorly produced anterior margin and emarginate posterior margin. (iii) SOLDIER (MINOR) : Head light reddish yellow with sparse hairs. Pronotum and postmentum also hairy.

Head longer than broad, weakly converging lateral sides with bulging posterior margin and with weak emargination on its either side. Fontanelle and Postmentum as in major soldier. Labrum elongate, extending beyond the tips of mandibles with hyaline, hairy and bilobed apex. Mandibles thin and elongate; left with two and right with one sharply pointed teeth. Postmentum

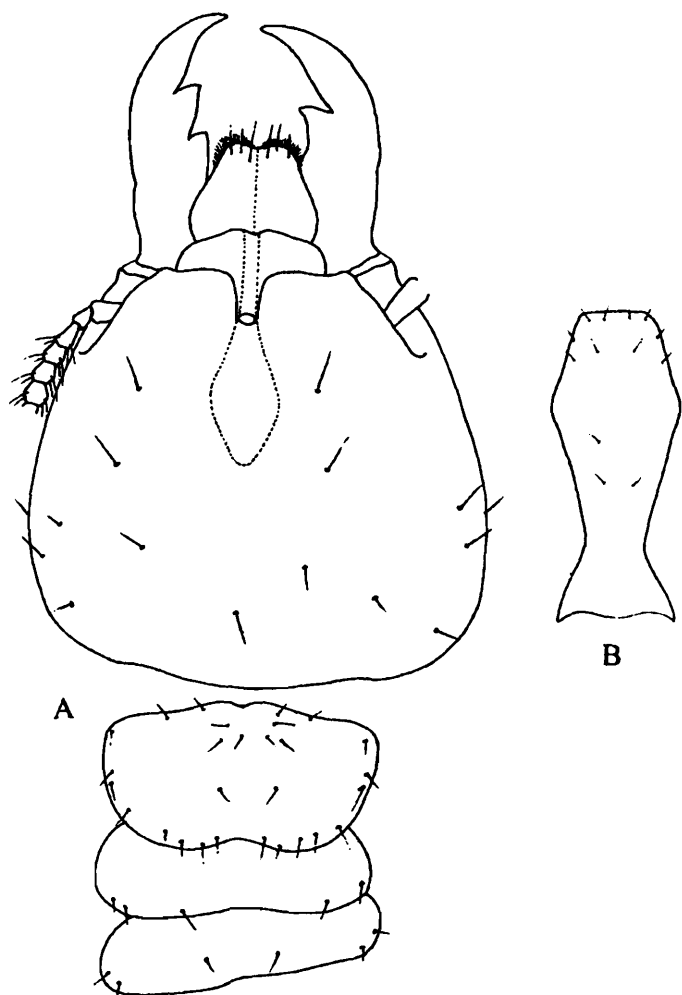


Fig. 131. *Schedorhinotermes sarawakensis* (Holmgren) A-B, Soldier (major). A. Head, pronotum, mesonotum and metanotum, dorsal view; B. Postmentum.

arched, waist very wide, but narrower than its maximum width at anterior third. Pronotum with anterior margin outcurved, posterior margin weakly incurved and fringed with marginal hairs.

Measurements : Table-58 (Im.), 66 S. (maj. and min.).

Types : Primary types not traceable.

Distribution : ASIA : Malaysia : Sabah Dist. Kalabakan : Brantian; Luasong; Umas Umas. Dist. Kota Kinabalu : Lumat. Dist. Kunak - Mostya : Kalumpang; Kunak. Dist. Keningau : Biah; Mile 39 Tambunan. Dist. Lamag : Balat; Pin, Sukau and Tenegang Besar. Dist. Sandakan North : Kolapis, Mile 42 and 43, Labuk Road. Dist. Sandakan South, Lungmanis. Borneo, Sarawak. India : Meghalaya, Myanmar : Misty Hollow, W. side of Dawana Hill, Lower Myanmar (ca, 2200 ft.) Indonesia; Selangor, Gap, Kajan, Sumatra, Lau

Boentoe, Doekoe bel Padang. Singapore : Bukit Timah, Cambodia and Vietnam. Thailand : Kachong, Tung Sa - Long Luang, Mae Sod (Ahmad, 1965) and Doi Suthep.

Remarks : It is one of largest species of the genus with head wider than long, much narrowed anteriorly and feebly bulging at the posterior margin. However, the species is somewhat well established one in the south-east Asia including the eastern India. Biologically, the species is least known except, its occurrence largely in the rotten wood in Sabah as recorded by Thapa (1982).

143. *Schedorhinotermes solomonensis* (Snyder)

1. *Rhinotermes* (*Schedorhinotermes*) *solomonensis* Snyder

1925. Snyder, J. *Washington Acad. Sci.*, 15 (17) : 406-407, S. maj. and min. *Type locality* : Pamua, San Cristobal Isl. and Solomon Isl.

2. *Schedorhinotermes solomonensis* (Snyder)

1949. Snyder, *Smiths. Misc. Coll.*, 112 : 95.

1958. Harris and Brown, *Commonw. Agric. Bureau*, pp. 737, 740, 744. Guadalcanal; Honiara and Gold Ridge.

Material : Since no material was available, the diagnostic characters are based on Snyder (1925).

Diagnostic character : (i) IMAGO : Unknown. (ii) SOLDIER (MAJOR) (Fig. 132A) : Head light castaneous brown with scattered hairs, quadrangular posteriorly, lateral sides narrowing sharply anteriorly and posterior margin round. Fontanelle opening circular with a forwardly running shallow groove up to tip of labrum. Labrum light yellowish brown, tongue-shaped, longer than broad with bilobed anterior margin reaching up to tip of mandibles with fringe of short hairs. Mandibles slender with pointed apices, left with two subequal pointed and right with a single similar marginal tooth. Antennae with 16 segments, 3 longer than 2 or 4. Pronotum with anterior margin convex medially and posterior margin with median emargination. (iii) SOLDIER (MINOR) : Head yellowish brown,

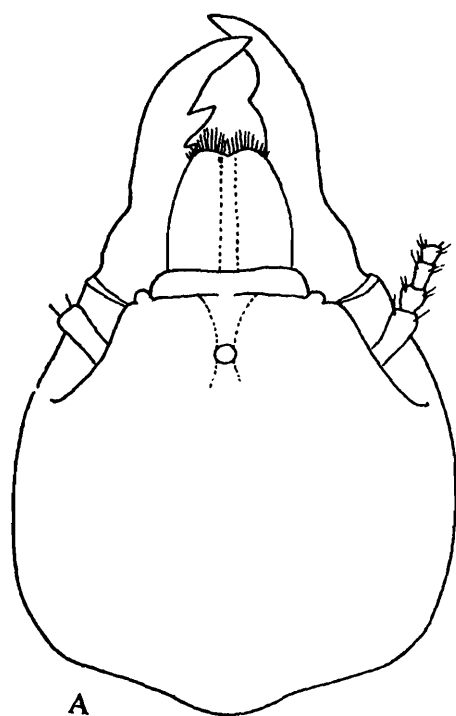


Fig. 132. *Schedorhinotermes solomonensis* (Snyder) A. Soldier (major). A. Head, dorsal view.

broadest at the base of antennal socket whence narrowing posteriorly and terminating into round posterior margin. Fontanelle distinct and hyaline with anteriorly running groove up to tip of labrum. Labrum elongate, longer than broad with bilobed hyaline apices with fringe of minute hairs. Mandibles long with finely pointed apices, left with sharply pointed two and right with single similar marginal teeth. Antennae with 15 segments, 3 shorter than 2, or 4, 4 shorter than 2. Pronotum yellowish brown, anterior margin convex and posterior margin concave medially.

Measurements : Table-71 (S. maj., min.).

Types : Holotypes Major Soldier (Cat No. 15292), in Mus. Comp. Zool., Cambridge, Mass : *Morphotype* Major Soldier and Paratypes in U.S. Nat. Mus. Washington.

Distribution : ASIA : Solomon Islands : Pamua, San Cristobal Isl; Mann at Auki, Malaita Isl. (Snyder, 1925). Guadal canal : Honiara and Gold Ridge (Harris and Brown, 1958).

Remarks : The specie is smaller than most of the species of the genus and the soldiers and workers are dimorphic as in *S. marjriae*. The Species generally occurs in timber in building,

logs of dry wood in forest (500 ft.) and wooden floor in soil contact in Honiara (Harris and Brown, 1958).

144. *Schedorhinotermes tarakanensis* (Oshima)

1. *Rhinotermes* (*Schedorhinotermes*) *tarakanensis* Oshima

1914. Oshima, *Annat. zool. Jap.*, 8 : 564, pl. 10, fig. 2, S. W. *Type-locality* : Tarakan, Borneo, Indonesia

2. *Rhinotermes* (*Schedorhinotermes*) *tarakanensis* Oshima

1920. Oshima, *Philipp. J. Sci.*, 17 (5) : 492, pl. 3, fig. 5, 7 pl.A, figs. 6, 7, S. W.

1921. Light, *Philipp. J. Sci.*, 18 (3) : 251.

3. *Schedorhinotermes tarakanensis* snyder

1949. Snyder, *Smiths. misc. coll.*, 112 : 95 - 96

1958. Ahmad, *Biologia*, 4 (1-2) : 81 - 82.

1960. Snyder, and Francia, *Philipp. J. Sci.*, 89 (1) : 64, 69, 74. Philippine.

1966. Roonwal and Maiti, *Treubia*, 27 (1) : 91, Peutjang Isl., Java Sea.

1983. Thapa, *Sabah For. Rec.*, No. 12 : 142 - 147.

1992. Thakur and Thakur, *Treubia*, 30 (3) : 215, 265 - 268. Java : Cartia, Panaitan Isl.

Material : Im. FRI., Dehra Dun : 2S. (minor), Carita, West Java, Indonesia, coll.T.Abe, 25.x.1982, ex "Wood"

Diagnostic character : (i) IMAGO : Unknown. (ii) SOLDIER (MAJOR) (Fig. 133. A-C) : Head reddish yellow and sparsely hairy. Pronotum moderately and abdomen somewhat densely hairy.

Head subsquarish, slightly narrowing anteriorly, posterior margin weakly produced with weak depression on either side. Fontanelle small and with a forwardly running groove. Antennae with 15-16 segments, 3 slightly longer than 2, 2 subequal to 4. Postclypeus medially grooved. Labrum with hyaline, bilobed apical margins fringed with small hairs. Mandibles with

strongly incurved apical teeth, left with two blunt and right with one sharp tooth. Postmentum with wider waist. Pronotum with outcurved anterior and medially emarginate posterior margin. (iii) SOLDIER (MINOR) (Fig. 133. D) : Head brownish yellow with sparse hairs. Pronotum and posterior portion of postmentum sparsely hairy. Head slightly longer than broad, lateral side feebly diverging anteriorly. Fontanelle small with a groove running in front. Antennae with 14-15 segments, in 14 segmented antennae, segment 3 longer than 2, 4 shorter than 2. Labrum extending beyond mandibles grooved, bilobed and hyaline at apices with fringe of hairs. Mandibles long thin elongate, left with 2 sharp teeth and right with one tooth. Postmentum arched with broad waist, but narrower than widest width with very weak lateral outbulge. Pronotum with outcurved anterior and weakly incurved posterior margins.

Measurements : Table 72 S. maj. and min.

Types : Not traceable.

Distribution : ASIA : Malayasia : Kalabakan : Brantian Luasong and Umas Umas : Dist. Kota Kinabalu : Lumat. Dist. Kunak-Mostyn :

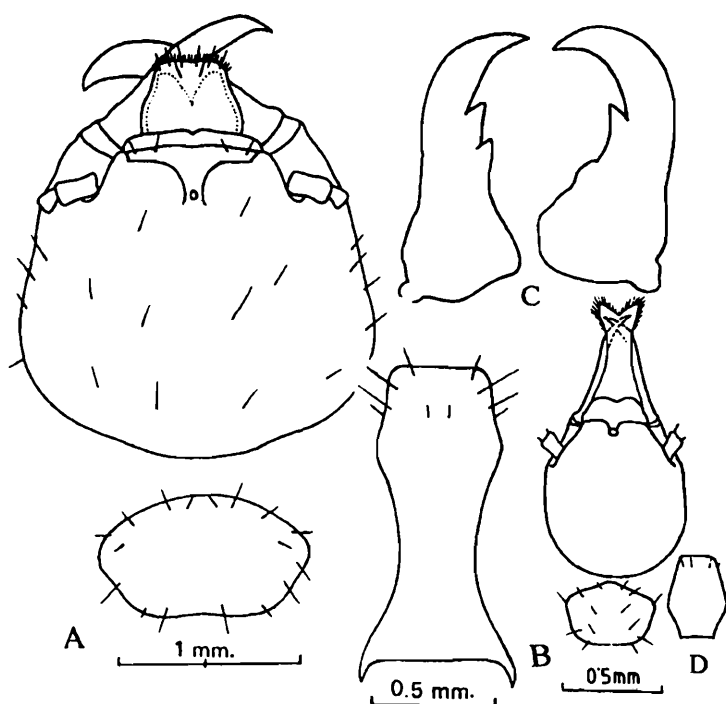


Fig. 133. *Schedorhinotermes tarakensis* (Oshima); A–C, Soldier (major). A. Head and pronotum, dorsal view; B. Postmentum; C. Mandibles. D. Soldier (minor). D. Head, pronotum and postmentum.

Kalumpang. Dist. Lamag : Balat, Koyah II and Pin. Dist. Beaufort : Beaufort. *Indonesia* : Borneo : Tarakan. Peutjang Ist. (near tip of Java), Java Sea (Roonwal and Maiti, 1966) Java : Carita, Panaitan Ist. (Thakur and Thakur, 1992). *Philippines* : Luzon, Laguna Province, near Paete.

Remarks : In recent times, it has been recorded by Roonwal and Maiti (1966) and Thakur and Thakur (1992) based on Soldiers (minor). Nothing is known about its biology except its record from wood in the field.

The slightly longer than broad head with a feeble median bulge on posterior margin of soldier major brings the species very close to *S. mediobscurus* which has distinctly longer head being devoid of any posterior bulge.

The soldiers (minor) from Carita and Panaitan Islands are no doubt *S. tarakanensis* (Oshima), except that they are smaller in size (Thakur and Thakur, 1992).

145. *Schedorhinotermes tewarii* Roonwal and Thakur

1. *Schedorhinotermes tewarii* Roonwal and Thakur

1963. Roonwal and Thakur, *Indian J. agric. Sci.*, 33 (2) : 109-117, S. (Maj. and Min.), W. Type-locality : Chouldhari, South Andaman.
1970. Roonwal and Bose, *Rec. zool. Surv. India*, 62 (324) : 140-141, S. (Min.), and W. Little Andaman.
1980. Bose, *Rec. zool. Surv. India*, 77 (1-4) : 101, S. W. Baratang, South Andaman.
1989. Roonwal and Chhotani, *Fauna of India*, Isopter.
1994. Maiti and Chakraborti, *Occ. Paper, Rec. Zool. Surv. India*, No. 167, pp. 56-58 (*Termites*), I, pp. 554-559.

Material : One vial with 2S. maj., sv. S. Min. and W. from Bakultala, P.K. Maiti and party coll., 13. ii. 1979, F.C No. M9/13.2.79.

Diagnostic character : (i) IMAGO : Unknown. (ii) SOLDIER (MAJOR) (Fig. 134. A) : Head, postclypeus, thorax yellowish brown; other parts lighter.

Head subrectangular, slightly longer than broad, weakly narrowed above the antennal foveolae. Fontanelle circular with forwardly running groove up to weakly bilobed, hyaline apices fringed with microhairs. Antennae with 16 segments, 3 longer than 2, 4 shortest. Mandibles strongly sickle-shaped, left with two and right with a single bluntly pointed marginal teeth. Postmentum club-shaped, widest width at anterior one-third with weak outbulge one either side being only slightly narrower than that. Pronotum sparsely pilose, much narrower than head, anterior margin medially produced, posterior, margin feebly emarginate. (iii) SOLDIER (MINOR) (Fig. 134. B-C) : Head overall light yellow, other parts paler. Head and thorax sparsely hairy.

Head slightly longer than broad, broadest below the antennal insertion. Fontanelle circular with a forwardly running groove reaching to the tip of hyaline, bilobed with densely pilose apical margin of labrum, labrum elongate reaching to

tip of mandibles. Antennae with 15 segments, 3 shorter than 2 or 4. Mandibles elongate, left with two and right with only one marginal teeth. Postmentum with maximum width at the anterior fourth, whence converging posteriorly up to waist at posterior fourth, body with a few scattered hairs.

Pronotum rounded with anteriorly produced anterior margin and very weakly emarginate posterior margin.

Measurements : Table-73 S. (maj., min.)

Types : Holotype S. major in ZSI, Kolkata.

Distribution : ASIA : India : South Andaman, Baratang; Chouldhary (type-locality); Garacharma; Mathura; Rutland Isl. and Wrafters Creek. Middle Andaman : Bakultala and Kadamtala (Naya Dera). North Andaman : Smith Isl. Little Andaman : Hut Bay; Laitora near Tokoibuea.

Remarks : The species very close to *S. bidentatus* and *S. nancowriensis*, but this is a smaller species atleast in its head size.

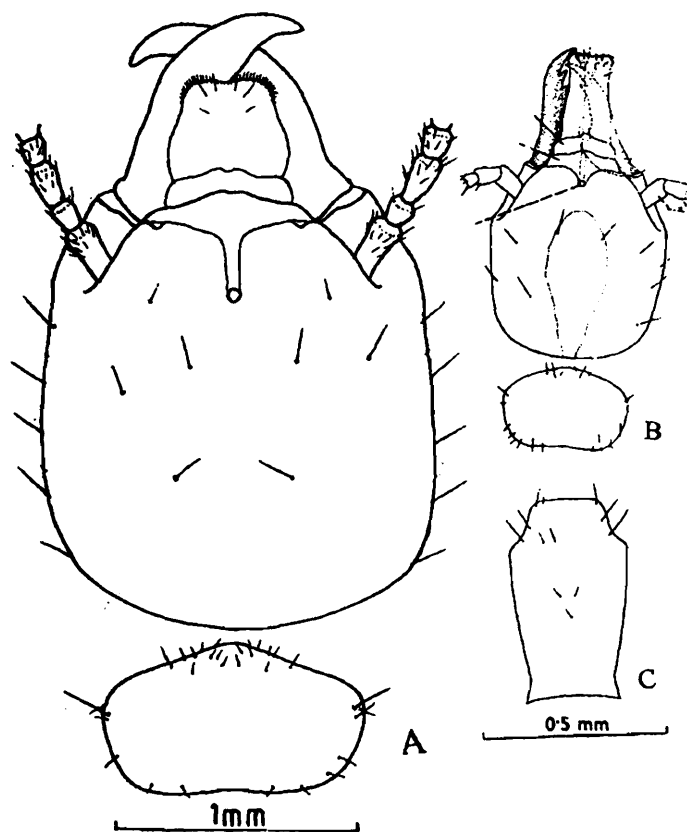


Fig. 134. *Schedorhinotermes tewarii* Roonwal and Thakur A, Soldier (major). A. Head and pronotum, dorsal view; B-C, Soldier (minor). B. Head and pronotum; C. postmentum.

146. *Schedorhinotermes translucens* (Haviland)

1. *Termes translucens* Haviland

1898. Haviland, *Journ. Linn. Soc. London*, **26** (169) : 394, Im., S. and W. Type-locality : Borneo, Sarawak, Malaysia.

2. *Rhinotermes* (*Schedorhinotermes*) *translucens* (Haviland)

1911a. Holmgren, *K. Sven. Vet. Akad. Handl.*, **46** (6) : 79.

1911b. Holmgren, *Mitt. Berlin Zool. Mus.*, **5** (3) : 458, Im.

1913. Holmgren, *K. Sven. Vet. Akad. Handl.*, **50** (2) : 83.

1913-14. Holmgren, *Zool. Jahrb., Abt. Syst.*, **36** (2-3) : 240-241, Im.

1942. Hill, *Termites (Isoptera) from the Australian region*. 199-201 pp. Australian CSIR Type No. 299.

3. *Schedorhinotermes translucens* (Haviland)

1949. Snyder, *Smiths Misc. Coll.*, **112** : 96.

1958. Ahmad, *Biologia*, **4** (1 & 2) : 78, 80 (Key).

1966. Roonwal and Maiti, *Treubia*, **27** (1) : 92, Indonesia (Java) and West Irian.

1975. Akhtar, *Bull. Deptt. Univ. Panjab (NS)*, Art. 7 : 52-58 Bangladesh.
1983. Chhotani *Orient. Insects*, 17 : 120.
1987. Roonwal and Chhotani, *Fauna of Indis*, (Isoptera), I. pp. 559-563, India : Meghalaya.
1999. Bose, *Rec. zool. Surv. India, Occ. Paper*, No. 171, p. 19, Meghalaya.

4. *Schedorhinotermes brevialatus* (Haviland) :
wrong determination

1977. Lahiri, Ghosh and Biswas, *Bull. Meghalaya. Sci. Soc.* 2 : 36. Meghalaya.

Diagnostic character : (i) IMAGO (E-H) : Head light reddish brown, pronotum lighter than head abdomen darker, other parts generally paler.

Head subround, broader than long, posterior margin rounded with feebly produced medially. Eyes suboval, large. Ocelli oval, closely placed near the eyes, separated from it even less than their short diameter. Postclypeus large, conical, medially produced and over hanging on anteclypeus, median line indistinctly marked at base. Labrum dome-shaped. Pronotum flat, subrectangular, much broader than long, but narrower than head with scattered micro-hairs throughout.

Wings hyaline, median close to cubitus with 4-5 branches from the middle. Cubitus with 10-11 branches. (ii) SOLDIER (MAJOR) (Fig. 135. A-B) : Head and pronotum reddish yellow to light yellow with sparsely pilose surface.

Head subsquarish, little longer than broad. Fontanelle circular with a groove running to tip of labrum. Labrum slightly broader than long, broadest almost at the middle, apical margin with fringe of microhairs.

Mandibles moderately hooked, left with two blunt and right with a single marginal tooth. Antennae with 16-17 segments, 3 almost one and a half times as long as 2; 4 shortest. Postmentum elongate with pilosity on anterior half, widest width slightly more than waist. Pronotum much narrower the head width, anterior margin medially produced and posterior margin

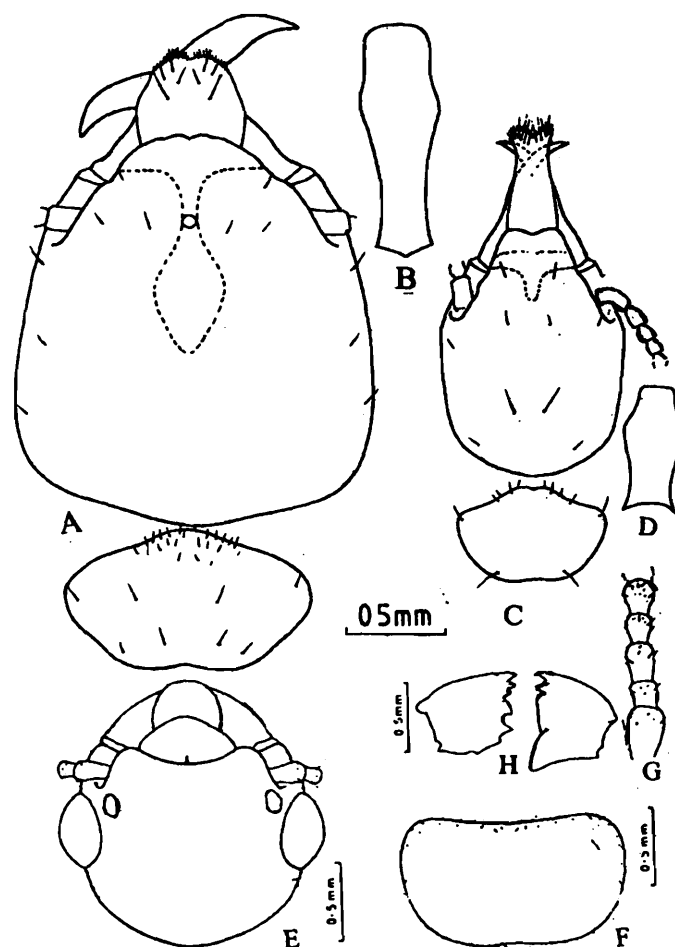


Fig. 135. *Schedorhinotermes translucens* (Haviland); A-B, soldier (major). A. Head and pronotum, dorsal view; B. Postmentum; C-D, Soldier (minor). C. Head and pronotum, dorsal view; D. postmentum. E-H Imago. E. Head, dorsal view; F. pronotum; G. antenna.

indistinctly emarginate. (iii) SOLDIER (MINOR) (Fig. 135. C-D) : Head pronotum and abdomen brownish yellow, head more densely pilose than pronotum.

Head somewhat hexagonal with narrower margins above antennal faveolae, posterior margin medially produced (slightly angularly). Fontanelle small and circular with a groove running to bilobed hyaline apex with fringe of hairs. Labrum projected below the mandibular tip. Postclypeus dome-shaped. Antennae with 15-16 segments, 3 shortest. Mandibles delicate, left with two finely pointed and right with more pointed one teeth. Postmentum strongly arched, short, vash-shaped with maximum width at anterior third and waist almost near the base.

Pronotum pentagonal with medially produced anterior and feebly emarginate posterior margins.

Measurements : Table-53 (Im.); 73 S. maj. and min.

Distribution : ASIA : India : Meghalaya : Indonesia : Borneo : Sarawak. Celebes : Macassar. Java : Bogor. Samatra : Eastern and Central areas. West Irian (= W. New Guinea) : Meerv Lakte, Idenburg River Bank (Roonwar and Maiti, 1966) Malaysia : Malacca. New Guinea (North-East Territory) : Sattelburg near Finschhafen, 'German New Guinea'; and Kola (Samoa Hafen, Huon-Golf) (Holmgren, 1911). Bangladesh : Shishak Forest, Dariadighi Forest, Srimongal and Ukhia.

Remarks : The species is very close to *S. brevipalpus* (Haviland) but differs in having more hooked apices of the mandibles : Biology of the species is not known. Imagoes occur in the nest in the month of November in West Irian (Roonwal and Maiti, 1966).

147. *Schedorhinotermes umbraticus* (Hill)

1. *Rhinotermes umbraticus* Hill

1927. Hill, *Termites from the Australian region* Part I : Mem. Nat. Mus. Melbourne, No. 7; 20-23, pl. I, figs. 17-18, dealated adult, minor S., W. Type-locality : New Britain : Bai (near Rabaul).

2. *Rhinotermes* (*Schedorhinotermes*) *umbraticus* Hill

1942. Hill, *Termites (Isoptera) from the Australian region*, Australian Council Sci. and Indus. Res., pp. 201-202. Holotype : dealated male; morphotype : minor S. and W., in Nat. Mus., Melbourne.

3. *Schedorhinotermes umbraticus* Snyder

1949. Snyder, *Smiths. Misc. Coll.*, 112 : 96.

Material : Present in F.R.I., Dehra Dun : 1S. min. and 2W., Paratypes from type-colony "Rhinotermes" det. and Coll. G.F. Hill, Bai near Rapaul, New Britain Isl., vi 1922.

Diagnostic character : (i) IMAGO (Dealate) : Head yellowish brown, postclypeus and mandible deep brown, wing stumps dark brown. Postclypeus narrowed anteriorly, nose-like, overhanging the base of the labnum. Eyes small,

broadly oval, very prominent. Ocelli small, prominent, well separated from the eyes. Frons strongly arched and deeply grooved, vertex and frons markedly rugose. Thorax and abdomen with scanty long hairs. (ii) SOLDIER (MAJOR) : Unknown. (iii) SOLDIER (MINOR) (Fig. 136. A-B) : Smaller form. Head short and wide, widest at the middle and much narrowing beyond the antennal insertion, posterior margin round with a few hairs. Labrum long, grooved in the middle, terminating into bilobed apical margin fringed with minute hairs and extending beyond the tips of the mandibles. Mandibles long and thin with pointed apices, left with two and right with one marginal teeth. Antennae with 12-13 segments, normally with 13, 3 smallest. Pronotum small, anterior margin medially produced and posterior margin with median emargination.

Measurements : Table - 57 (Im.)

Type : Holotype : dealated male and morphotype S. (min.) and W. in National Mus., Melbourne, Australia.

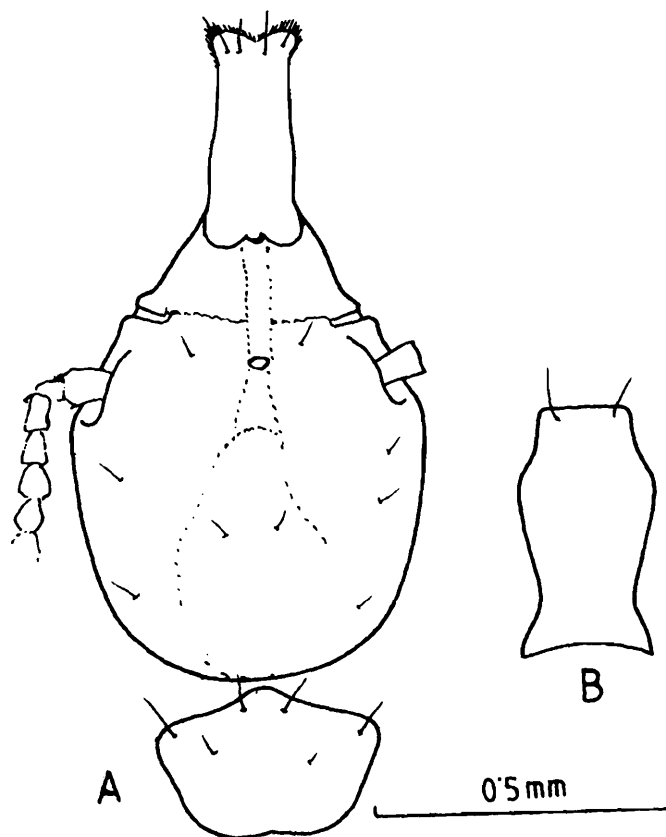


Fig. 136. *Schedorhinotermes umbraticus* Hill A-B. Soldier (minor). A. Head and pronotum, dorsal view; B. prostmentum.

Distribution : ASIA : New Britain, Bai (near Rabaul).

Remarks : The reproductive caste is characterised by nose-like postclypeus by which

it can be distinguished from all other Australian species of the genus. The minor soldiers of the species is very small to which *S. celebensis* has similarity. The species is very rarely known only occurring in a rotten log.

Table-53. Measurements (in mm) etc., of Caste - Imago

<i>Schedorhinotermes</i> spp.	<i>S. eleanorae</i>	<i>S. translucens</i>
Total body-length <i>with</i> wings (excluding antennae), ca.	—	12.00–15.00
Total body-length <i>without</i> wings, (excluding antennae), ca.	6.08–7.00	6.70–7.40
Length of head to lateral base of mandibles	1.38–1.40	1.24–1.32
Max. width of head (with eyes)	1.75	1.67–1.75
Max. length of labrum	0.37	—
Max. width of labrum	0.53	—
Max. diameter of compound eye (with ocular sclerite)	0.50–0.53	0.47–0.53
Max. diameter of lateral ocellus	0.18	0.13–0.18
Min. diameter of lateral ocellus	0.13	—
Min. eye-ocellus distance	0.05–0.08	0.06–0.07
Max. length of pronotum	0.85–0.90	0.80–0.88
Max. width of pronotum	1.48–1.55	1.40–1.55
Length of forewing with scale	—	9.95–10.40
Length of forewing scale	1.30	—
Length of hindwing scale	—	9.80–10.00
Length of hindwing scale	0.78	—
Number of antennal segments	—	20

Table-54. Measurements (in mm) etc., of Caste - Imago

<i>Schedorhinotermes</i> spp.	<i>S. inter. intermedius</i> (Hill, 1942)	<i>S. inter. dorosus</i>	<i>S. inter. breinli</i>
Total body-length <i>with</i> wings (excluding antennae), ca.	17.20–18.00	12.00–15.00	11.00–12.25
Total body-length <i>without</i> wings, (excluding antennae), ca.	8.50–9.50	6.75–7.00	6.00–7.25
Length of head to lateral base of mandibles	1.38	—	—

Table-54 (Contd.)

<i>Schedorhinotermes</i> spp.	<i>S. inter. intermedius</i> (Hill, 1942)	<i>S. inter. dorosus</i>	<i>S. inter. breinli</i>
Max. width of head (with eyes)	1.65-1.75	1.38-1.46	1.35-1.40
Max. length of postclypeus	0.38	—	—
Max. width of postclypeus	0.66	—	—
Max. length of labrum	0.34	—	—
Max. width of labrum	0.65	—	—
Max. diameter of compound eye (with ocular sclerite)	0.42-0.55	0.40	0.44
Max. diameter of lateral ocellus	0.14-0.18	0.16-0.18	0.18
Min. diameter of lateral ocellus	0.15	—	—
Min. eye-ocellus distance	0.07	—	—
Min. eye-antennal distance	0.07	—	—
Max. length of pronotum	0.80-0.92	0.69-0.72	0.69-0.80
Max. width of pronotum	1.46-1.66	1.17-1.25	1.11-1.24
Length of forewing	—	8.50	9.00-9.50
Length of forewing scale	13.40-14.00	—	—
Length of hindwing scale	0.96	—	—
Number of antennal segments	20	—	—

Table - 55. Measurements (in mm) etc., of Caste - Imago

<i>Schedorhinotermes</i> spp.	<i>S. inter. seclusus</i>	<i>S. marjorae</i> (Snyder, 1925)
Total body-length <i>with</i> wings (excluding antennae), ca.	14.50-15.25	12.50
Total body-length <i>without</i> wings, (excluding antennae), ca.	8.25-9.50	6.00
Length of head to lateral base of mandibles	1.44	1.45
Max. width of head (with eyes)	1.80-1.88	1.80-1.85
Max. diameter of compound eye (with ocular sclerite)	0.44-0.55	0.45
Max. diameter of lateral ocellus	0.22	—
Max. length of pronotum	0.85-0.99	0.80
Max. width of pronotum	1.54-1.70	1.60
Length of forewing with scale	10.50	9.50
Number of antennal segments	—	19-20

Table – 56. Measurements (in mm) etc., of Caste - Imago

<i>Schedorhinotermes</i> spp.	<i>S. medioobscurus</i> (Maiti & Chakraborty, 1994)	<i>S. putorius</i> (Harris, 1968)	<i>S. lamanianus</i> (Harris, 1968)
Length of head to lateral base of mandibles	1.30–1.34	—	—
Max. width of head (with eyes)	1.61–1.76	1.60–1.68	1.77–1.93
Max. length of postclypeus	0.26–0.30	—	—
Max. width of postclypeus	0.72	—	—
Max. length of labrum	0.43–0.45	—	—
Max. width of labrum	0.53–0.55	—	—
Max. diameter of compound eye (with ocular sclerite)	0.39–0.54	0.50–0.54	0.59–0.64
Max. diameter of lateral ocellus	0.14–0.20	0.13–0.15	0.13–0.18
Min. diameter of lateral ocellus	0.11–0.15	0.10–0.13	0.10–0.13
Min. eye-ocellus distance	0.06–0.10	0.07–0.09	0.09–0.13
Max. length of pronotum	0.78–0.83	0.82–0.86	0.95–1.14
Max. width of pronotum	1.35–1.48	1.41–1.50	1.68–1.86
Length of forewing with scale	9.33–10.19	8.60–9.00	11.60–14.00
Length of forewing scale	1.20–1.30	—	—
Length of hindwing with scale	8.28–9.62	—	—
Length of hindwing scale	0.70–0.72	—	—
Number of antennal segments	20	20	—

Table – 57. Measurements (in mm) etc., of Caste - Imago

<i>Schedorhinotermes</i> spp.	<i>S. reticulatus</i> (Hill, 1942)	<i>S. umbraticus</i>	<i>S. intermedius actuosus</i> (Hill, 1942)
Total body-length <i>with</i> wings (excluding antennae), ca.	12.00–13.50	—	12.50–14.00
Total body-length <i>without</i> wings, (excluding antennae), ca.	6.50–7.50	7.00–7.50	7.00–8.00
Max. width of head (with eyes)	1.50–1.66	1.61–1.67	1.50–1.66
Max. diameter of compound eye (with ocular sclerite)	0.33–0.37	0.39–0.42	0.40–0.48
Max. diameter of lateral ocellus	0.07–0.11	0.12	0.16–0.22
Max. length of pronotum	0.74–0.82	0.73–0.77	0.77–0.85
Max. width of pronotum	1.29–1.44	1.20–1.32	1.32–1.40
Length of forewing	9.00–10.00	—	10.00–12.40

Table – 58. Measurements (in mm) etc., of Caste - Imago

<i>Schedorhinotermes</i> spp.	<i>S. sarawakensis</i> (Thapa, 1982)	<i>S. brevipalatus</i> (Thapa, 1982)	<i>S. javanicus</i>
Total body-length <i>with</i> wings (excluding antennae), ca.	—	—	12.50
Total body-length <i>without</i> wings, (excluding antennae), ca.	—	—	7.50–8.20
Length of head to lateral base of mandibles	1.65–1.80	1.45	1.26–1.34
Max. width of head (with eyes)	2.10–2.17	1.68	1.64–1.77
Max. length of postclypeus	—	—	0.29–0.34
Max. width of postclypeus	—	—	0.63–0.73
Max. length of labrum	—	—	0.38–0.48
Max. width of labrum	—	—	0.55–0.62
Max. diameter of compound eye (with ocular sclerite)	0.60–0.63	0.42	0.49–0.58
Max. diameter of lateral ocellus	0.15–0.17	0.12	0.20–0.24
Min. diameter of lateral ocellus	0.12–0.15	0.08	0.14–0.15
Min. eye-ocellus distance	0.07–0.11	0.15	0.03–0.06
Max. length of pronotum	1.20–1.35	0.88	0.81–0.91
Max. width of pronotum	1.85–1.97	1.50	1.38–1.53
Length of forewing with scale	—	—	10.20–11.00
Length of forewing scale	—	—	10.20–11.00
Length of hindwing with scale	—	—	10.00
Length of hindwing scale	—	—	0.76–0.80
Number of antennal segments	—	—	20

Table–59. Measurements (in mm) etc. of Caste - Soldier.

<i>Schedorhinotermes</i> spp.	<i>S. dimorphus</i>		<i>S. browne</i>
	(<i>S. maj.</i>)	(<i>S. min.</i>)	
Length of head to lateral base of mandibles	1.38	0.80–0.92	1.00–1.04
Max. width of head	1.30–1.34	0.70–0.76	0.91
Width of head at anterior end	0.88–0.92	0.50–0.57	—
Head contraction index (Ant. W./max. width)	0.67	0.71–0.75	—

Table-59 (Contd.)

<i>Schedorhinotermes</i> spp.	<i>S. dimorphus</i>		<i>S. browne</i>
	(<i>S. maj.</i>)	(<i>S. min.</i>)	
Head index (width / length)	0.95	0.82–0.87	0.91
Max. length of labrum	0.45	0.40	—
Max. width of labrum	0.38	0.14	—
Length of mandible (Upper base of condyle to tip)	0.88	0.50	—
Head-mandibular Length Index (mand.-length / head-length)	0.63	0.58	—
Min. median length of postmentum	0.96	0.55	—
Max. width of postmentum	0.36	0.28	—
Width of postmentum at waist	0.23	0.23	—
Max. length of pronotum	0.42	0.36–0.40	—
Max. width of pronotum	0.73	0.50–0.57	—
Pronotum index (length/width)	0.57	0.70–0.72	—
Pronotum head index (pronotum width / head-width)	0.56	0.71–0.75	—
Number of antennal segments	15	15	—

Table-60. Measurements (in mm) etc. of Caste - Soldier

<i>Schedorhinotermes</i> spp.	<i>S. fortignathus</i> (<i>S. major</i>)	<i>S. ganlanbaensis</i> (<i>S. minor.</i>)
Length of head to lateral base of mandibles	1.62–1.72	1.57–1.60
Max. width of head	1.45–1.55	1.45
Width of head at anterior end	1.07–1.25	1.05
Head contraction index (Ant. W./max. width)	0.74	0.72
Head index (width / length)	0.93	0.91
Length of mandible (Upper base of condyle to tip)	1.12–1.17	1.20
Head-mandibular length Index (mand.-length / head-length)	0.68	0.64
Min. median length of postmentum	1.05–1.12	1.05
Max. width of postmentum	0.47–0.50	0.45–0.47

Table-60 (Contd.)

<i>Schedorhinotermes</i> spp.	<i>S. fortignathus</i> (<i>S. major</i>)	<i>S. ganlanbaensis</i> (<i>S. minor</i> .)
Width of postmentum at waist	0.27–0.30	0.30
Max. length of pronotum	0.65–0.70	0.60
Max. width of pronotum	0.97–1.10	0.87
Pronotum index (length / width)	0.65	0.68
Pronotum head index (pronotum width / head-width)	0.66	0.60

Table-61. Measurements (in mm) etc. of Caste - Soldier

<i>Schedorhinotermes</i> spp.	<i>S. intermedius</i> (<i>S. maj.</i>)	<i>intermedius</i> (<i>S. min.</i>)	<i>S. inter.</i> (<i>S. maj.</i>)	<i>brenli</i> (<i>S. min.</i>)
Length of head to lateral base of mandibles	1.69–2.08	0.80–0.92	1.61	0.88
Max. width of head	1.65–1.85	0.88–0.96	1.31–1.40	0.80
Width of head at anterior end	1.19	–	1.00	0.57
Head contraction index (Ant. W./max. width)	0.72	–	0.74	0.71
Head index (width / length)	0.97	1.04–1.10	0.83	0.90
Max. length of labrum	0.46	–	0.32–0.42	0.30–0.40
Max. width of labrum	0.57	–	0.50	0.23–0.28
Length of mandible (Upper base of condyle to tip)	0.96	–	0.96–1.00	0.46–0.59
Head-mandibular length Index (mand.-length / head-length)	0.57	–	0.60	0.59
Min. median length of postmentum	1.00	–	1.19	0.42–0.65
Max. width of postmentum	0.54	0.27–0.29	0.42–0.45	0.19–30
Width of postmentum at waist	0.32–0.6	–	0.19–0.23	10.19
Max. length of pronotum	–	–	0.57–0.61	0.30–0.36
Max. width of pronotum	1.26	–	1.11–1.19	0.57–0.65
Pronotum index (length/width)	–	–	0.51	0.84–0.85
Pronotum head index (pronotum width / head-width)	0.76	–	0.84–0.85	0.52–0.56
Number of antennal segments	16	–	17	16

Table-62. Measurements (in mm) etc. of Caste - Soldier

<i>Schedorhinotermes</i> spp.	<i>S. inter.</i> (S. maj.)	<i>seclusus</i> (S. min.)	<i>S. inter.</i> (S. maj.)	<i>dorosus</i> (S. min.)
Length of head to lateral base of mandibles	2.00	0.88	2.20	0.91
Max. width of head	2.00	0.88	2.20	0.90
Width of head at anterior end	1.23	—	—	0.65
Head contraction index (Ant. W./max. width)	0.61	—	0.57	0.72
Head index (width / length)	1.00	1.00	1.00	0.98
Max. length of labrum	0.34	0.38	—	0.48
Max. width of labrum	0.57	0.21	—	0.20
Length of mandible (Upper base of condyle to tip)	1.23	—	—	0.66
Head-mandibular length Index (mand.-length / head-length)	0.61	—	—	0.72
Min. median length of postmentum	1.11	—	1.42	0.52
Max. width of postmentum	0.46	—	0.60	0.30
Width of postmentum at waist	0.26	—	0.30	0.22
Max. length of pronotum	0.61	0.38	0.74–0.82	0.38
Max. width of pronotum	1.23	0.65	1.18–1.40	0.72
Pronotum index (length/width)	0.49	0.50	0.60	0.52
Pronotum head index (pronotum width / head-width)	0.61	0.73	0.59	0.80

Table-63. Measurements (in mm) etc. of Caste - Soldier

<i>Schedorhinotermes</i> spp.	<i>S. javanicus</i>		<i>S. longirostris</i>	
	(S. maj.)	(S. min.)	(S. maj.)	(S. min.)
Length of head to lateral base of mandibles	1.43–1.52	0.87–0.93	1.40–1.54	0.80–0.82
Max. width of head	1.46–1.50	0.78–0.82	1.33–1.44	0.71–0.73
Width of head at anterior end	—	—	0.70	0.49–0.50
Head contraction index (Ant. W./max. width)	—	—	0.52	—
Head index (width / length)	0.92	—	0.93–0.95	0.89–0.91
Max. length of labrum	—	—	—	0.37–0.40
Max. width of labrum	—	—	—	0.17–0.20
Length of mandible (Upper base of condyle to tip)	0.77–0.82	0.56–0.60	0.80	0.51–0.53

Table-63 (Contd.)

<i>Schedorhinotermes</i> spp.	<i>S. javanicus</i>		<i>S. longirostris</i>	
	(S. maj.)	(S. min.)	(S. maj.)	(S. min.)
Head-mandibular length Index (mand.-length / head-length)	0.53	—	0.54	0.63–0.64
Min. median length of postmentum	0.98–1.10	0.57–0.60	0.90	0.47–0.50
Max. width of postmentum	0.41–0.45	0.30–0.33	0.40	0.30
Width of postmentum at waist	—	—	0.27	0.23–0.25
Max. length of pronotum	0.48–0.52	0.39–0.42	0.44	0.30–0.33
Max. width of pronotum	0.80–0.83	0.52–0.55	0.72–0.82	0.43–0.47
Pronotum index (length/width)	0.60–0.62	0.75–0.76	0.57	0.69–0.70
Pronotum head index (pronotum width / head-width)	0.54–0.55	0.66–0.67	0.54	0.60–0.64
Number of antennal segments	16	16	16	15–16

Table – 64. Measurements (in mm) etc. of Caste - Soldier

<i>Schedorhinotermes</i> spp.	<i>S. lamanianus</i>		<i>S. putorius</i>	
	(S. maj.)	(S. min.)	(S. maj.)	(S. min.)
Length of head to lateral base of mandibles	1.00–1.32	1.82–2.23	1.64–2.09	1.00–1.32
Max. width of head	0.86–1.14	1.72–2.13	1.64–2.09	0.86–1.14
Head index (width / length)	0.86	0.95	1.00	—
Max. length of labrum	0.46	0.30	—	—
Max. width of labrum	0.36	0.57	—	—
Length of mandible (Upper base of condyle to tip)	0.64–0.91	0.91–1.18	0.82–1.09	0.64–0.91
Head-mandibular length Index (mand.-length / head-length)	0.64–0.68	0.51–0.52	0.51	0.66
Min. median length of postmentum	0.80	1.26	—	—
Max. width of postmentum	0.36	0.53	—	—
Width of postmentum at waist	—	0.23	—	—
Max. length of pronotum	0.43–0.54	0.59–0.82	0.54–0.73	0.43–0.54
Max. width of pronotum	0.64–0.91	1.00–1.50	1.00–1.28	0.64–0.91
Pronotum index (length/width)	0.60–0.67	0.56	0.56	0.62
Pronotum head index (pronotum width / head-width)	0.74–0.79	0.62	0.61	0.74
Number of antennal segments	—	17	17	—

Table – 65. Measurements (in mm) etc. of Caste - Soldier

<i>Schedorhinotermes</i> spp.	<i>S. magnificus</i> (S. maj.)	<i>S. interactuosus</i>	
		(S. maj.)	(S. min.)
Length of head to lateral base of mandibles	2.30	2.00–2.14	1.11
Max. width of head	2.54	1.77–1.88	0.96
Width of head at anterior end	1.34	1.34	0.69
Head contraction index (Ant. W./max. width)	0.52	0.75	0.71
Head index (width / length)	0.90	0.87–0.88	0.86
Max. length of labrum	0.46	0.30–0.34	0.42–0.46
Max. width of labrum	0.57	0.53–0.57	0.28–0.30
Length of mandible (Upper base of condyle to tip)	1.42	1.08	0.73
Head-mandibular length Index (mand.-length / head-length)	0.61	0.52	0.65
Min. median length of postmentum	1.57	1.22–1.50	0.73
Max. width of postmentum	0.62	0.60	0.30
Width of postmentum at waist	0.26	0.28	0.21
Max. length of pronotum	0.80	0.65–0.73	0.42–0.48
Max. width of pronotum	1.46	1.34–1.38	0.80
Pronotum index (length / width)	0.54	–	0.56
Pronotum head index (pronotum width / head-width)	0.57	–	0.83
Number of antennal segments	18	18	–

Table – 66. Measurements (in mm) etc. of Caste - Soldier

<i>Schedorhinotermes</i> spp.	<i>S. magnus</i> (S. maj.)	<i>S. sarawakensis</i>	
		(S. maj.)	(S. min.)
Length of head to lateral base of mandibles	1.53–2.00	2.28–2.52	1.04–1.27
Max. width of head	1.64–1.92	2.00–2.64	0.92–1.11
Width of head at anterior end	–	1.45–1.61	0.67–0.78
Head contraction index (Ant. W./max. width)	0.62	0.64	–
Head index (width / length)	1.02	0.97	–
Max. length of labrum	–	0.50	–

Table-66 (Contd.)

<i>Schedorhinotermes</i> spp.	<i>S. magnus</i> (S. maj.)	<i>S. sarawakensis</i>	
		(S. maj.)	(S. min.)
Max. width of labrum	—	0.73	—
Length of mandible (Upper base of condyle to tip)	0.84	1.14–1.50	0.72–0.80
Head-mandibular length Index (mand.-length / head-length)	0.52	0.55	—
Min. median length of postmentum	—	1.56–1.84	0.72–0.80
Max. width of postmentum	0.47–0.50	0.62–0.67	0.33–0.39
Width of postmentum at anter. end	—	—	—
Width of postmentum at waist	0.25–0.32	0.33–0.39	0.23–0.31
Max. length of pronotum	0.50–0.57	0.61–0.81	0.46–0.52
Max. width of pronotum	0.94	1.30–1.56	0.72–0.81
Pronotum index (length / width)	0.58	0.49	—
Pronotum head index (pronotum width / head-width)	0.55	0.60	—
Number of antennal segments	—	16–17	—

Table – 67. Measurements (in mm) etc. of Caste - Soldier

<i>Schedorhinotermes</i> spp.	<i>S. makassarensis</i>		<i>S. rectangularis</i>	
	(S. maj.)	(S. min.)	(S. maj.)	(S. min.)
Length of head to lateral base of mandibles	1.34–1.52	0.80–0.92	1.30–1.43	0.67–0.78
Max. width of head	1.38–1.50	0.77–0.81	1.14–1.24	0.59–0.70
Width of head at anterior end			0.62–0.93	0.44–0.54
Head contraction index (Ant. W./max. width)	0.75	—	0.71	—
Head index (width / length)	0.99–1.00	—	0.85	—
Length of mandible (Upper base of condyle to tip)	0.84	—	0.98	0.55–0.62
Head-mandibular length Index (mand.-length / head-length)	0.54	—	0.57	0.80
Min. median length of postmentum	—	0	1.04	0.49–0.57
Max. width of postmentum	0.28	0.28	0.39	0.26–0.29
Width of postmentum at waist	—	—	0.22–0.24	0.20–0.26
Max. length of pronotum	0.49–0.55	0.37–0.40	0.41	0.29–0.56

Table-67 (Contd.)

<i>Schedorhinotermes</i> spp.	<i>S. makassarensis</i>		<i>S. rectangularis</i>	
	(S. maj.)	(S. min.)	(S. maj.)	(S. min.)
Max. width of pronotum	0.67–0.72	0.54–0.57	0.70	0.45–0.59
Pronotum index (length/width)	0.66	–	0.58	0.61
Pronotum head index (pronotum width / head-width)	0.55	–	0.58	–
Number of antennal segments	15–16	15–16	–	–

Table – 68. Measurements (in mm) etc. of Caste - Soldier

<i>Schedorhinotermes</i> spp.	<i>S. malaccensis</i>		<i>S. eleanorae</i> (S. min.)
	(S. maj.)	(S. min.)	
Length of head to lateral base of mandibles	2.28–2.34	1.04–1.26	0.73–0.79
Max. width of head	2.14–2.34	0.91–1.02	0.68–0.70
Width of head at anterior end	1.50	–	0.47–0.50
Head contraction index (Ant. W./max. width)	0.66	–	0.69–0.71
Head index (width / length)	0.91	–	0.88–0.93
Max. length of labrum	–	–	0.38–0.43
Max. width of labrum	–	–	0.15–0.20
Length of mandible (Upper base of condyle to tip)	1.10	0.50	0.45–0.50
Head-mandibular length Index (mand.-length / head-length)	0.52	–	0.61–0.63
Min. median length of postmentum	1.16	0.65	0.38–0.40
Max. width of postmentum	0.60	0.36	0.28
Width of postmentum at waist	0.33	0.26	0.18–0.20
Max. length of pronotum	0.77	0.44–0.48	0.30
Max. width of pronotum	1.38	0.57–0.73	0.43–0.48
Pronotum index (length / width)	0.56	0.70	0.69
Pronotum head index (pronotum width / head-width)	0.59	0.67	0.63–0.68
Number of antennal segments	16	15–16	14

Table – 69. Measurements (in mm) etc. of Caste - Soldier

<i>Schedorhinotermes</i> spp.	<i>S. pyricephalus</i> (S. maj.)	<i>S. insolitus</i> (S. maj.)
Length of head to lateral base of mandibles	2.25–2.42	2.20–2.25
Max. width of head	2.15–2.45	2.07–2.11
Width of head at anterior end	1.32–1.50	1.45–1.50
Head contraction index (Ant. W./max. width)	0.65	0.70
Head index (width / length)	–	0.95
Length of mandible (Upper base of condyle to tip)	–	1.50
Head-mandibular length Index (mand.-length / head-length)	–	0.61
Min. median length of postmentum	–	1.47–1.55
Max. width of postmentum	–	0.57–0.60
Width of postmentum at waist	0.32–0.36	0.27–0.30
Max. length of pronotum	–	0.75–0.77
Max. width of pronotum	–	1.35–1.40
Pronotum index (length / width)	–	0.55
Pronotum head index (pronotum width / head-width)	–	0.74

Table – 70. Measurements (in mm) etc. of Caste - Soldier

<i>Schedorhinotermes</i> spp.	<i>S. sanctae-crois</i>		<i>S. nancowriensis</i>	
	(S. maj.)	(S. min.)	(S. maj.)	(S. min.)
Length of head to lateral base of mandibles	1.50	0.80	1.98–2.08	1.00–1.05
Max. width of head	1.70	0.80	1.98–2.08	0.80–0.92
Width of head at anterior end	1.10	–	1.34–1.38	0.63–0.68
Max. height of head	0.90	0.50	–	–
Head contraction index (Ant. W./max. width)	–	–	0.66	–
Head index (width / length)	1.13	–	1.00	0.80–0.87
Max. length of labrum	–	–	–	0.50–0.53
Max. width of labrum	–	–	–	0.24–0.28

Table-70 (Contd.)

<i>Schedorhinotermes</i> spp.	<i>S. sanctae-crois</i>		<i>S. nancowriensis</i>	
	(S. maj.)	(S. min.)	(S. maj.)	(S. min.)
Length of mandible (Upper base of condyle to tip)	1.15	0.60	1.08–1.10	–
Head-mandibular length Index (mand.-length / head-length)	0.76	0.75	0.53	0.70–0.72
Min. median length of postmentum	–	–	1.30–1.38	0.72–0.74
Max. width of postmentum	–	–	0.56–0.63	0.34–0.37
Width of postmentum at waist	–	–	0.26–0.28	0.24–0.26
Max. length of pronotum	0.50	0.35	0.63	0.43–0.48
Max. width of pronotum	1.00	0.55	1.14–1.20	0.65–0.68
Pronotum index (length / width)	0.50	0.63	0.53	0.66–0.70
Pronotum head index (pronotum width / head-width)	0.58	–	0.58	0.73–0.81
Number of antennal segments	–	–	16	16

Table – 71. Measurements (in mm) etc. of Caste - Soldier

<i>Schedorhinotermes</i> spp.	<i>S. solomonensis</i>		<i>S. marjoriae</i>	
	(S. maj.)	(S. min.)	(S. maj.)	(S. min.)
Length of head to lateral base of mandibles	1.50	0.90	1.68	0.73
Max. width of head	1.50	0.80	1.60	0.68
Width of head at anterior end	–	–	1.10	0.62
Max. height of head	–	0.50	–	–
Head contraction index (Ant. W./max. width)	0.65	–	0.68	–
Head index (width / length)	1.00	–	1.00	–
Max. length of labrum	–	–	–	0.57
Max. width of labrum	–	–	–	0.21
Length of mandible (Upper base of condyle to tip)	0.95	0.60	1.00	0.62
Head-mandibular length Index (mand.-length / head-length)	0.63	–	0.62	0.86
Min. median length of postmentum	–	–	1.00	0.55
Max. width of postmentum	–	–	0.40	0.35
Width of postmentum at waist	–	–	0.40	0.28

Table – 71 (Contd)

<i>Schedorhinotermes</i> spp.	<i>S. solomonensis</i>		<i>S. marjoriae</i>	
	(S. maj.)	(S. min.)	(S. maj.)	(S. min.)
Max. length of pronotum	0.50	0.35–0.40	0.57	0.38
Max. width of pronotum	0.90	0.55–0.60	1.00	0.52
Pronotum index (length / width)	0.55	–	0.57	0.73
Pronotum head index (pronotum width / head-width)	0.60	–	0.62	0.74
Number of antennal segments	–	–	16–17	16–17

Table – 72. Measurements (in mm) etc. of Caste - Soldier

<i>Schedorhinotermes</i> spp.	<i>S. tarakanensis</i>		<i>S. medioobscurus</i>	
	(S. maj.)	(S. min.)	(S. maj.)	(S. min.)
Length of head to lateral base of mandibles	1.28–1.42	0.70–0.76	1.45–1.61	0.75–0.85
Max. width of head	1.21–1.35	0.58–0.62	1.40–1.61	0.66–0.72
Width of head at anterior end	0.90–0.97	–	0.98–1.09	0.48–0.54
Head contraction index (Ant. W./max. width)	0.71–0.74	–	0.66	0.72–0.75
Head index (width / length)	0.94–0.95	0.81–0.82	1.00	0.84–0.88
Max. length of labrum	0.37–0.43	0.37–0.40	–	–
Max. width of labrum	0.38–0.43	0.16–0.17	–	–
Length of mandible (Upper base of condyle to tip)	0.85–0.93	0.50–0.57	0.85–0.93	0.52–0.59
Head-mandibular length Index (mand.-length / head-length)	0.65–0.66	0.71–0.75	0.59	0.69
Min. median length of postmentum	0.82–0.95	0.45–0.50	0.93–1.09	0.52–0.54
Max. width of postmentum	0.35–0.38	0.27–0.28	0.40–0.46	0.27–0.29
Width of postmentum at waist	0.22–0.25	0.20–0.22	0.26–0.28	0.23–0.24
Max. length of pronotum	0.40–0.50	0.55	0.52–0.57	0.35–0.40
Max. width of pronotum	0.70–0.80	0.45–0.51	0.85–0.95	0.42–0.54
Pronotum index (length / width)	0.57–0.62	0.72	0.58	0.74–0.83
Pronotum head index (pronotum width / head-width)	0.57	0.77–0.82	0.59	0.63–0.70
Number of antennal segments	15–16	14–15	17	–

Table – 73. Measurements (in mm) etc. of Caste - Soldier

<i>Schedorhinotermes</i> spp.	<i>S. tiwarii</i>		<i>S. translucens</i>	
	(S. maj.)	(S. min.)	(S. maj.)	(S. min.)
Length of head to lateral base of mandibles	1.68–1.85	0.90–1.07	1.88	0.86–1.02
Max. width of head	1.60–1.68	0.76–0.90	1.84	0.88–0.99
Width of head at anterior end	1.00	–	1.20	0.80
Head contraction index (Ant. W./max. width)	0.60	–	0.65	0.86
Head index (width / length)	0.89–0.97	0.84	0.97	0.97–1.02
Max. length of labrum	–	0.36–0.43	0.45	–
Max. width of labrum	–	0.23–0.24	0.58	0.34
Length of mandible (Upper base of condyle to tip)	0.96–1.02	0.58–0.64	1.00	0.78
Head-mandibular length Index (mand.-length / head-length)	0.51–0.57	0.59–0.64	0.53	0.82
Min. median length of postmentum	1.12–1.18	0.48–0.58	0.48	–
Max. width of postmentum	0.43–0.50	0.30–0.34	–	–
Width of postmentum at waist	0.30–0.32	0.23–0.25	–	–
Max. length of pronotum	0.60–0.63	0.38–0.40	0.65	0.47–0.55
Max. width of pronotum	1.00–1.09	0.55–0.63	1.35	0.71–0.91
Pronotum index (length / width)	0.59	0.63–0.69	0.48	0.60–0.66
Pronotum head index (pronotum width / head-width)	0.66	0.70–0.72	0.73	0.80–0.91
Number of antennal segments	16	15	–	–

Table – 74. Measurements (in mm) etc. of Caste - Soldier

<i>Schedorhinotermes</i> spp.	<i>S. translucens</i>		<i>S. braviolatus</i>	
	(S. maj.)	(S. min.)	(S. maj.)	(S. min.)
Length of head to lateral base of mandibles	1.60–1.88	0.74–1.05	1.69–1.90	0.92–1.05
Max. width of head	1.60–1.84	0.67–0.98	1.61–1.74	0.72–0.85
Width of head at anterior end	1.04–1.23	0.49–0.72	1.09–1.15	0.55–0.67
Head contraction index (Ant. W./max. width)	0.66	0.73	0.64	0.76–0.78
Head index (width / length)	0.98	0.90–0.93	1.00	0.78–0.80
Max. length of labrum	–	–	0.42–0.47	0.47–0.55
Max. width of labrum	–	–	0.47–0.50	0.20–0.22

Table – 74 (Contd.)

<i>Schedorhinotermes</i> spp.	<i>S. translucens</i>		<i>S. braviolatus</i>	
	(S. maj.)	(S. min.)	(S. maj.)	(S. min.)
Length of mandible (Upper base of condyle to tip)	0.92–1.10	0.54–0.73	0.90	0.67–0.75
Head-mandibular length Index (mand.-length / head-length)	–	0.69–0.72	0.52	0.71–0.72
Min. median length of postmentum	1.00–1.20	0.46–0.67	1.17–1.22	0.60–0.70
Max. width of postmentum	0.41–0.46	0.28–0.33	0.43–0.53	0.30–0.35
Width of postmentum at waist	0.28–0.33	0.21–0.26	0.28–0.31	0.22–0.26
Max. length of pronotum	0.51–0.61	0.30–0.46	0.62–0.63	0.45–0.58
Max. width of pronotum	0.95–1.13	0.46–0.69	0.98–1.06	0.60–0.70
Pronotum index (length / width)	0.54	0.65–0.66	0.50	0.75–0.82
Pronotum head index (pronotum width / head-width)	0.61	0.68–0.70	0.61	0.82
Number of antennal segments	16–17	15	17	16

Genus *Rhinotermes* (Hagen) EmersonType of genus : *Rhinotermes nasutus* (Perty)1. *Rhinotermes* (Hagen)a. Key to the species of *Rhinotermes* Hagen
(soldier, major)

1858. Hagen, *Linn. Entom.*, 12 : 233 (subgenus of *Termes*)
1896. Froggatt, *Proc. Linn. Soc. N.S.W.*, 21 (4) : 518, 539.
1904. Desneux, *Gen. Insectorum*, 25 : 26 28.
1905. Froggatt, *Agric. Gaz. N.S.W.*, 16 : 654.
1911. Holmgren, *K. Sven. Vet. Acad. Handl.*, 46 (6) : 79.
1913. Holmgren, *K. Sven. Vet. Acad. Handl.*, 50 (2) : 80.
1925. Emerson, *Zoologica*, 6 (4) : 346.
1942. Hill, *Termites (Isoptera) Australian Region*, p. 175
1949. Snyder, *Smiths, misc. Coll.*, 112 : 96.
1955. Emerson, *Fioldiana Zool.*, 37 : 493.
1969. Roonwal and Chhotani, *Fauna of India (Isoptera)* 1 : 106. 520.
1970. Ardujo, In : *Biology of Termites*, (Eds. Krishna and Weesner), 2 : 533.
1970. Krishna, In : *Biology of Termites* (Eds. Krishna and Weesner), 2 : 139.
1971. Emerson, *Bull. Amer. Mus. nat. Hist.*, 146 (3) : 248, 256.
1977. Mathews, *Acad. Brasil Ciencias*, p. 90.

1. Head almost as long as broad 2
- Head either slightly longer than broad or broader than long 3
2. Smaller species, head-length 2.26, head-width 2.25, posterior margin of head weakly bow-shaped; postero-lateral angles of head narrowly rounded *R. marginalis* (Linne)
- Larger species, head-length 2.50, head-width 2.35–2.45; postero-lateral angles of head not so narrowly rounded. Posterior margin of head indistinctly bow-shaped *R. manni* Snyder
3. Head slightly longer than broad. Head length 2.20, head-width 2.14 *R. hispidus* Emerson
- Head slightly broader than long, head-length 2.23–2.28, head-width 2.30–2.32 *R. nasutus* (Perty)

148. *Rhinotermes hispidus* (Emerson)1. *Rhinotermes* (*Rhinotermes hispidus*)

Emerson

1925. Emerson, *Zoologica*, 6 (4) : 350-352, S. maj. and S. min. Type-locality : Kartabo, Guayana.

2. *Rhinotermes hispidus* Emerson

1949. Snyder, *Smiths. misc. coll.*, 112 : 97

Material : In F.R.I., Dehra Dun : *Topotype* : from Kartabo, Guayana, Coll. and det. Emerson, 1.viii.1924.

Diagnostic Character : (i) IMAGO : Unknown. (ii) SOLDIER (MAJOR) (Fig. 137. A-B) : Head reddish yellow; labrum, antennae, pronotum and legs paler; abdomen yellowish white. Head and abdomen somewhat densely and pronotum sparsely hairy.

Head somewhat rectangular, lateral sides fairly converging anteriorly; only slightly longer than broad, width of head at the anterior end about three-fourths of maximum width; posterior margin slightly bow-shaped. Fontanelle opening small, placed in a slightly depressed frontal area and on one-fifth of anterior head-length, a narrow groove arising anterior to the opening and running almost to the tip of labrum. Eyes and ocelli absent. Antennae with 16 segments, 3 conspicuously longer than 2, 2 equal to 4. Labrum proportionately wide, hyaline tip rounded with a few microhairs on the margin, antero-lateral margins with dense coat of microhairs, sparsely hairy throughout. Mandibles sickle-shaped with pointed and incurved apex, almost equal to three-fourths of head-length and equal to head-width at anterior end. Left mandible with an apical and two marginal teeth, 1st larger than 2nd with isolateral margins and pointed tip; 2nd placed closely to 1st with long posterior margin. Right with also an apical and two marginal teeth, inner margin of apical tooth slightly above the 1st marginal tooth outcurved distinctly, 2nd much larger than 1st and placed much below the 1st with an incurved inner margin in between the two.

Postmentum club-shaped, as long as mandibles, maximum width at about anterior third and slightly more than double the minimum width at posterior third; a few scattered hairs on the anterior half.

Pronotum much narrower than head-width, only slightly more than half the head-width; anterior margin produced into a small lobe with a weak median emargination; both the margins and disc with a few scattered hairs; antero-lateral margins rounded; hind margin only slightly emarginate. (iii) SOLDIER (MINOR) (Fig. 137. C) Smaller than soldier (major), otherwise as in figure.

Measurements : Table No.- 76

Types : In : F.R.I., Dehra Dun : (i) *Holotype* S. major and *Morphotype* S. Minor in Emerson's coll., Zool. Soc., New York. (ii) *Autotype* and *Metatype* S. in Wasmann coll. Natur. Mus. of Maastricht.

Distribution : SOUTH AMERICA : Guayana : Kartabo.

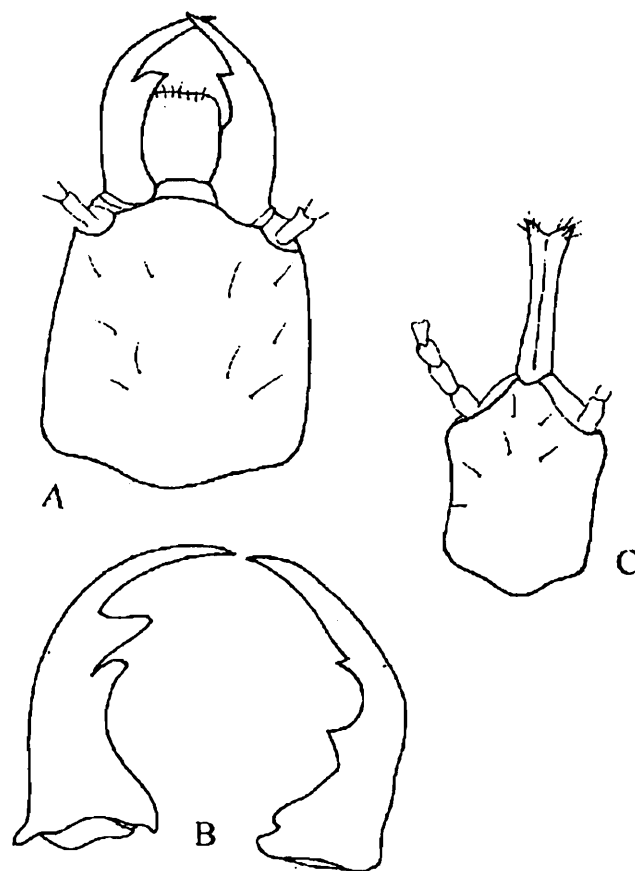


Fig. 137. *Rhinotermes hispidus* Emerson A-B, soldier (major). A. Head in dorsal view; B. Mandibles. C, soldier (minor). C. Head in dorsal view.

149. *Rhinotermes manni* Snyder

1. *Rhinotermes manni* Snyder

1926. Snyder, *Proc. U. S. nat. Mus.*, 68 (14) : 9, Im. (male), S. maj. and S. min. Type-locality : Rurrenabaque, Bolivia.

1949. Snyder, *Smiths. misc. Coll.*, 112 : 97.

Material : Not available for study, hence Snyder's description has been followed.

Diagnostic Character : (i) IMAGO (Snyder, 1926) : Head light yellowish brown, clypeus darker; head slightly longer than broad, sides round, somewhat narrowing posteriorly. Horn (clypeus) outlined by V-shaped grooves originating from the fontanelle, elongate and broad with a median groove. Fontanelle hyaline, small, round, opening placed well forwardly. Eyes black, almost round, out bulged and placed close to lateral margin of head. Ocelli hyaline, suboval and placed apart, less than its diameter from the eyes. Antennae with 20 segments, 3 elongate and slender, longer than 4 and 5 together.

Pronotum nearly rectangular, slightly saddle-shaped, corners rounded and posterior margin slightly concave with long hairs on margins.

Wing scale of forewing longer than pronotum and hind wingscale shorter than pronotum. Wings gray in color, costal veins golden brown. In forewing, median parallel and close to cubital branches reaching apex of wing in both wings; subcosta with a few branches near apex. In hindwing, median parallel and close to cubitus, more distant from subcosta than in forewing; cubitus not reaching apex of wing, with many branches to lower margin of wing.

Measurements :

Total length	18.00
Total body length (without wings)	10.05
Length of head	2.40
Length of pronotum	3.00
Length of forewing	18.05
Diameter of eye	0.62

Width of head	2.35
Width of pronotum	2.10
Width of forewing	3.50

(ii) SOLDIER (MAJOR) (Fig. 138. A) – Head yellowish brown, flat, longer than broad, broadest posteriorly with narrow postero-lateral angles and scattered long hairs. Fontanelle small with a groove leading from opening to labrum. Labrum tongue-shaped, as broad as long, with a median groove, tip white, fleshy, broadly rounded with short hairs. Left mandible with two sharp marginal teeth near the middle, first larger than second; right mandible with upper tooth near the middle, not prominent; lower tooth prominent, sharp near base. Antennae with 18 segments, 2 short, 3 subequal to 4. Pronotum yellowish-brown, anterior margin raised, slightly emarginate. (iii) SOLDIER (MINOR) (Fig. 138. B) – Head light yellowish brown, longer than broad, broadest anteriorly, sides incurved and slopes posteriorly, posterior margin rounded. Postclypeus and labrum prolonged into a light castaneous brown, chitinated rod, forked at the tip, narrow at the base and broadens to apex, with median longitudinal groove, apex emarginate,

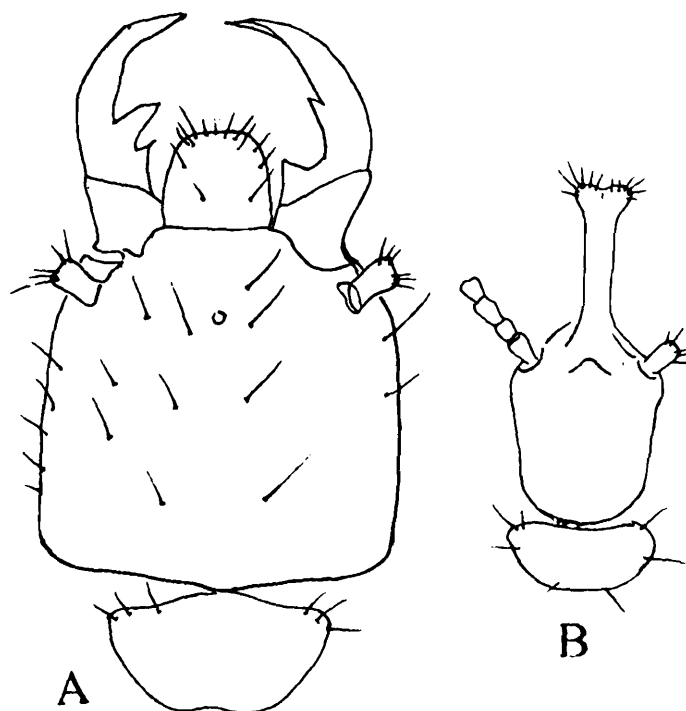


Fig. 138. *Rhinotermes manni* Snyder A, soldier (major). A. Head and pronotum in dorsal view. B. Soldier (minor). B. Head and pronotum in dorsal view.

forked tip fringed with dense short hairs and few long hairs at the base of rod; fontanelle produced into a short truncate tube directed towards the deep groove in the labrum. Mandibles slender and elongate. Antennae with 16 segments, 3 double the 4, 2 longer than 4. Pronotum with anterior margin elevated, sides sloping to posterior margin and posterior margin concave with long hairs.

Measurements :

	S. major	S. minor
Length of head	2.50	1.40-1.45
Width of head	2.35-2.45	1.05-1.10
Length of labrum	0.76	0.95
Width of labrum	0.70	-
Length of mandible	1.00	0.37
Length of pronotum	0.80	0.60
Width of pronotum	1.50	0.85

Types : S. (maj.), Im. (male) and S. (min.) in W.S.N.M., Washington.

Distribution : SOUTH AMERICA : Bolivia : Rurrenabaque.

150. *Rhinotermes marginalis* (Linne)

1. *Hemerobius marginalis* Linne :

1758. Linne, *Systema Naturae* (10th ed.), 1 (genus *Termes* described), p. 550. America.

2. *Termes (Rhinotermes) marginalis* Hagen

1858. Hagen, *Linn. Entomol.*, 10 : 234, Im. *Type-locality :* Surinam.

1925. Emerson, *Zoologica*, 6 (4) : 348-350, S. (major and minor).

3. *Termes marginalis* Hagen

1858. Hagen, *Catalogue of the specimens of Neuropterous insects in the collection of British Mus.*, Part-1 (Termitina), p. 33, Im. Surinam.

4. *Rhinotermes marginalis*, Holmgren

1906. Holmgren, *Zool. Jahrb. (Abt. Syst.)*, 23 (5) : 94.

1926. Snyder, *Proc. U. S. nat. Mus.*, 68 (14) : 12.

1949. Snyder, *Smiths. misc. Coll.*, 112 : 97.

1977. Mathews, *Studies on termites from the Mato Grosso State, Acad. Brasil. Cien. (Ed.)*, pp. 91 - 92.

Material : In : F.R.I., Dehra Dun : 1S. and 1W. from Oronoque River near Junction with New River, Guayana, Coll. N. Weber (No. 600), 27.vii.1926 (from Prof. Emerson, U.S.A)

Diagnostic Character : (i) IMAGO – Not available for study. (ii) SOLDIER (MAJOR) : Head light reddish yellow; antennae, labrum, pronotum and abdomen yellowish white. Head and pronotum with a few hairs.

Head somewhat squarish, almost as long as broad, lateral margins weakly narrowing anteriorly; width of head at anterior end slightly more than three-fourths of maximum head-width; posterior margin slightly bow-shaped.

Fontanelle opening small and placed in an frontal depression much anteriorly. Fontanelle groove running up to the upper margin of anteclypeus. Eyes and ocelli absent. Antennae with 17 segments, 3 almost double than 2 or 4, 4 slightly longer than 2. Anteclypeus whitish strip-like and postclypeus chitinised and weakly convex Labrum rather wide and grooved, rounded at the tip, with dense coat of micro-hairs and apical third with a few erect hairs. Mandible dark reddish brown with long, sharp incurved apex, much more than half the head-length and less than head-width as the anterior end.

Left mandible with three marginal teeth; 1st marginal large, placed below the middle, 2nd much smaller than 1st and placed close to the 1st, 3rd also smaller than 2nd with blunt apex, inner margin of apical tooth outcurved below the middle. Right mandible with two stout teeth in the middle of the inner margin, inner margin of apical tooth weakly outcurved. Postmentum club-shaped, much longer than mandibles, maximum width at about anterior third and almost double the minimum width at below posterior third.

Pronotum much narrower than head-width, anterior margin very weakly produced with a

median very weak emargination; lateral margins rounded, posterior margin with distinct emargination; both margins and disc with a few erect hairs intermingled with smaller one too.

Measurements : Table 75.

Types : Not traceable.

Distribution : SOUTH AMERICA : Peru, Surinam, Guayana and Bolivia; Haiti, Martinique.

Remarks : *R. marginalis*, an island-hopper, spreads though the Lesser Antilles to Haiti in South America (Emerson, 1955).

151. *Rhinotermes nasutus* (Perty)

1. *Termes nasutum* Perty

1830. Perty, *Delectus Animalium Articulorum Braziliam Monachji*. (Termites, pp. 127-128), Im. North Brazil.

2. *Termes (Rhinotermes) nasutus* Hagen

1858. Hagen, *Linn. Entomol.*, 12 : 237, Im.

1958. Hagen, *Catalogue of the specimens of neuropterous insects in the collection of British Museum, Part I, (Termitina)*, pp. 33, Im., Brazil.

3. *Rhinotermes (Rhinotermes) nasutus* Holmgren

1911. Holmgren, *K. Sven. Vet. Akad. Handl.* 46, (6) : 8 (Isoptera) S.

1925. Emerson, *Zoologica*, 6 (4) : 347 348.

4. *Rhinotermes nasutus* Holmgren

1912. Holmgren, *K. Sven. Vet. Akad. Handl.*, 48 (4) : 19.

1926. Snyder, *Proc. U. S. Nat. Mus.*, 68 (14) : 13, Bolivia.

1949. Snyder, *Smiths. misc. coll.*, 112 : 98.

1970. Araujo, *Biology of Termites* (Krishna and Weesner eds.), 2 : 544 545

5. *Rhinotermes taurus* Desneux

1904. Desneux, *Ann. Soc. Ent. Belg.*, 48 (3) : 146.

Material : Present in Z.S.I., Dehra Dun : 1A, 3S. (maj. and min.) and 2W.

Diagnostic character : (i) IMAGO (After,

Emerson, 1925) (Fig. 139. A) : Head orange yellow with numerous bristles, round with two large conspicuous misle incertion in front of ocelli. Antennae with 20 segments, 3 large, 3 times longer than 2. Eyes large, one-fourth of their own diameter apart from the lower margin of head. Ocelli rather large, less than their diameter from the eyes. Clypeus projecting as in other member of the genus. Pronotum orange yellow, nearly as wide as head, sides round, posterior margin slightly emarginate. Wings hyaline, base brownish near the suture and reticulate throughout.

Measurements :

Length with wings	18.91
Length without wings	10.00-11.00
Length of head	2.47-2.57
Width of head	2.28-2.35
Diameter of eyes	0.65
Length of pronotum	1.25-1.28
Width of pronotum	2.12-2.15
Length of anterior wing	14.18
Width of anterior wing	4.02

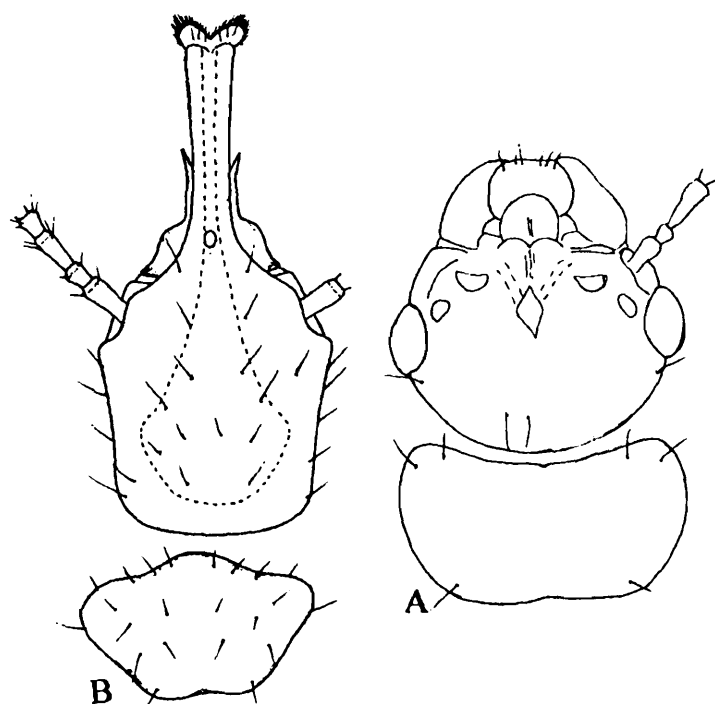


Fig. 139. *Rhinotermes nasutus* (Perty) A, Imago. A. Head in dorsal view; B. soldier (minor).

(ii) SOLDIER (MAJOR) – Not studied. (iii) SOLDIER (MINOR) (Fig. 139. B) : Head sparsely hairy, longer than broad, feebly diverging anteriorly attending its maximum width below the antennal insertion, whence weakly narrowing up to the base of mandible; lateral sides feebly incurved and posterior margin weakly outcurved. Fontanelle circular and small, placed slightly above the mandibular base. Labrum narrow and very much elongated with forked apical margin set with fringe of microhairs and with narrow median groove leading from fontanelle to tip of labrum. Mandibles very prominent with very pointed apical spine-like processes. Antennae broken, segment 2 subequal to 4 and half of 3. Pronotum sparsely hairy, distinctly broader than head-width, anterior lobe small, weakly impressed on either side and posterior margin

with median emargination; antero-lateral corners somewhat narrow.

Table-75, (S.maj & S. min.)

Types : In Emerson's collection, A.M.N.H., New York.

Distribution : SOUTH AMERICA : Peru, Brazil, Bolivia, Surinum and Guayana.

Remarks : *Rhinotermes nasutus* (Perty) generally is found in the rain forest in the wide area of northern South America. It is reported inhabiting the aerial and dead roots of a palm tree (*Bactris ciliata*). It also excavates galleries in rotting logs lying on soil in contact of moisture. Swarming was observed in Peru and Bolivia in November. Further biological information goes to the credit of Araujo (1970).

Table – 75 Measurements (in mm) etc. of Caste - Soldier

<i>Rhinotermes spp.</i>	<i>R. marginalis</i> (S. maj.)	<i>R. nasutus</i>	
		(S. maj.)	(S. min.)
Length of head to lateral base of mandibles	2.26	2.23–2.28	0.90
Max. width of head	2.25	2.30–2.32	0.72
Width of head at anterior end	1.53	1.50	–
Head contraction index (Ant. W./max. width)	0.67	0.65	–
Head index (width / length)	1.00	1.03	0.80
Max. length of labrum	0.50	0.45	–
Max. width of labrum	0.65	0.60	0.10?
Length of mandible (Upper base of condyle to tip)	1.40	1.37	1.21?
Head-mandibular length Index (mand.-length / head-length)	0.61	0.61	–
Min. median length of postmentum	1.55	1.67	0.45
Max. width of postmentum	0.60	0.65	0.35
Width of postmentum at waist	0.30	0.27	0.23
Max. length of pronotum	0.70	0.75	–
Max. width of pronotum	1.42	1.25	–
Pronotum index (length / width)	0.49	0.60	–
Pronotum head index (pronotum width / head-width)	0.63	0.54	

**Table 76. Measurements (in mm) etc. of
Caste - Soldier**

<i>Rhinotermes</i> sp.	<i>R. hispidus</i> (S. maj.)
Length of head to lateral base of mandibles	2.20
Max. width of head	2.14
Width of head at anterior end	1.53
Head contraction index (Ant. W./max. width)	0.71
Head index (width / length)	0.97
Max. length of labrum	0.65
Max. width of labrum	0.73
Length of mandible (Upper base of condyle to tip)	1.61
Head-mandibular length Index (mand.-length / head-length)	0.73
Min. median length of postmentum	1.64
Max. width of postmentum	0.57
Width of postmentum at waist	0.26
Max. length of pronotum	0.70
Max. width of pronotum	1.34
Pronotum index (length / width)	0.52
Pronotum head index (pronotum width / head-width)	0.62
Number of antennal segments	16

Genus *Dolichorhinotermes* Snyder
and Emerson

1. *Rhinotermes* Emerson

1925. Emerson, *Zoologica*, 6 (4) : 346.
 1926. Snyder, *Proc. U. S. nat. Mus.*, 68 (14) : 7.
 1928. Emerson, *Bull. Amer. Mus. nat. Hist.*, 57 : 406, 424.
 1955. Emerson, *Fieldiana Zool.*, 37 : 493.
 1970. Araujo, In : *Biology of Termites* (Eds. Krishna and Weesner), 2 : 533, 248.
 1970. Krishna, In : *Biology of Termites* (Eds. Krishna and Weesner), 2 : 533.

Type of Genus : *Macrorhinotermes maximus*
(Holmgren)

General character : (i) Imago : Very similar to that of *Rinotermes*, but with antennal segment 3 markedly shorter than 1. (ii) *Soldier (major)* : Head small with angularly rounded posterior lateral margins. Labrum longer than wide. Pronotum with anterior margin convex. Other characters as in *Rhinotermes*. (iii) *Soldier (minor)* : Head broader with convex lateral margins. Other characters as in *Rhinotermes*.

**Key to the species of *Dolichorhinotermes*
based on (soldier, major)**

1. Left mandible with second marginal tooth placed much below the first marginal tooth (smaller species, head-length 1.00–1.12; head-width 1.12–1.15) *D. tenebrosus* (Emerson)
- Left mandible with second marginal tooth placed close to first marginal tooth..... 2
2. Right mandible with two marginal teeth, first marginal much smaller than second; antennae with 15 segments, 2 slightly longer than 3 or 4..... *D. longidens* (Snyder)
- Right mandible with a single marginal tooth having two points; antennae with 16 segments 3
3. Smaller species, head-length 1.05, head width 1.10; antennal segment 3 subequal to 2 and longer than 4. *D. latilabrum* (Snyder)
- Larger species, head-length 1.65–1.75; antennal segment 3 longer than 2 or 4 *D. longilabius* (Emerson)

152. *Dolichorhinotermes latilabrum* (Snyder)

1. *Rhinotermes latilabrum* Snyder

1926. Snyder, *Proc. U. S. nat. Mus.*, 68 (14) : 7, S. (major) and S. (minor). *Type locality* : Type-locality : Rio Ivon, Bolivia.

2. *Dolichorhinotermes latilabrum* (Snyder)

1949. Snyder, *Smiths. misc. Coll.*, 112 : 98, Bolivia.

Material : In F.R.I., Dehra Dun : Cotype from type Colony, det T.E. Snyder as *Rhinotermes* (R.),

Rio Ivon, Bolivia, Coll. W.M. Mann, 1S (min.) and 2W from Emerson.

Diagnostic character : (i) IMAGO : Unknown. (ii) SOLDIER (MAJOR) (After, Snyder, 1926) (Fig. 140. A and D) : Head straw-yellow; labrum yellowish brown, paler towards apex.

Head narrowing anteriorly, rounded posteriorly with scattered hairs all over. Labrum elongate, broadest at base with long hairs at apex. Mandibles elongate, slender, sharply pointed and incurved at the apices with prominent marginal teeth, right mandible with a single margin with double points. Antennae with 16 segments, 3 subequal to 2 and longer than 4.

Pronotum straw-yellow, saddle-shaped, posterior margin emarginate, margin all over fringed with short and long hairs.

(iii) SOLDIER (MINOR) (Fig. 140. B-C) : Head straw yellow and labrum yellowish conical in profile, head with three rows of long hairs.

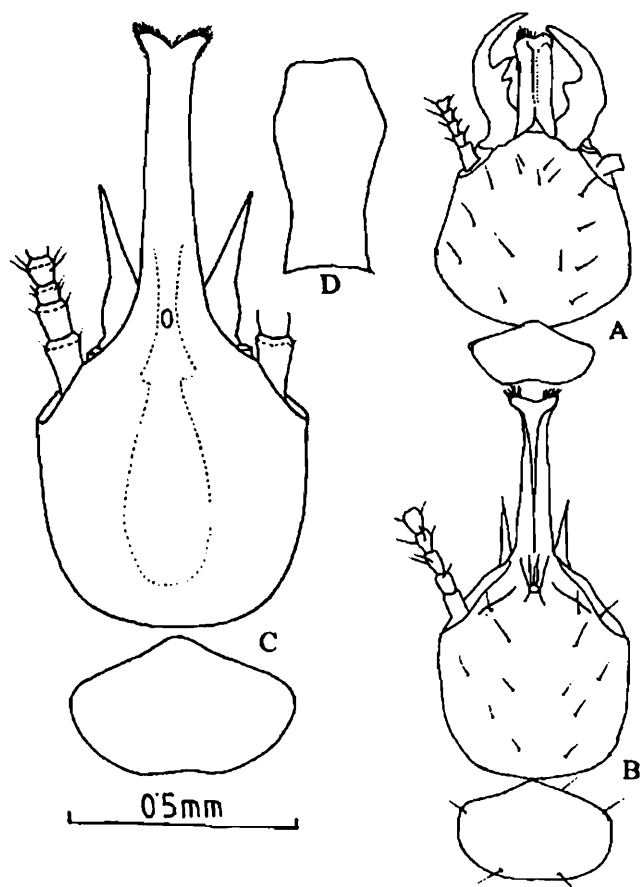


Fig. 140. *Dolichorhinotermes latilabrum* (Snyder) A and D. Soldier (major). A. Head and pronotum in dorsal view; D. Postmentum. B-C, Soldier minor. B and C. Head and pronotum in dorsal view.

Labrum elongate, slender, broadest at base, with one hair and dense hairs on each forked apices. Mandibles long, straight, sharp and with pointed tips, nearly as long as half the length of labrum. Antennae with 14 segments, 3 longer than 2 or 4.

Pronotum straw yellow, saddle-shaped, anterior margin not sharply turned up, narrower and pronounced; posterior margin roundedly emarginate. Postmentum short and with less narrowed waist.

Measurements : Table No. 77.

Types : Morphotype S. (major) in U.S.N.M., Washington.

Distribution : SOUTH AMERICA : Bolivia, Rio Ivon (type-locality).

153. *Dolichorhinotermes longidens* (Snyder)

1. *Rhinotermes longidens* Snyder

1926. Snyder, *Proc. Biol. Soc. Wash.*, 37 : 83-86, S. (maj.) and S. (min.). Type-locality : Rio Chinilla, Canal Zone, Panama.

2. *Dolichorhinotermes longidens* (Snyder)

1949. Snyder, *Smiths. misc. Coll.*, 112 : 98.

Material : Since no material is available for study, the diagnostic characters are based on snyder's (1924) publication.

Diagnostic character : (i) IMAGO : Unknown. (ii) SOLDIER (MAJOR) (Fig. 141. A) : Head broadest at base, slightly broader than long, covered with fairly dense hairs. Fontanelle minute with a narrow groove running forward up to clypeus. Labrum long and narrow with median narrow groove and forked tips fringed with hairs. Mandibles toothed as in figure. Left with two marginal teeth, 1st larger than 2nd. Right also with two marginal teeth, 2nd much larger than 1st. Antennae with 15 segments, 2 slightly longer than 3 or 4.

Pronotum very narrow with smaller anterior lobes devoiding any median emargination, lateral sides converging posteriorly, posterior margin emarginate medially. (iii) SOLDIER (MINOR) (Fig. 141. B) : Head broadest behind the antennal

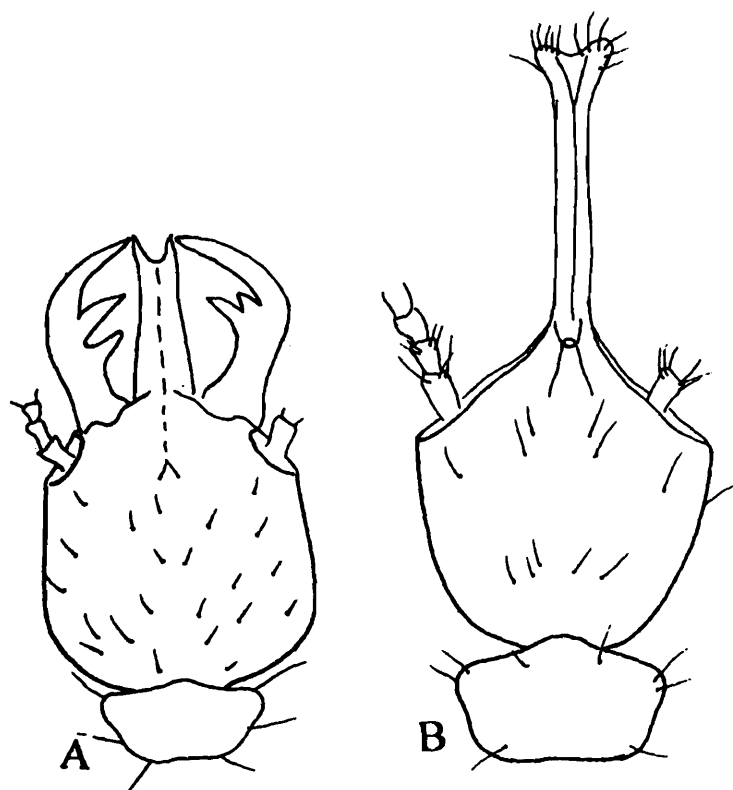


Fig. 141. *Dolichorhinotermes longidens* (Snyder) A. Soldier (major). A. Head and pronotum in dorsal view. B, soldier (minor). B. Head and pronotum in dorsal view.

insertions, whence covering posteriorly and terminating into a rounded posterior margin, head with a few scattered hairs. Fontanelle opening minute at the base of labrum. Labrum very long and narrow, diverging anteriorly and terminating into forked margin, fringe with hairs. Antennae with 14 segments, 2 shorter than 2 and slightly longer than 4.

Pronotum transversely rectangular with outcurved anterior margin, antero-lateral angles narrower than postero-lateral angles, posterior margin substraight.

Types : S. (maj.) in U.S.N.M. (No. 26533), Washington.

Distribution : CENTRAL AMERICA : PANAMA.

154. *Dolichorhinotermes longilabius* (Emerson)

1. *Rhinotermes* (*Rhinotermes*) *longilabius* Emerson

1925. Emerson, *Zoologica*, 6 (4) : 352-354, Im. S. (maj.) and S. (min.). Type-locality : Kartabo, Guayana.

2. *Dolichorhinotermes longilabius* (Emerson)

1949. Snyder, *Smiths. misc. Coll.*, 112 : 98.

1977. Mathews, *Studies on termites from the Mato Grosso State, Acad. Brasil. Cien.* (Ed.), p. 92, S. (maj.) and S. (min.).

Material : Since no material is available, the characters are based on Emerson (1925).

Diagnostic character : (After Emerson, 1925) (i) IMAGO (Fig. 142. A) : Head brown, clothed with fine hairs, round. Fontanelle small and on a line between ocelli; frons of head raised to meet the base of clypeus, several dark wrinkles sloping away from in front of the fontanelle. Antennae with 20 segments; 2, 3, 4 subequal. Eyes large, two-thirds diameter from lower margin of head, ocelli small, less than its diameter from eyes. Clypeus yellow, prolonged above the labrum, proportionately wide at base, a groove extending along the median line.

Pronotum as wide as head with few long hairs. Wings dark and reticulate.

Measurements :

Length with wings	8.00	8.50
Length without wings	5.50	5.80
Length of head	1.29	1.50
Width of head	1.28	1.29
Diameter of eye		0.29
Length of pronotum	0.50	0.59
Width of pronotum	1.06	1.07
Length of anterior wing	5.36	5.59
Length of queen		12.50

(ii) SOLDIER (MAJOR) (Fig. 142. B-C) : Head yellowish with numerous bristles, broadest posteriorly, posterior margin round. Antennae with 16 segments, 3 slightly longer than 2 or 4. Labrum elongate, reaching just below the tip of mandibles, tip emarginate with fine hairs. Mandibles long. Left with two large pointed teeth, 2 smaller than 1 (a third very small, only visible near the base). Right with one large double

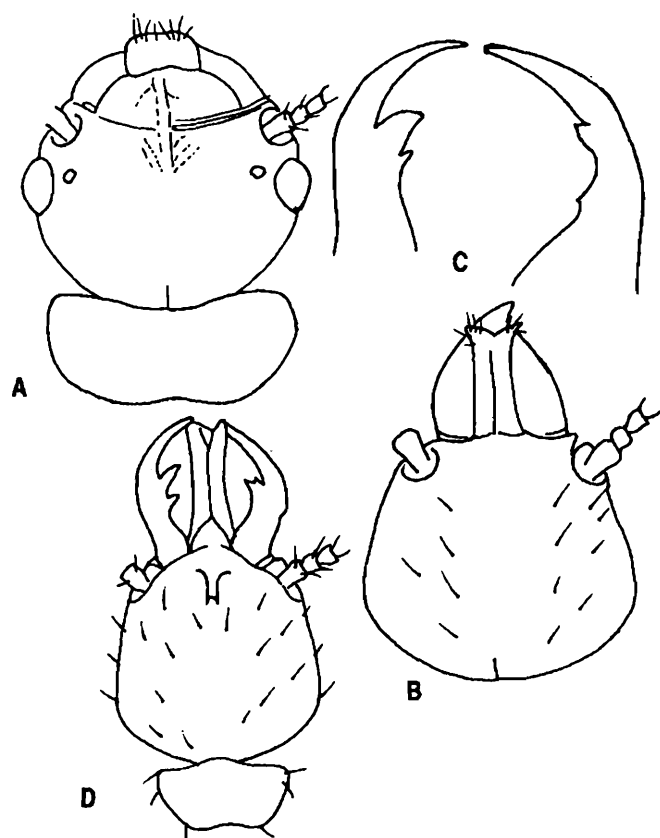


Fig. 142. *Dolichorhinotermes longilabius* (Emerson) A. Imago. A. Head and pronotum in dorsal view. B-C, soldier (major). B. Head in dorsal view; C. mandibles. D Soldier (minor). D. Head and pronotum in dorsal view.

pointed tooth, 1st pointed on anterior side and 2nd at the apex of tooth, 3. very small at base. Pronotum yellow with numerous bristles. (iii) SOLDIER (MINOR) (Fig. 142. D) : Head, thorax and abdomen yellowish and with hairs. Head widest behind the antennae, posterior margin round. Labrum elongate, narrowly forked at tip. Mandibles vestigial. Antennae with 14 segments.

Measurements :

	S. (maj.)	S. (min.)
Length of head	1.65-1.76	1.10-1.12
Width of head	1.06-1.10	0.53
Length of pronotum	0.35-0.38	0.22-0.23
Width of pronotum	6.65-0.66	0.40-0.41
Length of left mandible	0.70-0.75	-

Types : Autotype and Topotype (Im.), (labelled A.E. Emerson) in Wasmann Coll. in Natur. Mus. Maastrich (Netherlands).

Distribution : SOUTH AMERICA : Guayana : Kartabo.

155. *Dolichorhinotermes tenebrosus* (Emerson)

1. *Rhinotermes* (*Rhinotermes*) *tenebrosus* Emerson

1925. Emerson, *Zoologica*, 6 (4) : 354-356, Im. and S. (maj.) Type-locality : Kartabo, Guayana.

2. *Dolichorhinotermes tenebrosus* (Emerson)

1949. *Smiths. misc. Coll.*, 112 : 98 Guayana.

Material : In. FRI., Dehra Dun : 1A; 9 S.(maj.), 1S (min.) and 1 Im. nymph from Guayana, Coll. A.E. Emerson, 20.v.1924, Emerson det. as *Rhinotermes*, *Autotype* and *Topotype*.

Diagnostic character : (i) IMAGO (Fig. 143. A) : Head almost round, sparsely hairy, both posterior and lateral sides together from a semi-circular appearance, fontanelle small, with a diverging fontanelle running up to postclypeus. Postclypeus swollen and projecting forward when viewed from lateral side. Two marks of muscle insertion visible on either sides above antennal

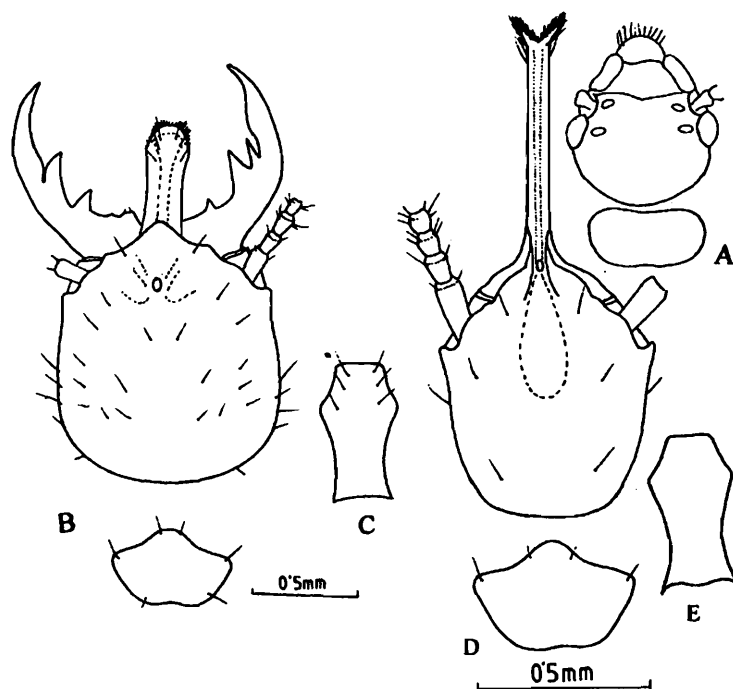


Fig. 143. *Dolichorhinotermes tenebrosus* (Emerson) A, Imago. A. Head and pronotum in dorsal view. B-C, soldier (major). B. Head and pronotum in dorsal view; C. postmentum. D-E. soldier (minor). D. Head and pronotum in dorsal view; E. postmentum.

insertions. Eyes small, bulging out. Ocelli small, separated from eyes by more than their long diameter. Labrum broad with round apical margin. Antennae broken, segment 3 much longer than 2 or 4. (ii) SOLDIER (MAJOR) (Fig. 143. B-C) : Head fairly densely hairy, broader than long, broadest near base, lateral sides feebly outcurved, posterior margin weakly emarginate medially. Fontanelle small and circular with a groove running forward up to clypeus. Labrum long and narrow with a median groove, tip forked and fringed with minute hairs. Mandibles sickle shaped with fine incurved apices. Left with two marginal teeth, 1st incurved and large, 2nd small with fine tip. Right with 3 marginal teeth 1st small, 2nd thick and blunt, 3rd very minute and placed near base. Antennae broken, 3 smaller than 2 or 4. (iii) SOLDIER (MINOR) (Fig. 143. D-E) : Head and pronotum brown; posterior half of labrum dark brown and anterior half much paler; antennae light brown; abdomen pale brown. Head and pronotum with a few scattered hairs.

Head slightly longer than broad, lateral sides diverging anteriorly, widest behind the antennal faveolae. Fontanelle round, small and whitish,

placed much anterior at the base of labrum, whence a groove gradually becoming shallow and widening anteriorly and extending up to tip of labrum. Eyes and ocelli absent. Antennae with 15 segments, 3 narrowest subequal to either 2 or 4.

Labrum very long, gradually diverging anteriorly with a forked terminal end with fine hairs; clypeus hardly demarcated. Mandibles vestigial with a single spine-like process in each. Postmentum broadly club-shaped, widest at anterior third and narrowest at posterior third.

Pronotum very weakly saddle-shaped, anterior lobe weakly projecting out and devoid of median notch, anterolateral angles narrowly and posterolateral angles broadly rounded, posterior margin weakly emarginate.

Measurements : Table —78

Types : (i) *Holotype* S. (maj.) and *Morphotype* Im. in New York. Zool. Soc., U.S.A; (ii) *Paratype* S. and Im. from *Holotype* colony, in Wasmann Coll., Natur. Mus. Maastricht.

Distribution : SOUTH AMERICA : Guayana, Kartabo.

Table – 77. Measurements (in mm) etc. of Caste - Soldier

<i>Dolichorhinotermes</i> spp.	<i>D. latilabrum</i>		<i>D. hagene</i>	
	(S. maj.)	(S. min.)	(S. maj.)	(S. min.)
Length of head to lateral base of mandibles	1.05	0.60	—	0.62
Max. width of head	1.10	0.57	—	0.67
Width of head at anterior end	—	0.40	—	0.45
Head contraction index (Ant. W./max. width)	—	0.70	—	0.75
Head index (width / length)	1.04	0.95	—	1.08
Max. length of labrum	0.60	0.62	—	0.67
Max. width of labrum	0.22	0.15	—	0.09
Length of mandible (Upper base of condyle to tip)	0.80	0.32	—	—
Head-mandibular length Index (mand.-length / head-length)	0.76	0.53	—	—

Table -77 (Contd.)

<i>Dolichorhinotermes</i> spp.	<i>D. latilabrum</i>		<i>D. hagene</i>	
	(S. maj.)	(S. min.)	(S. maj.)	(S. min.)
Min. median length of postmentum	—	0.32?	—	—
Max. width of postmentum	—	0.27	—	—
Width of postmentum at waist	—	0.11	—	—
Max. length of pronotum	0.35	0.30	—	—
Max. width of pronotum	0.75	0.47	—	0.40
Pronotum index (length / width)	0.46	0.63	—	—
Pronotum head index (pronotum width / head-width)	0.68	0.82	—	—
Number of antennal segments	—	13?	—	—

Table - 78. Measurements (in mm) etc. of Caste - Soldier

<i>Dolichorhinotermes</i> sp.	<i>D. tenebrosus</i>	
	(S. maj.)	(S. min.)
Length of head to lateral base of mandibles	1.10–1.12	0.69
Max. width of head	1.12–1.15	0.61
Width of head at anterior end	0.75	—
Head contraction index (Ant. W./max. width)	0.66	—
Head index (width / length)	1.00	0.88
Max. length of labrum	0.50	0.46
Max. width of labrum	0.20	0.09
Length of mandible (Upper base of condyle to tip)	0.82	—
Head-mandibular length Index (mand.-length / head-length)	0.73	—
Min. median length of postmentum	0.62	0.38
Max. width of postmentum	0.37	0.26
Width of postmentum at waist	0.20	0.20
Max. length of pronotum	0.37	0.30
Max. width of pronotum	0.62	0.53
Pronotum index (length / width)	0.59	0.56
Pronotum head index (pronotum width / head-width)	0.55	0.86
Number of antennal segments	16	—

Genus *Acorhinotermes* Emerson1. *Acorhinotermes* Emerson

1925. Emerson, *Zoologica*, 6 (4) : 346.
 1928. Emerson *Bull. Amer. Mus. nat. Hist.*, 57 (7) :
 1955. Emerson, *Fieldiana Zool.*, 37 : 493.
 1970. Araujo, In : *Biology of Termites* (Eds. Krishna and Weesner), 2 : 533.
 1970. Krishna, In : *Biology of Termites* (Eds. Krishna and Weesner), 2 : 139.
 1971. Emerson, *Bull. Amer. Mus. nat. Hist.*, 146 (3) : 248, 251, 256, 257.

Type of Genus *Acrohinotermes subfusciceps* (Emerson)

Emerson and Snyder (in Snyder 1949 : 99, 374) established the genus *Acorhinotermes* with the type species *Acorhinotermes subfusciceps* (Emerson which was lacking major soldiers. The minor soldier with the opening of frontal gland placed on a forwardly projection of head; sides of head concave both in front and behind the widest portion. The imagoes very much similar to that of *Dolichorhinotermes*.

156. *Acorhinotermes subfusciceps* (Emerson)1. *Rhinotermes* (*Rhinotermes*) *subfusciceps* Emerson

1925. Emerson, *Zoologica*, 6, (4) : 356-357, Im., Type-locality : S. Kartabo, Guayana.

2. *Acorhinotermes subfusciceps* (Emerson) :

1949. Snyder, *Smiths. misc. Coll.*, 112 : 99. Guayana.
 1977. Mathews, *Studies on termites from the Mata Grozso, Brazil, Acad. Brasil.*, (Ed.).

Material : Since no material is available, characters are based on Emerson (1925).

Diagnostic character : (i) IMAGO (one queen) (Emerson, 1925) (Fig. 144. A-B) : Head reddish yellow, widely oval with a few long bristles. Lateral and posterior margins united to form a regular rounded margin. Antennae broken, 3 longer than 2 or 4 and not so long as first, 2

subequal to 4. Eyes of medium size, 1.3 mm. from the lower margin of head, oval in shape. Ocelli of medium size, oval, placed about their long diameter from eye. Clypeus projecting viewed from the sides, appearing pointed tip. Pronotum reddish yellow with numerous long bristles, sides and posterior margin making nearly a perfect semi-circle posterior margin, devoid of any emargination. Wing scale and abdomen yellow.

Measurements :

Head-length	1.50
Head-width	1.35
Diameter of eye	0.32
Length of pronotum	0.67
Width of pronotum	1.06
Length of queen	8.27

- (ii) SOLDIER (MAJOR) : Unknown. (iii) SOLDIER (MINOR) (Fig. 144. C) : Head golden

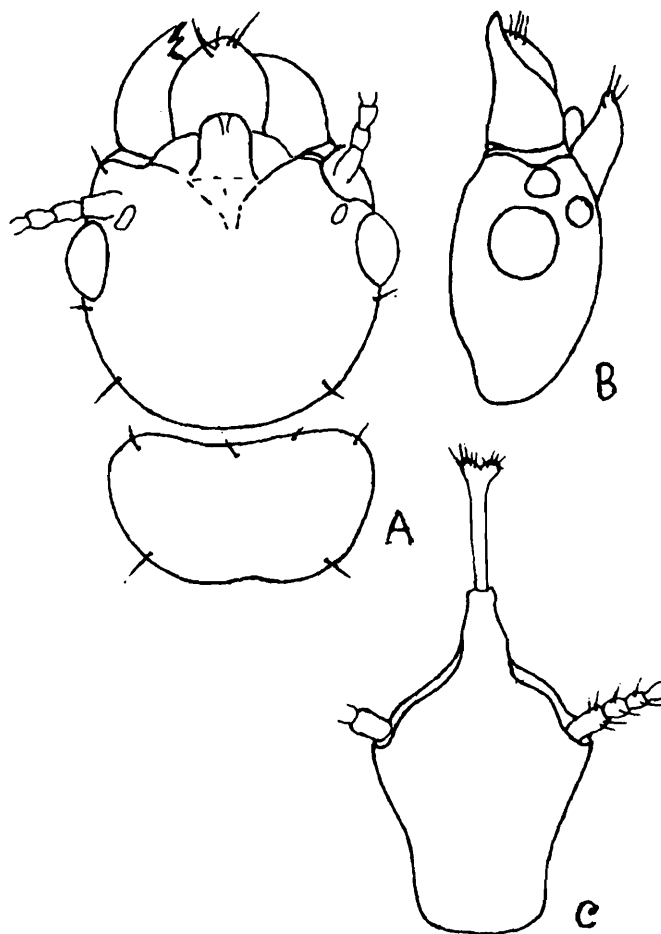


Fig. 144. *Acorhinotermes subfusciceps* (Emerson); A-B. Imago A. Head and pronotum in dorsal view; B. Head in lateral view. C. soldier (minor). C. Head in dorsal view.

brown, contrasting with labrum. Head somewhat constricted behind, making sides concave, widest in front of the middle, clothed with numerous bristles. A tubercle visible at the base of each antennae. Antennae with 15 segments, 3 longer than 2, 4 a little enlarged at tip, 2 equal to 4. Labrum much elongate, thin and forked at tip, a groove extending down the middle. Mandible vestigial, but visible as sharp points beneath the labrum.

Pronotum same colour as that of head, width at the middle, posterior margin not emarginate, front prolonged, somewhat projected into a lobe. Abdomen reddish yellow.

Measurements :

Length of head	1.48
Width of head	0.65 0.68
Length of pronotum	0.42
Width of pronotum	0.51

Types : *Holotype* : Queen; *Morphotype* : S. (min.) in N. Y. Zool. Soc., Chicago.

Distribution : SOUTH AMERICA : Guayana.

Remarks : The monotypic *Achorhinotermes* is restricted to Guayana represented by *A. subfusciceps* only.

ACKNOWLEDGMENTS

Grateful acknowledgment is made to Dr. J.R.B. Alfred, Director, Zoological Survey of India, Kolkata and the Ministry of Environment and Forests, Govt. of India, for the award of the assignment of 'Emeritus Scientist' to undertake a research project –the result of which have been dealt with in the present monograph. Sincere thanks are extended to Dr. R.A. Khan, Scientist SF and O/C, Emeritus Scientist unit, for various help. Sincere gratitude is expressed to Dr. (Mrs.) Nivedita Saha, O/C, Isoptera Section, for extending free access for studying termite material as well as for rendering help during the preparation of the manuscript. Further cooperation received from all the members of the Isoptera section, namely, Sri P.H. Roy, Ms. P. Mukherjee, Mrs. Ava Sar, Ms. J. Basak, Sri S.K. Mondal, Sri P. Sardar and B. Mondal is duly acknowledged.

The author also remains grateful to late Dr. P.K. Sen-Sarma, formerly Director, Biological Research Branch, F.R.I. Dehra Dun and to members of the same Branch, for excellent gesture of co-operation in various ways.

This formality will not be completed, if heartiest thanks are not extended to Mrs. Kalpana Maiti and Dr. Paulomi Maiti of 32A, Dover Place, Kolkata for their ever ready help in various ways.

REFERENCES

- ABE, Y. 1937. On the distribution of the Oriental termite *Coptotermes formosanus* Shiraki in Japan. *Sci. Rep. Tohoku Univ.*, (4) 4 : 463-472.
- AHMD. M. 1950. The phylogeny of termite genera based on imago worker mandibles. *Bull. Am. Mus. nat. Hist.*, 95 (Art. 2) : (1-6) + 43-86.
- AHMAD, M. 1955. Termites of West Pakistan. *Biologia* (Lahore), 1 (2) : 202-264.
- AHMAD, M. 1958a. Key to Indomalayan termites. (Part 1.) *Biologia* (Lahore), 4 (1) : 33-118.
- AHMAD M. 1958b. Key to Indo-Malayan termites (concluded). *Biologia* (Lahore), 4 (2) : 119-198 + i-xii (index)
- AHMAD, M. 1962. Termite fauna of West Pakistan. In *Termites in the Humid Tropics* : (Proc. New Delhi Sympos., UNESCO, 1960) : 67-68. Paris (UNESCO).
- AHMAD, M. 1965. Termites (Isoptera) of Thailand. *Bull. Am. Mus. nat. Hist.*, 131(1) : 1-113.

- AKHTAR. M.S. 1974. Zoogeography of the termites of Pakistan. *Pakistan J. Zool.*, 6 : 85-104.
- AKHTAR, M.S. 1975. Taxonomy and zoogeography of the termites (Isoptera) of Bangladesh. *Bull. Dept. Zool. Univ. Punjab*, Art. 7 : 1-199.
- AMPION. M. AND QUENNEDY, A. 1980 D, evolution des glandes tergaes et sternale dans la phylogenese de termites (Abstract.) In *Int. Sympos. Biosystemat. Soc. Insects* (Paris, Jan. 1980) : 25. Paris (Int. Un. Study Soc. Insects).
- ANDER, K. 1942. Die Insektenfauna des Baltischen Bernsteins nebst damit verknüpften Zoogeographischen Problemen. *Lunds Univ. Arsskrift (N.F.Avd. 2)*, 38 : 1-82
- ARAUJO, R.L. 1977. Catalogo dos. Isoptera deo Novo. Mundo. *Acad. Brasil. Ciencias*, Rio de Janeiro, 1-92 pp.
- BANKS, N. 1919. Antillean Isoptera. *Bull. Mus. Comp. Zool., Harvard Coll.*, 62 (110) : 475-489, 2 pls.
- BANKS. N. AND SNYDER. T.E. 1920. A revision of the nearctic termites with notes on biology and geographic distribution. *Bull. U.S. natn. Mus.*, No. 108 : 1-228.
- BATHELLIER. J. 1927. Contribution a l'etude systematique et biologique des termites de l' Indochine. *Faune colon. Fr.*, 1 (4) : 4 + 125-365, 13 pls.
- BECKER, G. 1975. *Heterotermes indicola* (Ins., Isoptera) damaging wood in building at Kathmandu (Nepal). *Material u. Organismen*, 10 : 260-275.
- BEESON. C.F.C. 1941. *The Ecology and Control of the Forest Insects of India and the Neighbouring Countries* ii + 1007 pp., many figs. Dehra Dun (Vasant Press). (Reprint 1961. 8 + 10 + 767 pp. Manager of Publ.. Govt. of India, Delhi.)
- BOSE GEETA, 1980. A further contribution to the study of termite fauna of Andaman and Nicobar Islands. *Rec. zool. Surv. India*, 77 : 93-109.
- BOSE G. 1984. Termite fauna of Southern India. *Occ. Pap., Rec. zool. Surv. India*. No. 49, ix + 1-270 + 1 pp.
- BOSE, GEETA, 1999. Termite fauna of North Eastern India, *Rec. zool. Surv. India, Occ. Pap.* No. 171 : 1-148.
- BOSE, GEETA AND DAS, B.C. 1982. Termite Fauna of Orissa, eastern India, *Rec. zool. Surv. India*, 80 (1-2) : 197-213.
- BOSE, GEETA. AND DAS. B.C. 1987. Insecta : Isoptera (A Check-list). *State Fauna Series. No. 1* : 103-111.
- BOSE, GEETA AND MAITI, P.K. 1976. Genus *Protrhinotermes* Silvestri from the Indian mainland. *Newslet. zool. Surv. India*, 2 (1) : 15-16.
- BOSE, GEETA AND ROY, P.H. 1984. On a small collection of termites (Isoptera, Insecta) from Bangladesh, with notes on distribution. *Bull. zool. Surv. India*, 5 (2-3) : 189-190.
- BRAUER, F. 1865. Fünfter bericht über die auf der Weltfahrt der kais. Fregatte *Novara* gesammelten Neuropteren. *Verh. zool. bot. Ges. Wien*, 15 : 975-978.
- BRAUER, F. 1866. *Reise der österreichischen Fregatte Novara um die Erde in den Jahren 1857. 1858. 1859*

unter den Befehlen des Commodore B. von Wullerstorf Urbair, Zoologischer Theil. Band 2 (Abth. 1, Art. 4) Neuropter., pp. 1-104, 2 pls. Vienna (kais. - konig. Hof-u. Staats drucke).

- BRULLE, A. 1832. Des animaux articulés. *Exped. sci. Moree*, 3 (1) (Zool.) 66, 100. (Order Isopteres.)
- BUGNION, E. 1913a. Les termites de Ceylan avec quelques indications sur la distribution géographique de ces isectes. *La Globe (Mem.)*, 52 : 24-58, 8 pls.
- BUGNION, E. 1913b. Liste des termites indomalais, avec l'indication du nombre des articles des antennes dans les trois castes. *Bull. Soc. Vaud. Sci. nat.*, 49 (180) : 165-172.
- BUGNION, E. 1914. Le *Termitogeton umbilicatus* Hag. (de Ceylan). (Corrodentia, Termitidae.). *Annls Soc. ent. Fr.*, 83 (1) : 39-47, 1 pl.
- BUGNION, E. 1915. Le biologie des termites de Ceylon. (Corrodentia, Termitidae). *Bull. Mus. natn. Hist. nat.*, 20 (4) (1914) : 170-204, 8 pls.
- BUGNION, E. AND FERRIERE, C. 1911. L'imago du *Coptotermes flavus*. Larvae portant des rudiments d' ailes prothoraciques. *Mem. Soc. zool. Fr.*, 24 (7) : 97-106, 2 pls.
- BUGNION, E. AND POPOFF, N. 1910a. Le termite a latex de Ceylon (*Coptotermes travians* Haviland). Avec un appendice comprenant la description des *Coptotermes gestroi* Wasm. et *flavus* nov sp. *Mem. Soc. zool. Fr.*, 23 (8) : 107-123, 2 pls.
- BUGNION, E. AND POPOFF, N. 1910b. Les *Calotermes* de Ceylon. *Mem. Soc. zool. Fr.*, 23 (9) : 124-144, 3 pls.
- CALABY, J.H. AND GAY, F.J. 1956. The distribution and biology of the Genus *Coptotermes* Wasm. (Isoptera) in western Australia. *Australian J. Zool.*, 4 (1) : 19-39.
- CHATTERJEE, P.N. AND THAKUR, M.L. 1967. Contributions to the knowledge of systematics of North-Western Himalayan termite fauna (Insecta : Isoptera). III. Systematic account of the survey. *Indian Forest Rec. (N.S.) (Ent.)*, 11 (1) : 1-57.
- CHATTERJEE, P.N. AND THAKUR, M.L. 1968. On a collection of termites from Daman. *Indian Forester*, 94 (7) : 560-567.
- CHAUDHRY, M.I. AND AHMAD, M. 1972. *Termites of Pakistan. Identity, Distribution and Ecological Relationships. (Final Technical Report.)* xiv + 70 + 3 pp. + 15 pls. + 2 pp. (errata) + 81 pp. (figs.) + 3 pp. (index). Peshawar (Pakistan Forest Inst.). PL—480 programme. [Both West Pakistan and East Pakistan (Bangladesh). 36 genera and 89 species listed. One n. g., 33 n. sp., all are *nomena nuda*; but distribution and habits given]
- CHHOTANI, O.B. 1972. Problems of taxonomy of the Indian termites. In *Termite Problems in India* (Ed. by M.L. Roonwal) : 22-27. New Delhi (Counc. sci. & ind. Res.)
- CHHOTANI, O.B. 1977a. Termites of Kanha National Park (Madhya Pradesh), India. *Rec. zool. Surv. India*, 72 : 367-388, 5 pls.
- CHHOTANI, O.B. 1977b. A review of taxonomy of Indian termites. *Rec. zool. Surv. India, Occ. Pap.* No. 9, 4 + 36.
- CHHOTANI, O.B. 1977c. Distribution and zoogeography of the oriental termites of families Termopsidae, Hodotermitidae, Stylotermitidae and Rhinotermitidae. *Proc. 8th int. Congr. Int. Un. Stud. Soc. Insects.* Wageningen, Sept. (1977) (Ed. by J. de Wiede), Wageningen : 116-117.

- CHHOTANI, O.B. 1979. A review of Oriental Rhinotermitidae and Stylotermitidae (Isoptera). *Abstrs. Workshop Adv. Insect Taxon. India & Orient* (Manali, Oct. 1979) : 43-44.
- CHHOTANI, O.B. 1980. Termite pests of agriculture in the Indian Region and their control. *Tech. Monogr. Zool. Surv. India*, No. 4 : 4 + 94 pp., 7 pls.
- CHHOTANI, O.B. 1983. A review of the Rhinotermitidae and Stylotermitidae (Isoptera) from the Oriental Region. *Orient. Insects*. 17 : 109-125.
- CHHOTANI, O.B. 1985. Distribution and zoogeography of the Oriental termites of families Termopsidae, Hodotermitidae, Stylotermitidae and Rhinotermitidae. *Z. ang. Ent.*, 100 : 88-95.
- CHHOTANI, O.B., 1986. Affinities of Indian North-eastern borderland termites with those from other parts of the Oriental Region. *Rec. zool. Surv. India* 83 (3 & 4) : 19-21.
- CHHOTANI, O.B. 1989. Wood-destroying Rhinotermitidae (Isoptera) of the Oriental Region. *Zoologiana*, No. 5 : 43-51.
- CHHOTANI, O.B. 1988. Termites of Oman. *J. Oman Studies Spec. Rep.*, No. 3 : 363-371
- CHHOTANI, O.B. AND BOSE G. 1973. Distribution of termites in relation to the ecology of the Indian Region. *Zool. Anz.* 190 (3-4) : 231-236.
- CHHOTANI, O.B. AND BOSE G. 1979a. Nesting behaviour and nests of indian termites. *Zoologiana*, No. 2 : 16-25, 4 pls.
- CHHOTANI, O.B. AND BOSE G. 1979b. Insects of Saudi Arabia. Isoptera. *Fauna of Saudi Arabia*, 1 : 75-83.
- CHHOTANI, O.B. AND BOSE G. 1982. Insects of Saudi Arabia. Isoptera (Part 2). *Fauna of Saudi Arabia*, 4 : 73-83.
- CHHOTANI, O.B. AND BOSE G. 1983. Insects of Saudi Arabia. Isoptera (Part 3). Distribution of Isoptera and their affinities with the termites from the Indian Desert and neighbouring countries. *Fauna of Saudi Arabia*, 5 : 121-128.
- CHHOTANI, O.B. AND BOSE G. 1985a. *Isoptera of Saudi Arabia* (Part 4). *Fauna of Saudi Arabia*, 7 : 121-124.
- CHHOTANI, O.B. AND BOSE G. 1985b. Fauna of Namdapha : Arunachal Pradesh 'A proposed Biosphere Reserve' Insects : Isoptera *Rec. zool. Surv. India*, 82 (1-4) : 53-60.
- CHHOTANI, O.B. AND BOSE G. 1991. Isoptera from Saudi Arabia and Kuwait, with a key to Arabian species *Fauna of Saudi Arabia*, 12 : 257-265.
- CHHOTANI, O.B. AND DAS B.C. 1979. Variability in size and morphometric analysis of the soldier caste in *Heterotermes indicola* (Wasmann) (Rhinotermitidae : Heterotermitinae). *Zool. Surv. India, Special Publ. (Proc. of Symposia)*, No. 1 : 47-52.
- CHHOTANI O.B. AND DAS, B.C. 1983. A review of the Indian species of the genus *Reticulitermes* Holmgren (Isoptera : Rhinotermitidae). *Rec. zool. Surv. India*, 80 (3-4) (1982) : 315-329.
- COATON, W.G.H. 1949. Infestation of buildings in South Africa by subterranean wood-destroying termites. *Bull. Dept. agric. For. Un. S. Africa* (Ent. Ser 20), 299 : 1-89.

- COATON W.G.H AND SHEASBY, J.L. 1973. National Survey of the Isoptera of South Africa 2. The genus *Schedorhinotermes* Silvestri (Rhinotermitidae) *Cimbebasia*, A 3 (2) : 1-17.
- COATON, W.G.H. and SHEASBY, J.L., 1976. National Survey of the Isoptera of Southern Africa. 11. The Genus *Coptotermes* Wasmann (Rhinotermitidae : Coptotermitinae). *Cimbebasia*, (A) 3 (11) : 139-172.
- DECARVALHO, BRITO, J.H. 1970. Notes on the presence of *Psammotermes allocerus* Silvestri in Mozambique (Isoptera). *Rev. Clenc. Anronomicas*, 3 (A) : 151-154.
- DESNEUX, J. 1902 Termites du Sahara Algerian recueillis par M. le professeur Lameere. *Ann. Soc. Ent. Belg.*, 46 (10) : 436-440.
- DESNEUX, J. 1904a (Mar. 29). Notes termitologiques. *Annls. Soc. ent. Belg.*, 48 (3) : 146-151.
- DESNEUX, J. 1904b. A propos de la phylogenie des termitides. *Annls Soc. ent. Belg.*, 48 (8) : 278-286.
- DESNEUX, J. 1904c (Sept. 2) Trois termites nouveaux. *Annls Soc. ent. Belg.*, 48 (8) : 286-289.
- DESNEUX, J. 1904d (Nov. 10) Remarques critiques sur la phylogenie et la division systematique des termitides. (Reponse a M. Wasmann.) *Annls Soc. ent. Belg.* 48 (10) : 372-378.
- DESNEUX, J. 1904e (Feb. 10). A new termite from India. *J. Bombay nat. Hist. Soc.*, 15 (3) : 445-446.
- DESNEUX, J. 1904f (Nov. 15). Isoptera, Family Termitidae. In *Genera Insectorum* (Ed. P. Wytsman), 25 : 52 pp., 2 pls.
- DESNEUX, J. 1906a (Jan. 25). Varietes termitologiques. *Annls. Soc. ent. Belg.*, 49 (12) (1905) : 336-360.
- DESNEUX, J. 1906b. The Kashmir termite, *Termopsis wroughtoni*. *J. Bombay nat. Hist. Soc.*, 17 (2) : 293-298.
- DESNEUX, J. 1908 (Jan. 3). Varietes termitologiques. II Quelques especes nouvelles. *Annls Soc. ent. Belg.*, 51 (12) (1907) : 388-400.
- DESNEUX, J. 1918. Un nouveau type de nids de termites. *Rev. Zool. Afr.*, 5 (3) : 307.
- EMERSON, A.E. 1929, The termites of Kartabo-Bartica District, British Guinea.- *Zoologica*, 6 (4) : 291-459.
- EMERSON, A.E. 1928, Termites of the Belgian Congo and Cameroon. *Bull. Amer. Mus. nat. Hist.*, 57 (7) : 401-574.
- EMERSON, A.E. 1928, Le development des soldats termites. *Annales Sci. nat. (Bot. et. Zool.)*, (10) 11 : 261-284.
- EMERSON, A.E. 1939, Report of the cases of introduction of *Coptotermes*. (Typed note, 2 pp. *C. javanicus*, *C. havilandi*, Summary in *Rev. appl. Ent.*, (A) 27 : 384 (1939).
- EMERSON, A.E. 1950, Five new genera of termites from South America and Madagascar (Isoptera : Rhinotermitidae, Termitidae) *Amer. Mus. Novt.*, No. 1444, pp. 1-14.
- EMERSON, A.E. 1952. The biogeography of termites. *Bull. Am. Mus. nat. Hist.*, 99 (Art. 3) : 217-225.
- EMERSON, A.E. 1955. Geographical origins and dispersions of termite genera. *Fieldiana (Zool.)*, 37 : 465-521.

- EMERSON, A.E. 1971. Tertiary fossil species of the Rhinotermitidae (Isoptera), phylogeny of genera, and reciprocal phylogeny of associated Flagellata (Protozoa) and the Staphylinidae (Coleoptera). *Bull. Am. Mus. nat. Hist.*, 146 (Art. 3) : 243-303.
- ENDERLEIN, G. 1909. Die klassifikation der Embiidinen nebst morphologischen and physiologischen Bemerkungen besonders uber das Spinnen derselben. *Zool. Anz.*, 35 (6) : 166-191.
- ERNEST, E. AND ARAUJO, R.L. 1986. A bibliography of Termite 1968-1978. *Trop. Deb. Res. Inst.*, Swiss Trop. Inst.
- ESCHERICH, K. 1911. *Termitenleben auf Ceylon. Neue Studien zur Soziologie der Tiere zugleich ein Kapitel kolonialer Forstentomologie.* (Mit einem systematischen Anhang mit Beiträgen von A. Forel, Nils Holmgren, W. Michaelson, F. Schimmer, F. Silvestri and E. Wasmann) xxxii + 263 pp., 3 pls. Jena (Gustav Fischer).
- FERNANDO, H.E. 1962. Termites of economic importance in Ceylon. In *Termites in Humid Tropics* (Proc. New Delhi Sympos., 1960) : 205-210. Paris (UNESCO).
- FLETCHER, T.B. 1912. Termites or white ants. *Agric. J. India*, 7 (3) : 219-239, 3 pls.
- FLETCHER, T.B. 1914. *Some South Indian Insects and Other Animals of Importance Considered Especially from an Economic Point of View*, xxi + 565 pp., 50 pls. Madras. (Govt. Press). (Reprinted 1984, Dehra Dun; Bishen Singh, etc.)
- FLETCHER, T.B. 1916. One hundred notes on Indian insects. 100. *Coptotermes gestroi* in India. *Bull. agric. Res. Inst. Pusa*, No. 59 : v + 39 pp.
- FLETCHER, T.B. 1920. Annotated list of Indian crop pests. *Rept. Proc. 3rd ent. Mtg. Pusa* (3rd 15th Feb. 1919). 1 : 33-314, 7 pls.
- FLETCHER, T.B. 1921. Koenig's paper on South Indian termites. (Translated from German into English, and discussed). *Proc. 4th ent. Mtg. Pusa. Calcutta*, pp. 312-333, 6 pls. (Also includes a note on the life of Koenig; a translation of Koenig's paper of 1779 : and several original Fletcher's photos of mounds and observations on South Indian termites. Also see KOENIG, J.G. 1779.
- FULLER, C. 1915. Observations on some South African termites. *Ann. Natal. Mus.*, 3 (2) : 329-505, 11 pls.
- GAO, D. AND PAUL, K.S.L. 1986. Notes on the Termites (Isoptera) of Hong Kong, including description of a new specie and a check list of Chinese species. *Mem. Hong Kong nat. Hist. Soc.*, 17 : 67-83.
- GAO, D., PAN, Y., MA, X. AND SHI, W. 1982 (Dec.). Notes on the genus *Reticulitermes* from Sichuan, China, with descriptions of new species. (In Chinese with English summary.) *Entomotaxonomia*, Peking, 4 (4) : 299-306.
- GAY, F.J. 1963. The synonymy, distribution and biology of *Coptotermes elisae* (Desneux). *Pacific Ins.*, 5 (2) : 421-423.
- GAY, F.J. 1967. A world review of introduced species of termites. *Bull. Commonw. Sci. Ind. Res. Organis.* (Austral.), No. 286 : 1-88.
- GAY, F.J. 1969. Species introduced by man. In *Biology of Termites* (Ed. by K. Krishna and F.M. Weesner), Vol. 1, pp. 459-494. New York and London (Academic Press.)

- GAY, F.J. and WATSON, J.A.L. 1974. *Isoptera (Termites)*. In : *The insects of Australia*, Melbourne Univ. Press, pp. 37-39.
- GERINI, V. 1992. Aggiornamento bibliografico sulle Termiti (1798-1999) *Relaz. Monogr. Agrar. Subtrop. Tropicali*, No. 110, pp. 1-52.
- GRASSE, P.-P. 1949. Order des Isopteres ou termite. (Isoptera Brulle 1852). In *Traite de Zoologie*, (Ed. P.P. Grasse), 9, *Insectes* : 408-544. Paris (Masson).
- GRASSE, P.-P. 1986. *Termitologia, Anatomie, Physiologic, Biologic, Systematique des Termites*, 3, 715 pp. Paris (Masson).
- GREEN, E.E. 1913 (June). Catalogue of Isoptera (termites) recorded from Ceylon. *Spolia Zevlan.*, 9 (33) : 7-15.
- GRIFFIN, F.J. 1951. A bibliography of the Isoptera (termites) 1758-1949. *J. Soc. Bibliogr. nat. Hist.*, 2(8) : 261-368.
- HAGEN, H.A. 1853. Hr. Peters berichate uber die von ihm gesamelten und von Hrn. Dr. Herman Hagen bearbei-tenen Neuropteren aus Mosambique. *Ber. Koningl. preuss. Akad. Wissens.*, 1853 : 479-482.
- HAGEN, H.A. 1855. Monographie der Termiten. Part 1. *Linn. ent.*, 10 : 1-144; and 270-325.
- HAGEN, H.A. 1858a. Monographie der Termiten. Part 2. *Linn. ent.*, 12 : 1-342, 3 pls.; and 459 (errata).
- HAGEN, H.A. 1858b. *Catalogue of the Specimens of Neuropterous Insects in the Collection of the British Museum. Part 1. Termitina*. 34 pp. London (Brit. Mus. Nat. Hist.).
- HAGEN, H.A. 1860a. Monographie der Termiten. Part 3. *Linn. Ent.*, 15 : 73-99.
- HAGEN, H.A. 1860b. Nachtrag zur Monographie der Termiten. *Linn. Ent.*, 15 : 100-128.
- HARE, L. 1937. Termite phylogeny as evidenced by soldier mandible development. *Ann. ent. Soc. Am.*, 30 (3) : 459-486, 13 pls.
- HARRIS, W.V. 1957. An introduction to Malayan termites. *Malay. Nat. J.*, 12 : 20-32, 1 pl., Also in *Malay. Forester*, 21 : 87-97, 1 pl.
- HARRIS, W.V. 1959. Notes on termites injurious to forestry in British Honduras. *Emp. For. Rev.* 38 : 181-185.
- HARRIS, W.V. 1961. *Termites : Their Recognition and Control*. xii + 187 pp., sev. pls. (8 col.), 1 figd. and charts. London (Longmans, Green & Co.).
- HARRIS, W.V. 1963. Isoptera. *Explor. Parc. Nat. Garamba Miss. Des Saegar fasc.*, 42 : 6-8.
- HARRIS, W.V. 1963. The Termites of Hong Kong. *Mem. Hong Kong nat. Hist. Soc.*, No. 6 : 1-9.
- HARRIS, W.V. 1966. Type-localities of the Isoptera described by Haviland. *Proc. Linn. Soc. Lond.*, 117 : 11-17.
- HARRIS, W.V. 1966. On the genus *Coptotermes* in Africa (Isoptera : Rhinotermitidae). *Proc. R. ent. Soc. Lond.*, (B) 35 : 161-171.
- HARRIS, W.V. 1968. Isoptera from Vietnam, Cambodia and Thailand. *Opusc. Ent.*, 33 (1-2) : 143-154.

- HARRIS, W.V. 1968. A new *Coptotermes* from Gabon (Isoptera : Rhinotermitidae). *Rev. Zool. Bot. afr.*, **77** : 236-238.
- HARRIS, W.V. 1968. African termites of the genus *Schedorhinotermes* (Isoptera : Rhinotermitidae) and associated termitophiles (Lepidoptera : Tineidae). *Proc. R. ent. Soc. Lond. (B)*, **37** : 103-113.
- HARRIS, W.V. 1970. Termites of the Palearctic Region. In *Biology of Termites* (Ed. by K. Krishna and F.M. Weesner), Vol. 2, pp. 295-313. New York and London (Academic Press).
- HAVILAND, G.D. 1894. [Note on habits of termites of Singapore.] *Proc. ent. Soc. Lond.*, 1894 : viii.
- HILL, G.F., 1921. The white-ant pest in Northern Australia. *Commonw. Australia Inst. sci. industa. Bull.*, **21** : 1-26, 15 pls.
- HILL, G.F. 1921. New and rare Australian termites with notes on their biology. *Proc. Linn. Soc. N.S.W.*, **46** (4) : 443-456, 1 pl.
- HILL, G. F., 1922. Descriptions and Biology of some North-Australian termites. *Proc. Linn. Soc. N.S.W.*, **47**(2) : 142-160.
- HILL, G.F. 1925. Termites from the Australian Region, descriptions of new species and hitherto undescribed castes. *Proc. Roy. Soc. Victoria (N.S.)*, **37** (2) : 206-229, 4 pls.
- HILL, G.F. 1926. Australian Termites (Isoptera). Notes on *Stolotermes*, *Calotermes* and *Coptotermes*, with descriptions of new species. *Proc. r. Soc. Victoria*, **38** : 192-214.
- HILL, G.F. 1932. Termites (white ants) in southeastern Australia. *C.S.I.R.O., Pamphlet No. 25* : 1-8.
- HILL, G.F. 1933. Australian *Rhinotermes*. *Proc. Roy. Soc. Victoria (N.S.)*, **44** (1) : 1-17, 4 pls.
- HILL, G.F. 1942. *Termites (Isoptera) from the Australian Region (including Australia, New Guinea and Islands South of the Equator between 140° E longitude and 170° W Longitude*. 4 + 479. pp., 24 pls. Melbourne (Counc. Sci. Ind. Res. Commonw., Australia.
- HOLMGREN, K. AND HOLMGREN, N. 1917 (Aug.). Report on a collection of termites from India. *Mem. Dept. Agric. India (Ent.)*, **5** (3) : 137-171. [With notes on synonymy by T.B.Fletcher.]
- HOLMGREN, N. 1906. Studies uber Sudamerikanische Termiten. *Zool, Jb. (Syst.)*, **23** (5) : 521-676.
- HOLMGREN, N. 1911a. *Om Termiter och myrov. En. Inblick i Sociala Insekters Biology*. 286 pp. Stockholm (Veteaskap och bildning, Bd. 11).
- HOLMGREN, N. 1911b. Ceylon-Termiten gesammelt von Prof. K. Escherisch, nebst einer synoptischen ubersicht uber alle bis jetzt von Ceylon und den angrenzenden Festland bekannten Termitenarten. In *Termitenleben auf Ceylon, u.s.w.* (by K. Escherisch). Systematischer Anhang : Termiten und Termitophilen von Ceylon, pp. 183-212, 2 pls. Jena (Gustav Fischer).
- HOLMGREN, N. 1911c (July 26). Termitenstudien. 2 Systematik der Termiten. *K. Svenska Vet. Akad. Handl.*, **46** (6) : 1-86, 6 pls.
- HOLMGREN, N. 1911d (June 13) Bemerkungen uber einige Termiten Arten. *Zool, Anz.*, **37** (26) : 545-553.
- HOLMGREN, N. 1912a (May 20). Termitenstudien. 3. Systematik der Termiten. Die Familie Metatermitidae. *K. Sven.Vet.Akad. Handl.* **48**(4) : 1-166, 4 pls.

- HOLMGREN, N. 1912b (July 30). Termites from British India (Bombay) collected by Dr. J. Assmuth. *J. Bombay nat. Hist. Soc.*, **21** (3) : 774-793, 4 pls.
- HOLMGREN, N. 1913a (Apr. 21). Termites from British India (near Bombay, in Gujarat and Bangalore) collected by Dr J. Assmuth S. J. Part II. *J. Bombay nat. Hist. Soc.*, **22**(1) : 101-117, 3 pls
- HOLMGREN, N. 1913b (May 23). Termitenstudien. 4. Versuch einer Systematischen Monographie der Termiten der orientalischen Region. *K. Sven.Vet. Akad. Handl.*, **50**(2) : 1-276, 8 pls.
- HOLMGREN, N. 1913c (June 30). Termiten aus Java und Sumatra gesammelt von Edward Jacobson. *Tijds. Ent.*, **56** : 13-28, 2 pls.
- HOLMGREN, N. 1914a (Jan.). On some termites collected by Mr. Green in Ceylon. *Cey. Spolia Zeylan.*, **8** (32) (1913) : 277-284.
- HOWEL, H.M. *et al.* 1987. Geographical distribution of the termite genera *Reticulitermes*, *Coptotermes* and *Incisitermes* in Texas. *Southwestern Ent.*, **12** (2) : 119-125, Dept. Ent. Texas.
- HOZAWA, S. 1915. Revision of Japanese termites. *J. College Sci. Imp. Univ. Tokyo*, **35** : 1-161.
- HSIA, K.L. AND FAN, S.T. 1970. Notes on the genus *Reticulitermes* Holmgren of China (Isoptera, Rhinotermitidae). *Acta ent. Sinica*, **3** (1968) : 51-75.
- HUTSON, J.C. 1923a. Notes on termites attacking tea in Ceylon. *Trop. Agric.*, **60**(2) : 83-87.
- HUTSON, J.C. 1923b. Notes on termites attacking tea in Ceylon. *Trop. Agric.*, **60**(5) : 291-298, 2 pls.
- IKEHARA, S. 1966. Distribution of termites in the Ryukyu Archipelago. *Bull. Art Sci. Div. Univ. Ryukyu*, No. **9** : 49-176, 3 pls.
- IMMS, A.D. 1957. *A General Text-book of Entomology. Including the Anatomy. Physiology. Development and Classification of Insects.* (9th Ed., revised by C.W. Richards and R.G. Davies). x + 886 pp. London (Methuen and Co.).
- JACOBSON, G.G. 1905. Zur Kenntnis der termiten Russlands. *Ann. Mus. zool. Acad. imp. Sci.*, St. Petersburg, **9**(1904) : 57-107. With a section on biology of *Hodotermes vagans septentrionalis*, by J.W. Wassieljew, pp. 97-103.
- JEPSON, F.P. 1927. A preliminary note on the distribution of the Ceylon tea *Calotermes*. *Yearbk. Dept. Agric. Ceylon*, 1927 : 19-21, 1 pl.
- JEPSON, F.P. 1930. Termites attacking *Hevea brasiliensis* in Ceylon. *Trop. Agric.*, **75**(3) : 143-156, 5 pls.
- JOHN, O. 1913 (Oct.). Notes on some termites from Ceylon. *Spolia Zeylan.*, **9**(34) : 102-116.
- JOHN, O. 1925 (Dec.). Termiten von Ceylon, der Malayischen Halbinsel, Sumatra, Java und den Arulnseln. *Treubia*, **6**(3-4) : 360-419, 8 pls.
- JOHNSTON, H.R. and BEAL, R.H. 1969. What's new with the Formosan termite? *Pest Control.*, **37**(2) : 24, 26, 30, 32.
- JOHNSON, R.A. 1979. Configuration of the digestive tube as an aid to identification of worker Termitidae (Isoptera). *Syst. Ent.*, **4** : 31-38.
- JONES, S.C., LA FAGE, J.P. AND HOWARD, R.R. 1982. Isopteran sex-ratio strategies. In *The Biology of Social Insects (Proc. 9th Congr. int. Un. soc. Ins., Boulder, Aug. 1982)* (Ed. by M.D. Breed, C. Mitchner and H.E. Evans) : 406. Boulder (Westview Press).

- KAMBHAMPATI, S., KJER, K.M., THORNE, B.L. 1996. Phylogenetic relationship among termite families based on DNA sequences of mitochondrial 16S ribosomal RNA gene. *Insect. mol. biol.*, 5(4) : 229-238.
- KELSEY, J.M. 1946. A variation of the Termite *Coptotermes lacteus* Froggatt from New Zealand, *New Zealand J. Sci. and Tech.* 27(6) (Sec.B) : 458-464 (Ent. Div. Publ., 52)
- KEMNER, N.A. 1925a. Zwei neue Chinesische Termiten aus der Sammelausbeute der Kolthoffschen Expedition nach China 1921-1922. *Ark. Zool.*, (A) 17 (28) : 1-6.
- KEMNER, N.A. 1925b. Larva termitovorax, eine merkwürdige parasitische Fliegenlarve, die im Kopfe von Termitensoldaten lebt, und durch die Verunstaltung desselben Veranlassung zur Aufstellung eines besonderen Termitengenus mit zwei Arten gegeben hat. *Ark. Zool.*, (A) 17(29) : 1-15, 1 pl.
- KEMNER, N.A. 1926. Some termites from Ceylon. *Bull. ent. Res.*, 16(4) : 397-392
- KEMNER, N.A. 1930. Fauna Sumatrensis Termitidae *Tijds. Ent.*, 72 : 298-324.
- KEMNER, N.A. 1931. Die Termitenfauna von Amboina. *Lunds Univ. Arssk. (NF)*, Avd. 2, 27(13) : 1-53.
- KEMNER, N.A. 1932. Neue Termiten aus der Orientalischen Region. I-II. *Ent. Tijds.*, 53(2) : 133-155.
- KEMNER, N.A. 1933. Resultats scientifiques du voyage aux Indes Orientales neerlandaises de LL. A.A. R.R. le Prince et la Princesse Leopold de Belgique. Isoptera. *Mem. Mus. Roy. Hist. nat. Belg.*, 4(8) (Hors serie) : 17-30, 1 pl.
- KEMNER, N.A. 1934. Systematische und biologische Studien über die Termiten Javas und Celebes. *K. Sven. Vet. Akad. Handl.*, (3) 13(4) : 1-241, 22 pls.
- KEMNER, N.A. 1936. Zur naheren Kenntnis der *Termitoxenia jagerskioldi* Wasm. als Typus eines neuen Genus der Termitoxenien. *Opusc. Ent.*, 1(2) : 35-39.
- KEMNER, N.A. 1943. Ein Blick auf Termiten Javas und Celebes. *Jb. dtsh. Auslandsamtes d. deutsch. Dozentenschaft*, 1943 : 50-53.
- KHAN, M.A. AND AHMAD, M. 1954. Termites of Lahore. *Proc. 6th Pakistan Sci. Conf. (Abstr.)* : 140.
- KISTNER, D.H. 1969. The biology of termitophiles. In *Biology of Termites* (Ed. by K. Krishna and F.M. Weesner), Vol. 1 : 525-557. New York (Academic Press).
- KOFOID, C.A. (Ed. by) 1934 (Jan.). *Termite and Termite Control. A Report to the Termite Investigations Committee*. xxv + 734 pp., 1 frontp. Berkeley (Calif. Univ. Press) and London (Cambridge Univ. Press). (2nd Ed., Dec. 1934.)
- KOFOID, C.A. (Ed. by). 1946. Ditto. (2nd Ed., 2nd printing). 4 + xxvi + 795 pp., 1 frontp. Berkeley (Calif. Univ. Press).
- KONIG, J.G. 1779. Naturgeschichte der sogenannten weissen Ameisen. *Beschr. berlin. Ges. Naturf. Freunde* : 4 : 1-28. English translation and comments, by T.B. Fletcher, in *Proc. 4th ent. Meeting (Pusa. 1921)*, 4 : 312-333, 6 pls. 1921; see T.B.Fletcher, 1921 above.
- KRISHNA, K., 1956. Two new species of *Coptotermes* Wasmann from Malaya (Isoptera, Rhinotermitidae, Coptotermitinae). *Amer. Mus. Novit.*, No. 1809, pp. 1-5.
- KRISHNA, K. 1965. Termites (Isoptera) of Burma. *Am. Mus. Novit.*, No. 2210 : 1-34.

- KRISHNA, K. 1969. Introduction. In *Biology of Termites* (Ed. by K. Krishna and F.M. Weesner), Vol. 1 : 1-17. New York and London (Academic Press).
- KRISHNA, K. 1970. Taxonomy, phylogeny and distribution of termites. In *Biology of Termites* (Ed. by K. Krishna and F.M. Weesner), Vol. 2 : 127-152. New York and London (Academic Press)
- KRISHNA, K. AND WEESNER, F.M. (Ed. by). 1969. *Biology of Termites*. Vol. 1 : xii + 598 pp. New York and London (Academic Press).
- KRISHNA, K. AND WEESNER, F.M. (Ed. by). 1970. *Biology of Termites*. Vol. 2 : xiv + 1 + 643 pp. New York and London (Academic Press).
- LIGHT, S.F. 1921a (Mar.) Notes on Philippine termites. I. *Philipp. J. Sci.*, 18(3) : 243-257.
- LIGHT S.F. 1921b (July). Notes on Philippine termites. II. *Philipp. J. Sci.*, 19(1) : 23-64, 6 pls.
- LAHIRI, A.R. AND GHOSH, A.K. 1980. Termites of Manipur, India, with new records (Insecta : Isoptera). *Rec. zool. Surv. India*. 76 : 65-70.
- LAHIRI, A.R., GHOSH, A.K. AND BISWAS, S. 1977. A preliminary study of insect fauna of Meghalaya. 11. Isoptera : Four new records and notes on other species. *Bull. Meghalaya Sci. Soc.*, 2 : 35-38.
- LEFROY, H.M. 1906. *Indian Insect Pests*. vii + 318 pp. Calcutta (Govt. of India). (Reprinted 1971, New Delhi, Today and Tomorrow's Printers, etc.)
- LI, G.X. AND XIAO, W.L. 1989. Eight new species of termites from Guangxi, China. *Acta Ent. Sinica.*, 32 : 4, 465-476.
- LIGHT, S.F. 1924. The termites (white ants) of China, with description of six new species. *China J. Sci. & Arts.*, 2(1-4) : 50-60; 140-142; 242-254; and 354-358.
- LIGHT, S.F. 1929. Notes on Philippine termites. III. *Philipp. J. Sci.*, 40(4) : 421-452, 8 pls.
- LIGHT, S.F. 1930 (May). Notes on Philippine termites. IV. *Philipp. J. Sci.*, 42(1) : 13-58, 8 pls.
- LIGHT, S.F. 1931. Present status of our knowledge of the termites of China. (With an Appendix, p. 600, on : Instructions for preparation of slides of Protozoa of termites for study.) *Lignan Sci. J.*, 7(1929) : 581-600.
- LIGHT, S.F. 1933. Termites of Wester Mexico. *Calif. Univ. Publ. Ent.* 6(5) 79-164.
- LIGHT, S.F. 1934a. A world view of termites. In *Termites and Termite Control* (Ed. by C.A. Kofoid) (2nd Ed.) : 108-117. Berkeley (Univ. Calif. Press).
- LIGHT, S.F. 1934b. Habitat and habit types of termites and their economic significance. In *Termites and Termite Control* (Ed. by C.A. Kofoid) (2nd Ed.) : 127-140. Berkeley (Univ. Calif. Press).
- LIGHT, S.F. 1934c. Dry-wood termites, their classification and distribution. In *Termites and Termite Control* (Ed. by C.A. Kofoid) (2nd Ed.) : 197-200. Berkeley (Univ. Calif. Press).
- LIGHT, S.F. 1934d. Termites and growing plants. In *Termites and Termite Control* (Ed. by C.A. Kofoid) (2nd Ed.) : 286-292. Berkeley (Univ. Calif. Press).
- LIGHT, S.F. 1934e. The termite fauna of the Philippine Islands and its economic significance. In *Termites and Termite Control* (Ed. by C.A. Kofoid) (2nd Ed.) : 319-322. Berkeley (Univ. Calif. Press).

- LIGHT, S.F. 1937. (Jan - Apr.). A collection of termites from Ceylon and Java. *Pan-Pacific Ent.*, 13(1-2) : 15-24.
- LIGHT, S.F. 1946a. A world view of termites. In *Termites and Termite Control*. (Ed. by C.A. Kofoid) (2nd Ed. rev.) : 117-126. Berkeley (Univ. Calif. Press).
- LIGHT, S.F. 1946b. Habitat and habit type of termites and their economic significance. In *Termites and Termite Control*. (Ed. by C.A. Kofoid) (2nd Ed. rev.) : 136-149. Berkeley (Univ. Calif. Press).
- LIGHT, S.F. 1946c. Dry-wood termites, their classification and distribution. In *Termites and Termite Control*. (Ed. by C.A. Kofoid) (2nd Ed. rev.) : 206-209. Berkeley (Univ. Calif. Press).
- LIGHT, S.F. 1946d. Termites and growing plants. In *Termites and Termite Control*. (Ed. by C.A. Kofoid) (2nd Ed. rev.) : 314-320. Berkeley (Univ. Calif. Press).
- LIGHT, S.F. 1946e. The termite fauna of the Philippine Islands and its economic significance. In *Termites and Termite Control* (Ed. by C.A. Kofoid) (2nd Ed. rev.) : 347-350. Berkeley (Univ. Calif. Press).
- LINNAEUS, C. 1758. *Systema Naturae per Regna Tria Naturae*. (Ed. 10), Vol. 1.
- LINNAEUS, C. 1778-93. *Systema Naturae*. (Ed. 13, aucta, reformatacura Joh. Friedr. Gmelin) Vol. 1, pt. 5.
- MAITI, P.K. 1977. The geographical origin, dispersion and evolution of termites (Isoptera) of the Andaman and Nicobar Islands, Indian Ocean. *Abstrs. 2nd Orient. Ent. Sympos.* (Madras, Mar. 1977) : 54.
- MAITI, P.K. 1978. Investigation on the seasonal variation, population estimation and some aspects of bioecology of *Cryptotermes havilandi* (Sjost.) (Isoptera) in West Bengal. *Abstrs. Sympos. Ecol. anim. Popul.* (Calcutta, Oct : 1978) : 69.
- MAITI, P.K. 1979. The composition and geographical origin of the termites (Isoptera) of the Great Nicobar Island, Indian Ocean. *Proc. zool. Soc.*, 30(1-2) (1977) : 131-135.
- MAITI, P.K. 1981. Faunal zones and bioecological notes on the soil inhabiting termites (Isoptera) of West Bengal, India. In *Progress in Soil Biology and Ecology in India* (Ed. by G.K. Veeresh) : 265. Bangalore (Univ. Agric. Sci.).
- MAITI, P.K. 1983. Termite fauna (Isoptera) of West Bengal, India. Their recognition, biology and ecology. *Occ. Pap., Rec. zool. Surv. India*, No. 42 : iv + 152, maps.
- MAITI, P.K. 1994. Termite Fauna (Isoptera) of the Andaman and Nicobar Islands, Indian Ocean. *Occ. Pap., Rec. Zool. Surv. India*, No.167, pp. 1-107.
- MAITI, P.K. AND MANDAL, D.K. 1977. Some highlights on the entomological. exploration of Great Nicobar Islands, Indian Ocean. *Newslet. Zool. Surv. India*, 3 : 66-68.
- MAITI, P.K., LAHIRI, A.R., SAHA, N AND ROY, P.H. 1995. *Zool. Surv. India, State Fauna Series 4 : Fauna of Meghalaya* : Part 3 : 431-455.
- MAITI, P.K., AND SAHA, N. 1993. *Zool. surv. India, Insecta : State Fauna Series 3 : Fauna of West Bengal*, Part 4 : 511-523.
- MAITI, P.K. AND SAHA, N. 1996. Studies on Biodiversity of Termites of the Himalaya. *Proc. Symp. on Perspective of Biodiversity, Zool. Soc., Calcutta.* p : 4 (Abs.)

- MAITI, P.K. AND SAHA, N. 1997. *Zool. Surv. India, State Fauna Series 6*, : Fauna of Delhi, pp. 207-213.
- MAITI, P.K. AND SAHA, N. 1998. Faunal Diversity in India, Isoptera. In : *Faunal Diversity in India* (Eds. J.R.B. Alfred *et al.*) : 219-232, ENVIS CENTRE, Z.S.I., Kolkata.
- MAITI, P.K., SAHA, N. AND ROY, P.H. 1999. *Zool. Surv. India, State Fauna Series, 7 : Fauna of Tripura*, (Part-2) : 295.
- MAITI, P.K. SAHA, N. AND ROY, P.H. 2001. *Zool. Surv. India, State Fauna Series, 11 : Fauna of Mizoram* : 1-8.
- MAITI, P.K., SAHA, N., ROY, P.H. AND SAR, A. 2003. *Zool. Surv. India, State Fauna Series 9, Fauna of Sikkim* (part-2) : 251-262.
- MAITI, P.K. SAHA, N. AND ROY, P.H. 2004. *Zool. Surv. India, Fauna of Sikkim. State Fauna Series, Fauna of Manipur* (In press)
- MARGABANDHU. V. 1934 (Dec. 15). An annotated list of Indo-Ceylonese termites. *J. Bombay nat. Hist. Soc.*, **37**(3) : 700-714.
- MARGABANDHU. V. 1935 (Aug. 15). An annotated list of Indo-Ceylonese termites. [Additions.] *J. Bombay nat. Hist. Soc.*, **38**(1) : 208-209.
- MATHEWS, A.G.A. 1977. Studies on termites from the Mato Grosso State, Brazil. *Acad. Brazil Cienc.*, Riode Jeneiro : 267 pp.
- MATHUR, R.N. AND CHHOTANI, O.B. 1969 (Oct.). Two new termites of the genera *Coptotermes* Wasmann and *Heterotermes* Froggatt (Rhinotermitidae) from India. *J. Timber Devel. Assoc. India*, **15**(4) : 1-10.
- MATHUR, R.N. AND SEN-SARMA, P.K. 1959. Notes on the habits and biology of Dehra Dun termites. [Part 1.] *J. Timber Dryers and Preserv. Assoc. India*, **5**(3) : 3-9, 2 pls.
- MATHUR, R.N. AND SEN-SARMA, P.K. 1960. Notes on the habits and biology of Dehra Dun termites. [Part 2.] *J. Timber Dryers and Preserv. Assoc. India*, **6**(2) : 23-27.
- MATHUR, R.N. AND SEN-SARMA, P.K. 1962. Notes on the habits and biology of Dehra Dun termites. [Part 3.] *J. Timber Dryers and Preserv. Assoc. India*, **8**(1) : 1-18, 2 pls.
- MATHUR, R.N. AND THAPA, R.S. 1962. A revised catalogue of Isoptera (white ants) of the Entomological Reference Collection at the Forest Research Institute, Dehara Dun. *Indian Forest Leaffl. (Ent.)*, No. 167 : 1-122. (Errata, pp. 1-9, issued 1963.)
- MATHUR, R.N. AND THAPA, R.S. 1963. Survey of the termites of South Bihar. *J. Soc. Indian Foresters*, **3**(3 & 4) : 105-110.
- MAXWELL-LEFROY, H. See LEFROY, H.M.
- MILL, A.E. 1983. Generic keys to the soldier caste of New World Termitidae (Isoptera : Insecta). *Syst. Ent.*, **8** : 179-190.
- MILLER, E.M. 1969. Caste differentiation in the lower termites. In *Biology of Termites* (Ed. by K. Krishna and F.M. Weesner), Vol. 1 : 283-310. New York (Academic Press).

- MORIMOTO, K. 1973. Termites from Thailand. *Bull. Govt. Forest Exper. Sta.*, No. 257 : 57-80.
- MUKHOPADHYAY, P. 2002. *Studies on the Termite (Isoptera) Fauna of the Himalaya*, PH.D. Thesis : 1-281, Univ. of Calcutta, (Unpublished).
- NAWA, U. 1910. On a termite *Coptotermes gestroi* Wasm. *Konchu Sekai* 14 : 597-600.
- NOIROT, C. 1969. Formation of castes in the higher termites. In *Biology of Termites* (Ed. by K. Krishna and F.M. Weesner), Vol. 1 : 311-350. New York and London (Academic Press).
- NOIROT, C. 1970. The nests of termites. In *Biology of Termites* (Ed. by K. Krishna and F.M. Weesner), Vol. 2 : 73-125. New York and London (Academic Press).
- OSHIMA, M. 1910. On the Formosan termites. (In Japanese.) *Dobust. Zasshi*, 22 : 343-346; 376-382 and 411-413.
- OSHIMA, M. 1914a (Jan. 16). Two species of termites from Singapore. *Philipp. J. Sci.*, (D) 8(4) (1913) : 283-286.
- OSHIMA, M. 1914b (Dec. 25). Notes on a collection of termites from the East Indian Archipelago (Malaya and the Philippines). *Annot. zool. Jap.*, 8 : 553-585, 2 pls.
- OSHIMA, M. 1914c. On *Coptotermes* of Hong Kong., [In Japanese] *Rept. Res. White Ants.*, Taihoku, 4 : 7-9.
- OSHIMA, M. 1914d. On the white ants of Singapore. [In Japanese] *Rept. Res. White Ants.*, Taihoku, 4 : 10-16.
- OSHIMA, M. 1914e. Studies on the termites of Indian Archipelago. [In Japanese] *Rept. Res. White Ants.*, Taihoku, 4 : 17-52.
- OSHIMA, M. 1915. White ants of the Philippine Islands. [In Japanese] *Rept. Res. White Ants.*, Taih, 5 : 41-54.
- OSHIMA, M. 1916 (Nov.). A collection of termites from the Philippine Islands. *Philipp. J. Sci.*, (D) 11(6) : 351-369, 2 pls.
- OSHIMA, M. 1917a (July). Notes on a collection of termites from Luzon obtained by R.C.McGregor. *Philipp. J. Sci.*, (D) 12(4) : 221-225.
- OSHIMA, M. 1917b. *Sixth Report on Termite Investigations*. [In Japanese.] : 175 pp., 13 pls. Taihoku.
- OSHIMA, M. 1917c. Two species of termites from Foochow, China. *Coll. Essays for Y Nawa*, 1917 (Ed. by K. Nagano) : 5-7.
- OSHIMA, M. 1920 (Nov.). Philippine termites collected by R.C. McGregor, with descriptions of one new genus and nine new species. *Philipp. J. Sci.*, 17(5) : 489-512, 4 pls.
- OSHIMA, M. 1923 (Apr.). Fauna Simulurensis. Termitidae. *Capita Zool.*, 2(3) : 1-22.
- PING, Z.M. 1985. Eight new species of the genus *Coptotermes* and *Reticulitermes* from Guangdong province, China. *Entomotaxonomia*, 7 (4) : 326-328.
- PING, Z.M. et. al. 1983. Four new species of the termites from Guizhou Province, China, (Isoptera : Rhinotermitidae). *Entmotaxon.*, 5 (2) : 151-157.

- PING, Z.M. 1984. Two new species of the genus *Coptotermes* (Isoptera : Rhinotermitidae) *Trop-Subtrop. For. Ecosys.*, 2 : 184-189.
- PING, Z.M. AND XU, Y. 1986. Trunk-dwellers termites and five new specis from Guizhou Province, China. *Scientia silvae sjnicae*. 22 (2) : 156-160.
- PING, Z.M. AND XU, Y. 1989. Systematics on the genus *Prorhinotermes* Silvestri (Isoptera : Rhinotermitidae : Prorhinotermitinae) from China. *Acta Ent. Sinica*, 32(3) : 330-335.
- PARIHAR, D.R. 1978. Field observations on the nature and extent of damage by Indian Desert termites and their control. *Annals Arid Zone*, 17(2) : 192-199, 2 pls.
- PARIHAR, D.R. 1980. Termite problem in desert plantations. *Annals Arid Zone*, 19(3) : 329-334.
- PARIHAR, D.R. 1981. Some observations on distribution and pest status of termites attacking forestry plantations in the Rajasthan Desert. *Indian J. Forestry*, 4(1) : 22-25.
- QUENNEDEY, A. AND DELIGNE, J. 1975. L'arme frontale des soldat de termite. I. Rhinotermitidae. *Insectes Sociaux*, 22(3) : 243-267. (Also a new subfam. Prorhinotermitinae.)
- RAJAGOPAL, D. 1983. Habit and habitat studies of some termites from Karnataka. *J. Soil Biol. Ecol.*, 3(2) : 100-121.
- RAO, H., SRINIVASA. 1957. History of our knowledge of the Indian fauna through the ages. *J. Bombay nat. Hist. Soc.*, 54(2) : 251-280, 2 pls.
- RATTAN LAL, AND MENON, R.D. 1953. *Catalogue of Indian Insects*. Part 27. *Isoptera*. 4 + 94 pp. Delhi (Govt. of India Press).
- REDDY, M.V. 1980. Structural wood destroying activity of *Coptotermes kishori* Roonwal and Chhotani at Nagaland. *Abstrs. Papers 5th All India Congr. Zool.* (Bhopal, Nov. 1980) : 95.
- ROONWAL, M.L. 1953 (June). Systematics of oriental termites. No. 1.A new species of termite, *Heterotermes gertrudae*, sp. nov., from North India. (Isoptera, Family Rhinotermitidae). *Indian J. Ent.*, 15(2) : 115-118.
- 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.*, 52 : 463-467, 1 pl.
- ROONWAL, M.L. 1954b. A list of insect pests of forest plants in India and the adjacent countries. (Arranged alphabetically according to plant genera and species, for the use of forest officers.) Part 1. General Introduction. *Indian Forest Bull. (N.S.) (Ent.)*, No. 171 (1) : 1-4.
- ROONWAL, M.L. 1954c. A brief review of the progress of entomology in India during the period 1938-1950, together with a bibliography. *Mem. ent. Soc. India*, No. 3 : 1-119.
- ROONWAL, M.L. 1955. Termites ruining a township. *Z. angew. Ent.*, 38(1) : 103-104.
- ROONWAL, M.L. 1956a. External genitalia of termites (Isoptera). *J. zool. Soc. India*, 7(2) (1955) : 107-114.
- ROONWAL, M.L. 1956b. Isoptera. In *Taxonomist's Glossary of Genitalia in Insects* (Ed. by S.L. Tuxen), pp. 34-38. Copenhagen (S. Munksgaard).

- ROONWAL, M.L. 1958. Recent work on termite research in India (1947-57). *Trans. Bose Res. Inst.*, **22** : 77-100, 4 pls.
- ROONWAL, M.L. 1959. Biology and ecology of oriental termites (Isoptera). No. 4. The drywood termite *Coptotermes heimi* (Wasm.) in India. *J. Bombay nat. Hist. Soc.*, **56**(3) : 511-523, 3 pls.
- ROONWAL, M.L. 1962a. Address by the President. In *Termites in the Humid Tropics* (Proc. New Delhi Sympos. 1960) : 9-11. Paris (Unesco).
- ROONWAL, M.L. 1962b. Recent developments in termite systematics (1949-1960). In *Termites in the Humid Tropics* (Proc. New Delhi Symp., 1960) : 31-50. Paris (Unesco).
- ROONWAL, M.L. 1964. Termite measurements and indices. In *Etudes sur les Termites Africains* (Un Coloq. Int. Unesco, Leopoldville (Univ. Lovanium) : 69-75. Paris (Masson et Cie).
- ROONWAL, M.L. 1970a. Termites of the Oriental region. In *Biology of Termites* (Ed. by K. Krishna and F.M. Weesner), Vol. 2 : 315-391. New York and London (Academic Press).
- ROONWAL, M.L. 1970b. Measurements of termites (Isoptera) for taxonomic purposes. *J. zool. Soc. India*, **21**(1) (1969) : 9-66.
- ROONWAL, M.L. 1970c. Isoptera. In *Taxonomist's Glossary of Genitalia in Insects* (2nd Ed.). (Ed. by S.L. Tuxen), pp. 41-46. Copenhagen (S. Munksgaard).
- ROONWAL, M.L. 1972a. Papillae on tibial spines and spurs in the termite *Mastotermes darwiniensis*. *Sci. & Culture*, **38**(5) : 255.
- ROONWAL, M.L. 1972b. Opening remarks by the Chairman. In *Termite Problems in India* (Ed. by M.L. Roonwal) : vii - viii. New Delhi (Counc. sci. & ind. Res.).
- ROONWAL, M.L. (Ed. by). 1972c. *Termite Problems in India*. (A symposium held under the auspices of the Biological Research Committee, Council of Scientific and Industrial Research, New Delhi, March, 1970.) : viii + 81 pp. New Delhi (Counc. sci. & ind. Res.).
- ROONWAL, M.L. 1973. On a new phylogenetically significant ratio (Width/Length in termite eggs (Isoptera). *Abstrs. Sympos. Orient. Ent.*, (Calcutta, Nov., 1973) : 10-11.
- ROONWAL, M.L. 1974. Occurrence of papillae on tibial spines and spurs in the Australian termite, *Mastotermes darwiniensis*, with remarks on some other primitive species. *J. zool. Soc. India*, **24**(2) (1972) : 155-160.
- ROONWAL, M.L. 1975a. Phylogeny and status of termite families Stylotermitidae and Indotermitidae with three-segmented tarsi, and the evolution of tarsal segmentation in the Isoptera. *Biol. Zbl.*, **94**(1) : 27-43.
- ROONWAL, M.L. 1975b. On a new phylogenetically significant ratio (Width/Length) in termite eggs (Isoptera). *Zool. Anz.*, **195**(1-2) : 43-50.
- ROONWAL, M.L. 1975c. Sex ratios and sexual dimorphism in termites. *J. sci. & ind. Res.*, **34** : 402-416.
- ROONWAL, M.L. 1976. Field ecology and eco-biogeography of Rajasthan termites : A study in desert environment. *Zool. Jahrb. (Syst.)*, **103** : 455-504.

- ROONWAL. M.L. 1977a. Micro-sculpturing on termite wings (Isoptera), and its significance. *Proc. zool. Soc. Calcutta*, **28**(1975) : 31-39.
- ROONWAL. M.L. 1977b. Rajasthan termites (Insecta : Isoptera). In *The Natural Resources of Rajasthan* (Ed. by M.L. Roonwal), Vol. 1 : 373-379, 1 pl. Jodhpur (Univ. of Jodhpur).
- ROONWAL. M.L. 1977c. Termite ecology in the Indian Desert ecosystem. A review of recent work. In *Desert Eco-System and Its Improvement* (Ed. H.S. Mann) : 323-328. Jodhpur (Central Arid Zone Res. Inst., Monogr. No. 1).
- ROONWAL. M.L. 1978a. Bioecological and economical observations on termites of Peninsular India. *Z. angew. Ent.*, **85**(1) : 15-30.
- ROONWAL. M.L. 1978b. Termites from the Himalaya. (In Symposium on Impact of Man on the Mountain Ecosystem, Agra 1976.) *Mem. School of Ent.*(St. John's College, Agra), No. 6 : 101-106.
- ROONWAL. M.L. 1978c. Field data on intraspecific variability in mound construction and nesting habits in termites and its ecological relationships. *Proc. Indian natnl. Sci. Acad.*, (B) **43**(5) (1977) : 159-174 (2 pls.)
- ROONWAL. M.L. 1979a. Termite damage to railway coaches in India. (*Coptotermes heimi*). *Indian J. Forestry*, **2**(4) : 307-310.
- ROONWAL. M.L. 1979b. *Termite Life and Termite Control in Tropical South Asia*. xii + 177 pp., 8 pls. Jodhpur (Scientific Publishers).
- ROONWAL. M.L. 1981a. Evolution and systematic significance of wing micro-sculpturing in termites (Isoptera). XI. Some hitherto unstudied genera and species in five families. *Proc. Indian natn. Sci. Acad.*, (B) **47** : 467-473.
- ROONWAL. M.L. 1981b. Termites of agricultural importance in India and their control. In *Progress in Soil Biology and Ecology in India* (Ed. by G.K. Veeresh) : 253-265. Bangalore (Univ. Agric. Sci.).
- ROONWAL. M.L. 1982a. The identity of two economically important termites, *Heterotermes gertrudae* and *H. indicola* (Rhinotermitidae) from India. *Bull. Ent.*, **23** : 1-4.
- ROONWAL. M.L. 1982b. The termite *Heterotermes indicola* as a pest of the vegetable Karela or bitter gourd (*Momordia charantia*) in the Indian Desert. *Ann. Arid Zone*, **21**(3) : 131-133.
- ROONWAL. M.L. 1982c. Fauna of the Great Indian Desert. Past and present composition, zoogeography, ecology, biology, physiology and conservation. In *Desert Resources and Technology* (Ed. by Alam Singh), Vol 1 : 1-86 (8 pls.). Jodhpur (Scientific Publishers and Geotech-Academia).
- ROONWAL, M.L. 1983a. The ecology of termite swarming in the Indian Desert. In *Insect Interrelations in Forest and Agroecosystem* (Ed. by P.K. Sen-Sarma, S.K. Sangal and S.K. Kulshrestha) : 9-13. DehraDun (Jugal Kishore & Co.).
- ROONWAL. M.L. 1983b. Universal occurrence of external cuticular, microscopic papillae and allied structures as an essential character of termites (Isoptera, Insecta), and redefinition of the order. *Zool. Anz.*, **211** (1-2) : 137-144.
- ROONWAL. M.L. 1983c. Evolution and systematic significance of wing micro-sculpturing in termites. XIII. Order Isoptera. *Proc. Indian natn. Sci. Acad.*, (B) **49**(5) : 359-391 (4 pls.).

- ROONWAL, M.L. 1984. The abdomen, genitalia and accessory structures in termites (Isoptera). *Mem. ent. Soc. India*, No. 9 : 1-79.
- ROONWAL, M.L. 1985a. Wing microsculpturing in termites (Isoptera) under the scanning electron microscope. *Zool. Anz.*, 215 (3-4) : 219-230.
- ROONWAL, M.L. 1985b. Scanning electron microscopic studies of wing microsculpturing in termites (Isoptera). I. Genera *Heterotermes* and *Microtermes*. *Proc. Indian natnl. Sci. Acad.*, (B) 51 (1) : 6-14 (4 pls.).
- ROONWAL, M.L. 1985c. The Har Swarup Memorial Lecture. Recent researches on wing microsculpturing in termites (Isoptera), and its evolutionary and biological significance. *Proc. Indian natnl. Sci. Acad.*, (B)51(2) : 135-168 (12 pls.).
- ROONWAL, M.L. 1986. Second contribution to wing microsculpturing in termites (Isoptera) under the scanning electron microscope. *Zool. Anz.*, 216 : 81-89.
- ROONWAL, M.L. 1988. Field ecology and soldier polymorphism in the Indian Sand Termite, *Psammotermes rajasthanicus* (Rhinotermitidae, Psammotermitinae). *Indian J. Ent.*, 47(4) : 455-460.
- ROONWAL, M.L. AND BOSE, G. 1960 (July). A new termite, *Psammotermes rajasthanicus* sp. nov. from Rajasthan, India. *Sci. & Culture*, 26(1) : 38-39.
- ROONWAL, M.L. AND BOSE, G. 1962 (Dec. 28). An African genus *Psammotermes* in Indian termite fauna, with fuller description of *P. rajasthanicus* from Rajasthan, India, *Rec. Indian Mus.*, 58(3-4)(1960) : 151-158, 2 pls.
- ROONWAL, M.L. AND BOSE, G. 1964. Termite fauna of Rajasthan, India. *Zoologica*, 40(3)(Heft 113) : VI + 58 pp., 5 pls.
- ROONWAL, M.L. AND BOSE, G. 1965. Zoogeography of Andaman and Nicobar termites. *Bull. syst. Zool.*, 1(1) : 3-4.
- ROONWAL, M.L. AND BOSE, G. 1969. Fauna of Rajasthan., India. Part 4. A check-list of Rajasthan termites (Insecta : Isoptera). *Rec. Zool. Surv. India*, 61(3-4)(1963) : 437-450d, 4 pls.
- ROONWAL, M.L. AND BOSE, G. 1970a (Oct.). Taxonomy and zoogeography of the termite fauna of Andaman and Nicobar Island, Indian Ocean. *Rec. zool. Surv. India*: 62(3-4) (1964) : 109-170d, 4 pls.
- ROONWAL, M.L. AND BOSE, G. 1970b. Scaly serrations on spines and apical spurs of tibia in the Himalayan Termite *Archotermopsis wroughtoni*. *Sci & Cult*, 36(12) : 673.
- ROONWAL, M.L. AND CHHOTANI, O.B. 1960a. The apical tibial spur formula in the termite genus *Coptotermes*. *J. zool. Soc. India*, 11(2)(1959) : 125-132.
- ROONWAL, M.L. AND CHHOTANI, O.B. 1962a (Aug. 26). Termite fauna of Assam region, eastern India. *Proc. natn. Inst. Sci. India*, (B)28(4) : 281-406, 26 pls.
- ROONWAL, M.L. AND CHHOTANI, O.B. 1962b (Nov.). Indian species of Termite Genus *Coptotermes*, ix+115 pp. (18 pls.). Delhi (*Indian Coun. Agric. Res., Ent. Monogr.* No. 2), [Manager of Publ. Govt of India].
- ROONWAL, M.L. AND CHHOTANI, O.B. 1977. Ergebnisse der Bhutan Expedition 1972 des Naturhistorischen Museums Basel. Isoptera Isoptera (termites). *Entomologica Basiliensia*, 2 : 39-84.

- ROONWAL, M.L. AND CHHOTANI, O.B. AND BOSE, G. 1962. Some recent zoogeographical findings in Indian termites. In *Termites in Humid Tropics* (Proc. New Delhi. Sympos., 1960) : 51-54, 1 pl. Paris (Unesco).
- ROONWAL, M.L. CHHOTANI, O.B. AND VERMA, S.C. 1981. Evolution and systematic significance of wing microsculpturing in termites (Isoptera). X. Subfamily Nasutitermitinae of family Termitidae. *Proc. Indian natnl. Sci. Acad.*, (B) 47(3) : 341-369 (3 pls.).
- ROONWAL, M.L. AND KRISHNA, K. 1955. Systematics of oriental termites. II. A new species, *Coptotermes gaurii*, from Ceylon. *Indian J. agric. Sci.* 25(2) : 143-152.
- ROONWAL, M.L. AND MAITI, P.K. 1966. Termites from Indonesia, including West Irian. *Treubia*, 27(1) : 63-140.
- ROONWAL, M.L. AND PANT, G.D. 1953. A Systematic Catalogue of the Main Identified Entomological Collection at the Forest Research Institute, DehraDun. Part 9. Isoptera. *Indian Forest Leaflet* (Ent.), No. 121(3) : 39-60.
- ROONWAL, M.L. AND RATHORE, N.S. 1977. Third study of evolution and systematic significance of wing microsculpturing in termites : Micrasters in some Rhinotermitidae and Termitidae. *Zool. Anz.*, 198(5-6) : 298-312.
- ROONWAL, M.L. AND RATHORE, N.S. 1979. Egg-wall sculpturing and micropylar apparatus in some termites and their evolution in the Isoptera. *J. zool. Soc. India*, 27(1-2) (1975) : 1-17.
- ROONWAL, M.L. AND RATHORE N.S. 1982. Evolution and systematic significance of wing-microsculpturing in termites (Isoptera). XII. Sculpturing on wing scales. *Proc. Indian natnl. Sci. Acad.*, (B) 48(3) : 322-343.
- ROONWAL, M.L. AND RATHORE, N.S. 1983. Wing microsculpturing in the small house cockroach, *Supella longipalpa* (Dictyoptera, Blattidae). *Proc. Indian Acad. Sci. (Anim. Sci.)*, 92(4) : 333-342.
- ROONWAL, M.L. AND RATHORE, N.S. 1984. Wing microsculpturing in some Embioptera (Insecta), with a new type of structure and ecological and taxonomic considerations. *Indian J. Ent.*, 45 : 323-334.
- ROONWAL, M.L. AND RATHORE, N.S. 1985. Wing microsculpturing in the Brazilian termite family Serritermitidae (*Serritermes serrifer*, Isoptera), and its bearing on phylogeny. *Proc. Indian Acad. Sci. (Anim. Sci.)*, 94(4) : 399-406.
- ROONWAL, M.L. AND SEN-SARMA, P.K. 1956. Systematics of oriental termites (Isoptera) No. 3. *Zoological Survey of India. Collections from India and Burma, with new of the genera Parrhinotermes, Macrotermes, Hypotermes and Hospitalitermes*, *Indian J. agric. Sci.*, Delhi, 26(1) : 1-37.
- ROONWAL, M.L. AND SEN-SARMA, P.K. 1960(Jan.). *Contributions to the Systematics of Oriental termites*. xiv + 407 pp. (65 pls.). New Delhi (Ent. Monogr. No.1, Indian Counc. Agric. Res.).
- ROONWAL, M.L. AND THAKUR, M.L. 1963 (June). Two new species of termites (Rhinotermitidae), *Prorhinotermes shiva* and *Schedorhinotermes tiwarii*, from the Andaman Islands (Bay of Bengal). *Indian J. agric. Sci.*, 33(2) : 102-117.
- ROONWAL, M.L. AND VERMA, S.C. 1976. Imago of the wood termite *Heterotermes gertrudae* Roonwal (Rhinotermitidae : Heterotermitinae) from North-West Himalaya. *Rec. zool. Surv. India*, 69 : 241-247.

- ROONWAL, M.L. AND VERMA, S.C. 1977. Re-survey of the termite fauna of Rajasthan, India, and its zoogeography. *Rec. zool. Surv. India*, 72 : 425-480.
- ROONWAL, M.L. AND VERMA, S.C. 1983. New data on wing microsculpturing in termites (Kalotermitidae, Rhinotermitidae and Termitidae). *Ann. Ent.*, 1(1) : 27-34.
- ROONWAL, M.L., VERMA, S.C. AND BISEN, S.S. (In Press). Scanning electron microscopic studies of wing microsculpturing in termites (Isoptera). VI. Genera *Psammotermes*, *Coptotermes* and *Dolichorhinotermes* (Rhinotermitidae). *Proc. Indian natn. Sci. Acad.*
- ROONWAL, M.L., VERMA, S.C. AND RATHORE, N.S. 1974. On a new systematic character in termites, the micrasters. *Z. zool. System. u. Evolutionsforsch.*, 12(1) : 55-76.
- ROONWAL, M.L., VERMA, S.C. AND THAKUR, M.L. 1979. Evolution and systematic significance of wing microsculpturing in termites (Isoptera). VI. Family Rhinotermitidae. *Proc. Indian. natn. Sci. Acad.*, (B) 45(4) : 332-253.
- ROSEN, K. VON. 1912 (Feb. 27). Neue Termiten aus der zoologischen Staatssammlung in Munchen sowie einigen anderen Sammlungen. *Zool. Anz.*, 39 : 221-232.
- SAHA, N., ROY, P.H. and SAR, A. 2006. *Zool. Surv. India : State Fauna Series; Fauna of Andhra Pradesh* (In press).
- SAHA, N., ROY, P.H. and SAR, A. 2006. *Zool. Surv. India : State Fauna Series Fauna of Uttaranchal* (In press).
- SALIHAI, Z. 1982. The Cuticular Structures Lining the Alimentary Canal of Termites and Their Phylogenetic Significance, Ph.D. thesis, University of Punjab, Lahore, 356 pp.
- SEN-SARMA, P.K. 1974. Ecology and biogeography of the termites of India. In *Ecology and Biogeography in India* (Ed. by M.S. Mani) : 421-472. The Hague (W. Junk Publ.).
- SEN-SARMA, P.K. 1981. Recent advances in termite research in India, and future strategy. In *Progress in Soil Biology and Ecology in India* (Ed. by G.K. Veeresh) : 236-253. Bangalore (Univ. Agric. Sci.).
- SEN-SARMA, P.K. AND CHATTERJEE, P.N. 1965. Colony foundation through substitute reproductives in *Heterotermes indicola* (Wasmann) under laboratory conditions (Insecta : Isoptera). *J. Timber Develop. Assoc.*, 11(3) : 9-11, 1 pl.
- SEN-SARMA, P.K. AND MISHRA, S.C. 1978. Population of soldiers in termite colonies (Insecta : Isoptera). *Abstrs. Sympos. Ecol. of anim. Popul.* (Calcutta, Oct. 1978) : 68-69.
- SEN-SARMA, P.K. AND THAKUR, M.L. 1978. Population ecology of Indian termites. *Bull. Ent.*, 19 : 89-99.
- SEN-SARMA, P.K. AND THAKUR, M.L. 1979 (Feb.). Termites of Tripura (Insecta : Isoptera). *Indian Forest Rec. (N.S.) (Ent.)*, 13(1) : i-ii + 1-67 11 pls.
- SEN-SARMA, P.K. AND THAKUR, M.L. 1980. On a collection of termites of Kumaon Hills, Uttar Pradesh, India (Insecta : Isoptera). *Indian Forest Rec. (N.S.) (Ent.)*, 14(1) : 1 + 1-30.
- SEN-SARMA, et al. 1975. *Wood Destroying Termites of India (Final Tech. Rep. PL. 480 Project A7-FS-58)* vii + 187 + 2 pp.
- SHIRAKI, T. 1909. [On the Japanese Termites] *Trans. ent. Soc. Japan*, 2 : 239-240.

- SILVESTRI, F. 1914 (July). Zoological results of the Abor Expedition, 1911-12. XXXII. Termitidae. *Rec. India Mus.*, 8(5) : 425-435.
- SILVESTRI, F. [In J.B. BATHELLIER]. 1927. [New species of termites from Indo-China.] In *Contributions a l' etude systematique et biologique des termites de l' Indochine*. (Fauna colonie Fr.), Paris, : 1 + 121-365 + 3. (New termites, pp. 132, 175, 177, attributed by Bathellier to Silvestri.)
- SILVESTRI, F. 1939. *Compendio di Entomologia Applicata (Agraria Forestale-Medica-Veterinaria)*. Vol. 1 (2), *Parte speciale*, : 449-974. Portici (Tipographia Bellavista).
- SJÖSTEDT, Y. 1900 (Apr. 11). Monographie der Termiten Afrikas. *K. Sven. Vet. Akad. Handl.*, 34(4) : 1-236, 9 pls.
- SJÖSTEDT, Y. 1904 (Sept. 3). Monographie der Termiten Afrikas. *K. sven. Vet. Akad. Handl.*, 38(4) : 1-120, 4 pls.
- SJÖSTEDT, Y. 1911. Termitidal noval a Cl. Dom. Maurice de Rothschild ex Aethiopia reportatae. *Ent. Tidskr.*, 32(3-4) : 171-172.
- SJÖSTEDT, Y. 1925. Nevue Termiten aus Africa und Madagascar. *Konowia*, 4(1 & 2) : 53-55.
- SJÖSTEDT, Y. 1926. Revision der Termiten Afrikas. 3. Monographie. *K. sev. Vet. Akad. Handl.*, (3) 3(2) : 1-419, 16 pls.
- SMEATHMAN, H. 1781. Some account of the termites which are found in Africa and other hot climates. *Trans. Philos. roy. Soc. Lond., London*, 71(1) : pp. 139-192, 4 pls.
- SNYDER, T.E. 1920. Two new termites from Arizona. *Proc. Ent. Soc.*, Washington, 22(2) : 38.
- SNYDER, T.E. 1924. Description of new species and hether to unknown castes of termites from America and Hawaii. *Proc. U.S. nat. Mus.*, 64(6) : 1-40.
- SNYDER, T.E. 1925. Notes on fossil termites with particular reference to Florissant Colorado. *Proc. Biol. Soc. Washington*, 38 : 149-166.
- SNYDER, T.E. 1926. Termites collected on the Mulford Biol. Expl. of the Amazan Basin 1921-1922. *Proc. U.S. Nat. Mus.*, 68(14) : 1-76.
- SNYDER, T.E. 1933a. New termites from India. *Proc. U.S. natn. Mus.*, 82(16) : 1-15, 1 pl.
- SNYDER, T.E. 1933b. Two new termites from India. *Proc. Biol. Soc. Washington*.
- SNYDER, T.E. 1934. New termites from India. *Indian Forest Rec.*, 20(11) : 1-28.
- SNYDER, T.E. 1935. *Our Enemy. The Termite*. xii + 196 pp., 10 pls. Ithaca, N.Y.(Comstock Publ. Co.).
- SNYDER, T.E. 1948. *Our Enemy, the Termite*, (Rev. ed.), xiii + 257 pp., Frontpce. London (Constable & Co.); Ithaca, N.Y. (Comstock Publ. Co.).
- SNYDER, T.E. 1949, Catalog of the termites (Isoptera) of the world. *Smiths. Misc. Coll.*, 112 : 1-490.
- SNYDER, T.E. 1956. Annotated subject-heading bibliography of termites : 1350 B.C. to A.D. 1954. *Smiths. misc. Coll.*, 130 : iv + 305 pp.
- SNYDER, T.E. 1961. Supplement to the annotated subject heading bibliography of termites, 1955 to 1960. *Smiths. misc. Coll.*, 143(3), 4 + 137 pp.

- SNYDER, T.E. 1968. Second supplement to the annotated subject heading bibliography of termites, 1961-65. *Smiths. misc. Coll.*, 152(3) : 4 + 188.
- SNYDER, T.E. and FRANZIA, C. 1960. A summary of Philippines termites with supplementary biological notes. *Philippine J. Sci.*, 89(1) : 63-77.
- SU, N. AND TAMASHIRO, M. 1987. An overview of the formosan subterranean termite (Isoptera : Rhinotermitidae) in the world. In *Biology and Control of the Formosan Subterranean Termite*, (Proc. int. Symp. Formosan Subterr. Termite, 67 Mtg. Pacif. Ent. Soc. of America). Honolulu, Hawaii, 1985) : 3-14.
- THAKUR, M.L. 1975c. Zoogeography of termites of north-western Himalayan region. *Indian Forester*, 101(6) : 341-345, 2 pls.
- THAKUR, M.L. 1978b. The problem of termite damage in poplars in the bhabar-tarai region of Uttar Pradesh. *Indian J. Forestry*, 1(3) : 217-222, 2 pls.
- THAKUR, M.L. 1980b. Ecobiogeography of termites of the Indian arid ecosystem. *Sociobiology*, 5 : 115-131.
- THAKUR, M.L. AND SEN-SARMA. P.K. 1979. Revision of termite genus *Heterotermes* Froggatt (Isoptera : Rhinotermitidae : Heterotermitinae) from the Indian Region. *Indian Forest Rec. (N.S.) (Ent.)*, 13(2) : 1 + 1 + 1-27.
- THAKUR, M.L. AND SEN-SARMA. P.K. 1980. A flourishing colony of *Coptotermes heimi* (Insecta : Isoptera) in a naval boat. *J. Bombay nat. Hist. Soc.*, 76(1979) : 188-189.
- THAKUR, M.L. AND THAKUR, R.K. 1992. Termites fauna of Krakatau and associated islands, Sunda Straits, Indonesia. *Freubia*, 30(3) : 213-317.
- THAKUR, R.K. 1984. Additions to the termite fauna of the Thar Desert. *J. Bombay nat. Hist., Soc.*, 81(2) : 496-497.
- THAKUR, R.K. 2001. Termite fauna of Gujarat (Insecta : Isoptera). *Indian For. Rec. (Ent)*, (NS), 15(1) : 1-75.
- THAKUR, M.L. and SEN-SARMA, P.K. 1979. Revision of termite genus *Heterotermes* Froggatt (Rhinotermitidae) from the Indian Region. *Indian For. Rec. (N.S.) (Ent)* 13(2) : 1-27.
- THAPA, R.S. 1982. Termites of Sabah. *Sabah For. Rec.*, No. 12 : iv + 374.
- TOXOPEUS, L.J. 1950. Over de pionier fauna van Anak Krakatau, met enige beschouwingen over het ontstaan van de Krakatau-fauna-chron. *Nat. Djakart* 106(1) : 27-34.
- TRUCKENBRODT. W. 1971. Untersuchungen am Ei-Chorion der Termite *Kalotermes flavicollis* Fabr. unter normalen Bedingungen und nach Behandlung des Weibchens mit Cobcemicid (Insecta, Isoptera). *Z. Moroh. Tiere.*, 69 : 48-81.
- TSAI. P.H. AND CHEN. N.S. 1963 (May). Termites from South China. [In Chinese, with English summary.]. *Acta ent. Sinica*, 12 : 167-198.
- TSAI. P.H. AND CHEN. N.S. 1964. Problems on the classification and fauna of termites in China. *Acta ent. Sinica*, 13(1) : 25-37.
- TSAI. P.H. AND HUANG, F.S. 1980. *The Chinese Termites*. [In Chinese.] 56 pp. Peking (Science Press, Academia Sinica).

- TSAI, P.H. AND HUANG, F.S. 1982. *Parrhinotermes khasii ruiliensis* sp. nov. from China, with notes on the distribution of the genus *Parrhinotermes* Holmgren (Isoptera : Termitidae). [In Chinese with English summary.] *Acta ent. Sinica*. **25** : 306-310.
- TSAI, P.H. AND HUANG, F.S. 1983. A taxonomy of the subfamily Heterotermitinae. (In Chinese). *Acta Ent. Sinica*, **26** : 43-436.
- TU.T. 1975. The termites of Formosa. *Formosan Sci.*, **9** : 80-87.
- TUXEN, S.L. (Ed. by). 1956. *Taxonomist's Glossary of Genitalia in Insects* (2nd Ed.). 359 pp. Copenhagen (E. Munksgaard).
- VERMA, S.C. 1980. Termites (Insecta : Isoptera). In *Fauna of Corbett National Park* (by B.S. Lamba and R.K. Bhatnagar). *Cheetal*, **21**(2-3) : 45-46.
- VERMA, S.C. 1984 (Dec.) On a collection of termites (Insecta : Isoptera) from Kerala (India) with a new species and keys to the Indian species of *Angulitermes* Sjostedt. *Rec. zool. Surv. India*, **81**(3-4) : 237-254.
- VERMA, S.C. 1985. On a collection of termites (Insecta : Isoptera) from Kerala (India) with a new species of *Pseudocapritermes* Kemner (Part II). *Indian J. Forestry*, **8**(3) : 176-183. (Errata in *Indian J. Forestry*, **8**(4) : 341, 1985).
- VERMA, S.C. AND THAKUR, R.K. 1976. On the occurrence of *Heterotermes gertrudae* Roonwal (Isoptera : Rhinotermitidae : Heterotermitinae) in Dehra Dun Valley, Uttar Pradesh, India. *Newslet. zool. Surv. India*, **2**(4) : 140.
- VERMA, S.C. AND THAKUR, R.K. 1977a. New records of termites (Insecta : Isoptera) from Pune, Maharashtra, India. *Newslet. zool. Surv. India*, **3**(5) : 259-264.
- VERMA, S.C. AND THAKUR, R.K. 1977b. New records of termites (Insecta : Isoptera) from Bihar and Orissa, India. *Newslet. zool. Surv. India*, **3**(5) : 361-365.
- VERMA, S.C. AND THAKUR, R.K. 1982. Termites from Madhya Pradesh, India, with new distributional records. *Rec. zool. Surv. India*, **79**(3-4) : 311-318.
- VISHNOI, H.S. 1957. The swarming termites of Delhi. *J. Bombay nat. Hist. Soc.*, **54** : 792-793.
- VISHNOI, H.S. 1962. A review of termite fauna from Delhi and its environs. In *Termites in the Humid Tropics* (Proc. New Delhi Sympos., 1960) : 107-109. Paris (Unesco).
- WALKER, F. 1853. *List of Specimens of Neuropterous Insects in the Collection of the British Museum*. Pt. 3. (Termitidae-Ephemeridae). 4 + 477-585 pp. London (Brit. Mus. Nat. Hist.).
- WASMANN, E. 1893 (Sept. 10). Einige neue Termiten aus Ceylon und Madagaskar, mit Bemerkungen über deren Gaste. *Wien. ent. Ztg.*, **12**(7) : 239-247.
- WASMANN, E. 1894. *Kritisches Verzeichnis der myrmekophilen und termitophilen Arthropoden. Mit Angabe der Lebensweise und mit Beschreibung neuer Arten*. xvi + 231 pp. Berlin.
- WASMANN, E. 1897. Viaggio di Leonardo Fea in Birmania e regione vicine. LXXVII. Einige neu termitophile Myrmedonien aus Birma. *Annali Mus. civ. Stor. nat. Genova*, **38** (Ser. 2. Vol. 18) : 28-31.
- WASMANN, E. 1899. Neue Termitophilen mit einer übersicht über die Termitengaste. *Verh. zool.-bot. Ges. Wien.*, **49** : 647-658.

- WASMANN, E. 1902 (July). Verzeichnis der von Dr. W. Horn auf Ceylon 1899 gesammelten Termiten, Termitophilen und Myrmekophilen. *Deutsch. ent. Z.*, **46**(1) : 79-80.
- WASMANN, E. 1905. Die phylogenetische Umbildung ostindischer Ameisengaste und Termitengaste. *C.R. 6th Congr. int. Zool.* (Berne, 1904), **6** : 436-449, 1 pl.
- WASMANN, E. 1909. Die phylogenetische Umbildung ostindischer Ameisengaste und Termitengaste. *Mitt. schweiz., ent. Ges.*, **11** : 66-70, 1 pl.
- WASMANN, E. 1916. Wissenschaftliche Ergebnisse einer Forschungsreise nach Ostindien. V. Termitophile und myrmekophile Coleopteren, gesammelt von Prof. Dr. V. Buttel-Reepen 1911-1912. *Zool. Jb. (Syst.)*, **39**(2) : 169-210. 2 pls.
- WASMANN, E. 1925. Kritische Bemerkungen zur Kenntnis der Myrmekophilen und Termitophilen (225. Beitrag.) *Biol. Cbl.*, **45** : 136-143.
- WASMANN, E. 1934. *Die Ameisen, die Termiten und ihre Gaste. Vergleichende Bilder aus dem Seelenleben von Mensch und Tier.* xviii + 148 pp., 9 pls. Regensburg (G.I. Manz).
- WEESNER, FRANCES M. 1960. Evolution and biology of termites. *Annual Rev. Ent.*, **5** : 153-170.
- WEESNER, FRANCES M. 1970. Termites of the Nearctic Region. In *Biology of Termites* (Ed. by K. Krishna and F.M. Weesner), Vol. 2 : 477-525. New York & London (Academic Press).
- WEIDNER, H. 1955. Körperbau, Systematik und Verbreitung der Termiten. In *Die Termiten.* (Ed. by H. Schmidt) : 5-81. Leipzig (Akad. Verlagsges. Geest & Portig).
- WEIDNER, H. 1958. Termites (Isoptera) aus dem Irak. *Ent. Mitt. zool. Mus. Hamburg*, No. **17** : 9-16.
- WEIDNER, H. 1960. Die Termiten von Afghanistan, Iran und Irak (Isoptera). (Contribution a l'etude de la faune d' Afghanistan. 29). *Abh. u. Verh. Naturwiss. Vereins Hamburg.* (N.F.) **4**(1959) : 43-69.
- WEIDNER, H. 1966a. Betrachtungen zur Evolution der Termiten. *Deutsch. ent. Z.*, (N.F.) **13** : 323-350.
- WEIDNER, H. 1966b. Die entomologischen sammlung des Zoologischen Statesinstitut und Zoologischen Museum Hamburg. VI. Teil. Insecta. III. *Mitt. Hamburg. zool. Mus. Inst.*, **63** : 209-264.
- WEIDNER, H. 1970a. Isoptera (Termiten). In *Handb. d. Zool.*, **4** (Arthropoda), Sec. 2. (Insecta), Pt. 2 (Special), Lief. 13, No. **14** : 1-147. Berlin (W. de Gruyter & Co.).
- WEIDNER, H. 1970b. Termiten aus Nepal. In *Khumbu Himal*, **3** : 457-461. Innsbruck (Universitäts Verlag, Wagner).
- WEIDNER, H. 1976. Fortschritte in der angewandten Termitenkunde. *Z. Pflanzenkrank.*, **83**(11) : 679-698.
- WEIDNER, H. 1981. Fortschritte in der angewandten Termitenkunde, 1976-1980. *Z. Pflanzenkrank. u. Pflanzensch.*, **88**(7) : 442-460.
- WESTWOOD, J.O. 1838. *Natural History of the Insects of India.* vi + 102, pp., with pls. London.
- WILLIAMS, R.M.C. 1968. Redescriptions of two termites from Burmese amber. *J. nat. Hist.*, **2** : 547-551.

- WUC.F 1935. *Catalogus insectorum Sinensim* (Order V : Isoptera), 1 : 1-iv+217-222. Peking.
- XIA, K. AND FAN, S. 1981. Note on new species of the genus *Reticulitermes* from China (Isoptera : Rhinotermitidae). *Contr. Sanghai Inst. Ent.*, p. 192
- XIA, K. AND HE. X. 1980. A study of the Chinese *Schedorhinotermes*, with descriptions of new species (Isoptera, Rhinotermitidae). [In Chinese with English summary.] *Contrib. Shanghai Inst. Ent.*, 1980 : 173-181.
- YU. S. AND PING. C. 1964a. Studies on the faunal regions of Isoptera in China. [In Chinese with English summary.] *Acta ent. Sinica*, 13(1) : 10-24.
- YU. ST. AND PING. C. 1964b (May). Systematics of Isoptera from China. I. Descriptions of a new genus. *Operculitermes* (Rhinotermitidae, Heterotermitinae), with reference to its two new species and three new subspecies. [In Chinese, with English summary.] *Acta ent. Sinica*, 13(3) : 344-361.
- ZHU, J.L. *et al.* 1984. A new species of *Coptotermes* (Isoptera : Rhinotermitidae). *Acta Zootax. Sinica* 91 : 90-94.