



**TROPICAL
PEST
BULLETIN
7**

**A taxonomic and biometric
study of the genus
Cryptotermes (Isoptera:
Kalotermitidae)**

S Bacchus

TROPICAL DEVELOPMENT AND RESEARCH INSTITUTE

Overseas Development Administration, Foreign and Commonwealth Office

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Kalotermitidae)

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TROPICAL DEVELOPMENT AND RESEARCH INSTITUTE
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Abstract

The economically important genus *Cryptotermes* of the family Kalotermitidae is revised. An account is given of the habits, importance of accurate identification, purpose of numerical methods, geographical distribution of the species and a history of the genus. The external morphology of 34 species (excluding those endemic to Australia) are illustrated. The biology and comparisons of the species are outlined in general and keys are provided to imago and soldier castes and for eight species of the alate nymph 2. Five species are new to science while two species are reinstated from synonymy; one species is regarded as a junior synonym. All available types were examined and appropriate lectotypes designated. The relationships of 24 species (based on 268 individuals and 16 characters) of the imago caste, 24 species (354 individuals and 18 characters) of the soldier caste, and 11 species (131 individuals and 21 characters) of the alate nymph 2, were investigated by three numerical methods. These include principal component analysis, canonical variate analysis and cluster analysis. The results of the analyses are in broad agreement, but differ somewhat in detail. Overall, none of the methods produced a convincing classification to suggest that the genus is other than homogeneous. There is no justification for attempting to isolate any one of them. Heavily weighted morphometric characters derived from ordination were used in the diagnostic keys of the imago, soldier and alate nymph 2.

Résumé

Le genre *Cryptotermes*, économiquement important, de la famille Kalotermitidae fait l'objet d'une révision. Un compte rendu est donné des habitudes, de l'importance d'une identification précise, du but des méthodes numériques, de la distribution géographique de l'espèce et d'un historique du genre. La morphologie externe de 34 espèces (à l'exclusion de celles endémiques à l'Australie) est illustrée. La biologie et les comparaisons de l'espèce sont esquissées en général et des clés sont fournies pour les castes imago et soldat, et pour huit espèces de la nymphe ailée 2. Cinq espèces sont nouvelles à la science, tandis que deux espèces sont rétablies de la synonymie; une espèce est considérée comme un synonyme mineur. Tous les types disponibles furent examinés et des spécimens appropriés déterminant les espèces furent désignés. Les relations de 24 espèces (basées sur 268 individus et 16 caractères) de la caste imago, 24 espèces (354 individus et 18 caractères) de la caste soldat, et 11 espèces (131 individus et 21 caractères) de la nymphe ailée 2, furent examinées à l'aide de trois méthodes numériques. Ces dernières comprennent une analyse de composant principal, une analyse de variable canonique et une analyse groupée. Les résultats des analyses sont en concordance générale, mais ils diffèrent quelque peu dans le détail. En général, aucune des méthodes n'a produit une classification convaincante pour suggérer que le genre est autrement qu'homogène. Il n'y a aucune justification pour tenter d'isoler l'un d'entre eux. Des caractères morphométriques pesant lourdement dérivés d'une ordination furent utilisés dans les clés diagnostiques de l'imago, du soldat et de la nymphe ailée 2.

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INTRODUCTION

The genus *Cryptotermes* belongs to the primitive family of termites known as the Kalotermitidae and is the most economically important drywood termite. The species are capable of living in the 'wild' and in 'domestic' situations under relatively dry conditions and they commonly damage buildings, furniture, living and dead parts of trees and cellulose material (Harris, 1950, 1956, 1971; Wilkinson, 1954; Hickin, 1971). Their habit of infesting wooden articles and structures has resulted in several species being distributed to many parts of the world where they have become important as pests or potential pests (Gay, 1967, 1970; Sen-Sarma and Thakur, 1974).

The genus *Cryptotermes* was first established by Banks (1906), to include his new species *Cryptotermes cavifrons* from Florida. Subsequently, Holmgren (1910, 1911, 1912, 1913), Emerson (1925, 1928), Bathellier (1927), Light (1933), Kemner (1934), Snyder (1934), Hare (1937) and Hill (1942) regarded *Cryptotermes* as a subgenus of *Kalotermes* (= *Calotermes*). It is, however, now recognised as a genus of the family Kalotermitidae in its own right. Snyder (1949) recognised 27 species in the genus in his catalogue of the termites of the world, while Emerson (1955) recorded 33 species (including 11 new ones). Krishna (1961) listed 23 species in his revision of the Kalotermitidae while Chhotani (1970), in a revision of the oriental species, considered 26 species in the world. Gay and Watson (1982) described 12 endemic and four exotic species in a revision of the Australian *Cryptotermes*. The Tropical Development and Research Institute (TDRI), UK world list showed 40 species worldwide at the end of 1983.

A comprehensive taxonomic and biogeographic study has never been attempted for *Cryptotermes* despite its economic importance. In the present study two species, *Cryptotermes bengalensis* Snyder and *Cryptotermes naudei* Coaton which were in synonymy, are raised to species level. *Cryptotermes parasitus* (Wasmann) (i.e. imago from Mauritius) is regarded as a junior synonym of *Cryptotermes dudleyi* Banks. The imago of *Cryptotermes parasitus* from Europa Island is a misidentification and belongs to the species *Cryptotermes havilandi* (Sjöstedt). Silvestri (1941), misidentified the species *Cryptotermes havilandi* and *Cryptotermes senegalensis*. His 'cotype' (syntype) material of *C. havilandi* examined is not con-specific with the lectotype of *C. havilandi*. In the British Museum (Natural History) the material labelled *C. senegalensis* is the species Silvestri described as *C. havilandi*, so to avoid confusion in the future this labelled material and Silvestri's types in Portici (Naples) and Stockholm are renamed *Cryptotermes silvestrii* in honour of the late Professor Silvestri. Four other new species, *Cryptotermes hemicyclius*, *Cryptotermes pyrodomus*, *Cryptotermes rhinoccephalus* and *Cryptotermes kororensis*, together with *Cryptotermes silvestrii* are described here and a total of 43 species including the 12 endemic Australian species are now recognised. Keys, diagnoses and diagrams are provided below for all species except for *Cryptotermes solidus* and the 12 endemic Australian species which were fully described and illustrated by Gay and Watson (1982). Material of the species, *Cryptotermes crassicornis* (Holmgren), *Cryptotermes rospigliosi* Snyder and *Cryptotermes venezolanus* (Holmgren) were not available for study. Their type material is either lost or misplaced.

GEOGRAPHICAL DISTRIBUTION

The genus *Cryptotermes* is tropicopolitan in distribution but a few species have extended their range into subtropical regions. The origin and established introductions of the pest species are shown in Table 1 and the distribution of the 47 species in the various geographical regions are given in Table 2. The most widely distributed species are *C. brevis*, *C. cynocephalus*, *C. domesticus*, *C. dudleyi* and *C. havilandi*. All the other species are found in only one of the eight regions except *C. cavifrons* which is found in both the Nearctic and Neotropical regions of the Caribbean and Central America. Twelve species are endemic to Australia. Localities of species examined, together with the distribution records of a few species given by reputable taxonomists are shown in Figs 1-3.

Table 1

Distribution of the significant pest species of *Cryptotermes*

Species	Palae-arctic	Afro-tropical	Malagasy	Papuan	Indo-Malaysian	Nearctic	Neo-tropical	Australian
<i>C. austrinus</i> *								0
<i>C. brevis</i>	I	I	I	I	I	I	? OI	I
<i>C. bengalensis</i>					O			
<i>C. cavifrons</i>						I	O	
<i>C. cristatus</i> *								O
<i>C. cynocephalus</i>				I	OI			I
<i>C. domesticus</i>				I	OI		I	I
<i>C. dudleyi</i>		I	I	I	I		I	I
<i>C. gearyi</i> *								O
<i>C. havilandi</i>		O	I		?I		I	
<i>C. hilli</i> *								O
<i>C. merwei</i>		O						
<i>C. pallidus</i>			O					
<i>C. paplosus</i> *								O
<i>C. perforans</i>					O			
<i>C. primus</i> *								O
<i>C. queenslandis</i> *								O
<i>C. riverinae</i> *								O
<i>C. secundus</i> *								O
<i>C. tropicalis</i> *								O

*For damage see Gay and Watson (1982) under 'Biology' section of the species. For other species, see under biology of the species in text.

O = origin. I = established introductions from other regions or land masses.

Table 2

Distribution of *Cryptotermes*

Species	Palae-arctic	Afro-tropical	Malagasy	Indo-Malaysian	Papuan	Australian	Nearctic	Neo-tropical
<i>C. albipes</i>					x			
<i>C. angustinotus</i>				x				
<i>C. austrinus</i>						x		
<i>C. bengalensis</i>				x				
<i>C. brevis</i>	x	x	x	x	x	x	x	x
<i>C. canalensis</i>					x			
<i>C. cavifrons</i>							x	x
<i>C. cristatus</i>						x		
<i>C. cubicoceps</i>								x
<i>C. cynocephalus</i>				x	x	x		
<i>C. darwini</i>								x
<i>C. declivis</i>				x				
<i>C. dolei</i>					x			
<i>C. domesticus</i>				x	x	x		x
<i>C. dudleyi</i>		x	x	x	x	x		x
<i>C. fatulus</i>								x
<i>C. gearyi</i>						x		
<i>C. havilandi</i>		x	x	x				x
<i>C. hemicyclus</i>								x
<i>C. hilli</i>						x		
<i>C. karachiensis</i>				x				
<i>C. kirbyi</i>			x					
<i>C. kororensis</i>					x			
<i>C. longicollis</i>								x
<i>C. luodianis</i>				x				
<i>C. merwei</i>		x						
<i>C. naudei</i>		x						
<i>C. nitidus</i>						x		
<i>C. pallidus</i>			x					
<i>C. papulosus</i>						x		
<i>C. perforans</i>				x				
<i>C. pingyangensis</i>				x				
<i>C. primus</i>						x		
<i>C. pyrodomus</i>								x
<i>C. queenlandis</i>						x		
<i>C. riverinae</i>						x		
<i>C. roonwali</i>				x				
<i>C. rhicnocephalus</i>								x
<i>C. secundus</i>						x		
<i>C. simulatus</i>						x		
<i>C. silvestrii</i>		x						
<i>C. solidus</i>	habitat unknown							
<i>C. sukauensis</i>				x				
<i>C. sumatrensis</i>				x				
<i>C. thailandis</i>				x				
<i>C. tropicalis</i>						x		
<i>C. verruculosus</i>								x
Number of species in each region	1	6	5	16	8	16	2	13

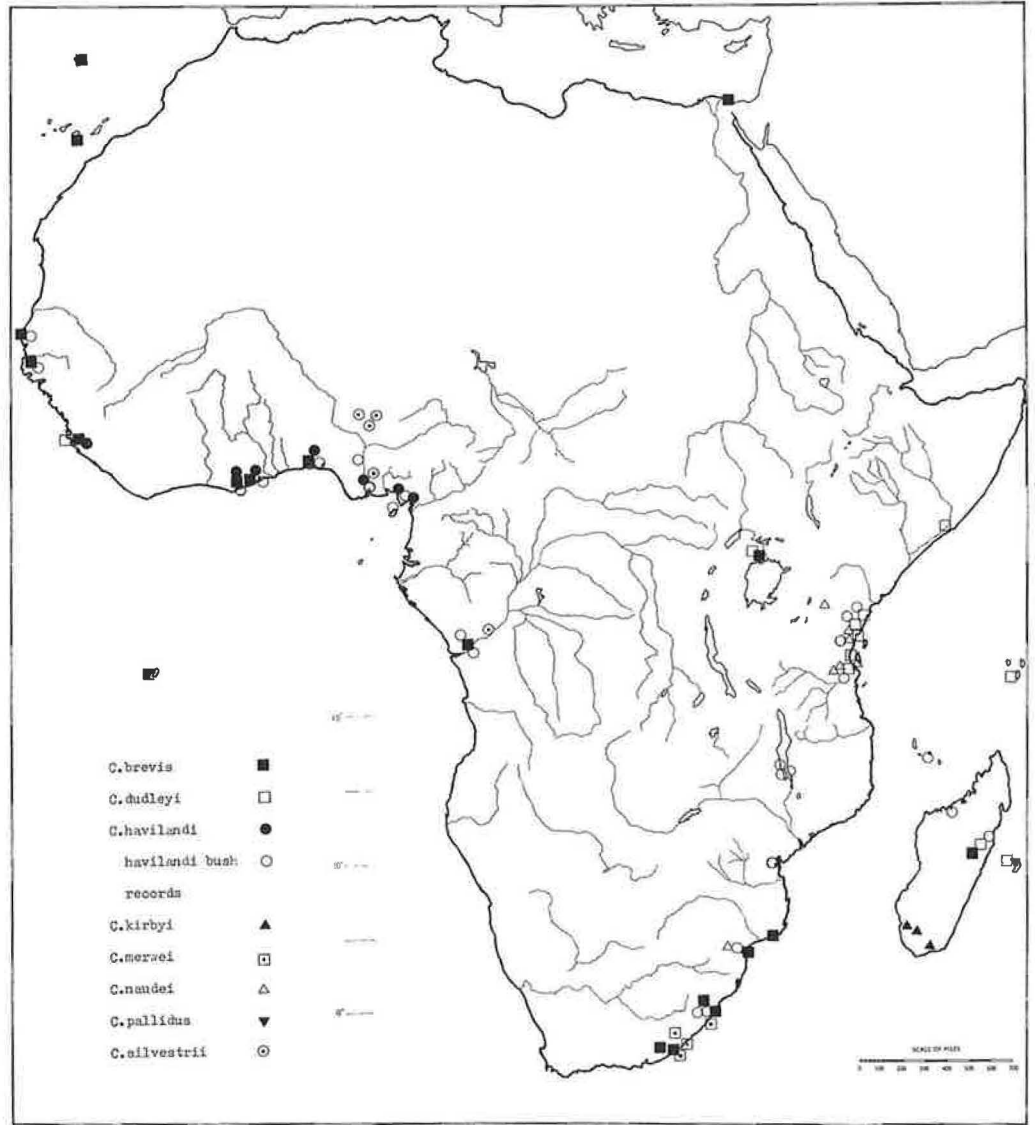


Fig. 1. The distribution of *Cryptotermes* species in the Afrotropical and Malagasy regions.

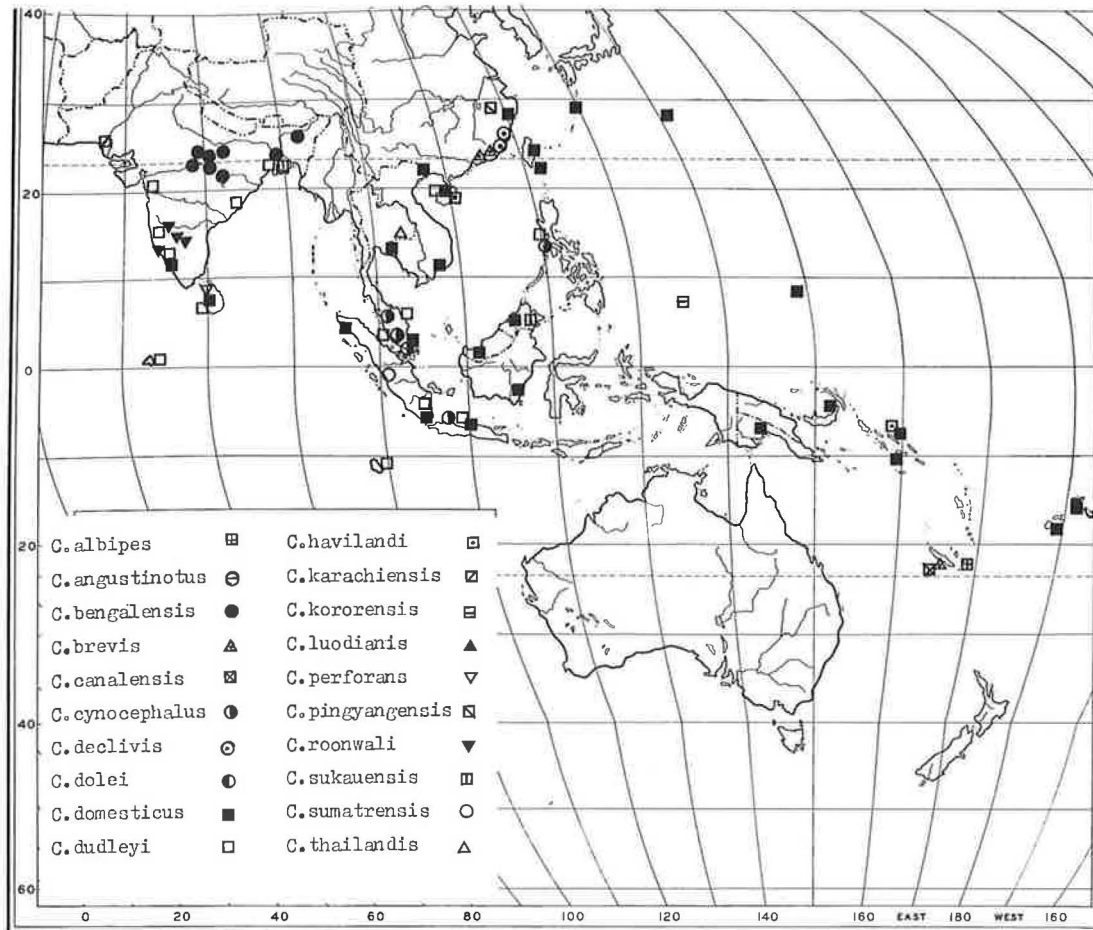


Fig. 2. The distribution of *Cryptotermes* species in the Indomalaysian and Papuan regions.

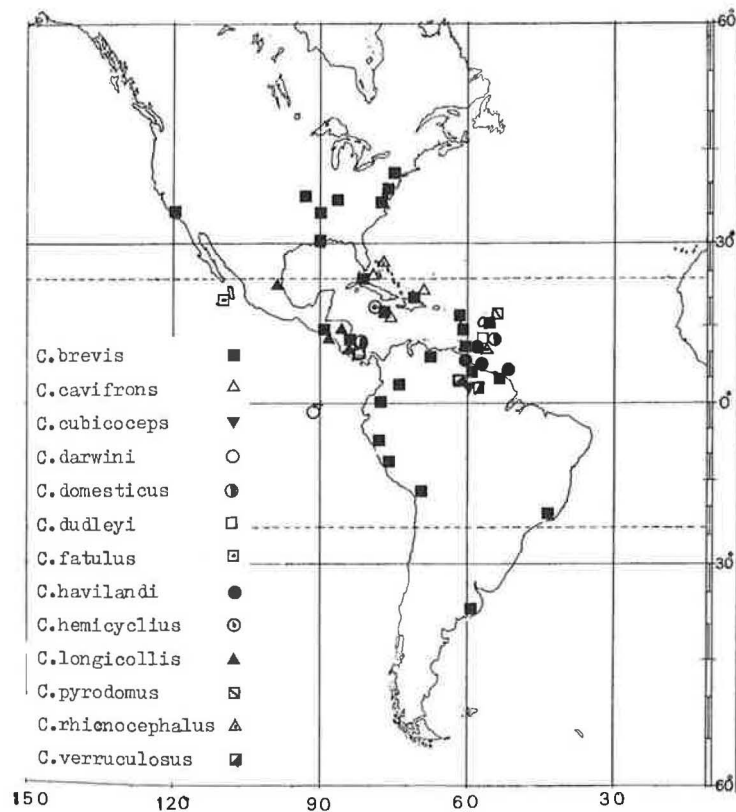


Fig. 3. The distribution of *Cryptotermes* species in the Nearctic and Neotropical regions.

MATERIAL AND DEPOSITORIES

This study is based on the examination of 896 specimens from 403 nest series of material deposited mainly in the British Museum (Natural History) (BMNH) and the American Museum of Natural History (AMNH), New York. Types and other specimens were also obtained on loan from the following museum collections:

CSIRO	Commonwealth Scientific and Industrial Research Organization, Canberra, Australia
IDEA	Istituto di Entomologia, Agraria, Portici, Naples, Italy
IZAS	Institute of Zoology, Academia Sinica, China
FRI	Forest Research Institute and College, Dehradun, India
MCZ	Museum of Comparative Zoology, Cambridge, Massachusetts, USA
MZ	Museum of Zoology, Cambridge, UK
MZUSP	Museu de Zoologia da Universidade de Sao Paulo, Brazil
NCI	Plant Protection Research Institute, Pretoria, Republic of South Africa
NR	Naturhistoriska Riksmuseet, Stockholm, Sweden
SIE	Shanghai Institute of Entomology, Academia Sinica, China
USNM	United States National Museum, Washington, DC, USA
ZI	Entomological Museum, Zoological Institute, Lund, Sweden
ZSI	Zoological Survey of India, Calcutta, India

Except where otherwise stated material examined is from the collections of the BMNH.

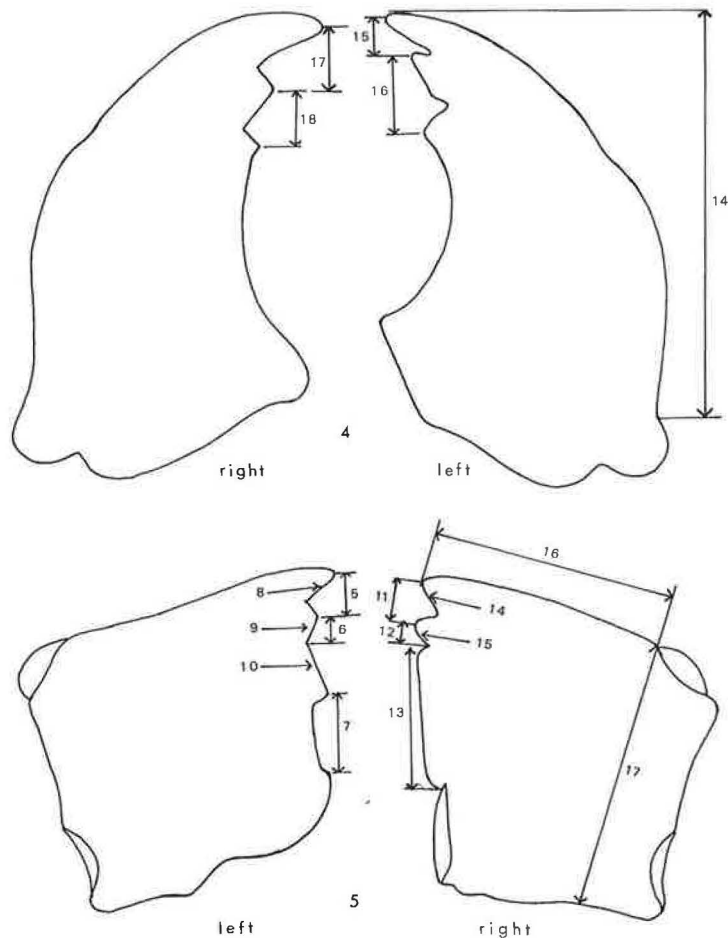
METHODS AND TERMINOLOGY

The 45 measurements for the imago, soldier and alate nymph 2 were adopted mainly from Roonwal (1969) and Sands (1972). They were carried out on a Leitz microscope attached to a Stogate logger reader and teleprinter. All measurements were instantaneously printed out and recorded on paper tape. The paper tape readings were copied on to computer files and the relationships of the species of all castes were investigated by three numerical methods, i.e. principal component analysis, canonical variate analysis and cluster analysis, carried out on CDC 6500 and Cyber 174 computers. Three analytical methods were used because no one of them can be described as the 'best' or 'most objective' way of seeking a pattern in character matrices. Each has features of logical value which contribute to a final view of the classification, but that remains a subjective choice among the alternatives offered.

In the soldier caste, the length of the head to the lateral base of the mandible was measured laterally for convenience, while, in the alate it was measured dorsally. The maximum and minimum diameter of the eye included the structure which is usually referred to as the ocular sclerite. Mandibular measurements for the soldier and alate nymph 2 are illustrated in Figs 4 and 5. In the soldier mandibles the range of measurements 0.44-0.56 mm is considered as very short; 0.57-0.69 mm as short, 0.70-0.82 mm as moderately long and 0.83-0.95 mm as long and 0.96 mm and above as very long. The alate nymph 2 was used as it is easily recognised from final moult pseudoworkers. The alate nymph 2 is the nymph before alate nymph 1, the latter after moulting gives rise to the adult (R. M. C. Williams, personal communication). All lectotypes designated have been selected from syntype series to comply with article 74 of the International Code of Zoological Nomenclature.

The terms used for colour in the descriptions are mainly from Watson and Perry (1981). Some of them, for example, dark yellowish-brown, reddish-brown, may be regarded as non-descriptive, but all specimens were identified by using a colour chart provided for the head of *Drepanotermes* soldiers (p. 118). This was found more useful for distinguishing the imagos of *Cryptotermes* than the colour charts of Kornerup and Wanscher (1967) and Smithe (1975).

All species examined have been redescribed. The descriptions are standardised for easy comparison using characters that have been found diagnostic, and omitting features that have not proved to be of taxonomic value; some of the characters were heavily weighted positively and negatively in the multivariate analyses. The figures were drawn with the aid of a drawing tube attached to a Wild M5 microscope or a Leitz microscope.



Figs 4-5. Measurements of mandibles. 4, soldier; 5, alate nymph 2.

THE GENUS *CRYPTOTERMES* BANKS

Type species: *Cryptotermes cavifrons* Banks, 1906: 336.

Diagnoses of genus

Imago. Head capsule pale yellow to dark yellowish-brown, reddish-brown, brown to dark brown, sparsely to moderately hairy; posterior margin evenly rounded from behind or from a point away from the eyes. Epicranial sutures generally present. Eyes small, round, nearly round or oval. Ocelli suboval to oval, or round, touching eye or near to eye. Antennae with 12-18 segments. Clypeus subtrapezoidal; anterior margin straight, convex or concave. Labrum broader than long. Left mandible with first plus second marginal tooth half as large at base as third marginal tooth; anterior margin of third marginal tooth twice as long as posterior margin of first plus second marginal tooth. Right mandible with posterior margin of second marginal tooth distinctly longer (one and one-half times) than molar socket. Pronotum narrower, as wide as, or slightly broader than head with eyes. Legs with three apical spurs on each tibia; tarsi four-jointed. Arolium present in a majority of species. Fore wing with all major veins arising independently at wing suture; radius simple; radial sector with 3-9 branches; media weak and unsclerotised, running midway between radial sector and cubitus in proximal half of wing, near middle or beyond middle of wing to meet radial sector.

Soldier. Head capsule generally dark brown, almost black in front; phragmotic, short, thick and in some species rough in the region of frons, vertex and sides; profile of frontal area vertical, near vertical or overhanging; usually with a thick frontal ridge between frons and vertex, with or without a median V-shaped notch. Two pairs of prominent horn-like projections; one in lateral margin of postclypeus in front of antennal socket, the other formed by a prolongation of ventral genae, in front of, and below, antennal socket; upper or lower or both projections referred to as frontal and genal horns in text are sometimes weakly developed in some species. Frons generally incurved; vertex behind frontal ridge usually depressed medially. Eyes usually distinct, unpigmented. Antennae with 11-15 segments. Clypeus subtrapezoidal. Labrum subtriangular or tongue-shaped. Mandibles very short to long, weakly to strongly shouldered externally in the middle, about middle or basal third, straight or curved inwards from middle to tip of apical tooth, weakly to strongly toothed. Postmentum broad posteriorly. Pronotum either slightly narrower, broader or as broad as head width; anterior margin strongly concave, usually irregularly wavy or serrated; sides and hind margin evenly rounded. Legs short; apical tibial spurs 3:3:3; tarsi four-jointed; cerci two-jointed.

Alate nymph 2. Head capsule pale yellow to orange-yellow usually darker than rest of body; subcircular, cranial suture absent, brain distinct; eyes present; ocelli absent. Antennae short with 11-15 segments. Clypeus subtrapezoidal. Mandibles as in imago. Pronotum subrectangular; anterior margin weakly to deeply concave. Legs short; apical tibial spurs 3:3:3; tarsi four-jointed; cerci two-jointed.

Soldiers

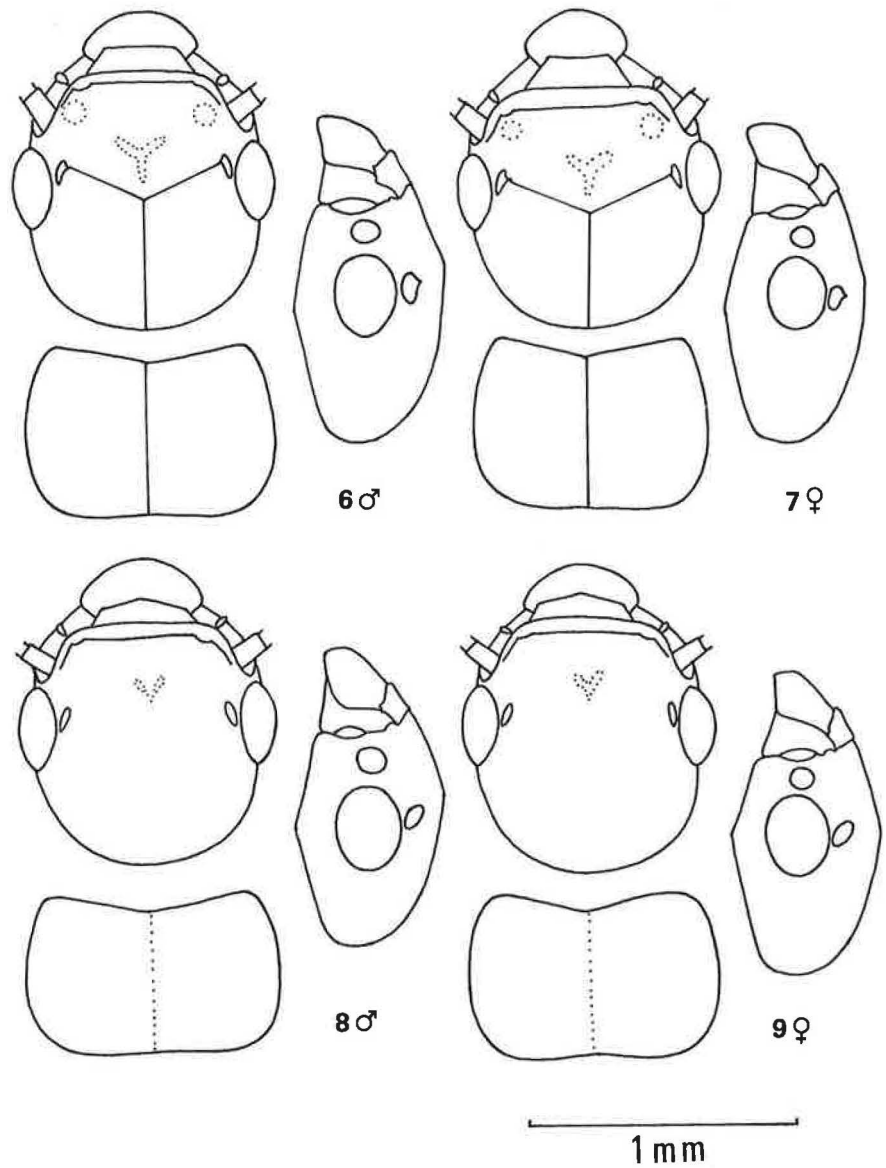
LHCr1: length of head to cephalic ridge 1; HW: maximum width of head.

1	Head strongly rugose behind frontal ridge (Figs 52 and 53)	2
-	Head smooth or weakly or moderately rugose behind frontal ridge (Figs 58, 54 and 70)	7
2	Head index ratio larger; LHCr1/HW = 1.18-1.25	<i>darwini</i> (p. 47)
-	Head index ratio smaller; LHCr1/HW = 0.95-1.16	3
3	Head moderately to strongly constricted behind antennal sockets, frontal and genal horns squat (Figs 52 and 53)	
-		<i>brevis</i> (p. 40)
-	Head weakly or not constricted behind antennal sockets, frontal and genal horns not squat	4
4	Genal horns well developed, same length as frontal horns or just longer	5
-	Genal horns hardly developed, frontal horns longer and thumb-like (Fig. 87)	<i>pyrodomus</i> (p. 72)
5	Length of mandible 0.56-0.65 mm, generally shouldered externally (Fig. 121)	<i>silvestrii</i> (p. 74)
-	Length of mandible less than 0.56 mm, not shouldered externally (Figs 119 and 123)	6
6	HW 1.02 mm; length of hind tibia 0.59 mm	<i>rhinocephalus</i> (p. 72)
-	HW 1.10-1.15 mm; length of hind tibia 0.66-0.69 mm	<i>verruculosus</i> (p. 78)
7	Frontal ridge from above broadest near antennal sockets (Figs 76, 85, 86 and 89)	8
-	Frontal ridge not broadest near antennal sockets	11
8	HW 1.22-1.33 mm	9
-	HW 1.01 mm	<i>roonwali</i> (p. 73)
9	Maximum width of pronotum 1.37 mm	<i>luodianis</i> (p. 64)
-	Maximum width of pronotum 1.18-1.22 mm	10
10	Head deeply depressed just above eyes; length of left mandible 0.56 mm	<i>pingyangensis</i> (p. 71)
-	Head not deeply depressed above eyes; length of left mandible 0.63 mm	<i>angustinotus</i> (p. 37)
11	Genal horns longer or same length as frontal horns	12
-	Genal horns shorter than frontal horns	22
12	Frontal ridge with a deep median cleft (Fig. 90)	<i>sumatrensis</i> (p. 76)
-	Frontal ridge without a deep median cleft	13
13	Length of head to cephalic ridge 2 longer than LHCr1	<i>domesticus</i> (p. 50)
-	Length of head to cephalic ridge 2 shorter than LHCr1	14
14	Head strongly depressed about level of antennal sockets and moderately so behind frontal ridge in mid-vertex region (Fig. 82)	15
-	Head not strongly depressed about level of antennal sockets and only weakly so behind frontal ridge in mid-vertex region	16
15	Length of left mandible 0.56 mm	<i>karachiensis</i> (p. 59)
-	Length of left mandible 0.71-0.82 mm	<i>kirbyi</i> (p. 60)
16	Genal horns longer than frontal horns	17
-	Genal horns same length as frontal horns	21
17	Head nearly truncate in front, frontal ridge not well defined, scarcely noticeable	<i>naudei</i> (p. 67)
-	Head not truncate in front, frontal ridge narrow and well defined	18
18	Head glossy, length of left mandible 0.59-0.65 mm	<i>haviandii</i> (p. 56)
-	Head not glossy, length of left mandible 0.63-0.96 mm	19
19	Length of left mandible 0.63 mm, frontal ridge with a broad median groove (Fig. 79)	<i>declivis</i> (p. 48)
-	Length of left mandible 0.65-0.96 mm, frontal ridge with a narrow median groove (Figs 58 and 72)	20
20	Frons rugose, steeply inclined, bordered on either side by an elevated roughened ridge; head capsule not constricted above antennal sockets (Fig. 72); left mandible, first to third marginal 0.13-0.20 mm	<i>merwei</i> (p. 65)
-	Frons rugose, slightly concave, lateral ridges weakly developed; head capsule above antennal sockets constricted (Fig. 58); left mandible first to third marginal 0.20-0.29 mm	<i>dudleyi</i> (p. 53)
21	Frontal ridge broadest in middle with median groove, head sides subparallel (Fig. 77)	<i>bengalensis</i> (p. 38)
-	Frontal ridge uniform, narrow with median groove, head widest in middle and tapering in front (Fig. 81)	<i>dolei</i> (p. 49)
22	Anterior margin of frontal ridge deeply concave making almost a semicircle (Fig. 68)	<i>hemicyclus</i> (p. 58)
-	Anterior margin of frontal ridge not so deeply concave	23
23	Head conspicuously depressed medially just behind the frontal ridge (Figs 56 and 57)	<i>cynocephalus</i> (p. 45)
-	Head not conspicuously depressed medially behind the frontal ridge (Figs 54, 62, 66, 83 and 84)	24
24	Frontal ridge broadest in middle region (Figs 54, 66 and 84)	25
-	Frontal ridge uniform, narrow with median groove (Fig. 83) or not well defined (Figs 62 and 63)	27
25	Length of left mandible 0.59-0.73 mm, right mandible, apical to first marginal 0.18-0.24 mm (Fig. 100)	<i>cavifrons</i> (p. 43)
-	Length of left mandible 0.42-0.52 mm, right mandible, apical to first marginal 0.11-0.16 (Figs 110 and 116)	26
26	Mandibles strongly shouldered externally in middle region (Fig. 116)	<i>perforans</i> (p. 69)
-	Mandibles weakly shouldered externally in middle region (Fig. 110)	<i>fatulus</i> (p. 55)
27	Mandibles curving inwards from middle region to tip of apical tooth (Fig. 112) (frontal ridge not well defined)	
-		<i>longicollis</i> (p. 62)
-	Mandibles straight (Fig. 105) (frontal ridge uniform, narrow with median groove)	<i>kororensis</i> (p. 61)

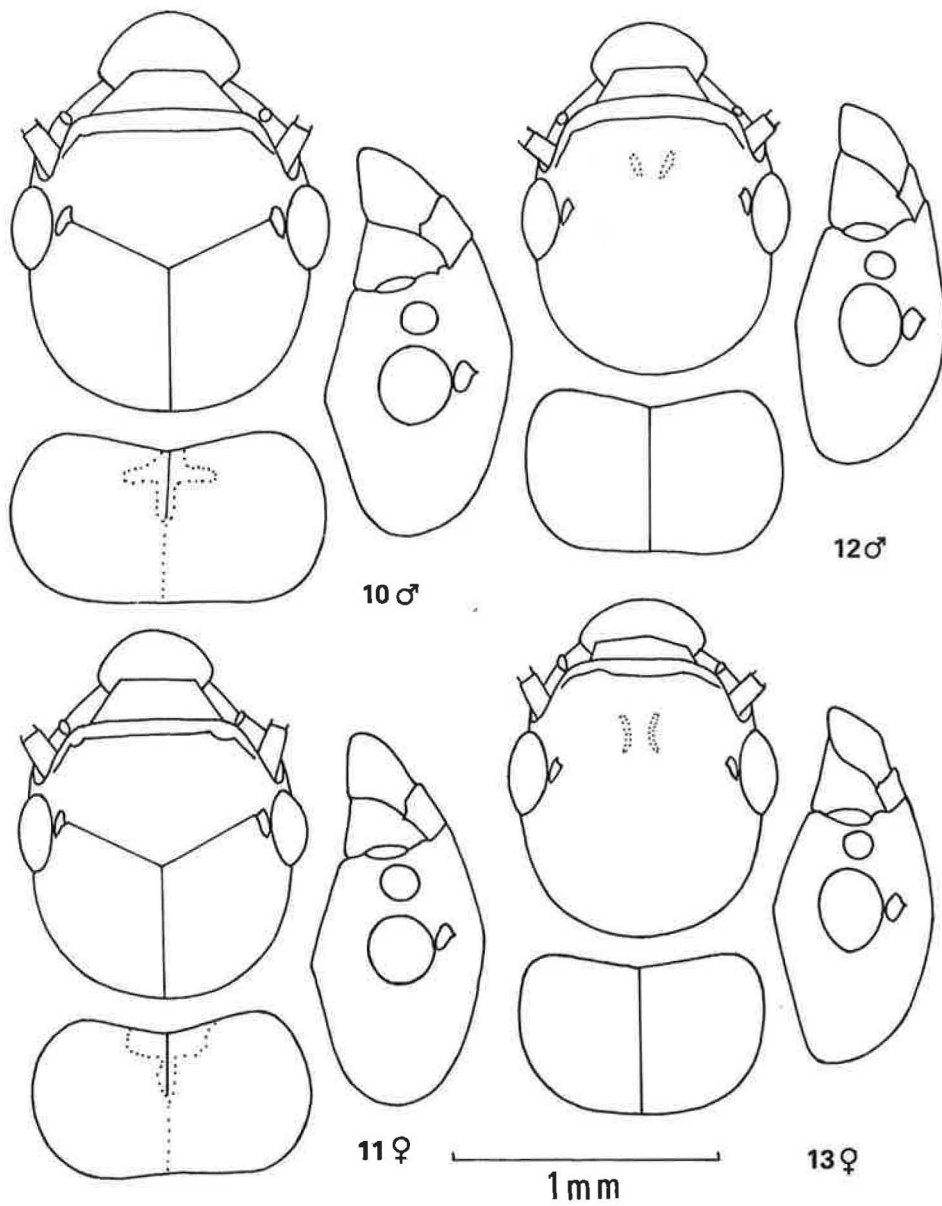
Alate nymph 2

1	Width of pronotum 0.72 mm (pronotum sides strongly angled posteriorly, Fig. 131), length of right mandible 0.22 mm	
-	Width of pronotum 0.76-1.30 mm (pronotum sides weakly to strongly rounded or nearly parallel with posterior ends moderately to strongly angled, Figs 124-130)	<i>perforans</i> (p. 69)
2	Maximum width of head 0.85-0.91 mm, head sides nearly parallel (Fig. 129)	<i>cynocephalus</i> (p. 45)
-	Maximum width of head 0.96-1.31 mm, head sides convex	3
3	Length of head to lateral base of mandibles 0.85-0.94 mm	<i>cavifrons</i> (p. 43)
-	Length of head to lateral base of mandibles 0.96-1.18 mm	4
4	Pronotum sides evenly rounded, posterior ends strongly angled (Fig. 126), pronotum width minus length 0.44-0.67 mm	
-		<i>brevis</i> (p. 40)
-	Pronotum sides evenly rounded, slightly to strongly convex, moderately angled posteriorly (Figs 125-127 and 130), pronotum width minus length 0.26-0.44 mm	5

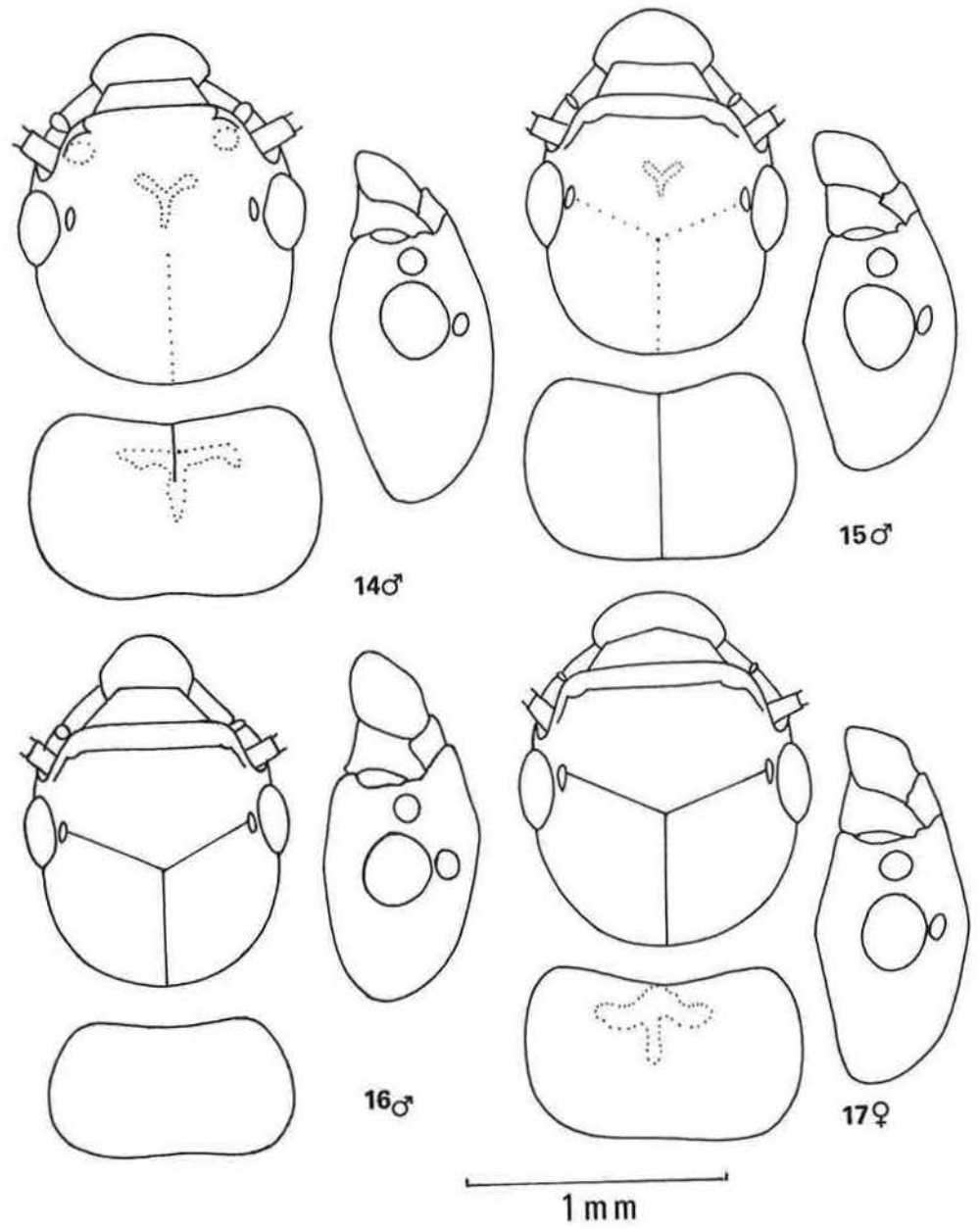
- 5 Anterior margin of clypeus slightly convex (Fig. 130) (head width 1.04–1.11 mm) *merwei* (p. 65)
- Anterior margin of clypeus slightly concave or straight (head width 1.00–1.25 mm) 6
- 6 Pronotum sides weakly rounded, moderately angled posteriorly, posterior margin weakly emarginate (Fig. 125) *domesticus* (p. 50)
- Pronotum sides nearly parallel or strongly rounded with posterior ends moderately angled, posterior margin almost straight or straight (Figs 126 and 127) 7
- 7 Left mandible, first to third marginal 0.11–0.12 mm, right mandible, length of molar plate 0.16–0.17 mm, hind tibia 0.70–0.86 mm *dudleyi* (p. 53)
- Left mandible, first to third marginal 0.09–0.11 mm, right mandible, length of molar plate 0.13–0.15 mm, hind tibia 0.61–0.70 mm *havilandi* (p. 56)



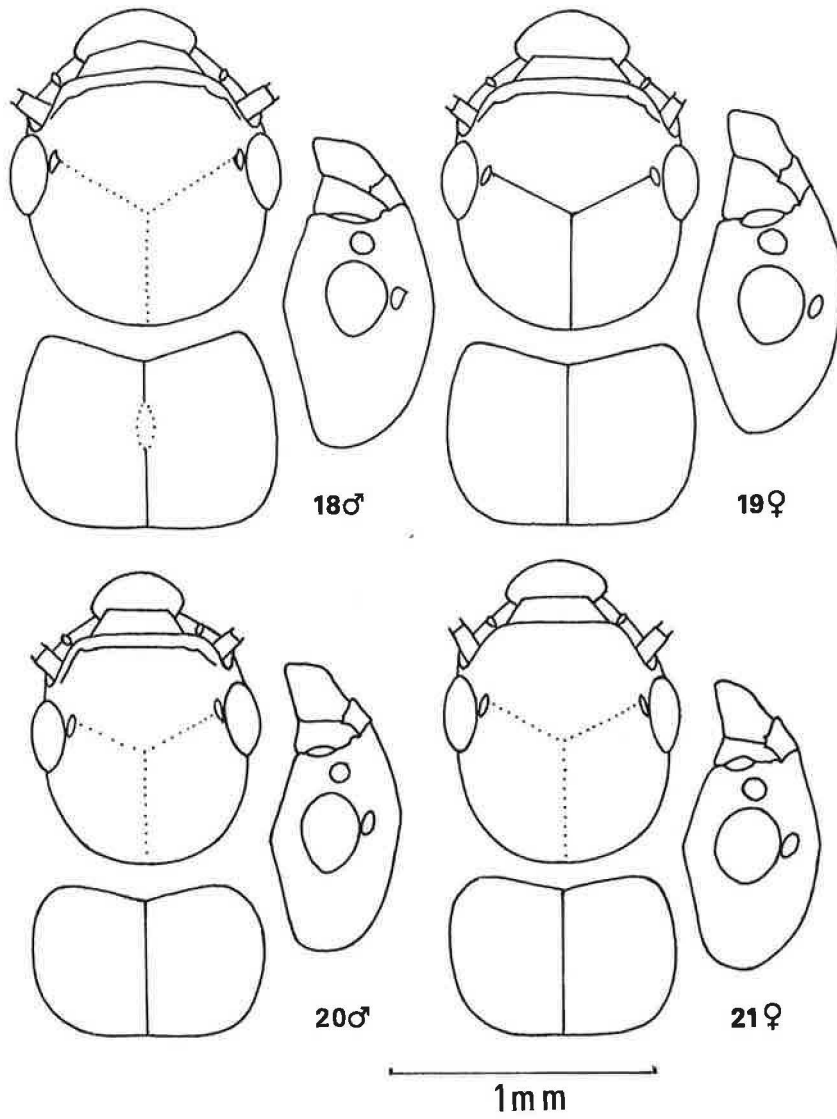
Figs 6-9. *Cryptotermes* imago head capsules and pronota, dorsal and lateral views. 6, 7, *C. albipes*; 8, 9, *C. bengalensis*.



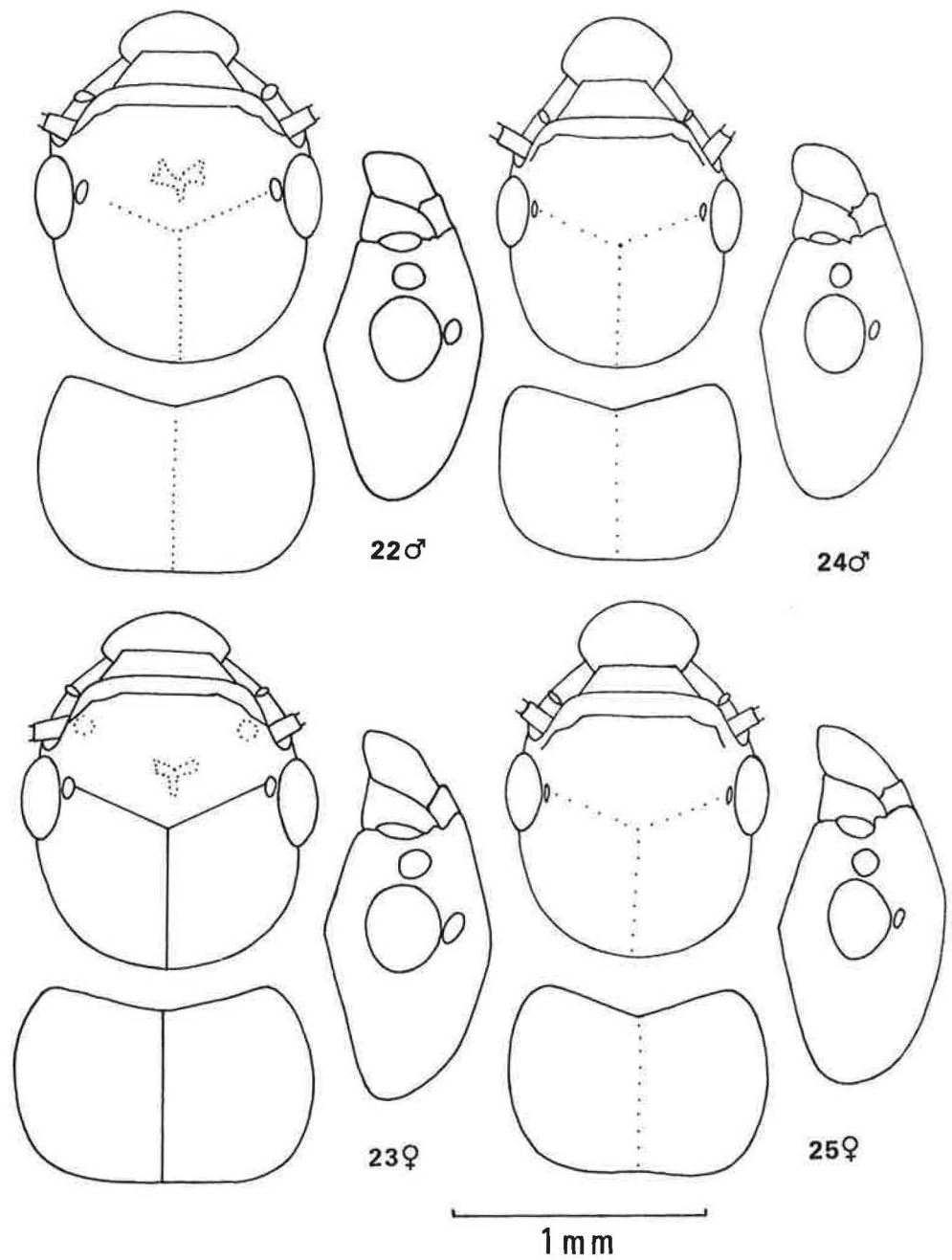
Figs 10-13. *Cryptotermes* imago head capsules and pronota, dorsal and lateral views. 10, 11, *C. brevis*; 12, 13, *C. dolei*.



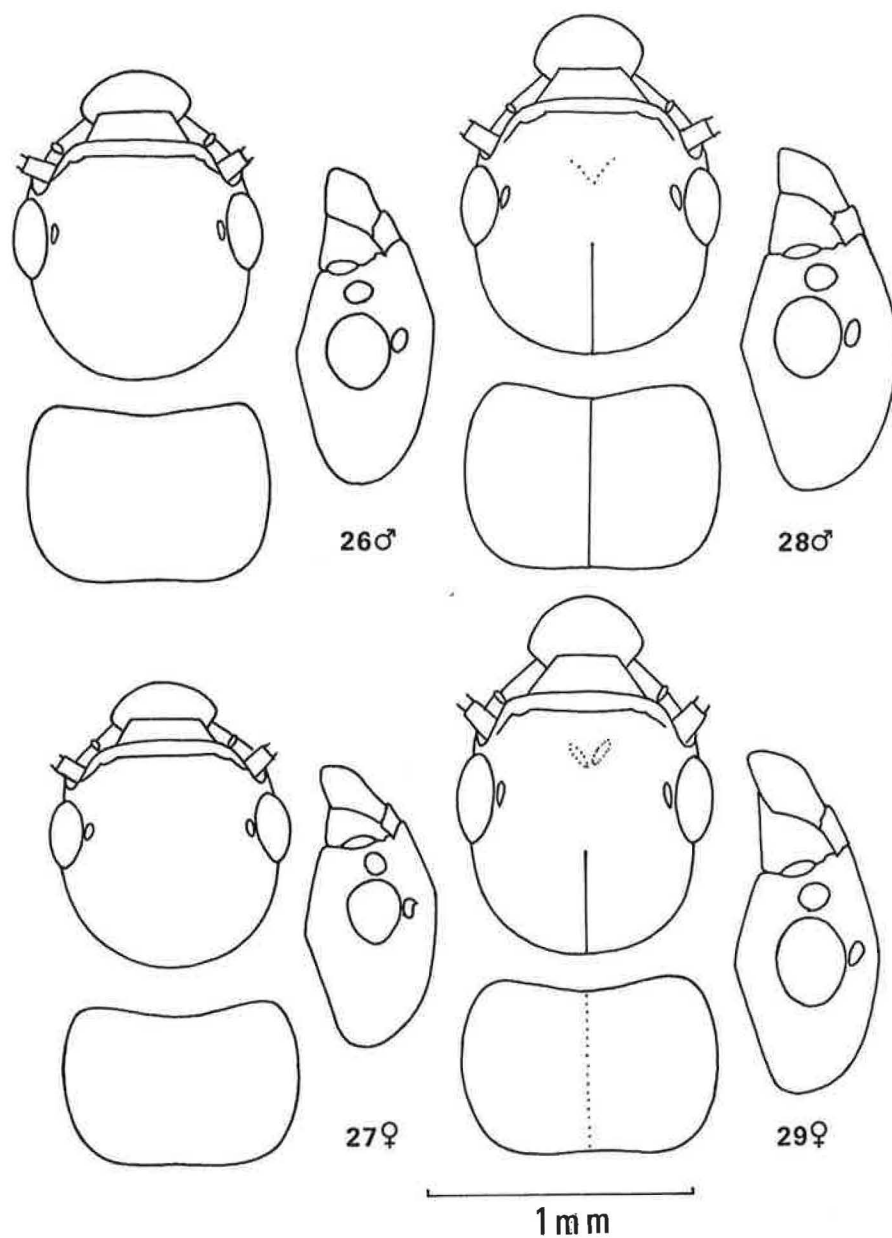
Figs 14-17. *Cryptotermes* imago head capsules and pronota, dorsal and lateral views. 14, *C. angustinotus*; 15, *C. canalensis*; 16, 17, *C. darwini*.



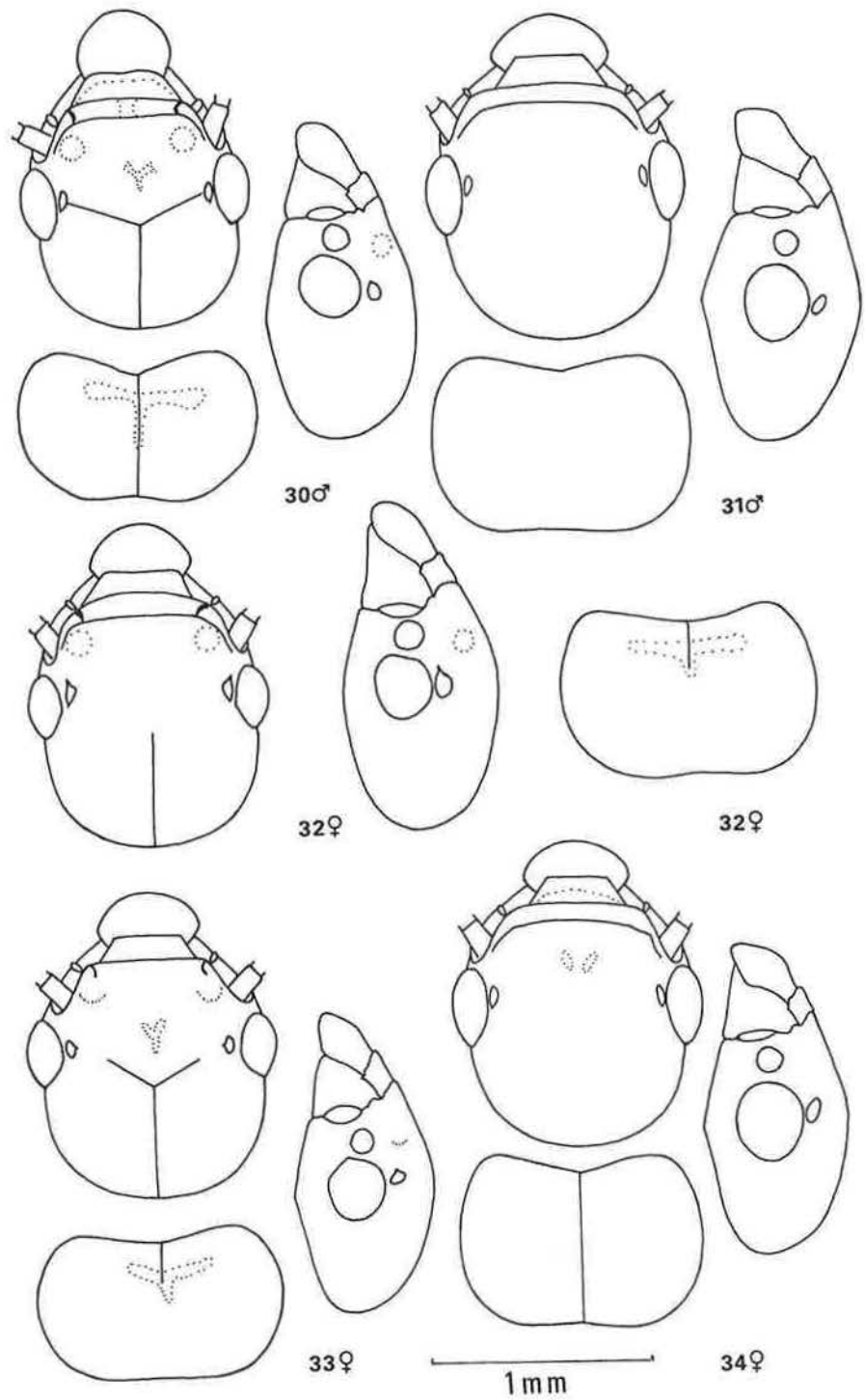
Figs 18-21. *Cryptoterme* imago head capsules and pronota, dorsal and lateral views.
 18, 19, *C. cavifrons*; 20, 21, *C. cynocephalus*.



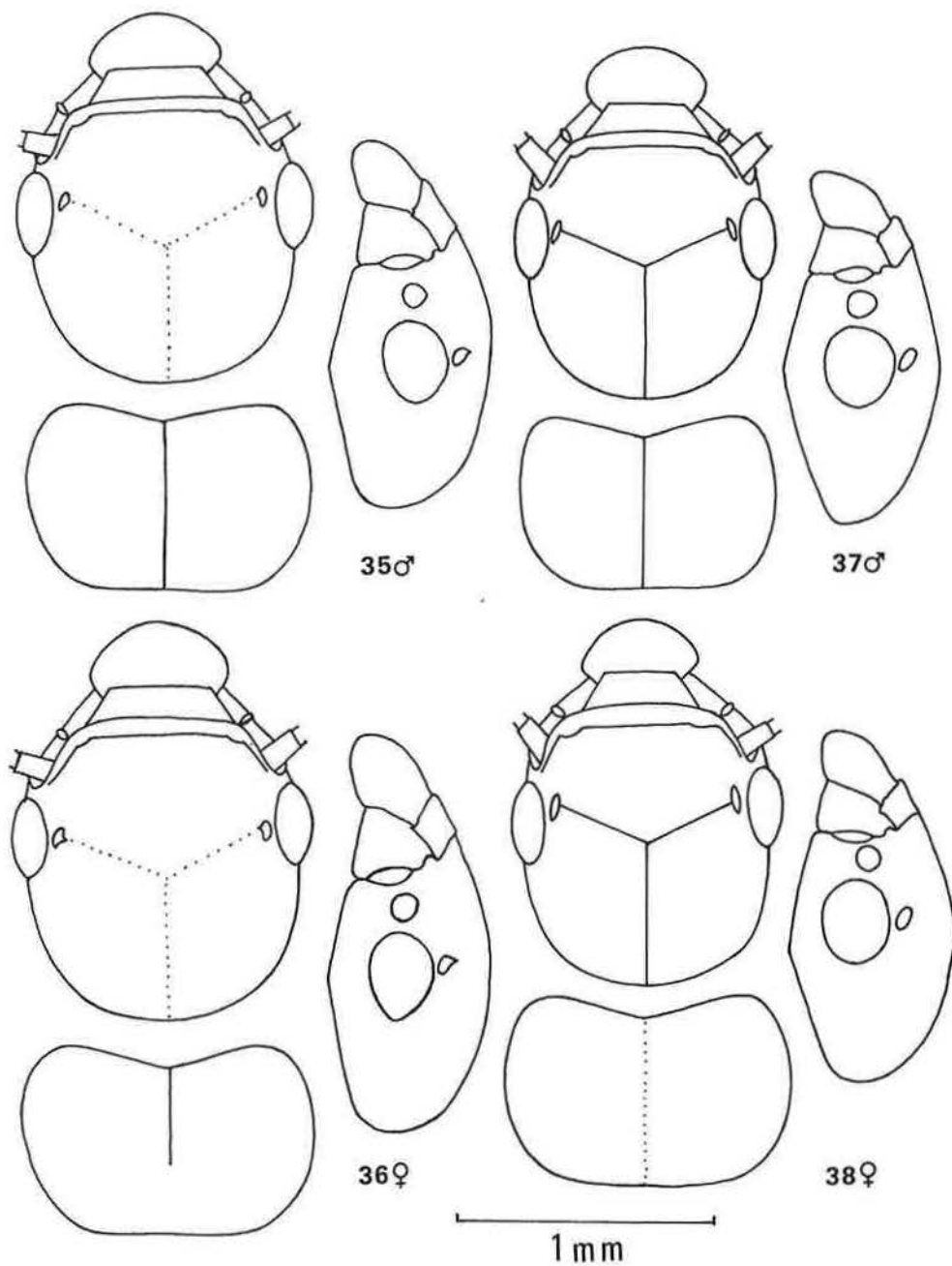
Figs 22–25. *Cryptotermes* imago head capsules and pronota, dorsal and lateral views. 22, 23, *C. dudleyi*; 24, 25, *C. domesticus*.



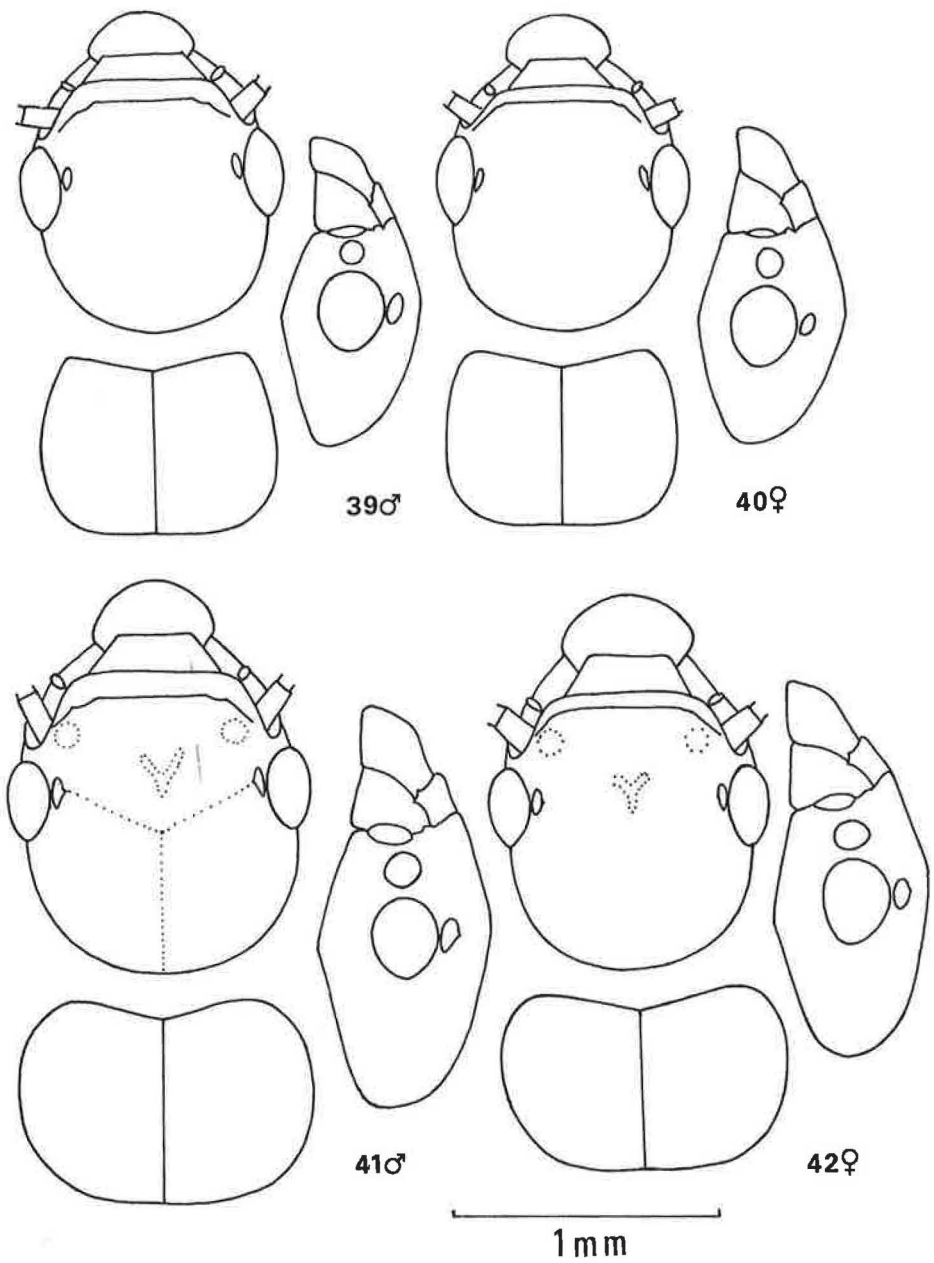
Figs 26-29. *Cryptoterme* imago head capsules and pronota, dorsal and lateral views. 26, 27, *C. fatulus*; 28, 29, *C. havilandi*.



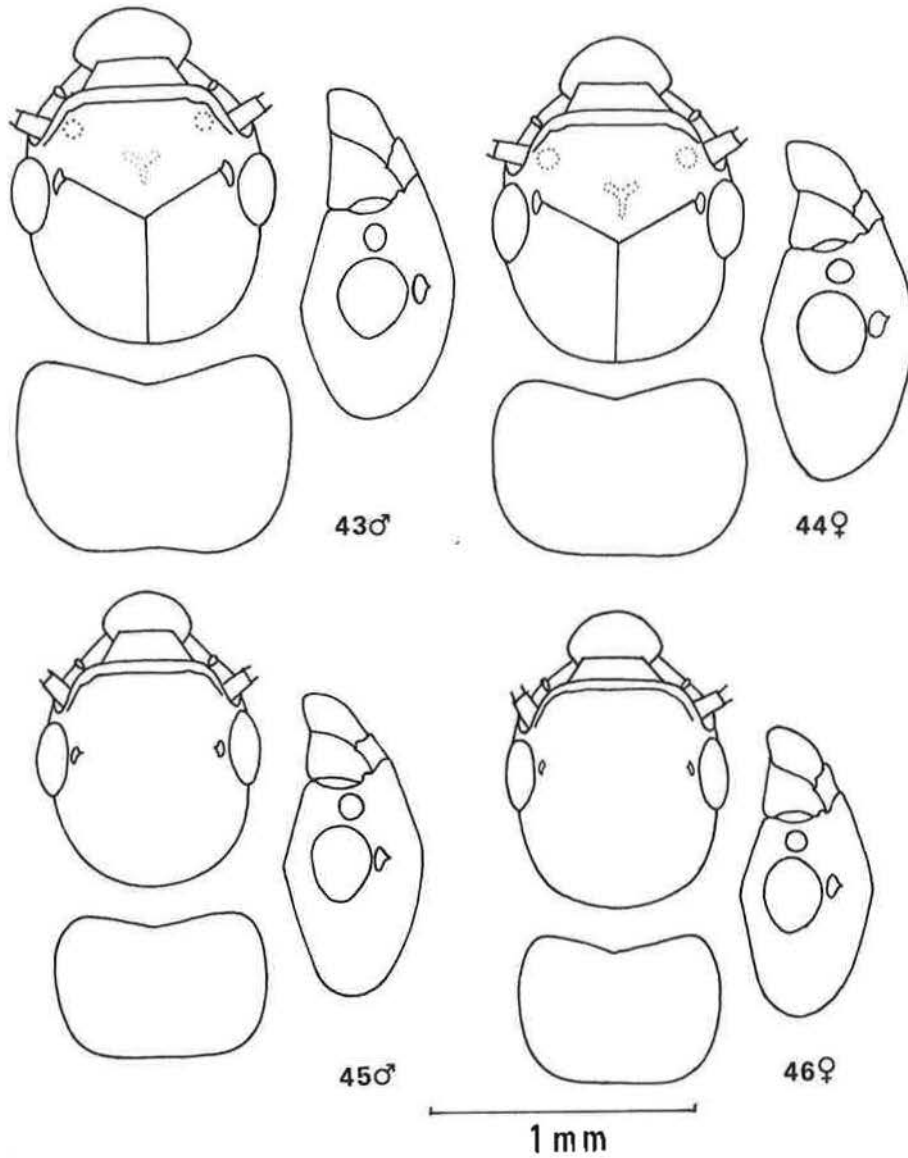
Figs 30-34. *Cryptotermes* imago head capsules and pronota, dorsal and lateral views. 30, *C. declivis*; 31, *C. hemicyclus*; 32, *C. luodianis*; 33, *C. pingyangensis*; 34, *C. sumatrensis*.



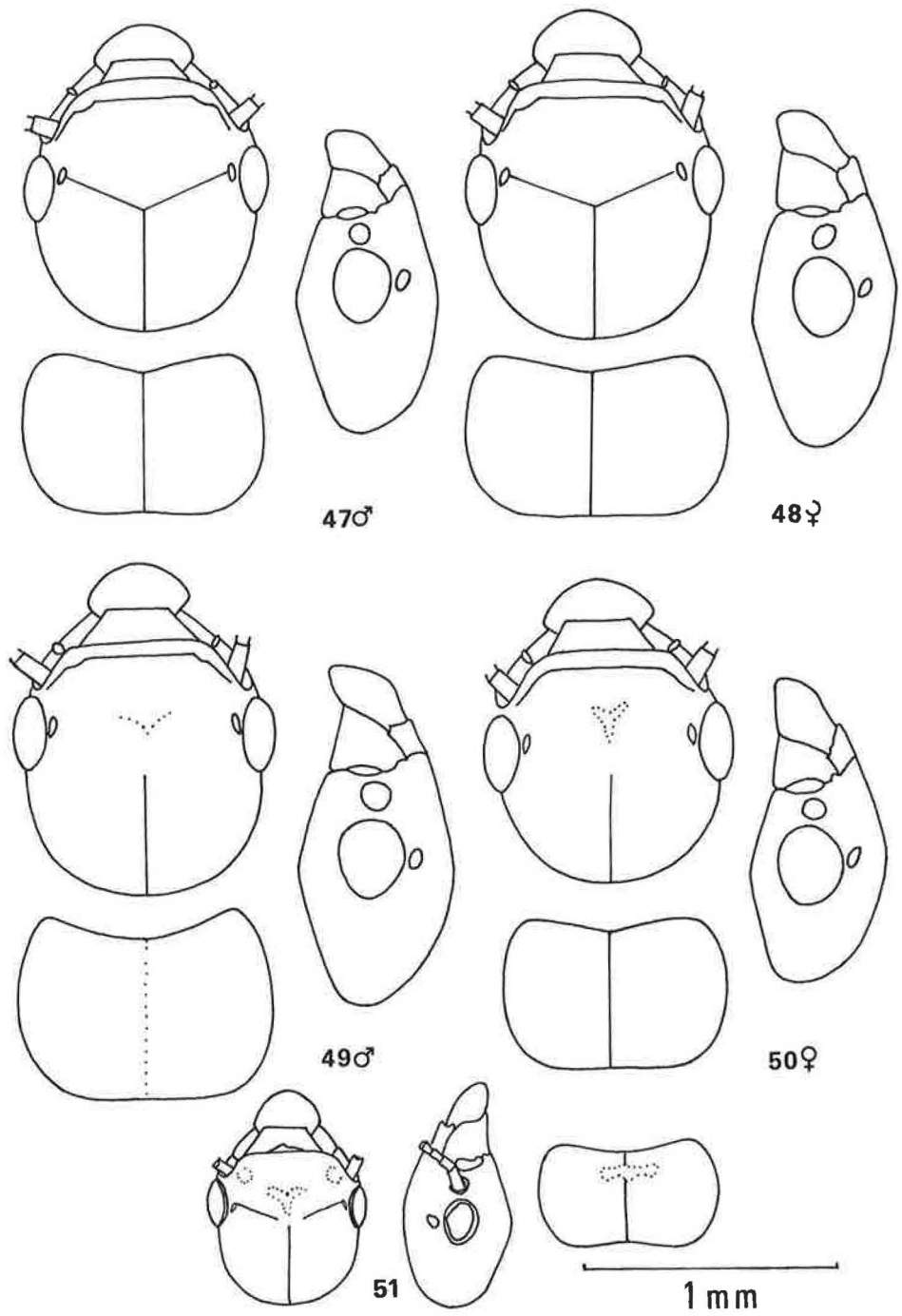
Figs 35-38. *Cryptotermes* imago head capsules and pronota, dorsal and lateral views. 35, 36, *C. kirbyi*; 37, 38, *C. kororensis*.



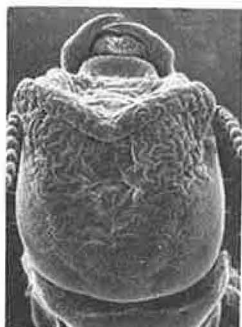
Figs 39-42. *Cryptotermes* imago head capsules and pronota, dorsal and lateral views. 39, 40, *C. longicollis*; 41, 42, *C. merwei*.



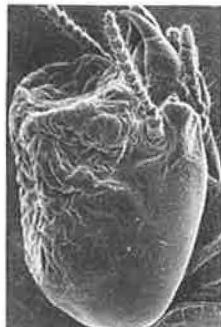
Figs 43-46. *Cryptotermes* imago head capsules and pronota, dorsal and lateral views. 43, 44, *C. naudei*; 45, 46, *C. perforans*.



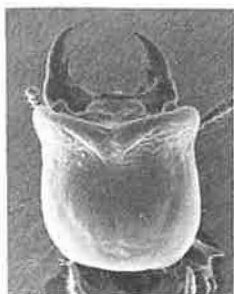
Figs 47-51. *Cryptotermes* imago head capsules and pronota, dorsal and lateral views. 47, 48, *C. silvestrii*; 49, 50, *C. verruculosus*; 51, *C. thailandis* (after Ahmad, 1965).



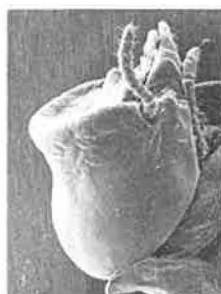
52



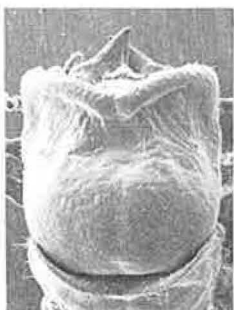
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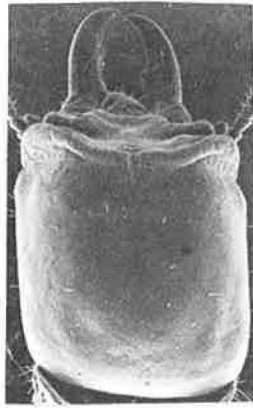


56

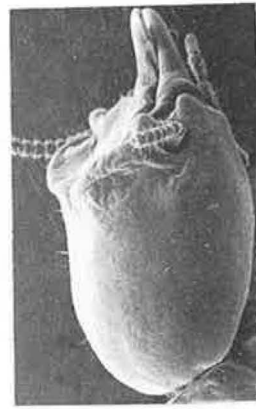


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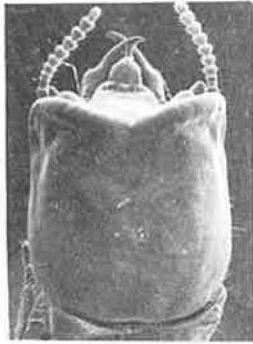
Figs 52-57. Scanning electron microscope photographs of *Cryptotermes* soldier head capsules, dorsal and lateral views. 52, 53, *C. brevis*; 54, 55, *C. cavifrons*; 56, 57, *C. cynocephalus*.



58



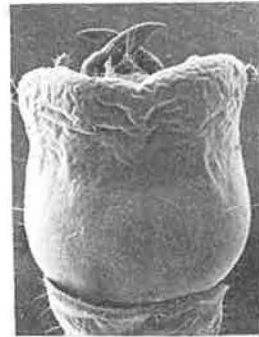
59



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61

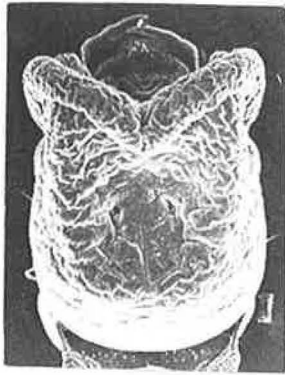


62

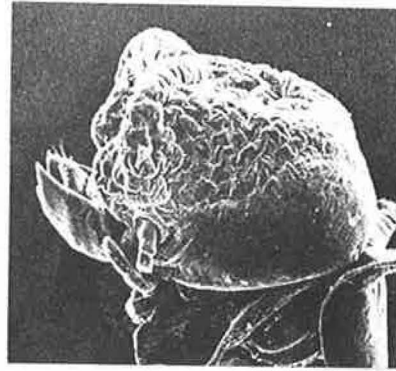


63

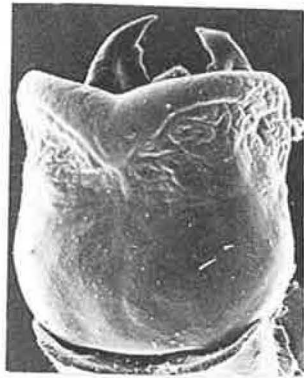
Figs 58-63. Scanning electron microscope photographs of *Cryptotermes* soldier head capsules, dorsal and lateral views. 58, 59, *C. dudleyi*; 60, 61, *C. havilandi*; 62, 63, *C. longicollis*.



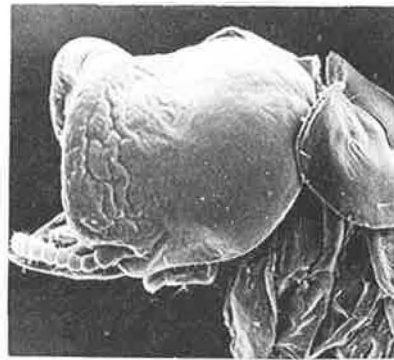
64



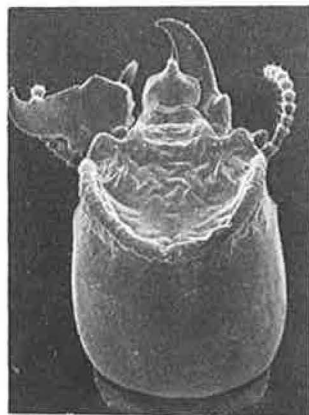
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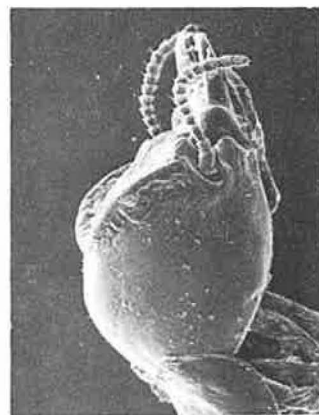
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67

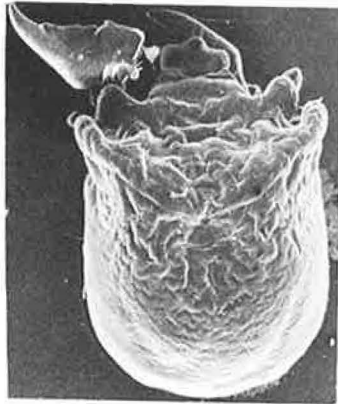


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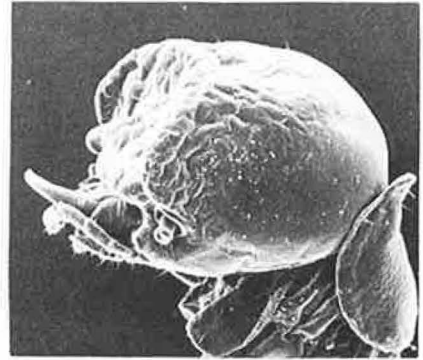


69

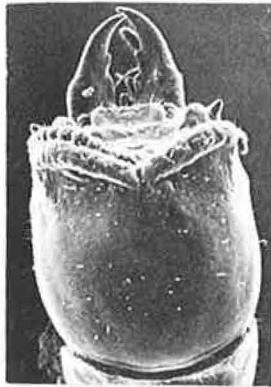
Figs 64-69. Scanning electron microscope photographs of *Cryptotermes* soldier head capsules, dorsal and lateral views. 64, 65, *C. darwini*; 66, 67, *C. fatulus*; 68, 69, *C. hemicyclus*.



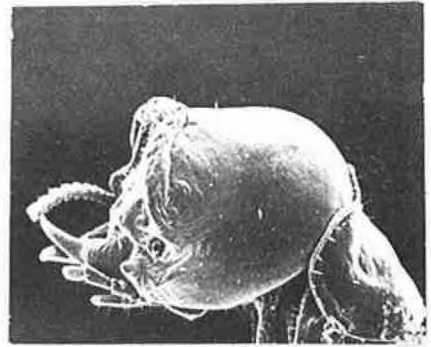
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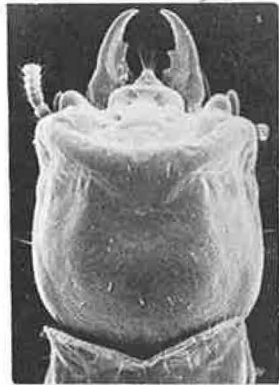
71



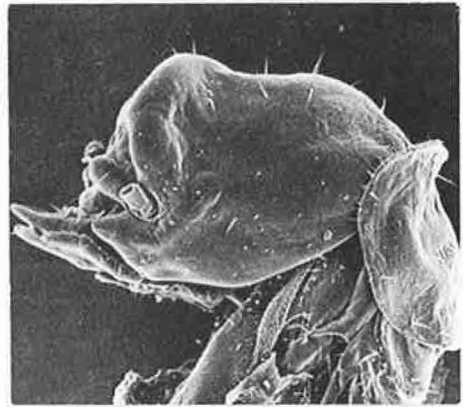
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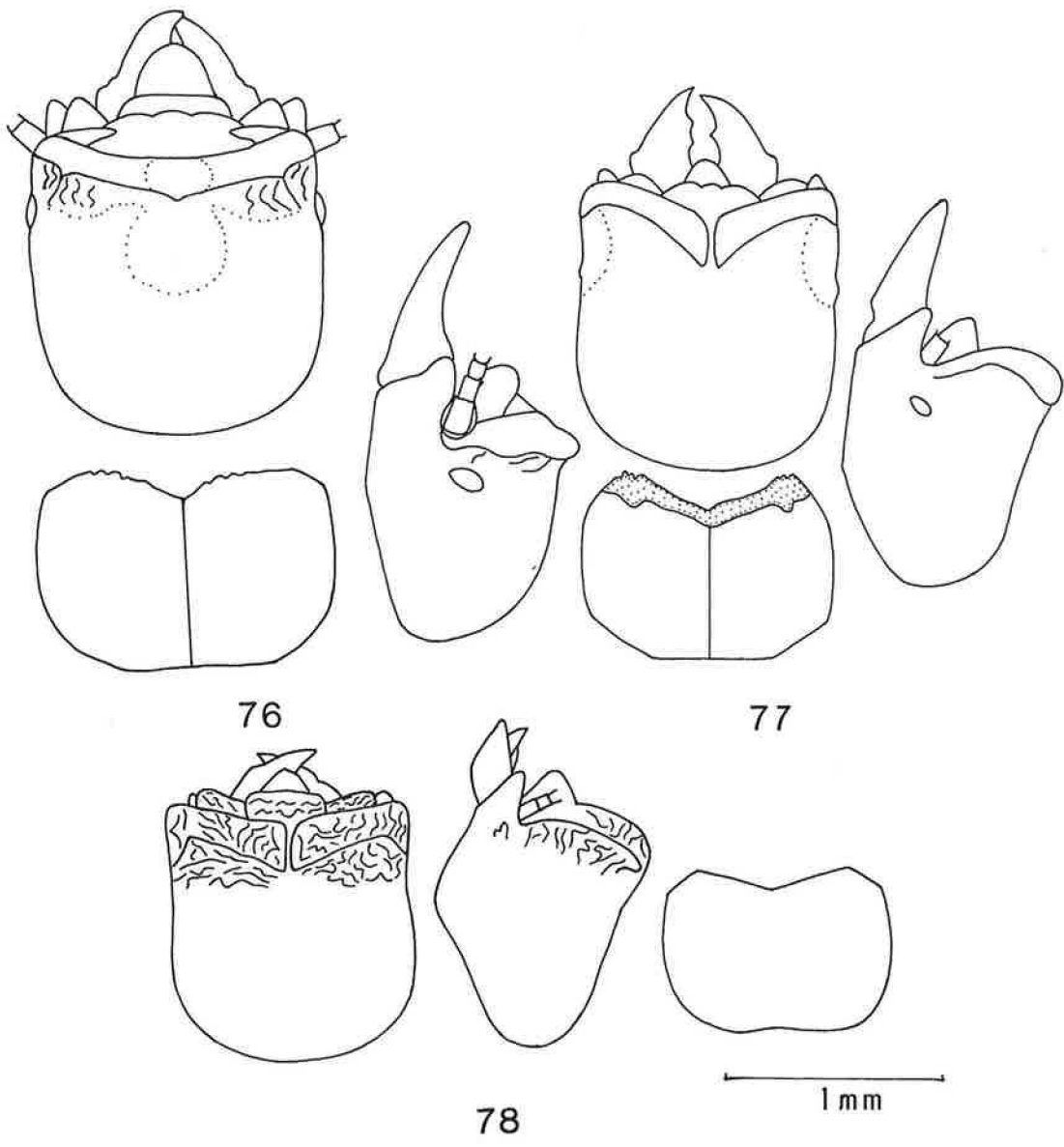


74

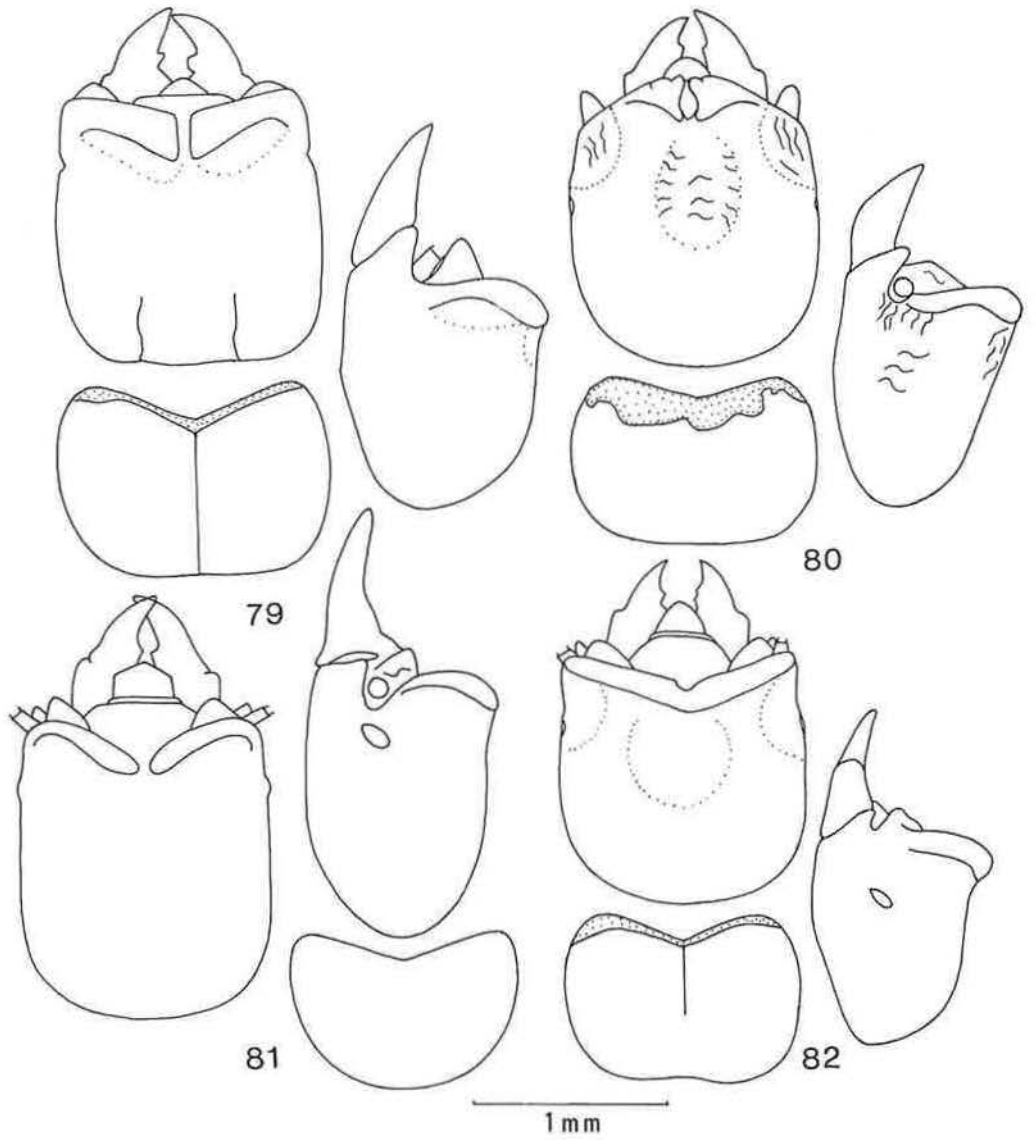


75

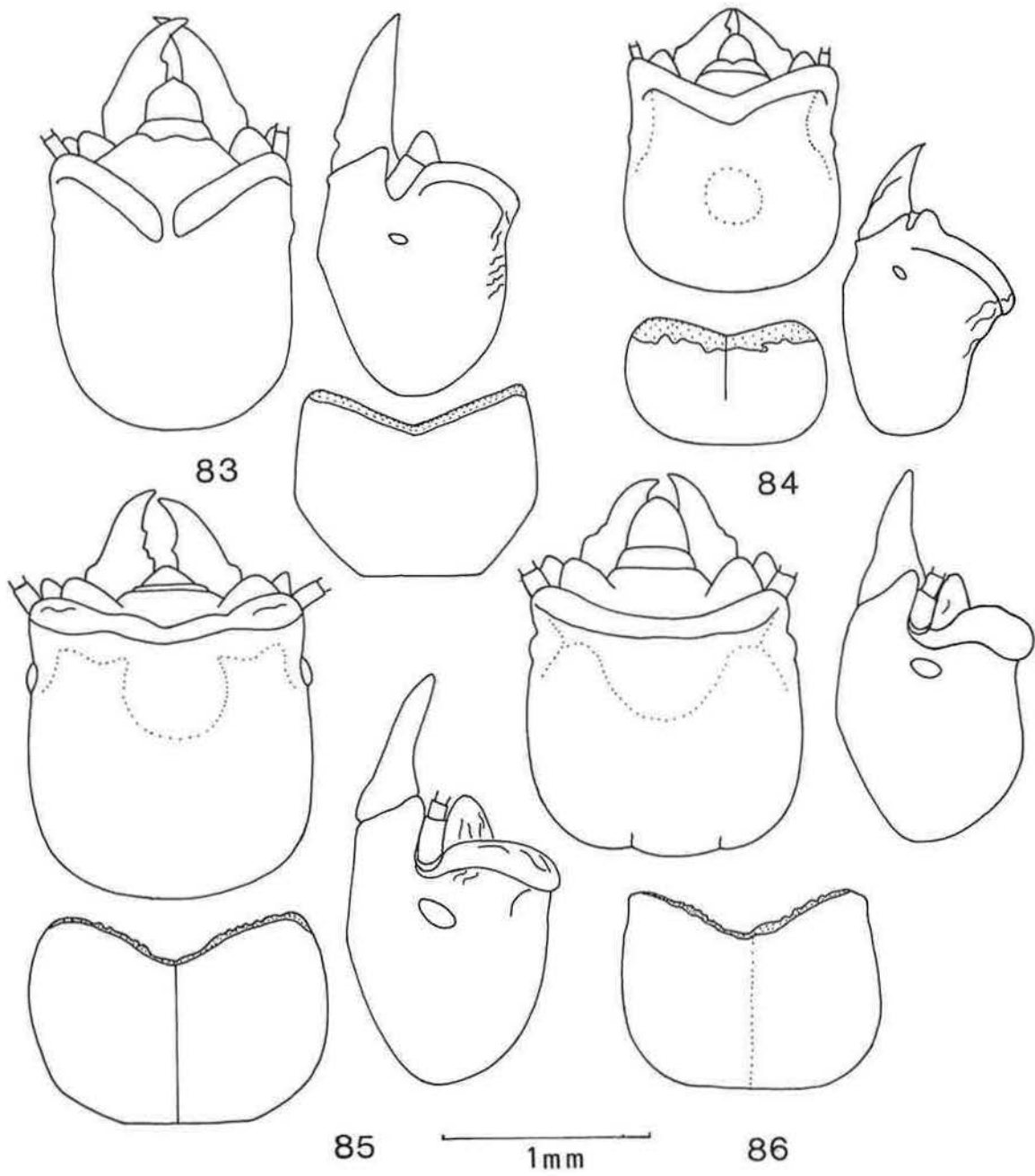
Figs 70-75. Scanning electron microscope photographs of *Cryptotermes* soldier head capsules, dorsal and lateral views. 70, 71, *C. kirbyi*; 72, 73, *C. merwei*; 74, 75, *C. naudei*.



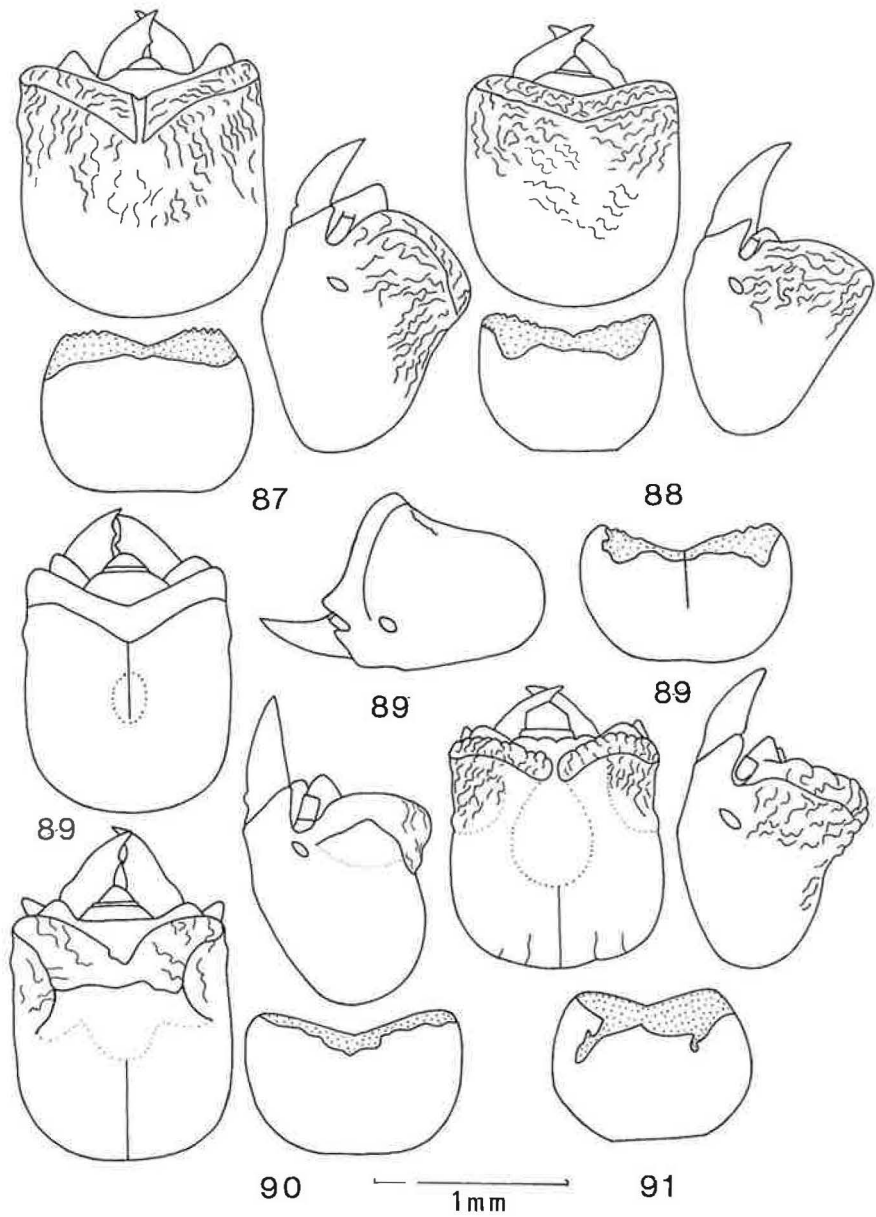
Figs 76-78. *Cryptoterme* soldier head capsules and pronota, dorsal and lateral views. 76, *C. angustinotus*; 77, *C. bengalensis*; 78, *C. cubicoceps* (after Emerson, 1925).



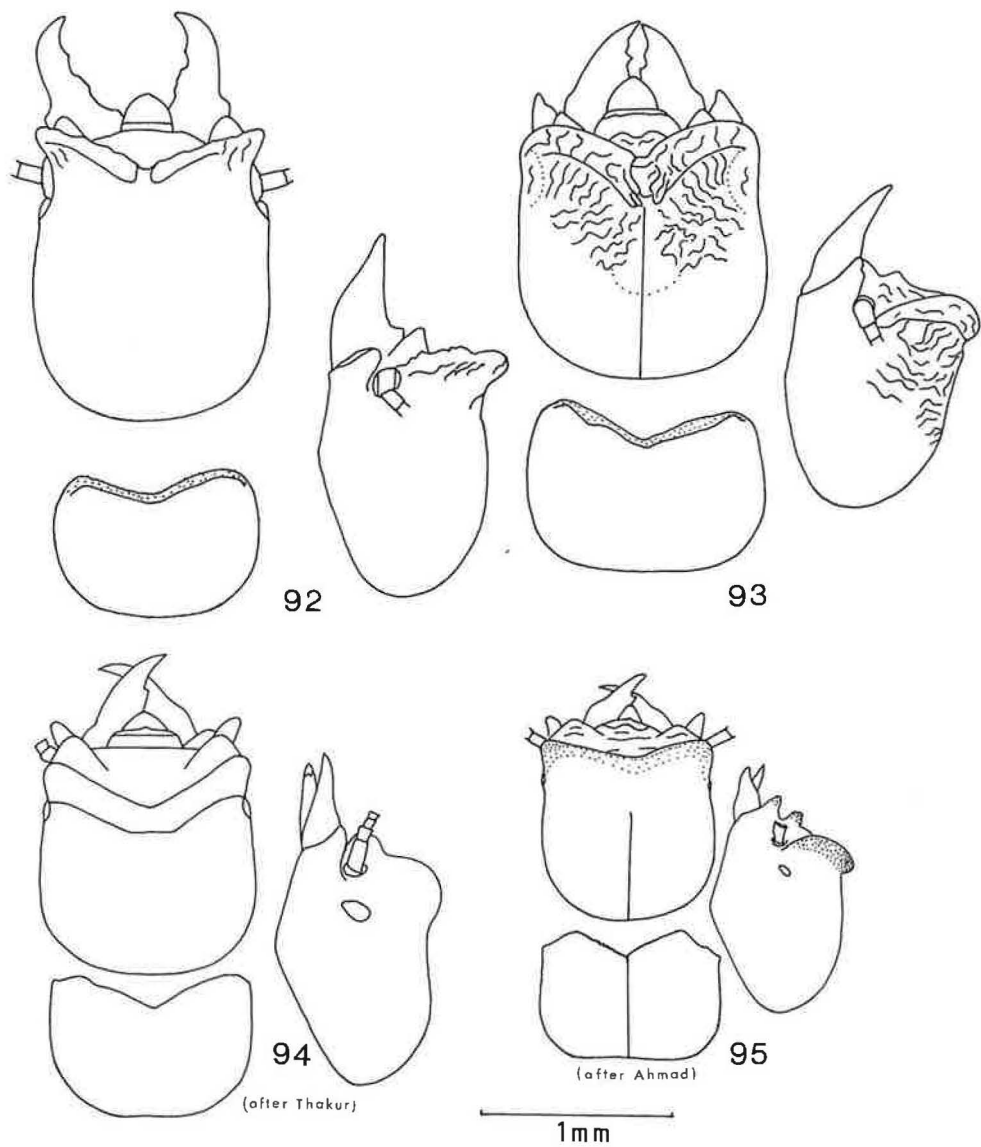
Figs 79-82. *Cryptotermes* soldier head capsules and pronota, dorsal and lateral views. 79, *C. declivis*; 80, *C. domesticus*; 81, *C. dolei*; 82, *C. karachiensis*.



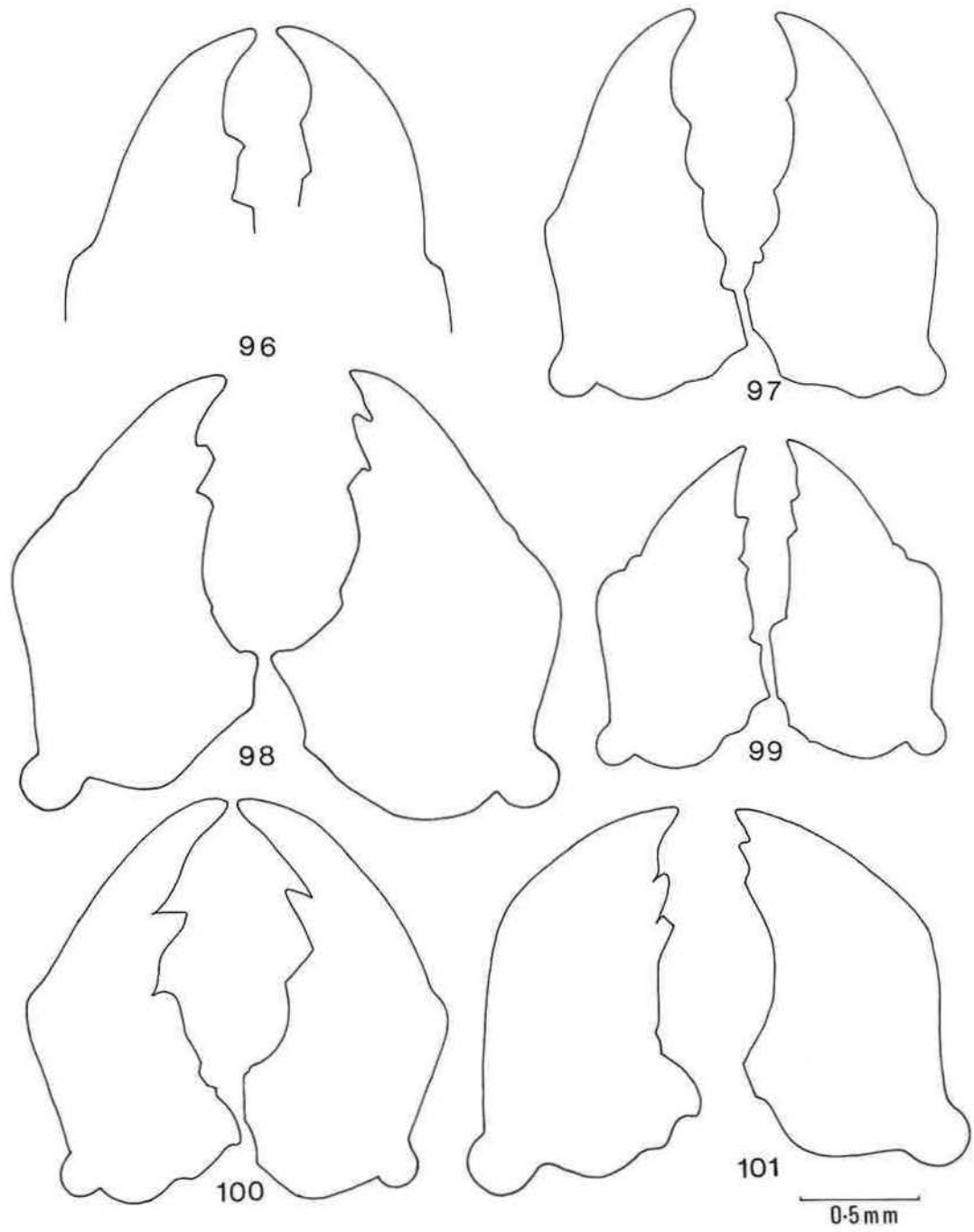
Figs 83-86. *Cryptoterme* soldier head capsules and pronota, dorsal and lateral views. 83, *C. kororensis*; 84, *C. perforans*; 85, *C. luodianis*; 86, *C. pingyangensis*.



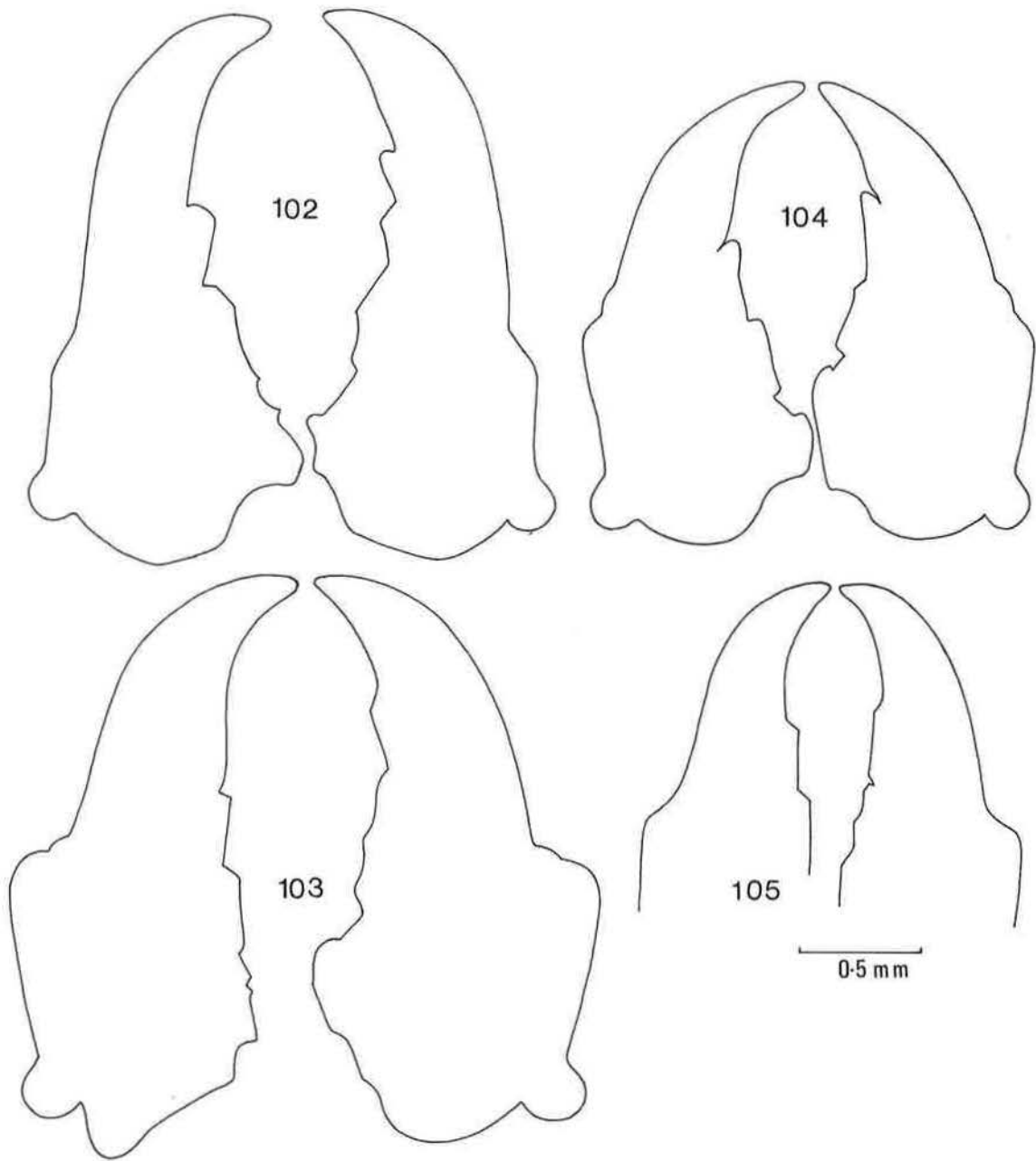
Figs 87-91. *Cryptotermes* soldier head capsules and pronota, dorsal and lateral views. 87, *C. pyrodomus*; 88, *C. rhinocephalus*; 89, *C. roonwali*; 90, *C. sumatrensis*; 91, *C. verruculosus*.



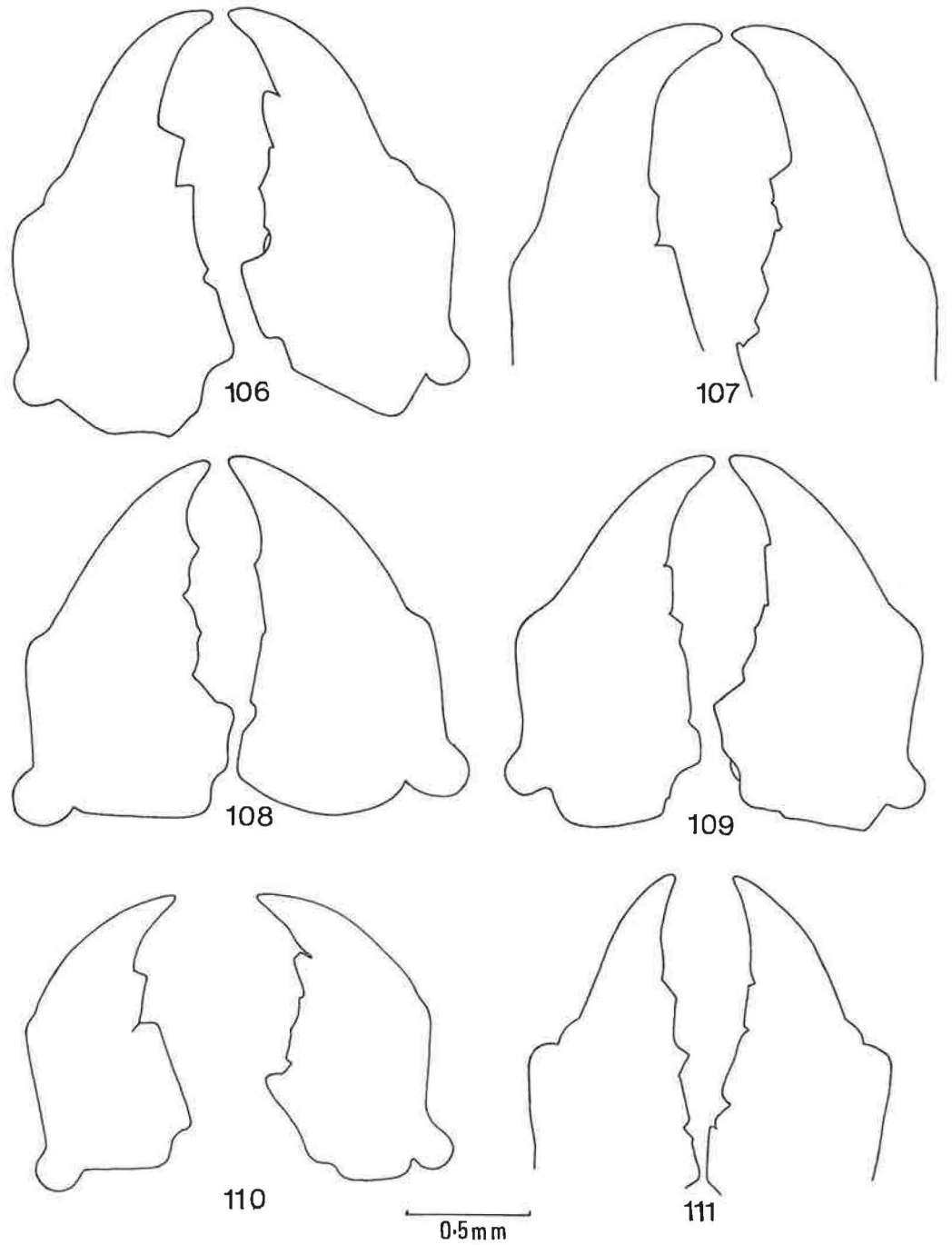
Figs 92-95. *Cryptotermes* soldier head capsules and pronota, dorsal and lateral views. 92, *C. pallidus*; 93, *C. silvestrii*; 94, *C. sukauensis* 95, *C. thailandis*.



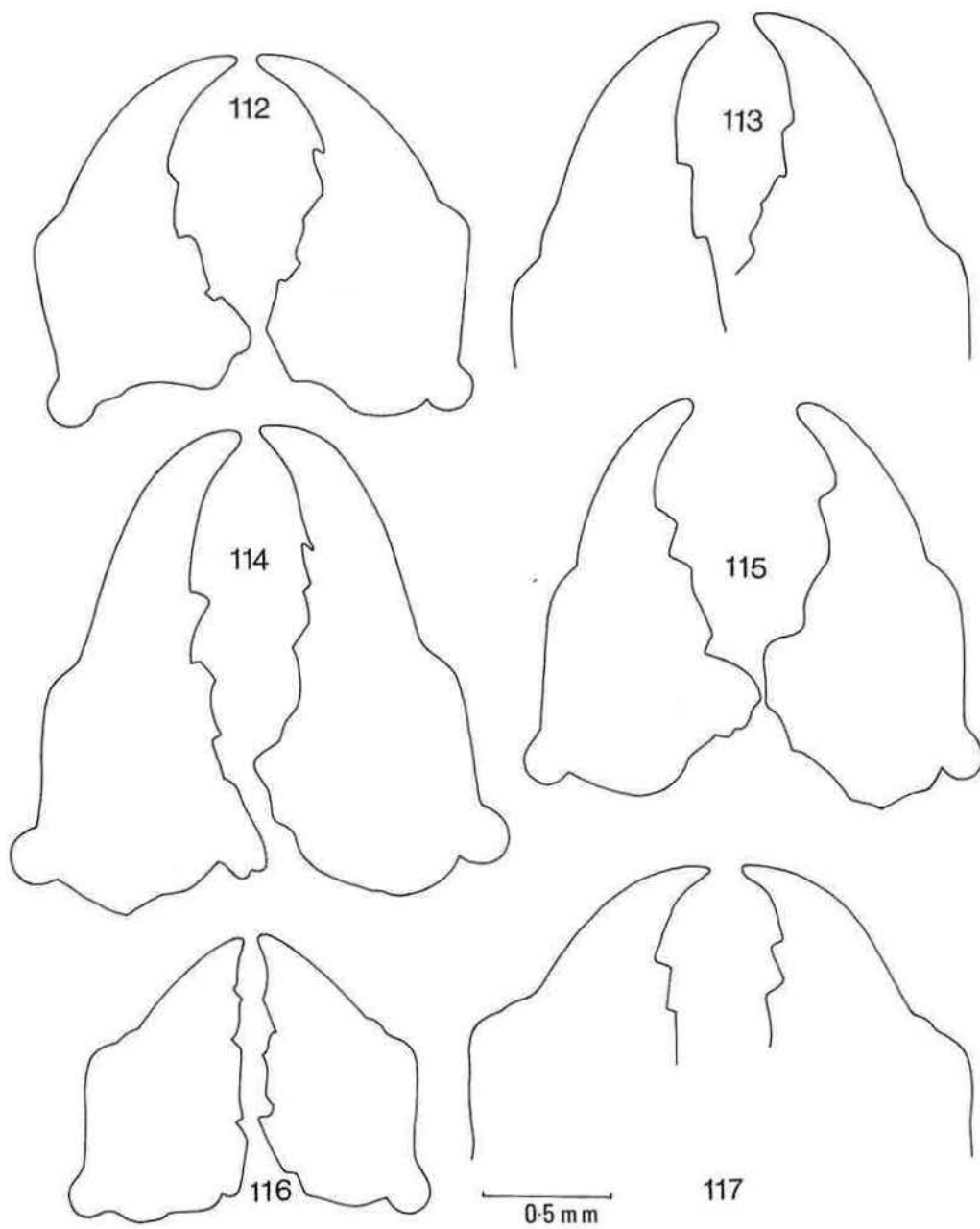
Figs 96-101. *Cryptotermes* soldier mandibles, ventral view. 96, *C. angustinotus*; 97, *C. bengalensis*; 98, *C. brevis*; 99, *C. cynocephalus*; 100, *C. cavifrons*; 101, *C. darwini*.



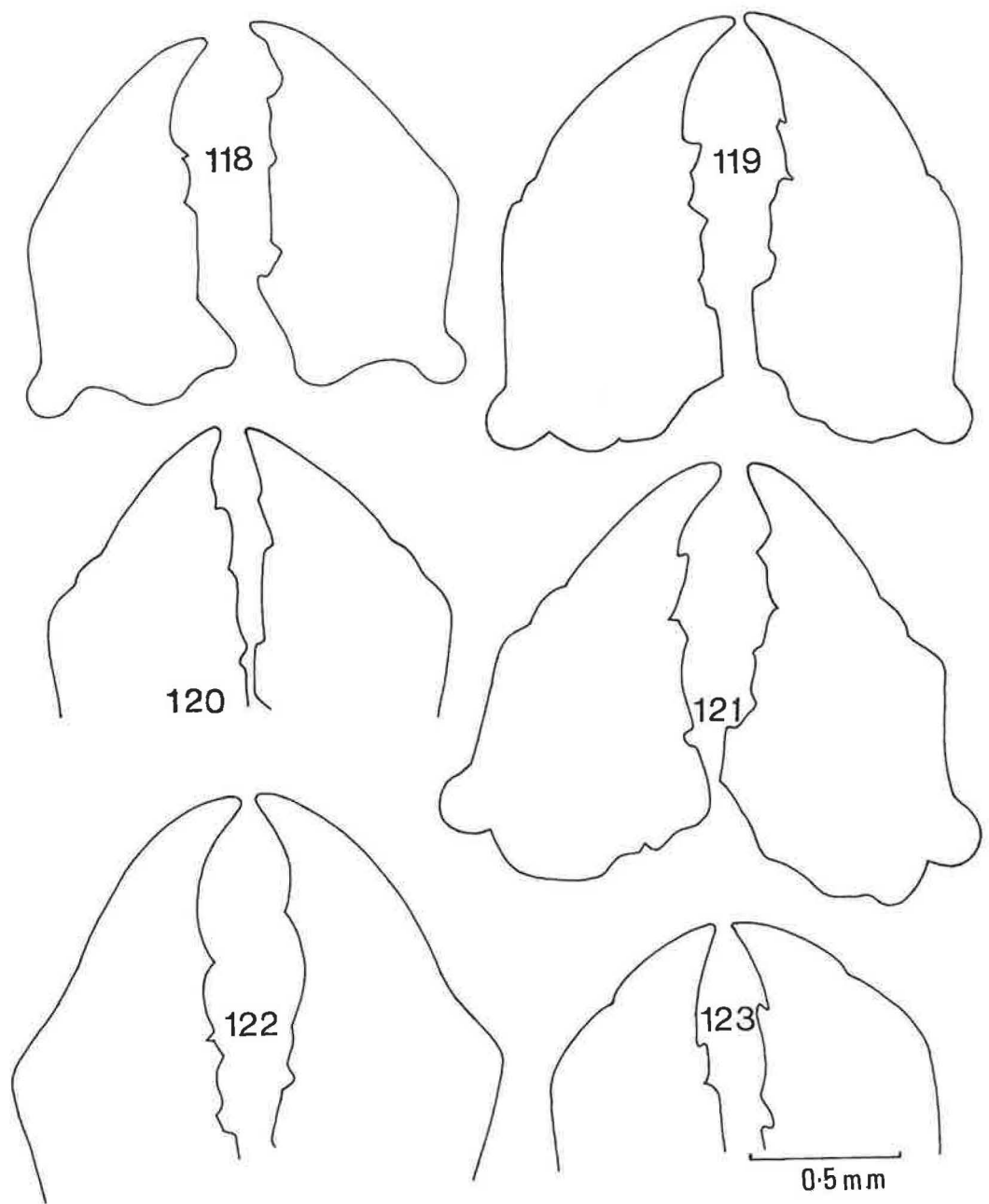
Figs 102-105. *Cryptotermes* soldier mandibles, ventral view.
102, *C. dudleyi*; 103, *C. hemicyclus*; 104,
C. kirbyi; 105, *C. kororensis*.



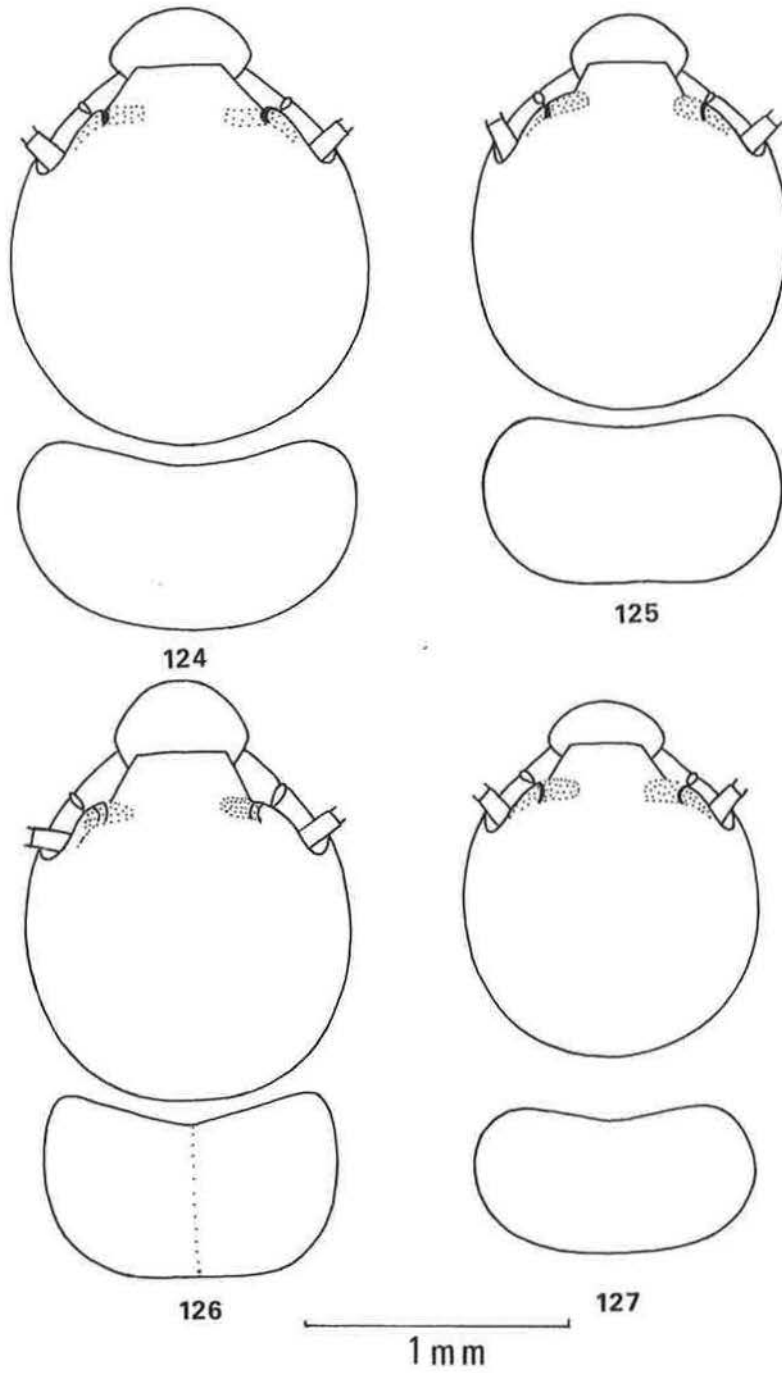
Figs 106-111. *Cryptotermes* soldier mandibles, ventral view. 106, *C. declivis*; 107, *C. dolei*; 108, *C. domesticus*; 109, *C. havilandi*; 110, *C. fatulus*; 111, *C. karachiensis*.



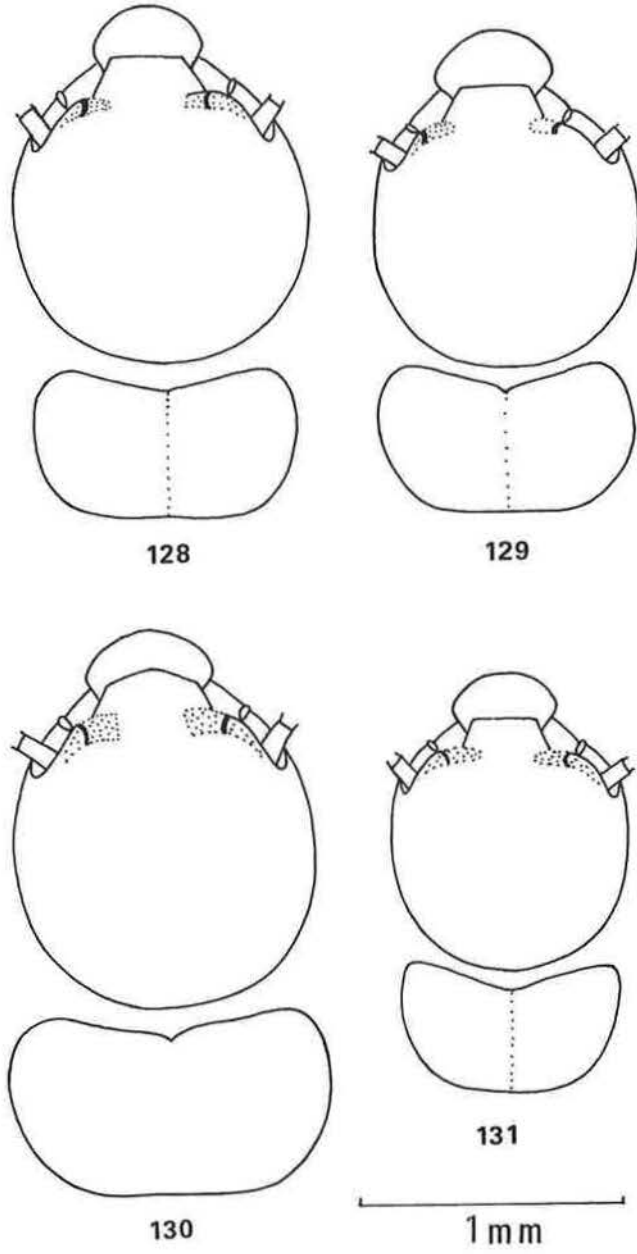
Figs 112-117. *Cryptotermes* soldier mandibles, ventral view. 112, *C. longicollis*; 113, *C. luodianis*; 114, *C. merwei*; 115, *C. naudei*; 116, *C. perforans*; 117, *C. pingyangensis*.



Figs 118-123. *Cryptotermes* soldier mandibles ventral view. 118, *C. pyrodomus*; 119, *C. rhinocephalus*; 120, *C. roonwali*; 121, *C. silvestrii*; 122, *C. sumatrensis*; 123, *C. verruculosus*.



Figs 124–127. *Cryptoterme* alate nymph 2, dorsal view of head capsules and pronota. 124, *C. brevis*; 125, *C. domesticus*; 126, *C. dudleyi*; 127, *C. havilandi*.



Figs 128-131. *Cryptoterme* alate nymph 2, dorsal view. 128, *C. cavifrons*; 129, *C. cynocephalus*; 130, *C. merwei*; 131, *C. perforans*.

DESCRIPTION OF THE SPECIES

Cryptotermes albipes (Holmgren & Holmgren)

(Figs 6 and 7; Table 2)

Calotermes albipes Holmgren & Holmgren, 1915: 85-93. LECTOTYPE imago, NEW CALEDONIA (AMNH) here designated [examined].

Imago. Head capsule dark yellowish-brown, paler anteriorly; frons with pale Y-shaped mark in middle and round white spot above each antennal socket; clypeus yellow-white; labrum yellow; antennal segments pale yellowish-brown, concolorous. Pronotum, abdominal tergites, coxae and femora dark yellowish-brown slightly paler than back of head; posterior margins of tergites darker than anterior margins; sternites and cerci pale yellowish-brown, paler than antennae; sternites paler in middle region; tibiae and tarsi yellow-white to yellow, distinctly paler than femora. Wings pale yellowish-brown, anterior veins darker.

Posterior margin of head evenly rounded, cranial suture distinct; eyes oval sometimes tapering slightly behind; ocelli suboval nearly touching eyes; anterior margin of clypeus straight or concave; antennae with 14 segments; segment 1 cylindrical, longer than 2, segments 2 to 5 subequal. Pronotum with faint to distinct median suture, narrower than maximum width of head with eyes; anterior margin widely and shallowly concave, sides slightly convex to nearly parallel and curved downwards; posterior margin weakly emarginate medially. Mesonotum and metanotum with distinct median sutures. Fore wing with only costal, radius and radial sector sclerotised; radial sector with six simple forward branches; media joining fourth branch of radial sector; cubitus with simple and forked branches. Arolium present.

Measurements (seven specimens from four nest series) in millimetres

	Range	Mean	Type
Head length to lateral base of mandibles	0.88-0.96	0.90	0.96
Maximum width of head with eyes	0.87-0.94	0.92	0.87
Maximum length of labrum	0.16-0.29	0.23	0.26
Maximum width of labrum	0.31-0.39	0.35	0.39
Maximum diameter of compound eye	0.29-0.34	0.31	0.29
Minimum diameter of compound eye	0.23-0.29	0.24	0.23
Maximum diameter of lateral ocellus	0.08-0.13	0.11	0.08
Minimum diameter of lateral ocellus	0.07-0.08	0.07	0.07
Minimum ocellus/antennal distance	0.13-0.20	0.16	0.18
Minimum eye/antennal distance	0.05	0.05	0.05
Minimum distance of eye from lateral base of head	0.10-0.18	0.14	0.13
Maximum length of pronotum	0.59-0.62	0.61	0.62
Median length of pronotum	0.53-0.57	0.56	0.57
Maximum width of pronotum	0.78-0.86	0.82	0.78
Length of hind tibia	0.62-0.75	0.70	0.62
Length of fore wing scale	0.68-0.83	0.73	0.75

Soldier. Recently known and will be described by J. Buckerfield, CSIRO (personal communication).

Biology. This species is found only in the Papuan region and its biology is unknown.

Comparisons. The imagos of *C. albipes*, *C. luodianis*, *C. angustinotus*, *C. pingyangensis* and *C. kirbyi* are darker than all other *Cryptotermes* species. These five species can be distinguished by the characters shown in the imago key.

Material examined. LECTOTYPE imago, NEW CALEDONIA: Mare Loyalty Islands, 17.xi.1911 (*Sarasin and Roux*) (AMNH).

Paralectotypes imagos, NEW CALEDONIA: same data as lectotype (AMNH; BMNH; USNM); (*Hill*) (AMNH).

Cryptotermes angustinotus Gao & Peng

(Figs 14, 76 and 96; Table 2)

Cryptotermes angustinotus Gao & Peng, 1982: 193. Holotype imago, CHINA (SIE) [examined].

Imago. Head capsule dark yellowish-brown slightly paler anteriorly; frons with pale Y-shaped mark in middle and semicircular white spot above each antennal sockets; clypeus yellow-white; labrum yellow; antennal segments pale yellowish-brown and concolorous; pronotum, abdominal tergites, coxae and femora dark yellowish-brown, slightly paler than back of head; pronotum with faint T-shaped mark; posterior margins of first two and last four tergites darker than anterior margins; sternites and cerci pale yellowish-brown paler than antennae; tibiae and tarsi yellow-white distinctly paler than femora and coxae. Wings pale yellowish-brown, anterior veins darker.

Posterior margin of head capsule evenly rounded; Y-suture with stem distinct, V not visible; eyes round, ocelli oval and close to eyes; antennae broken (14-15 segments, Gao and Peng, 1982), segment 1 twice length of 2 or 3; 2 and 3 equal in length, rectangular in shape, 4 and 5 ring-like. Pronotum narrower than maximum width of head with eyes, suture incomplete, visible to about half way along length; anterior margin widely and shallowly concave, sides slightly rounded, posterior margin slightly emarginate medially. Mesonotum and metanotum with distinct median sutures. Fore wing with only costal, radius and radial sector sclerotised; radial sector with six forward branches. Arolium present.

Measurements (one specimen from one nest series) in millimetres

Head length to lateral base of mandibles	1.00
Maximum width of head with eyes	1.07
Maximum length of labrum	0.15
Maximum width of labrum	0.41
Maximum diameter of compound eye	0.26
Minimum diameter of compound eye	0.26
Maximum diameter of lateral ocellus	0.09
Minimum diameter of lateral ocellus	0.06
Minimum ocellus/antennal distance	0.19
Minimum eye/antennal distance	0.06
Minimum distance of eye from lateral base of head	0.17
Maximum length of pronotum	0.70
Median length of pronotum	0.63
Maximum width of pronotum	1.00
Length of hind tibia	0.89
Length of fore wing scale	0.81

Soldier. Head capsule yellow posteriorly, reddish-brown in middle becoming dark brown anteriorly; frontal ridge and frons nearly black; mandibles dark reddish-brown; anteclypeus pale yellow, labrum yellow; antennae and legs pale yellow; thorax and abdomen pale yellowish-brown.

Head short and thick nearly truncate in front, rounded posteriorly; slightly depressed in mid-vertex region and behind frontal ridge above eyes; latter area slightly rugose. Stem of Y-suture distinct. Frontal ridge prominent, broader above eyes than in the middle, central area flattened to form a wide groove; anterior margin almost straight recurving above antennal sockets, not overhanging frons. Frons just concave, slightly rugose. Labrum thumb-shaped with two long setae. Genal horns longer than frontal horns. Eyes oval, unpigmented, distinct. Antennae with 14 segments, segments 3 to 5 approximately same length, shorter than 2, segment 1 longest and twice length of 2. Mandibles moderately shouldered externally about basal third, dentition well developed. Pronotum with median suture, anterior margin finely serrated, moderately V-shaped, sides just convex and rounded into posterior margin, posterior margin almost straight.

Measurements (one specimen from one nest series) in millimetres

Head length to lateral base of mandibles	0.96
Height of head excluding postmentum	0.85
Length of head to cephalic ridge 1	1.26
Length of head to cephalic ridge 2	1.18
Maximum width of head	1.26
Maximum length of labrum	0.22
Maximum width of labrum	0.30
Maximum length of pronotum	0.81
Median length of pronotum	0.70
Maximum width of pronotum	1.22
Maximum width of mesonotum	1.07
Maximum width of metanotum	1.04
Length of hind tibia	0.85
Length of left mandible	0.63
Left mandible, apical to first marginal	0.17
Left mandible, first to third marginal	0.16
Right mandible, apical to first marginal	0.19
Right mandible, first to second marginal	0.07

Biology. This species is known only from its type locality, Jianan, Sichuan Province where soldiers and winged forms were collected in January 1979 and October 1981 in the timber components of a building.

Comparisons. The imago and soldier of this species are very similar to that of *C. luodianis* and at first appeared to be the same species. For separation of the species see imago and soldier keys.

Material examined. Holotype imago, CHINA: Jianan, Sichuan Province, 17.i.1979 (*Peng Xin-fu*) (SIE). Paratype soldier, CHINA: same data as holotype (SIE).

***Cryptotermes bengalensis* (Snyder) sp. rev.**

(Figs 2, 8, 9, 77 and 97; Tables 1 and 2)

Kalotermes (*Cryptotermes*) *bengalensis* Snyder, 1934: 1. LECTOTYPE soldier, INDIA (BMNH) here designated [examined]. [Synonymised by Chhotani, 1970: 45.]

Imago. Head capsule and labrum yellow; antennal segments pale yellow and concolorous, pronotum and tergites yellow, slightly paler than head; sternites and legs pale yellow slightly darker than antennae.

Posterior margin of head evenly rounded, cranial suture usually indistinct; eyes and ocelli oval; ocelli near eyes; anterior margin of clypeus convex; antennae with 14 segments, segment 1 longer than 2, cylindrical, segments 2 to 5 cylindrical and subequal. Pronotum with faint median suture, usually narrower than maximum width across eyes; anterior margin widely and shallowly concave; sides slightly convex to nearly parallel; posterior margin weakly emarginate medially. Mesonotum and metanotum with distinct entire median sutures. Arolium present. (Wings absent in specimens examined.)

Measurements (five specimens from three nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.85-0.88	0.86
Maximum width of head with eyes	0.78-0.88	0.84
Maximum length of labrum	0.16-0.23	0.20
Maximum width of labrum	0.36-0.44	0.41
Maximum diameter of compound eye	0.26-0.31	0.29
Minimum diameter of compound eye	0.22-0.23	0.22
Maximum diameter of lateral ocellus	0.09-0.11	0.10
Minimum diameter of lateral ocellus	0.06	0.06
Minimum ocellus/antennal distance	0.15-0.19	0.18
Minimum eye/antennal distance	0.05-0.06	0.05
Minimum distance of eye from lateral base of head	0.12-0.19	0.18
Maximum length of pronotum	0.57-0.61	0.59
Median length of pronotum	0.52-0.55	0.54
Maximum width of pronotum	0.81-0.87	0.85
Length of hind tibia	0.68-0.74	0.71
Length of fore wing scale	0.75-0.81	0.79

Soldier. Head capsule reddish-brown posteriorly, anterior half almost black; labrum and antennae yellow; mandibles dark reddish-brown distally, darker basally; pronotum yellow, anterior margin brown; abdomen and legs yellow, same colour as back of pronotum.

Head in dorsal view nearly square with sides subparallel, rounded behind, depressed in mid-vertex region and behind frontal ridge above eyes, latter depressions slightly rugose. Stem of Y-suture prominent. Frontal ridge prominent, broader in the middle than above eyes, slightly rough with median groove separating widest part of ridge, anterior margin broadly and moderately V-shaped, recurved above antennal sockets. Frons almost vertical forming a cavity with postclypeus, weakly rugose. Labrum bluntly rounded. Frontal and genal horns same length, genal horns narrower. Eyes oval, unpigmented and distinct. Antennae with 13-14 segments, segment 3 shorter than 2, longer than 4. Mandibles short, dentition moderately developed, slightly shouldered externally about middle region. Pronotum with median suture, anterior margin deeply V-shaped, smooth or slightly serrated, sides partly rounded, posterior margin in middle straight, posterior ends from rounded sides straight, making obtuse angles with posterior margin.

Measurements (seven specimens from four nest series) in millimetres

	Range	Mean	Type
Head length to lateral base of mandibles	1.04-1.15	1.06	1.04
Height of head excluding postmentum	0.86-0.91	0.88	0.87
Length of head to cephalic ridge 1	1.15-1.25	1.20	1.18
Length of head to cephalic ridge 2	1.04-1.09	1.06	1.04
Maximum width of head	1.09-1.21	1.15	1.11
Maximum length of labrum	0.05-0.17	0.12	0.07
Maximum width of labrum	0.18-0.29	0.26	0.29
Maximum length of pronotum	0.74-0.88	0.81	0.78
Median length of pronotum	0.62-0.73	0.68	0.62
Maximum width of pronotum	1.07-1.14	1.09	1.11
Maximum width of mesonotum	0.94-1.12	1.00	1.00
Maximum width of metanotum	0.91-1.09	1.00	1.05
Length of hind tibia	0.59-0.78	0.70	0.68
Length of left mandible	0.57-0.60	0.59	0.60
Left mandible, apical to first marginal	0.13-0.18	0.15	0.13
Left mandible, first to third marginal	0.13-0.18	0.16	0.13
Right mandible, apical to first marginal	0.18-0.20	0.19	0.20
Right mandible, first to second marginal	0.13	0.13	0.13

Alate nymph 2. None available for study.

Biology. This termite is recorded only in the Indomalaysian region and was originally found in dried stumps and dried portions of living trees of *Heritiera minor* Lam. in Sunderban, Bangladesh by Snyder (1934). The species is now known to have attacked structural timbers such as posts, doors, sills, rafters etc. in Tripura and Assam. Colonies are composed of a few hundred individuals only. Data on swarming in nature are lacking. However, emergence from infested logs under laboratory conditions at Dehradun was recorded from the last week of May to the third week in June (Sen-Sarma *et al.*, 1975).

Comparisons. The imago of *C. bengalensis* is closest to that of *C. cynocephalus* in size, but is separable from *C. cynocephalus* in that the head capsule is yellow in colour and the pronotum and abdominal tergites are paler than the head. In *C. cynocephalus* the head capsule is yellowish-brown to pale brown and the pronotum and tergites are almost the same colour as the head.

The soldier of *C. bengalensis* is close to *C. havilandi*. Its synonymy with *C. havilandi* by Chhotani (1970) was refuted by Sen-Sarma *et al.* (1975), with whom I agree. In *C. bengalensis* the mid-vertex region just behind the frontal ridge is depressed and the frontal and genal horns are of equal length. The frontal ridge has a median groove and it is broader in the middle rather than above the eyes. In *C. havilandi* the mid-vertex region is slightly flattened and the genal horns are longer than the frontal horns. The frontal ridge is a uniform narrow strip and moderately developed. The head is shiny in *C. havilandi* but not in *C. bengalensis*.

Material examined. LECTOTYPE soldier, INDIA: Bengal, Sunderbans, 12.ii.1915 (*Beeson*) (BMNH).
Paralectotypes imagos, soldiers, INDIA: same data as lectotypes (AMNH; USNM). THAILAND: Bangkok
(*Becker*) (AMNH).

***Cryptotermes brevis* (Walker)**

(Figs 1, 2, 3, 10, 11, 52, 53, 98 and 124; Tables 1 and 2)

Termes brevis Walker, 1853: 524. LECTOTYPE imago, JAMAICA (BMNH) here designated [examined].

Termes indicus Walker, 1853: 524. LECTOTYPE, imago, COLOMBIA (BMNH) here designated [examined]. [Synonymised by Snyder, 1949: 39.]

Termes flavicollis Walker, 1853: 502. Syntypes, imago, soldier, AFRICA (lost). [Synonymised by Snyder, 1949: 39.]

Calotermes (Cryptotermes) brevis Holmgren, 1911: 55.

Kalotermes (Cryptotermes) brevis Emerson, 1925: 326-329.

Cryptotermes pseudobrevis Fuller, 1921: 30. LECTOTYPE soldier, SOUTH AFRICA (NCI) here designated [examined]. [Synonymised by Snyder, 1949: 39.]

Cryptotermes piceatus Snyder, 1922: 14. LECTOTYPE soldier, HONOLULU (USNM) here designated [examined]. [Synonymised by Snyder, 1949: 39.]

Imago. Head capsule yellowish-brown, sometimes reddish-brown posteriorly, paler anteriorly, usually with a darker V-shaped transverse band near eyes; clypeus yellow-white; antennal segments yellow, concolorous; labrum yellow. Pronotum yellow or yellowish-brown to reddish-brown, paler or same colour as head, with or without a paler T-shaped mark in the middle near anterior margin; abdominal tergites yellowish-brown to reddish-brown usually same colour as head; sternites yellow-white, pale yellow to yellow, distinctly paler than abdominal tergites; femora yellow-white to pale yellow; tibiae and tarsi pale yellow to yellow generally conspicuously darker than femora; wings very faintly tinged with brown; costal to radial sector darker.

Posterior margin of head evenly rounded from behind eyes, cranial suture usually distinct; eyes oval to nearly round; ocelli suboval, very close to or touching eyes; antennae with 14-18 segments, with little variation in size and rectangular shape between the segments 2 and 7. Pronotum with median suture; generally narrower than head, occasionally as wide as, or slightly wider, anterior margin widely and moderately concave, lateral margins convex, posterior margin weakly emarginate or straight. Mesonotum and metanotum with distinct median sutures. Hind tibiae, range 0.88-1.09 mm, distinctly longer than that of other species except *C. domesticus* (0.72-0.91 mm), *C. dudleyi* (0.81-0.94 mm) and *C. merwei* (0.85-0.99 mm). Fore wing with only subcosta, radius and radial sector sclerotised, radial sector with five to seven simple forward branches to costa; media joining radial sector beyond middle of wing. Arolium absent.

Measurements (45 specimens from 24 nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.99-1.17	1.02
Maximum width of head with eyes	1.01-1.18	1.13
Maximum length of labrum	0.13-0.36	0.24
Maximum width of labrum	0.42-0.55	0.49
Maximum diameter of compound eye	0.26-0.34	0.30
Minimum diameter of compound eye	0.23-0.31	0.28
Maximum diameter of lateral ocellus	0.11-0.18	0.14
Minimum diameter of lateral ocellus	0.07-0.13	0.09
Minimum ocellus/antennal distance	0.16-0.23	0.19
Minimum eye/antennal distance	0.05-0.09	0.07
Minimum distance of eye from lateral base of head	0.13-0.23	0.16
Maximum length of pronotum	0.57-0.78	0.69
Median length of pronotum	0.52-0.68	0.58
Maximum width of pronotum	0.99-1.22	1.06
Length of hind tibia	0.88-1.09	0.95
Length of fore wing scale	0.80-1.04	0.93

Soldier. Head capsule reddish or dark brown posteriorly, anterior half to two-thirds almost black; labrum and antennae yellowish-brown; mandibles dark reddish-brown, basal half generally black; pronotum yellowish-brown, darker anteriorly; body and legs yellow to pale brown.

Head in dorsal view moderately to strongly constricted about level of antennal sockets, usually widest at posterior third, conspicuously depressed in mid-vertex region; dorsal and lateral surfaces of anterior two-thirds very rugose. Frontal ridge prominent, rough, produced forward, broadly and shallowly V-shaped with median notch, recurved above antennal sockets. Frons incurved, weakly rugose. Postclypeus with prominent convex anterior margin. Labrum fleshy, broadly triangular or conical. Frontal and genal horns squat and rounded, scarcely prominent. Eyes oval, unpigmented, moderately distinct. Antennae with 10-14 segments, segment 1 longest and cylindrical, 2 shorter than 1, segment 3 shortest. Mandibles short to moderately long, strongly angled, basal half rugose externally. Pronotum generally narrower than head, anterior margin concave, anterolateral corners finely and evenly serrate, sides convex, posterior margin almost straight.

Measurements (89 specimens from 87 nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.96-1.33	1.21
Height of head excluding postmentum	0.75-1.04	0.96
Length of head to cephalic ridge 1	1.20-1.69	1.50
Length of head to cephalic ridge 2	1.09-1.51	1.30

Maximum width of head	1.16-1.53	1.36
Maximum length of labrum	0.08-0.22	0.17
Maximum width of labrum	0.26-0.39	0.34
Maximum length of pronotum	0.68-1.09	0.89
Median length of pronotum	0.52-0.86	0.70
Maximum width of pronotum	1.12-1.51	1.36
Maximum width of mesonotum	0.94-1.33	1.20
Maximum width of metanotum	0.99-1.40	1.24
Length of hind tibia	0.62-0.99	0.86
Length of left mandible	0.57-0.78	0.67
Left mandible, apical to first marginal	0.09-0.16	0.12
Left mandible, first to third marginal	0.10-0.16	0.13
Right mandible, apical to first marginal	0.13-0.16	0.15
Right mandible, first to second marginal	0.08-0.13	0.10

Alate nymph 2. Head, antennae, labrum, body and legs yellow-white to pale yellow. Head usually slightly darker than rest of body.

Head capsule subcircular, broader than long, with short distinct hairs, cranial suture not visible; brain distinct. Antennae with 13-15 segments, segment 1 longest, almost twice length of 2, segments 3 to 5 usually of equal size, shorter than 2. Apical teeth of mandibles short, L_A/L_1 0.55-0.66, R_A/R_1 1.50-1.75. Pronotum broader than long, hairier than head, with many longer distinct setae; anterior margin shallowly concave, sides strongly angled posteriorly, posterior margin straight or slightly incurved medially. Setae on posterior edge of sternites distinctly longer than those on tergites. Legs short and hairy; apical spur formula 3:3:3; tarsi four-jointed. Arolium absent.

Measurements (20 specimens from 10 nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	1.04-1.18	1.13
Maximum width of head	1.17-1.31	1.22
Length of pronotum	0.57-0.70	0.64
Median length of pronotum	0.48-0.63	0.59
Width of pronotum	1.07-1.30	1.17
Left mandible, apical to first marginal	0.06	0.06
Left mandible, first to third marginal	0.09-0.11	0.10
Left mandible, third marginal to molar	0.09-0.11	0.10
Left mandible, length of apical tooth	0.05-0.06	0.06
Left mandible, posterior cutting edge of first marginal	0.03-0.04	0.04
Left mandible, anterior cutting edge of third marginal	0.07	0.07
Right mandible, apical to first marginal	0.06-0.07	0.06
Right mandible, first to second marginal	0.04	0.04
Right mandible, posterior cutting edge of second marginal	0.15-0.20	0.18
Right mandible, length of apical tooth	0.04-0.06	0.05
Right mandible, posterior cutting edge of first marginal	0.03-0.04	0.04
Length of right mandible	0.30-0.35	0.33
Basal width of right mandible	0.33-0.37	0.34
Right mandible, length of molar plate	0.15-0.20	0.18
Right mandible, width of molar plate	0.07-0.09	0.09
Length of hind tibia	0.65-0.78	0.75

Biology. *C. brevis* is found in all the eight geographical regions of the world. It is essentially a domestic termite and all collection records refer to colonies in hard and soft woods of structural timbers, i.e. joists, skirting boards, rafters, ceiling, battens, inside and outside walls, beams and door and window frames, or furniture. There are no records of its occurrence in dead wood or scar tissue of living trees and shrubs. Almost total destruction of the article of timber involved may occur (see Coaton, 1948; Hughes, 1954; Coaton and Sheasby, 1979; Yule and Watson, 1976). The main swarming season in South Africa is during November and December. Alates have been found in nests in Port Elizabeth in early October (Coaton, 1950). The biology of the species is discussed in detail in Williams (1977) and Steward (1981, 1982, 1983a, 1983b).

Comparisons. The imago of *C. brevis* is distinguished from other species by its generally larger size and by the complete absence of an arolium between the tarsal claws, the latter character shared only with *C. darwini* and *C. kirbyi*. The three species, *C. brevis*, *C. darwini* and *C. kirbyi*, however, can be separated by two distinct characters, i.e. the length of head to the lateral base of the mandibles and length of the hind tibia. Head length to lateral base of mandible in *C. brevis* is 0.99-1.17 mm, in *C. darwini* 0.86-0.94 mm, and in *C. kirbyi* 1.00-1.09 mm. Length of hind tibia in *C. brevis* is 0.88-1.09 mm, in *C. darwini* 0.75-0.81 mm, and in *C. kirbyi* 0.68-0.78 mm.

The soldier of *C. brevis* is readily distinguished from all other species by its constricted and strongly rugose head, short, broad and noticeably angled mandibles and squat rounded frontal and genal horns. It is closest to *C. darwini* but the latter differs in that the head is decidedly lower and narrower and is more constricted about level of antennal sockets and sides at level of antennal sockets to forward splay

out. Some taxonomists believe *C. darwini* is a synonym of *C. brevis*, but the material of *C. darwini* examined is insufficient to arrive at this conclusion. Further collections in the Galapagos are necessary to establish an adequate measure of variation in the species. Species close to *C. brevis* are *C. verruculosus*, *C. silvestrii* and *C. rhinocephalus*. The size of the head capsule of the alate nymph of *C. brevis* is similar to that of *C. domesticus*, *C. kirbyi* and *C. dudleyi*. Head width range in *C. domesticus* is 1.02-1.17 mm, in *C. brevis* 1.17-1.31 mm, in *C. kirbyi* 1.03-1.22 mm, and in *C. dudleyi* 1.09-1.25. The measurements of the other characters are very similar and as a result separation of the species is difficult. The shape of the pronotum varies in the species, however, and this to some extent facilitates species identification (Figs 124-127). Also in *C. brevis* the range of the width of the pronotum minus its length is 0.44-0.67 mm whilst in the species listed above it is 0.26-0.44 mm.

Material examined. LECTOTYPE of *brevis* imago, JAMAICA: (Gosse) (BMNH). LECTOTYPE of *indecisus* imago, COLOMBIA: (Cuming) (BMNH). LECTOTYPE of *pseudobrevis* soldier, SOUTH AFRICA: (Fuller) (NCI). LECTOTYPE of *piceatus* soldier, HONOLULU: (Snyder) (USNM).

Paralectotypes imagos, soldiers, same data as lectotypes (BMNH; NCI; USNM). ASCENSION ISLAND: 8.xi.1952, two vials (Harris). BARBADOS: 1921 (Barlow); xi.1936 (Adamson). BERMUDA: 12.xii.1938 (Waters-ton); 12.xii.1938 (Westropp) (AMNH); Hamilton, 28.x.1958 (Harris). BRAZIL: iv.1935 (Silvestri) (AMNH). CHILE: Arica, 15.vi.1965 (Harris). COLOMBIA: Medellin, 1978 (Schmutzenhofer). COSTA RICA: San Jose, ix.1929 (Vicente) (AMNH); Turrialba, 30.iv.1979, two vials (King). CUBA: vii.1968 (Williams). ECUADOR: Palmar, 25.iii.1935 (Hagen); Portevello, 3.vii.1932, four vials (Temple) (AMNH). EASTER ISLAND: South Pacific, 23.vi.1965 (Ifford). EGYPT: Port Said, x.1975 (two vials) (Nached). EL SALVADOR: Sonsonate, 3.v.1942 (Marshall) (AMNH). FLORIDA: Tampa, 23.xi.1960 (McMahan); Carol Gables, 27.v.1936 (Callaway); Gainesville, 2.viii.1958 (Cowperth-White) (AMNH). THE GAMBIA: Banjul, 20.x.1973, 22.ii.1973, 21.xi.1973, 17 vials (Williams); Bakau, x.1974 (Williams). GHANA: Sekondi, 7.xi.1973, five vials (Williams, Ocloo and Lamb); Winneba, 23.xi.1973, four vials (Williams, Ocloo and Lamb). GUYANA: Georgetown, v.1922, 12.viii.1924, six vials (Emerson) (AMNH). HAWAII: Honolulu, 1927 (Fullaway), x.1927, 5.iii.1927 (Snyder) (USNM). GRENADA: Grand Bay, 5.iv.1942 (Adamson) (AMNH). LAYSAN ISLAND: no date (Fullaway) (AMNH). MADAGASCAR: Tanarive, 14.xii.1959 (Pavlia) (AMNH). MARQUESAS: Nouka Nivd, 1926, ii.1929 (Delmas and Light) (AMNH). MEXICO: Atoyac, Colima, viii.1932, 16.viii.1932 (Hagen). PERU: Quilabama, 23.iv.1971, two vials (Sands); Chinka Islands, 30.x.1939 (Schmidt); Lima, no date (Herrer), 7.v.1935 (Silvestri) (AMNH). PORTO RICO: Rio Piedros, 17.vi.1925 (Sein). SIERRA LEONE: Njala, 1936 (Hargreaves). SENEGAL: Dakar, 23.i.1976, 19.xii.1964, 7.v.1964, 10.xi.1965, five vials (Williams). SOUTH AFRICA: Natal, 23.ii.1935 (Kent); Durban, 20.x.52 (Harris). ST. LUCIA: Castries, v.1960 (Lang), 1913 (Moru) (AMNH). ST. VINCENT: Kingston, 25.viii.1936 (Adamson). TRINIDAD: St. Augustine (Emerson). UGANDA: Entebbe, 4.ii.67, two vials (Brown). USA: California, 28.vi.1943 (Cravens) (AMNH), xi.65, two vials (Harris). URUGUAY: 1920 (Silvestri).

Cryptotermes canalensis (Holmgren & Holmgren)

(Fig. 15; Table 2)

Calotermes (*Cryptotermes*) *canalensis* Holmgren & Holmgren, 1915: 88. Holotype imago, NEW CALEDONIA: (Basler Natural History Museum) 30.x.1911 (Sarasin & Roux) [not examined].

Imago. Head capsule pale yellowish-brown posteriorly, yellow anteriorly with a paler Y-shaped marking in the middle of the frons; clypeus yellow-white; labrum yellow; pronotum and tergites nearly same colour as posterior of head; posterior margins of tergites slightly darker than anterior margins. Sternites and cerci pale yellow; leg segments of varying shades of yellow; tibiae darker than femora; tarsi distinctly paler than tibiae. Wings faintly tinged with brown, anterior veins darker.

Posterior margin of head evenly rounded from a point behind eyes; cranial suture faint, eyes and ocelli oval; ocelli touching eyes; anterior margin of clypeus concave; antennae broken. Pronotum with median suture, nearly same width as maximum width of head across eyes; anterior margin widely concave, sides slightly convex, posterior margin weakly emarginate. Mesonotum and metanotum with distinct median sutures. Fore wing with costal, radius and radial sector sclerotised; radial sector with seven simple forward branches. Arolium present.

Measurements (one specimen from one nest series) in millimetres

Head length to lateral base of mandibles	0.86
Maximum width of head with eyes	0.96
Maximum length of labrum	0.29
Maximum width of labrum	0.29
Maximum diameter of compound eye	0.34
Minimum diameter of compound eye	0.27
Maximum diameter of lateral ocellus	0.10

Minimum diameter of lateral ocellus	0.08
Minimum ocellus/antennal distance	0.18
Minimum eye/antennal distance	0.05
Minimum distance of eye from lateral base of head	0.13
Maximum length of pronotum	0.68
Median length of pronotum	0.62
Maximum width of pronotum	0.62
Length of hind tibia	0.70
Length of fore wing scale	0.83

Soldier. Unknown. The soldier described by Hill (1942) has been renamed *Procryptotermes krishnai* by Emerson (see Krishna, 1961). I have examined the soldiers and imagos collected by Hill and Dumbleton and agree with Emerson.

Biology. This species has only been found in New Caledonia, Canalia, Noumea (Papuan region). Its biology is unknown.

Comparisons. The imago of *C. canalensis* is unique in that the tibiae are darker than the femora and the tarsi are distinctly paler than the tibiae and femora. It is, however, close to the imago of *C. dolei*. In the latter the femora and tibiae are yellow and the tarsi are pale yellow. The head capsule is orange-yellow versus pale yellowish-brown. The pronotum width is also larger, range 0.80–0.95 mm, while in *C. canalensis* the pronotum is smaller, maximum width 0.62 mm.

Material examined. NEW CALEDONIA: 30.x.1911; 1935 (*Jacques*) (AMNH).

Cryptotermes cavifrons Banks

(Figs 3, 18, 19, 54, 55, 100 and 128; Tables 1 and 2)

Cryptotermes cavifrons Banks, 1906: 336. Type (probably syntype) imagos, soldier, FLORIDA: *Kissimmee* (MCZ) [not examined].

Imago. Head capsule yellow, yellowish-brown or orange-yellow, usually paler anteriorly; frons with pale Y-shaped mark in middle and round white spot above each antennal socket; clypeus pale yellow to yellow; labrum yellow; antennae yellow, occasionally darker distally; pronotum yellow to yellowish-brown, paler than head; tergites yellow, pale yellowish-brown, paler or same colour as head; legs pale yellow to yellow; tibiae and tarsi sometimes darker than femora; wings faintly tinged brown and iridescent.

Posterior margin of head evenly rounded; cranial suture faint to distinct; eyes and ocelli oval; ocelli usually touching eyes; anterior margin of clypeus straight or convex; antennae with 13–16 segments, segment 2 equals 3; 4 shorter than 2 or 3, or 2 slightly longer than 3, 3 equals 4 or 2–5 equal. Pronotum with median suture, usually narrower, occasionally broader than maximum width of head with eyes; anterior margin moderately concave, sides almost parallel or slightly convex, posterior margin slightly emarginate. Mesonotum and metanotum with distinct median sutures. Fore wing with anterior veins sclerotised; radial sector with five to eight forward simple branches; media joining radial sector beyond middle of wing. Arolium present.

Measurements (16 specimens from 14 nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.81–0.96	0.86
Maximum width of head with eyes	0.86–1.00	0.92
Maximum length of labrum	0.09–0.19	0.16
Maximum width of labrum	0.31–0.44	0.38
Maximum diameter of compound eye	0.26–0.33	0.30
Minimum diameter of compound eye	0.22–0.28	0.25
Maximum diameter of lateral ocellus	0.09–0.13	0.11
Minimum diameter of lateral ocellus	0.06–0.08	0.07
Minimum ocellus/antennal distance	0.13–0.22	0.17
Minimum eye/antennal distance	0.04–0.09	0.06
Minimum distance of eye from lateral base of head	0.09–0.15	0.11
Maximum length of pronotum	0.56–0.77	0.65
Median length of pronotum	0.51–0.65	0.58
Maximum width of pronotum	0.80–0.99	0.89
Length of hind tibia	0.67–0.89	0.79
Length of fore wing scale	0.74–0.93	0.82

Soldier. Head capsule anterior fifth to half black, reddish-brown posteriorly; frons black; mandibles dark reddish-brown, antennae yellowish-white, anterior margin of pronotum brown, rest of body pale yellowish-brown; legs, labrum pale yellow.

Head in dorsal view phragmotic, short, thick, faintly rugose in front half. In profile, head slightly incurved medially just behind frontal ridge, raised posteriorly. Frontal horns short, rounded and prominent, genal horns smaller and shorter; frontal ridge a narrow strip, fairly prominent with or without a V-shaped notch, anterior margin shallowly concave; frons faintly rugose, vertical or near vertical. Eyes distinct and unpigmented. Antennae with 11–15 segments, segments 3 and 4 equal, 2 shorter than 1. Anteclypeus a narrow unsclerotised strip; postclypeus much larger, labrum pointed at tip. Mandibles short to moderately long, slightly or moderately shouldered in basal half, sharply curving inwards from middle region to tip of apical tooth. Teeth scarcely to well developed. Pronotum narrower, broader or same width as head, anterior margin widely and moderately concave, wavy or serrated and elevated; sides and hind margin evenly rounded.

Measurements (35 specimens from 34 nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.78-1.00	0.90
Height of head excluding postmentum	0.70-0.91	0.81
Length of head to cephalic ridge 1	0.96-1.17	1.06
Length of head to cephalic ridge 2	0.83-1.15	0.98
Maximum width of head	0.96-1.20	1.09
Maximum length of labrum	0.08-0.18	0.13
Maximum width of labrum	0.25-0.31	0.26
Maximum length of pronotum	0.62-0.88	0.77
Median length of pronotum	0.60-0.75	0.66
Maximum width of pronotum	0.86-1.17	1.05
Maximum width of mesonotum	0.78-1.04	0.89
Maximum width of metanotum	0.83-1.09	0.94
Length of hind tibia	0.60-0.73	0.68
Length of left mandible	0.59-0.73	0.63
Left mandible, apical to first marginal	0.15-0.20	0.17
Left mandible, first to third marginal	0.13-0.20	0.16
Right mandible, apical to first marginal	0.18-0.24	0.19
Right mandible, first to second marginal	0.09-0.14	0.12

Alate nymph 2. Head yellow or pale orange-yellow, labrum nearly same colour as head; clypeus yellow-white or pale-yellow. Pronotum pale yellow occasionally same colour as head; antennae, abdomen and legs pale yellow.

Head capsule subcircular with several short distinct setae; cranial suture absent; brain distinct. Antennae with 13-14 segments, segment 1 longest, segment 2 about twice length of 3, 3-4 subequal. Apical teeth of mandibles short, L_A/L_1 0.60-0.66, R_A/R_1 1.50-2.00. Pronotum width smaller than head width; lateral and posterior margins with several short distinct hairs; anterior margin broadly and moderately concave, sides round, slightly convex, posterior margin straight or weakly emarginate. Legs hairy; apical spur formula 3:3:3; tarsi four-jointed. Arolium absent.

Measurements (20 specimens from 10 nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.85-0.94	0.91
Maximum width of head	0.96-1.07	1.02
Length of pronotum	0.52-0.67	0.60
Median length of pronotum	0.44-0.57	0.51
Width of pronotum	0.81-1.14	0.96
Left mandible, apical to first marginal	0.06	0.06
Left mandible, apical to third marginal	0.09-0.10	0.09
Left mandible, third marginal to molar	0.08-0.09	0.09
Left mandible, length of apical tooth	0.04-0.05	0.04
Left mandible, posterior cutting edge of first marginal	0.03	0.03
Left mandible, anterior cutting edge of third marginal	0.07-0.08	0.08
Right mandible, apical to first marginal	0.06	0.06
Right mandible, first to second marginal	0.03-0.04	0.03
Right mandible, posterior cutting edge of second marginal	0.15-0.17	0.16
Right mandible, length of apical tooth	0.04	0.04
Right mandible, posterior cutting edge of first marginal	0.03	0.03
Length of right mandible	0.26-0.30	0.27
Basal width of right mandible	0.28-0.31	0.29
Right mandible, length of molar plate	0.13-0.15	0.14
Right mandible, width of molar plate	0.07	0.07
Length of hind tibia	0.59-0.67	0.62

Biology. *C. cavifrons* is native to Florida, Central America and the West Indies. The usual situation for this species is dry, sound hardwoods in the Hammock areas in Southern Florida, but Miller (1949) has reported one structural infestation in Tampa and has records of several others. The collections examined refer to colonies in coconut stumps, old Aca stumps, uprights of a pergola and in the dead wood of a living tree. Miller has indicated that the peak of the flight period of this termite is apparently February and March or flights occurring from December through June.

Comparisons. The imago of *C. cavifrons* is closest to *C. longicollis*. In the former the antennae have 13-16 segments, yellow in colour, sometimes darker distally. The tibiae and tarsi are sometimes darker than the femora and the wings are faintly tinged brown and iridescent while in the latter the antennae have 14-16 segments, the first four proximal segments are sometimes paler than the distal segments and the tibiae and tarsi are always darker than the femora, and the wings are hyaline. The soldier is also near to *C. longicollis* but can be separated from this species in that the head is weakly rugose and the mandibles are bent sharply near the middle becoming strongly angled to the apical tooth; in *C. longicollis* the mandibles are shorter and the head is more rugose. The alate nymph 2 of *C. cavifrons* is similar to that of *C. cynocephalus* in size, and they are difficult to separate entirely on

measured characters. Shape appears to be an important distinguishing feature and the two species can be separated if shape of the head and pronotum in particular are taken into consideration (Figs 128 and 129).

Material examined. BERMUDA: 1.xi.1934 (*Teevan*) (AMNH). CUBA: Finca, 28.ix.1966, two vials (*Hfdy*); Havana, 30.v.1976, two vials (*Hfdy*). FLORIDA: Adam Key, 22.iii.1941 (*Miller*); Big Pine Key, 2.ii.1941 (*Miller*); Brickell Hammock, 20.iii.1941 (*Miller*); Cape Sable, 27.iii.1941 (*Miller*); Eleven Palm Hammock, 16.iii.1941 (*Miller*); Elliot Key, 22.iii.1941 (*Miller*); Key Largo, 7.i.1924 (*Miller*); Key Vaca, 23.iv.1938 (*Miller*); Kissimmee, 1906 (*Banks*) (material probably from type colony); Long Pine Key, 27.xi.1931, 7.xii.1932, 22.x.1932, 12.i.1941 (*Miller*), 28.iii.1976 (*Snyder*); Palma Vesta, 23.iii.1941 (*Miller*); Paradise Key, 27.iii.1916, two vials (*Snyder*) (AMNH). JAMAICA: Blue Fields Bay, 16.v.1941, two vials (*Chapin*); Cane River Falls, 30.v.1941 (*Chapin*) (AMNH); Hope Gardens, 20 and 16.v.1941, two vials (*Harris*); Yallas, 20.v.1963 (*Harris*); 14 miles from Kingston, 22.x.1958, two vials (*Harris*).

Cryptotermes cubicoceps Emerson

(Fig. 78; Table 2)

Cryptotermes cubicoceps Emerson, 1925: 330-331. Holotype soldier, GUYANA: Kartabo (AMNH) 26.vii.1920 (*Emerson*) [not examined]. Imago unknown.

As the soldier was not available for study the original description by Emerson is given below.

Soldier. Head yellow-brown, front black; only two or three bristles on head; shape short and thick, front concave with a thick ridge between the front and top and the front and sides. Front with two pairs of short rounded projections, one on each side of the base of the mandible and one on each side of the clypeus. Top of head concave near the front, rest smooth and convex, ridge between the top and front deeply indented in the middle; ridges and front tuberculate. Antennae yellow with 12 segments, segment 3 shorter than 4, segment 4 shorter than 2. Eyes practically invisible, same colour as head. Mandibles short and black. Pronotum yellow-brown with numerous bristles; anterior margin widely emarginate, sides rounded, posterior margin nearly straight; angles between anterior margin and sides rounded. Abdominal tergites pale with numerous bristles. Styli present, not rudimentary.

Measurements in millimetres

Total length	5.88
Length of head	2.65
Width of head	2.12
Length of antennae	1.53
Length of pronotum	1.23
Width of pronotum	1.88
Length of hind tibia	1.25

Biology. This species is known only from the type locality, Kartabo, Guyana and described from a single soldier collected by Emerson in a dead liana stem.

Cryptotermes cynocephalus Light

(Figs 2, 20, 21, 56, 57, 99 and 129; Tables 1 and 2)

Cryptotermes cynocephalus Light, 1921: 36. LECTOTYPE soldier, PHILIPPINE ISLAND (AMNH) here designated [examined]. *Cryptotermes buitenzorgi* Kemner, 1934: 45, LECTOTYPE soldier, JAVA (AMNH) here designated [examined]. [Synonymised by Snyder, 1949: 40.]

Imago. Head capsule yellowish-brown or pale brown, paler anteriorly; frons sometimes with pale Y-shaped mark; clypeus pale yellow; labrum and legs yellow; antennal segments pale yellowish-brown and concolorous; pronotum and tergites almost same colour as head; pronotum with or without a T-shaped mark in median anterior region; posterior margins of tergites usually darker than anterior margins, occasionally only first two and last three segments darker; sternites yellow to pale yellowish-brown, middle region usually paler; wings faintly tinged with brown, anterior veins darker.

Head capsule subrectangular, sides almost parallel to a point just behind eyes; posterior margin evenly rounded; cranial structure present or absent; eyes and ocelli suboval; ocelli touching eyes; anterior margin of clypeus concave. Antennae with 13-15 segments, segment 3 smaller than 1 or 2. Labrum broadly tongued-shaped. Pronotum with incomplete or entire median suture; slightly narrower than head, anterior margin moderately concave, sides rounded and widest at posterior third, posterior margin weakly emarginate. Radial sector of fore wing with four to five forward branches, media and cubitus unsclerotised, media joining radial sector before middle of wing. Arolium present.

Measurements (22 specimens from 19 nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.78-0.83	0.80
Maximum width of head with eyes	0.78-0.85	0.82
Maximum length of labrum	0.11-0.24	0.16
Maximum width of labrum	0.30-0.37	0.34
Maximum diameter of compound eye	0.26-0.31	0.28
Minimum diameter of compound eye	0.20-0.26	0.23
Maximum diameter of lateral ocellus	0.09-0.13	0.11
Minimum diameter of lateral ocellus	0.05-0.09	0.07
Minimum ocellus/antennal distance	0.13-0.17	0.15
Minimum eye/antennal distance	0.04-0.07	0.06
Minimum distance of eye from lateral base of head	0.09-0.13	0.10
Maximum length of pronotum	0.52-0.63	0.56
Median length of pronotum	0.44-0.59	0.49
Maximum width of pronotum	0.65-0.81	0.72
Length of hind tibia	0.60-0.70	0.66
Length of fore wing scale	0.65-0.78	0.72

Soldier. Head capsule almost black in front half shading to orange or blackish-brown posteriorly; labrum yellow-white; antennae pale brown; mandibles black at base, reddish to blackish-brown distally; pronotum pale brown, anterior margin darker. Abdomen and legs pale brownish-white.

Head in dorsal view short and thick usually slightly constricted at sides about eyes, widest at posterior third; vertex conspicuously depressed medially behind frontal ridge and above eyes, weakly wrinkled; in profile moderately to strongly concave in middle. Frontal ridge a complete narrow strip, prominent, rough, and overhanging frons slightly medially and greatly laterally, anterior margin deeply V-shaped, with or without small median groove. Frons falling almost vertically to clypeus, moderately to deeply concave and weakly to moderately rugose. Frontal horns short, stout, bluntly rounded. Genal horns narrow, tapering anteriorly with rounded ends. Frontal horns slightly longer than genal horns. Eyes small, generally indistinct. Antennae with 8-12 segments, segment 3 smaller than 2 and more sclerotised. Anteclypeus a thin, narrow, apilose, hyaline strip. Labrum triangularly tongue-shaped. Mandibles very short, thick and broad basally, strongly angulate with distinct shoulder in basal half; teeth slightly developed. Pronotum with anterior margin elevated, finely serrate, broadly and moderately notched or V-shaped, sides slightly rounded, posterior margin almost straight.

Measurements (25 specimens from 20 nest series) in millimetres

	Range	Mean	Type
Head length to lateral base of mandibles	0.72-0.92	0.83	0.85
Height of head excluding postmentum	0.65-0.82	0.73	0.70
Length of head to cephalic ridge 1	0.92-1.09	0.96	1.05
Length of head to cephalic ridge 2	0.78-0.92	0.85	0.91
Maximum width of head	0.87-1.02	0.94	0.96
Maximum length of labrum	0.07-0.14	0.11	0.09
Maximum width of labrum	0.15-0.20	0.19	0.19
Maximum length of pronotum	0.52-0.68	0.61	0.56
Median length of pronotum	0.41-0.57	0.49	0.41
Maximum width of pronotum	0.82-0.97	0.90	0.91
Maximum width of mesonotum	0.64-0.86	0.75	0.74
Maximum width of metanotum	0.71-0.89	0.80	0.81
Length of hind tibia	0.49-0.60	0.55	0.56
Length of left mandible	0.44-0.54	0.49	0.44
Left mandible, apical to first marginal	0.10-0.12	0.11	0.11
Left mandible, first to third marginal	0.10-0.13	0.11	0.10
Right mandible, apical to first marginal	0.10-0.14	0.13	0.15
Right mandible, first to second marginal	0.08-0.10	0.09	0.10

Alate nymph 2. Head yellow-white to yellow usually darker than rest of body. Pronotum and sternites paler than head and slightly paler than or same colour as tergites. Antennae, legs nearly same colour as pronotum and sternites. Labrum nearly same colour as head.

Posterior margin of head capsule evenly rounded, sides nearly parallel, moderately hairy, cranial suture not visible, brain distinct. Antennae with 12-13 segments, segment 1 longest, almost twice length of 2, segments 3 to 5 usually subequal. Apical teeth of mandibles very short, L_A/L_1 0.44-0.66, R_A/R_1 1.30-1.60. Pronotum broader than long, moderately hairy, anterior margin broadly and shallowly concave, sides slightly convex with posterior ends moderately rounded in postero-lateral corners; posterior margin slightly incurved medially. Legs very short and hairy; apical spur formula 3:3:3; tarsi four-jointed. Arolium absent.

Measurements (12 specimens from seven nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.81-0.85	0.82
Maximum width of head	0.85-0.91	0.88
Length of pronotum	0.44-0.52	0.47
Median length of pronotum	0.39-0.44	0.42
Width of pronotum	0.76-0.87	0.80
Left mandible, apical to first marginal	0.04-0.06	0.05
Left mandible, first to third marginal	0.07-0.09	0.08
Left mandible, third marginal to molar	0.07-0.09	0.08
Left mandible, length of apical tooth	0.03-0.04	0.04
Left mandible, posterior cutting edge on first marginal	0.02-0.03	0.03
Left mandible, anterior cutting edge of third marginal	0.07-0.08	0.08
Right mandible, apical to first marginal	0.04-0.06	0.05

Right mandible, first to second marginal	0·03	0·03
Right mandible, posterior cutting edge of second marginal	0·15	0·15
Right mandible, length of apical tooth	0·04-0·05	0·04
Right mandible, posterior cutting edge of first marginal	0·02-0·03	0·03
Length of right mandible	0·25-0·26	0·26
Basal width of right mandible	0·25-0·28	0·26
Right mandible, length of molar plate	0·11-0·13	0·11
Right mandible, width of molar plate	0·07-0·08	0·07
Length of hind tibia	0·44-0·59	0·53

Biology. *C. cynocephalus* is found both in the 'wild' and in 'domestic' situations. In 1956 it was collected in Singapore by Harris in hardwood in the forest and from wood posts. Elsewhere it has been recorded in *Shorea* sp. timber, plywood panels and in flooring and doors of buildings. Yule and Watson (1976) reported that it was restricted to a limited area of coastal North Queensland in milled timber. It is now known to be common in natural situations in rain forest and sclerophyll woodland near Cooktown. Numerous colonies were collected from standing dead trees and saplings or from logs lying on the ground. The gallery systems of these colonies were mainly in the sapwood zone, although extensions into the heartwood also occurred. On the basis of this evidence Gay and Watson (1982) regarded *C. cynocephalus* as endemic to Australia.

Comparisons. The imago of *C. cynocephalus* is close to that of *C. perforans* and *C. bengalensis*. The soldier is close to *C. perforans* and *C. roonwali*. The shape of the head is slightly different in the three species (Figs 56, 57, 77 and 84).

Material examined. LECTOTYPE soldier, PHILIPPINE ISLAND: 28.viii.1920 (Yllarde) (AMNH).

LECTOTYPE of *buitenzorgi* soldier, JAVA: Buitenzorg, 6.ix.1920 (Kemner) (AMNH).

Paralectotypes imagos, soldiers, PHILIPPINE ISLAND; JAVA: same data as lectotypes (AMNH). CEYLON: Colombo, 11.vi.1971 (Ernst). JAVA: 9.x.1979 (Supriana); nr Batavia, 26.vii.1935 (Kirby); Buitenzorg, 27.vii.1935 (Kirby); Bogor, 30.ix.1954 (Alston); Gedeh, 21.vii.1935 (Kirby) (AMNH). MALAYA: Kepong, 11.vii.1956, 22.xi.1956, 17.xi.1957, 4.iii.1958, 6.i.1969 (Harris and Menon); Port Weld, 1.xii.1975 (Salick) (AMNH). SARAWAK: Kuching, 19.vi.1956 (Harris); Batu Lintang, 9.v.1961 (Wallace). SINGAPORE: (Hillman); 29.vii.1975 (Kirby) (AMNH), Bukit Timah, 16.vii.1956 (Harris).

Cryptotermes darwini (Light)

(Figs 3, 16, 17, 64, 65 and 101; Table 2)

Kalotermes (*Cryptotermes*) *darwini* Light, 1935: 242-244. Holotype soldier, GALAPAGOS: Charles Island, 24.iv.1932 (Larsen) (AMNH) [not examined].

Imago. Head capsule yellowish-brown to reddish-brown posteriorly dull yellow anteriorly, middle region with a dark V-shaped band across eyes behind frons; clypeus yellow-white; antennae and labrum yellow; pronotum, abdominal tergites yellowish-brown paler or same colour as head. Pronotum with a T-shaped mark near anterior margin. Sternites and legs yellow. Wings faintly tinged with brown; costal to radial sector darker.

Head capsule noticeably shorter than maximum width across eyes; posterior margin sharply rounded behind eyes; cranial suture distinct; eyes and ocelli oval to nearly round; ocelli touching eyes; antennae with 15 segments, segments 1 and 2 cylindrical, 1 longer than 2, 2 equals 3, segment 4 smaller. Pronotum width narrower than head width across eyes; anterior margin widely and shallowly concave, sides rounded, posterior margin slightly emarginate. Fore wing with only costal, radius and radial sector sclerotised; radial sector with four simple forward branches to costa; media extending to tip of wing and sending up several vertical branches to radial sector. Arolium absent.

Measurements (four specimens from three nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0·86-0·94	0·89
Maximum width of head with eyes	1·01-1·04	1·02
Maximum length of labrum	0·10-0·18	0·15
Maximum width of labrum	0·39-0·42	0·41
Maximum diameter of compound eye	0·27-0·31	0·30
Minimum diameter of compound eye	0·27-0·29	0·28
Maximum diameter of lateral ocellus	0·10-0·12	0·11
Minimum diameter of lateral ocellus	0·08-0·10	0·09
Minimum ocellus/antennal distance	0·17-0·18	0·17
Minimum eye/antennal distance	0·05-0·07	0·06

Minimum distance of eye from lateral base of head	0.12-0.14	0.13
Maximum length of pronotum	0.55-0.64	0.60
Median length of pronotum	0.52-0.55	0.53
Maximum width of pronotum	0.86-0.94	0.91
Length of hind tibia	0.75-0.81	0.78
Length of fore wing scale	0.83-0.86	0.84

Soldier. Posterior and lower sides of head capsule and anterior margin of pronotum yellowish-brown. Frons and interior region of head black; antennae pale yellow; labrum, body and legs yellow; mandibles very dark reddish-brown.

Head in dorsal view relatively long and narrow, widest about area of frontal ridge, weakly constricted about level of antennal sockets; sides about level of antennal sockets to forward splay out; mid-vertex region with a conspicuously large concavity; dorsal and lateral surfaces very rugose, tuberculated. Frontal ridge prominent, rough, produced forward, broadly and shallowly V-shaped with a median groove; recurved above antennal sockets. Frons almost vertical, weakly rugose. Postclypeus with a prominent convex anterior margin. Labrum fleshy. Frontal horns larger and longer than genal horns. Eyes oval, unpigmented and prominent. Antennae with 13-14 segments, segment 3 narrowest, slightly sclerotised, often incompletely separated from 4. Mandibles short and broad, dentition weakly developed. Pronotum generally wider than head, anterior margin smooth, deeply and broadly concave, sides convex, postero-lateral corners rounded, posterior margin shallowly convex.

Measurements (10 specimens from five nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.86-1.04	0.95
Height of head excluding postmentum	0.81-0.96	0.88
Length of head to cephalic ridge 1	1.27-1.43	1.38
Length of head to cephalic ridge 2	1.07-1.30	1.18
Maximum width of head	1.11-1.20	1.14
Maximum length of labrum	0.08-0.13	0.11
Maximum width of labrum	0.18-0.29	0.26
Maximum length of pronotum	0.68-0.83	0.77
Median length of pronotum	0.60-0.73	0.66
Maximum width of pronotum	1.09-1.25	1.17
Maximum width of mesonotum	0.96-1.20	1.04
Maximum width of metanotum	1.01-1.22	1.07
Length of hind tibia	0.62-0.78	0.71
Length of left mandible	0.55-0.57	0.56
Left mandible, apical to first marginal	0.09-0.13	0.10
Left mandible, first to third marginal	0.08-0.13	0.10
Right mandible, apical to first marginal	0.10-0.16	0.14
Right mandible, first to second marginal	0.08-0.10	0.08

Biology. Seven collections of *C. darwini* by the Zaca Expeditions are all from the Galapagos Islands. Most of the colonies were in standing dead trees and others in fallen dead branches. This is in direct contrast to *C. brevis* which is restricted to construction timber and furniture. That *C. darwini* is not a synonym of *C. brevis* is further supported by numerical analyses discussed later.

Comparisons. See comments under *C. brevis* for similarities and differences between the imago and soldiers of these two species. The imago of *C. darwini* is also close to that of *C. verruculosus*. It is distinguished from this species by the absence of an arolium between the tarsal claws.

Material examined. Paratypes imagos, soldiers, GALAPAGOS: Charles Island, 24.iv.1932 (*Larsen*) (AMNH; BMNH); 17.v.1932, 18.v.1932, 25.v.1932, 26.v.1932, 14.vi.1932, Nos. 15, 16, 18, 20, 30, five vials (*Larsen*) (AMNH).

Cryptotermes declivis Tsai & Chen (Figs 2, 30, 79 and 106; Table 2)

Cryptotermes declivis Tsai and Chen, 1963; 168. Holotype soldier, CHINA: Guantang Province, 10.iv.1954 (IZAS) [not examined]. [*Cryptotermes domesticus* (Haviland) *sensu* Tai, 1956: 153-154. Misidentification.]

As the imago of this species was not available for study, the original description translated from Chinese is given below. The description of the soldier incorporates some of the original description as only one soldier was examined.

Imago. Head reddish-brown. Antennae, maxillary palpi, labial palpi and labrum hairy, brownish-yellow. Thorax, abdomen and legs (partly) dark brown. Tibia and tarsi light yellow.

Head subrectangular, sides parallel, posterior margin arc-shaped. Compound eyes small and oval. Ocelli oval, lying above compound eyes, quite near the eyes, not touching. Postclypeus short, horizontal, inlaid, not clearly demarcated from frons, not swollen, anterior margin straight. Anteclypeus trapezoidal. Antennae with 14-16 segments; length of segments 2-4 equal, or 2 and 3 equal and 4 slightly shorter comparatively.

Pronotum as wide as head, anterior margin slightly concave. The fore wing and hind wing scales unequal. Fore wing scales overlying hind wing scales. Wing membrane punctate. The veins of fore wing, Sc very short; R extending up to one-third of wing length. Rs extending up to tip of wing with about seven short branches to anterior margins; M coming out independently from scale proximally near Cu but extending up to a half to three-quarters of wing length and bending up to meet Rs, with faint branches connected with Rs and Cu; Cu with more than 10 branches, the branches darker proximally near wing base, paler distally. Veins of hind wing almost similar to those of fore wing. M not coming out of scale independently but arising from Cu separating near the scale.

Measurements in millimetres

Total length	8.50	8.80
Length of body excluding wings	5.20	5.80
Length of fore wing	7.00	6.80
Length of head up to tip of labrum	1.36	1.40
Width of head with eyes	1.09	1.13
Length of compound eyes	0.27	0.31
Length of ocelli	0.09	0.08
Width of ocelli	0.06	0.15
Distance between compound eye and ocelli	0.02	0.02
Length of pronotum	0.61	0.65
Width of pronotum	1.04	1.13
Length of hind tibia	0.88	0.93

Soldier. Almost entire head, frons and mandibles black, posterior margin pale yellow, antennae yellow-white, segments 1 and 2 darker; labrum and body pale yellow; margins of pronotum edged with brown, darker anteriorly.

Head capsule except frontal ridge smooth, squarish with sides subparallel, posterior margin rounded behind; mid-vertex region slightly flattened, with a small depression above each eye. Frontal ridge prominent, slightly wrinkled, shallowly V-shaped with median groove, recurved above antennal sockets. Frons almost vertical, weakly rugose. Labrum tongue-shaped. Frontal and genal horns large, genal slightly longer. Eyes oval, unpigmented and moderately distinct. Antennae with 11–15 segments. Mandibles short and broad, moderately shouldered about basal third, teeth moderately developed. Pronotum almost as wide as head, anterior margin deeply V-shaped and elevated, sides convex, posterior margin slightly concave medially.

Measurements (one specimen from one nest series) in millimetres

Head length to lateral base of mandibles	1.18
Height of head excluding postmentum	1.00
Length of head to cephalic ridge 1	1.33
Length of head to cephalic ridge 2	1.22
Maximum width of head	1.33
Maximum length of labrum	0.11
Maximum width of labrum	0.26
Maximum length of pronotum	0.96
Median length of pronotum	0.74
Maximum width of pronotum	1.30
Maximum width of mesonotum	1.11
Maximum width of metanotum	1.15
Length of hind tibia	0.88
Length of left mandible	0.63
Left mandible, apical to first marginal	0.15
Left mandible, first to third marginal	0.11
Right mandible, apical to first marginal	0.20
Right mandible, first to second marginal	0.13

Material examined. Paratype soldier, CHINA: 10.iv.1954 (IZAS).

***Cryptotermes dolei* (Light)**
(Figs 12, 13, 81 and 107; Table 2)

Kalotermes (Cryptotermes) dolei Light, 1932a; 81. Holotype soldier, MARQUESAS: Anatuakina (Pacific Island Survey), 1.vi.1929 [not examined].

Imago. Head capsule yellowish-brown to orange-yellow, paler anteriorly, with or without a paler V-shaped mark on frons, with round whitish spot above each antennal socket; clypeus pale yellow to yellow; labrum yellow; antennal segments pale yellow to yellow, distal segments darker than first four; pronotum same colour as head with or without a faint T-shaped mark. Abdominal tergites slightly paler than head and pronotum; sternites, cerci, femora and tibiae yellow; tarsi slightly paler than other leg segments. Wings pale yellowish-brown; costal and radial veins darker.

Posterior margin of head evenly rounded; cranial suture absent. Eyes oval, ocelli suboval, ocelli touching eyes; antennae with 13 segments, segment 1 longer than 2, 2 and 3 equal. Pronotum with median suture, narrower than maximum width of head across eyes; anterior margin widely and shallowly concave; lateral margins convex; posterior margin emarginate. Mesonotum and metanotum with distinct median sutures. Fore wing with costal, radius and radial sector sclerotised; radial sector with five forward simple branches to costa; media joining radial sector beyond middle of wing. Arolium present.

Measurements (eight specimens from five nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.85-0.91	0.90
Maximum width of head with eyes	0.92-0.97	0.95
Maximum length of labrum	0.21-0.29	0.25
Maximum width of labrum	0.38-0.41	0.39
Maximum diameter of compound eye	0.28-0.33	0.29
Minimum diameter of compound eye	0.23-0.26	0.25
Maximum diameter of lateral ocellus	0.10-0.13	0.12
Minimum diameter of lateral ocellus	0.07-0.08	0.08
Minimum ocellus/antennal distance	0.15-0.19	0.17
Minimum eye/antennal distance	0.05-0.07	0.05
Minimum distance of eye from lateral base of head	0.10-0.18	0.13
Maximum length of pronotum	0.62-0.68	0.65
Median length of pronotum	0.52-0.55	0.54
Maximum width of pronotum	0.80-0.95	0.94
Length of hind tibia	0.74-0.79	0.77
Length of fore wing scale	0.66-0.86	0.77

Soldier. Head capsule reddish-brown anteriorly; yellow posteriorly and at sides; frontal ridge and frons very dark brown to black; mandibles very dark brown to black paler distally; labrum and anteclypeus yellow; body and legs yellow or very pale yellowish-brown; antennae yellow; anterior margin of pronotum reddish-brown.

Head in dorsal view rectangular, widest in middle or posteriorly, tapering in front, depressed weakly in mid-vertex region behind frontal ridge and above eyes; weakly rugose just behind frontal ridge, rest of head smooth. Frontal ridge narrow, prominent with median groove, anterior margin deeply V-shaped, recurved above antennal sockets. Frons sloping gradually to postclypeus; anteclypeus a narrow strip. Frontal and genal horns moderately developed and about same length. Labrum broadly rounded. Eyes oval and distinct. Antennae with 13 segments, segment 4 smallest. Mandibles moderately long, shouldered about middle, dentition weak. Pronotum narrower than head capsule, anterior margin serrated, deeply and widely Y-shaped, sides subparallel, posterior margin almost semicircular.

Measurements (six specimens from six nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	1.33-1.68	1.45
Height of head excluding postmentum,	0.89-1.02	0.96
Length of head to cephalic ridge 1	1.43-1.76	1.56
Length of head to cephalic ridge 2	1.17-1.61	1.36
Maximum width of head	1.22-1.43	1.30
Maximum length of labrum	0.10-0.18	0.16
Maximum width of labrum	0.28-0.31	0.30
Maximum length of pronotum	0.69-0.77	0.73
Median length of pronotum	0.56-0.64	0.60
Maximum width of pronotum	1.00-1.15	1.10
Maximum width of mesonotum	0.94-1.02	0.99
Maximum width of metanotum	1.00-1.07	1.04
Length of hind tibia	0.74-0.79	0.78
Length of left mandible	0.71-0.82	0.77
Left mandible, apical to first marginal	0.26-0.33	0.28
Left mandible, first to third marginal	0.13-0.15	0.14
Right mandible, apical to first marginal	0.31-0.38	0.33
Right mandible, first to second marginal	0.10-0.18	0.12

Biology. Collections of *C. dolei* are only known from the Marquesas Islands (Papuan region) and from a range of altitude of 100-1700 feet. The host plants are *Mangifera indica* L., *Cordia subcordata* Lam., *Sapindus saponaria* L., *Xylosma suaveoleus* and *Morinda citrifolia* (Light, 1932a). Alates were collected from nests in January and April.

Comparisons. The imago of *C. dolei* is similar to the imago of *C. canalensis*. The soldier is close to that of *C. dudleyi*, but can be distinguished from it in that the head tapers in front, the anterior margin of the frontal ridge is more deeply Y-shaped and the distance between the apical to the first marginal of the left mandible is longer, i.e. 0.26-0.33 compared with 0.18-0.27 mm.

Material examined. Paratypes imagos, soldiers MARQUESAS: Anatuakina (Pacific Island Survey), 1.vi.1929, six vials (AMNH); Futa Hiva (*Cheesman*).

Cryptotermes domesticus (Haviland)

(Figs 2, 24, 25, 80, 108 and 125; Tables 1 and 2)

Calotermes (*Cryptotermes*) *domesticus* Haviland, 1898: 374. LECTOTYPE soldier, SARAWAK (MZ) designated by Chhotani (1970: 33) [examined].

Calotermes (*Cryptotermes*) *buxtoni* Hill, 1926: 298. Holotype soldier, SAMOA (AMNH) [examined]. [Synonymised by Snyder, 1949: 41.]

Cryptotermes campbelli Light, 1924: 57. Holotype soldier, CHINA (AMNH) [examined]. [Synonymised by Snyder, 1949: 41.]
Calotermes (Cryptotermes) dentatus Oshima, 1914a: 289. Syntype imago, soldier, FORMOSA (type depository not known) [not examined]. [Synonymised by Snyder, 1949: 41.]
Calotermes (Cryptotermes) formosae Holmgren, 1912: 119. Syntype imago, soldiers and nymphs, FORMOSA (Naturhistorisches Museum, Vienna) [not examined]. [Synonymised by Snyder, 1949: 41.]
Calotermes (Cryptotermes) kotoensis Oshima, 1914b: 1. Syntype, FORMOSA (Institute of Science Government of Formosa) [not examined]. [Synonymised by Snyder, 1949: 41.]
Calotermes (Cryptotermes) agasawarensis Oshima, 1913: 274. Syntype imago, soldier, OGASAWARANJIMA OR BONIN ISLAND (Japanese Archipelago) (type depository not known) [not examined]. [Synonymised by Snyder, 1949: 41.]
Cryptotermes hermsi Kirby, 1925: 437. Holotype soldier, FANNING ISLAND (USNM) [examined]. [Synonymised by Snyder, 1949: 41.]
Calotermes (Cryptotermes) gulosus Hill, 1927: 11. Holotype soldier, NEW GUINEA (AMNH) [examined]. [Synonymised by Snyder, 1949: 41.]
Calotermes (Cryptotermes) repentinus Hill, 1927: 13. Holotype imago, NEW BRITAIN (AMNH) [examined]. [Synonymised by Snyder, 1949: 41.]

Imago. Head capsule pale yellowish-brown to yellowish-brown, paler anteriorly with or without a paler V-shaped marking in the middle of the frons; clypeus yellow-white to pale yellow; labrum yellow to yellowish-brown; antennae, sternites, legs, pale yellow, sometimes tibiae slightly darker than femora. Pronotum and tergites pale yellow to yellow, paler than head. Wings hyaline or faintly tinged with brown, anterior veins darker.

Head noticeably longer than wide, faintly narrowed in front eyes; posterior margin evenly rounded sometimes from a point behind eyes; moderately hairy; cranial suture faint to distinct; eyes and ocelli oval; ocelli very near eyes; anterior margin of clypeus concave; antennae with 12-16 segments. Pronotum with faint median suture; moderately hairy and usually narrower than maximum head width with eyes; anterior margin broadly and shallowly concave to almost straight; sides slightly convex, posterior margin moderately emarginate. Mesonotum and metanotum with distinct median sutures. Fore wing with only costal, radius and radial sector sclerotised; radial sector with five to seven simple forward branches; media joining radial sector beyond middle of wing. Arolium present.

Measurements (16 specimens from 14 nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.85-1.03	0.92
Maximum width of head with eyes	0.87-0.99	0.94
Maximum length of labrum	0.11-0.21	0.17
Maximum width of labrum	0.30-0.42	0.37
Maximum diameter of compound eye	0.26-0.34	0.31
Minimum diameter of compound eye	0.22-0.29	0.28
Maximum diameter of lateral ocellus	0.07-0.11	0.09
Minimum diameter of lateral ocellus	0.05-0.08	0.06
Minimum ocellus/antennal distance	0.15-0.18	0.17
Minimum eye/antennal distance	0.04-0.07	0.06
Minimum distance of eye from lateral base of head	0.11-0.16	0.13
Maximum length of pronotum	0.57-0.75	0.64
Median length of pronotum	0.52-0.65	0.56
Maximum width of pronotum	0.80-1.04	0.89
Length of hind tibia	0.70-0.83	0.79
Length of fore wing scale	0.67-0.91	0.82

Soldier. Head capsule very dark brown to black, paler posteriorly; antennae, labrum, legs and body yellow to yellowish-brown; pronotum darker around anterior margin; mandibles dark reddish-brown to black.

Head in dorsal view subrectangular, narrowest in front of eyes, posterior margin evenly rounded, sparsely hairy; in profile strongly concave medially behind frontal ridge, occasionally only weakly so. Genal horns well developed, frontal horns a weak swelling above antennal sockets. Frontal ridge prominent, anterior margin strongly convex, rarely only slightly so, with small to large median notch. Frons flat and vertical, slightly rugose. Eyes suboval, prominent, unpigmented, slightly projecting. Mandibles short to moderately long, teeth slightly developed; moderately shouldered externally. Pronotum widely and angularly notched, anterior margin finely serrate, sides convex, posterior margin straight.

Measurements (29 specimens from 25 nest series) in millimetres

	Range	Mean	Type
Head length to lateral base of mandibles	1.02-1.33	1.19	1.24
Height of head excluding postmentum	0.88-1.04	0.94	0.93
Length of head to cephalic ridge 1	0.99-1.25	1.12	1.18
Length of head to cephalic ridge 2	1.35-1.61	1.49	1.37
Maximum width of head	1.03-1.35	1.28	1.17
Maximum length of labrum	0.13-0.23	0.16	0.19
Maximum width of labrum	0.21-0.26	0.25	0.23
Maximum length of pronotum	0.75-1.01	0.86	0.77
Median length of pronotum	0.62-0.86	0.73	0.70
Maximum width of pronotum	1.09-1.38	1.22	1.07
Maximum width of mesonotum	0.86-1.20	1.04	0.90
Maximum width of metanotum	0.94-1.20	1.07	0.97
Length of hind tibia	0.69-0.88	0.77	0.86
Length of left mandible	0.59-0.73	0.65	0.59
Left mandible, apical to first marginal	0.15-0.21	0.18	0.18
Left mandible, first to third marginal	0.10-0.20	0.15	0.15
Right mandible, apical to first marginal	0.18-0.29	0.23	0.27
Right mandible, first to second marginal	0.09-0.15	0.12	0.13

Alate nymph 2. Head capsule pale yellow to yellow; antennae, thorax, legs and abdomen paler than head. Head capsule subcircular, broader than long, with short distinct setae; cranial suture absent; brain distinct. Antennae with 12-14 segments, segment 1 cylindrical and twice length of 2, segments 3-6 ring-like and smaller than 1. Apical teeth of mandibles very short to short, L_A/L_1 0.50-0.67, R_A/R_1 1.25-1.75. Pronotum narrower than head width, anterior margin shallowly and broadly concave, sides weakly rounded, posterior margin weakly emarginate. Legs short and hairy; apical spur formula 3:3:3, tarsi four-jointed, cerci two-jointed, styli single jointed. Arolium absent.

Measurements (14 specimens from seven nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.99-1.09	1.02
Maximum width of head	1.02-1.17	1.08
Length of pronotum	0.52-0.65	0.58
Median length of pronotum	0.44-0.56	0.50
Width of pronotum	0.87-1.04	0.96
Left mandible, apical to first marginal	0.05-0.06	0.06
Left mandible, first to third marginal	0.09-0.11	0.10
Left mandible, third marginal to molar	0.09-0.11	0.10
Left mandible, length of apical tooth	0.04-0.06	0.05
Left mandible, posterior cutting edge of first marginal	0.03-0.04	0.03
Left mandible, anterior cutting edge of third marginal	0.08-0.09	0.09
Right mandible, apical to first marginal	0.05-0.07	0.06
Right mandible, first to second marginal	0.04	0.04
Right mandible, posterior cutting edge of second marginal	0.17-0.19	0.18
Right mandible, length of apical tooth	0.04-0.05	0.05
Right mandible, posterior cutting edge of first marginal	0.03-0.04	0.03
Length of right mandible	0.28-0.31	0.31
Basal width of right mandible	0.30-0.34	0.32
Right mandible, length of molar plate	0.13-0.17	0.15
Right mandible, width of molar plate	0.07-0.08	0.07
Length of hind tibia	0.63-0.75	0.68

Biology. *C. domesticus* is found in four geographical regions of the world and is widely distributed throughout eastern and southern Asia and the Pacific region. Its status as a native or introduced species has been discussed by Gay (1967, 1970) and in Australia by Yule and Watson (1976). The latter authors suggested that *C. domesticus* may be indigenous to Australia and Gay and Watson (1982) have given evidence that this assumption may be correct.

Serious damage to wooden furniture and constructional timber has been reported by Harris (1968). Collection records refer mostly to colonies in structural timber, i.e. battens, flooring, wall cladding, plywood sheeting and doors, posts, house stumps, packing cases or furniture. An extensive list of timbers attacked in Australia is given by Yule and Watson (1976). *C. domesticus* is also common in the mangrove *Cerriops candolleianum* Arn. in the Darwin region. Two nest series from the mangroves show no morphological characters which would distinguish them from material collected from domestic situations (see Gay and Watson, 1982). Swarming of this termite seems to vary with locality and colonising flights may occur over a considerable period of the year, from April in Hakgala (Sri Lanka), June-July and November in the Solomon Islands, in October in Colombo (Sri Lanka) and Thursday Island (North Australia) (Snyder, 1949), Gay and Watson (1982) have attracted alates to light in Australia in January, May and August.

Comparisons. The head capsule of the imago of *C. domesticus* is subrectangular in shape and very similar to that of *C. cynocephalus* (Figs 24, 25, 20 and 21). The former, however, is much larger. The soldier is unique in that the head length to the cephalic ridge 2 is longer than the head length to cephalic ridge 1. For the alate nymph 2 see comments under *C. brevis*.

Material examined. LECTOTYPE soldier, SARAWAK: (*Haviland*) (MZ). Holotype of *buxtoni* soldier, SAMOA: Apia, Upolu Island, 10.xii.1924 (*Buxton*) (AMNH). Holotype of *campbelli* soldier, CHINA: Hainan, (*Campbell*) (AMNH). Holotype of *gulosus* soldier, NEW GUINEA: Papua, 22.vii.1922 (*Hill*) (AMNH). Holotype of *repentinus* soldier, NEW BRITAIN: Rabaul, vi.1922 (*Hill*) (AMNH).

Paralectotypes imago, soldier, SARAWAK: same data as lectotype (MZ). Paratypes imagos, soldiers, SAMOA: CHINA: NEW GUINEA: NEW BRITAIN: same data as holotypes (AMNH; BMNH). SRI LANKA: Colombo, 21.vii.1923 (*Emerson*). CHINA: Hainan, no date (*Campbell*) (AMNH). FIJI: Suva, 28.vii.1922 (*Vetawa*); Nasinu, 1976 (*Bulai*). GUAM: Piti, 27.x.1936 (*Swezey*); MARQUESAS: Tahuata, 16.viii.1930 (*Light*); NEW GUINEA: Papua, 19.vii.1928 (*Pemberton*). PANAMA: Botel Taboga Island, 14.vi.1972, two vials (*Holmgren*); 11.xi.1921 (*Kirby*) (AMNH). SAMOA ISLAND: 12.viii.1925 (*Buxton* and *Hopkins*). SARAWAK: Kuching, 19.vii.1956 (*Harris*); 1894 (*Haviland*). SINGAPORE: 14.ix.1956 (*Menon*); xi. 1978 (*Berry*); 29.xi.1935 (*Kirby*) (AMNH). SOLOMON ISLAND: Tulagi, 3.ix.1935 (*Lever*). GUADALCANAL ISLAND: 29.x.1955 (*Wilkinson*); 15.vii.1957, two vials (*Fennamore*). WASHINGTON ISLAND: 18.viii.1924 (*Witney*) (AMNH).

Cryptotermes dudleyi Banks

(Figs 1, 2, 3, 22, 23, 58, 59, 102 and 126; Tables 1 and 2)

Cryptotermes dudleyi Banks, 1918: 660. Holotype soldier, PANAMA (MCZ) probably lost.

Cryptotermes (Planocryptotermes) javanicus Kemner, 1934: 47. LECTOTYPE soldier, JAVA (AMNH) here designated [examined]. [Synonymised by Snyder, 1949: 41.]

Planocryptotermes nocens Light, 1921: 43. LECTOTYPE soldier, PHILIPPINES (AMNH) here designated [examined]. [Synonymised by Snyder, 1949: 41.]

Cryptotermes (Planocryptotermes) primus Kemner, 1932: 151. Holotype soldier, CEYLON (ZI) [not examined]. [Synonymised by Snyder, 1949: 41.]

Cryptotermes thompsonae Snyder, 1922: 16. Syntypes imago, soldier, PANAMA (USNM) [imago examined]. [Synonymised by Snyder, 1949: 42.]

Calotermes havilandi subspecies *parasita* Wasmann, 1910: 120. LECTOTYPE imago, MAURITIUS (AMNH) here designated [examined]. *Syn.n.* [Erroneously synonymised with *C. pallidus* (Voeltzkow) by Snyder, 1949: 43.]

Imago. Head capsule yellow, orange-yellow to dull yellowish-brown posteriorly, usually paler anteriorly, frons sometimes with V-shaped pale area; clypeus pale yellow, labrum yellow; antennae, pronotum and abdominal tergites yellow to yellowish-brown usually paler than head; legs, cerci and sternites pale yellow to yellow; wings with a slight brownish tinge, almost hyaline; anterior veins darker.

Posterior margin of head capsule evenly rounded. Cranial suture faint to distinct. Eyes suboval; ocelli oval to round sometimes not in contact with eyes. Antennae with 14–18 segments, usually 15 or 16, segment 1 longest, cylindrical, 2 about two-thirds length of 1, segment 3 generally shortest, sometimes subequal to 2 or 4. Pronotum with anterior margin widely and shallowly concave; sides gently rounded, posterior margin slightly concave medially. Fore wing with radial sector having five to seven simple forward branches, cubitus and media weak and unsclerotised; media joining radial sector beyond middle of wing. Arolium present.

Measurements (24 specimens from 18 nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.94–1.09	1.03
Maximum width of head with eyes	0.96–1.14	1.07
Maximum length of labrum	0.13–0.33	0.22
Maximum width of labrum	0.36–0.49	0.42
Maximum diameter of compound eye	0.30–0.36	0.33
Minimum diameter of compound eye	0.26–0.31	0.28
Maximum diameter of lateral ocellus	0.11–0.16	0.12
Minimum diameter of lateral ocellus	0.06–0.11	0.08
Minimum ocellus/antennal distance	0.16–0.23	0.18
Minimum eye/antennal distance	0.05–0.07	0.06
Minimum distance of eye from lateral base of head	0.11–0.18	0.15
Maximum length of pronotum	0.62–0.78	0.70
Median length of pronotum	0.55–0.70	0.63
Maximum width of pronotum	0.93–1.12	1.02
Length of hind tibia	0.81–0.94	0.85
Length of fore wing scale	0.78–0.99	0.85

Soldier. Head capsule yellowish-brown to dark brown posteriorly, almost black anteriorly; frontal ridge and frons almost black; mandibles dark reddish-brown to black; labrum, antennae pale yellow-brown; pronotum body and legs pale yellow to pale brown; anterior margin of pronotum darker.

Head in dorsal view subrectangular, much longer than wide, almost parallel-sided or narrowing slightly in front; in profile dorsal margin weakly convex except for slightly elevated frontal ridge. Frontal ridge fairly prominent, slightly raised, continuous from vertex of head, recurving laterally above antennal sockets, concave with a distinct median notch. Frons weakly concave, slightly rugose with weakly developed lateral ridges, lower margin with a transverse ridge in front of postclypeus. Genal horns prominent, much larger and longer than frontal horns. Eyes generally indistinct. Mandibles moderately long to long, thickened basally, strongly shouldered in basal third, teeth moderately developed. Antennae with 10–16 segments. Pronotum narrower than head, sometimes as wide, anterior margin widely and deeply concave, usually finely serrate, posterior margin almost straight.

Measurements (66 specimens from 43 nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	1.20–1.51	1.36
Height of head excluding postmentum	0.88–1.09	0.98
Length of head to cephalic ridge 1	1.25–1.64	1.49
Length of head to cephalic ridge 2	1.12–1.51	1.30
Maximum width of head	1.21–1.40	1.30
Maximum length of labrum	0.10–0.26	0.15
Maximum width of labrum	0.27–0.39	0.33
Maximum length of pronotum	0.62–1.01	0.83
Median length of pronotum	0.60–0.75	0.68
Maximum width of pronotum	1.04–1.40	1.18
Maximum width of mesonotum	0.94–1.27	1.12
Maximum width of metanotum	0.96–1.33	1.16
Length of hind tibia	0.70–0.96	0.86
Length of left mandible	0.73–0.96	0.79
Left mandible, apical to first marginal	0.18–0.27	0.24
Left mandible, first to third marginal	0.20–0.29	0.23
Right mandible, apical to first marginal	0.26–0.36	0.32
Right mandible, first to second marginal	0.12–0.17	0.13

Alate nymph 2. Head and body yellow-white to orange-yellow; head generally darker than antennae, thorax, legs and abdomen.

Head capsule subcircular broader than long with sparse, short, distinct hairs; cranial suture not visible; brain distinct. Eyes unpigmented, distinct. Antennae with 11-15 segments, 1 twice 2, segment 2 almost twice length of 3, segment 4 equals 5. Apical teeth of mandibles very short to short, L_A/L_1 0.36-0.58, R_A/R_1 1.50-1.75. Pronotum broader than long, narrower than head width, more hairy than head; anterior margin broadly and shallowly to moderately concave, sides nearly parallel; posterior margin weakly incurved medially. Setae on posterior edge of sternites distinctly longer than those on tergites. Legs long and hairy; apical spur formula 3:3:3, tarsi four-jointed. Arolium absent.

Measurements (12 specimens from six nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	1.00-1.17	1.07
Maximum width of head	1.09-1.25	1.16
Length of pronotum	0.56-0.70	0.64
Median length of pronotum	0.48-0.58	0.54
Width of pronotum	0.93-1.09	1.01
Left mandible, apical to first marginal	0.04-0.07	0.06
Left mandible, first to third marginal	0.11-0.12	0.11
Left mandible, third marginal to molar	0.09-0.11	0.10
Left mandible, length of apical tooth	0.04-0.05	0.04
Left mandible, posterior cutting edge of first marginal	0.03-0.04	0.04
Left mandible, anterior cutting edge of third marginal	0.07-0.09	0.08
Right mandible, apical to first marginal	0.05-0.08	0.05
Right mandible, first to second marginal	0.03-0.05	0.04
Right mandible, posterior cutting edge of second marginal	0.18-0.20	0.19
Right mandible, length of apical tooth	0.04-0.07	0.05
Right mandible, posterior cutting edge of first marginal	0.03-0.04	0.03
Length of right mandible	0.31-0.34	0.32
Basal width of right mandible	0.32-0.37	0.34
Right mandible, length of molar plate	0.16-0.17	0.17
Right mandible, width of molar plate	0.07-0.09	0.08
Length of hind tibia	0.70-0.86	0.78

Biology. *C. dudleyi* has been recorded from six of the geographical regions of the world. Collection records refer to colonies in both hard and soft woods in structural timbers such as rafters, joists, white pine roof beams, shelves, wall components, window and door frames, furniture, packing cases, in snags of trees (*Plumeria* sp. and *Thevetia nereifolia* Juss.), in the trunk of a living coconut palm and in the stem of an indigenous coastal shrub in Australia, in stored timber (*Heritiera minor* Lam.), bamboo constructions and from mangrove forests in Sunderbans, Lower Bengal and in Kenya round Mombasa, where it is common in buildings. In Java and Borneo it attacks many species of wood, such as *Tectona grandis* L., *Shorea leprosula* Miq. and *Erodia* sp. (Karlshoven, 1960).

Comparisons. The imago of *C. dudleyi* is closest to that of *C. merwei* (Figs 22, 23, 41 and 42). In *C. dudleyi*, the wings are slightly tinged brown and the tibia is 0.96-1.12 mm while in *C. merwei* the wings are distinctly tinged brown and the tibia is 0.85-0.99 mm. The soldier is also similar to that of *C. merwei* but is larger with a smooth frontal ridge. In *C. merwei* the frontal ridge is rough. It is also similar to *C. dolei*, see comments under that species. For alate nymph 2 see comments under *C. brevis*.

Material examined. LECTOTYPE of *javanicus* soldier, JAVA: (Kemner) (AMNH). LECTOTYPE of *nocens* soldier, PHILIPPINES: Manila, 4.x.1920 (*Light*) (AMNH). LECTOTYPE of *parasita* imago, MAURITIUS (*Voeltzkow*) (AMNH).

Paratypes soldiers, PANAMA: same data as holotype (MCZ). Paralectotypes imagos, soldiers, JAVA: PHILIPPINES: MAURITIUS: same data as lectotypes (AMNH). CHAGOS ARCH: Diego, 6.v.1971 (*Hutson*). COCOS KEELING ISLAND (*Emerson*). GILBERT ISLAND: Tarawa, 15.viii.1956 (*Brown*). JAVA, WEST: 18.iv.1956 (*Emerson*). KENYA: Kazingo, 18.iii.1976, five vials; Mombasa, mainland opposite Makupa, 19.iii.1976, five vials; 4.vii.1954. Makupa, 23.iii.1976; Nyali, 22.iii.1976; 5.vii.1954 (*Thorogood*); Tonoka, 24.iii.1976, four vials (*Williams and Pearce*); Malindi, 13.vii.1954 (*Wilkinson*); MADAGASCAR: 20.vii.1935 (*Kirby*). MALAYA: Kepong, 6.x.1957 (*Menon*). MAURITIUS: Reduit, 7.vii.1935 (*Kirby*). OMAN: xi.1972 (*Rentokil Ltd*). PAKISTAN: Dacca, 1.x.1974 (*University of Dacca*). PHILIPPINES: Maa, 27.vii.1902 (*Emerson*). SEYCHELLES: Mahe, vi.1965 (*Public Works Department*). SIERRA LEONE: Freetown, 6.i.1958 (*Wilkinson*). SOLOMON ISLANDS: Tulagi, iii.1933 (*Lever*). SOMALIA: Mogadiscio, 1957 (*Stephenson*). TANZANIA: Amani Road to Dorema, 6.x.1934 (*Emerson*) (AMNH); Dar-es-Salaam, 21.vii.1954; Kilifi, 9.vii.1951; Lindi, 30.vii.1954; Rilwa Kivinge, 25.vii.1954 (*Wilkinson*); Tanga, 5.x.1937 (*Harris*); Zanzibar, 6, 9 and 14.x.1954 (*Wilkinson*).

***Cryptotermes fatulus* (Light)**
(Figs 26, 27, 66, 67 and 110; Table 2)

Kalotermes (Cryptotermes) occidentalis Light, 1933: 103. Holotype imago, MARIA MADRE ISLAND (*Keifer*) [not examined].

Imago. Head capsule yellowish-brown, distinctly or just paler above ocelli; frons edged brown above antennal sockets, paler just behind middle of clypeus, with or without a V-shaped mark; clypeus pale yellow; labrum yellow; pronotum distinctly paler than head and abdominal tergites, abdominal tergites paler or same colour as back of head. Antennae yellow, concolorous. Legs and sternites pale yellow to yellow.

Posterior margin of head evenly rounded, cranial suture absent or present. Eyes and ocelli oval, ocelli touching or very close to eyes; anterior margin of clypeus convex; antennae incomplete (broken in the specimens examined), segment 3 shorter than 2. Pronotum narrower than maximum head width; anterior margin moderately and widely concave, sides almost parallel or rounded, posterior margin slightly emarginate or almost straight. mesonotum and metanotum with distinct median sutures. Wings absent in specimens examined. Arolium present.

Measurements (five specimens from three nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.78-0.91	0.84
Maximum width of head with eyes	0.85-0.91	0.89
Maximum length of labrum	0.18-0.20	0.19
Maximum width of labrum	0.37-0.49	0.42
Maximum diameter of compound eye	0.26-0.34	0.30
Minimum diameter of compound eye	0.22-0.26	0.24
Maximum diameter of lateral ocellus	0.07-0.10	0.09
Minimum diameter of lateral ocellus	0.05-0.09	0.08
Minimum ocellus/antennal distance	0.15-0.20	0.17
Minimum eye/antennal distance	0.03-0.06	0.04
Minimum distance of eye from lateral base of head	0.11-0.16	0.13
Maximum length of pronotum	0.59-0.70	0.62
Median length of pronotum	0.52-0.60	0.56
Maximum width of pronotum	0.78-0.90	0.84
Length of hind tibia	0.73-0.78	0.76
Length of fore wing scale	0.77-0.86	0.79

Soldier. Head capsule black in front half, reddish-brown posteriorly; antennae, labrum, body and legs yellow. Mandibles dark reddish-brown.

Head squarish narrowing slightly posteriorly, weakly to moderately rugose in black region. Frontal ridge fairly prominent, broader and thicker in middle region, with or without a narrow median groove; anterior margin weakly concave, recurved weakly above antennal sockets. In profile, head flattened just behind frontal ridge medially. Frons concave and tuberculate. Labrum tongue-shaped, anteclypeus a narrow strip. Antennae with 11-12 segments, segments 1 and 2 large, 3 short, 3 and 4 smallest, subequal. Mandibles very short and broad, strongly angled from basal third, dentition well developed. Genal and frontal horns small, frontal longer. Pronotum deeply concave in front, margin roughened, anterolateral corners somewhat acute, sides rounded, posterior margin faintly emarginate.

Measurements (19 specimens from 10 nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.60-0.81	0.71
Height of head excluding postmentum	0.65-0.86	0.78
Length of head to cephalic ridge 1	0.99-1.13	1.04
Length of head to cephalic ridge 2	0.88-1.07	0.96
Maximum width of head	0.96-1.04	1.00
Maximum length of labrum	0.10-0.14	0.12
Maximum width of labrum	0.16-0.22	0.20
Maximum length of pronotum	0.57-0.68	0.64
Median length of pronotum	0.49-0.60	0.55
Maximum width of pronotum	0.83-0.99	0.92
Maximum width of mesonotum	0.78-0.91	0.84
Maximum width of metanotum	0.83-0.99	0.87
Length of hind tibia	0.57-0.65	0.61
Length of left mandible	0.42-0.52	0.50
Left mandible, apical to first marginal	0.12-0.14	0.13
Left mandible, first to third marginal	0.10-0.13	0.12
Right mandible, apical to first marginal	0.13-0.16	0.15
Right mandible, first to second marginal	0.08-0.09	0.08

Biology. All the collection records refer to colonies from dead branches of living trees except one from a small bush.

Comparisons. See under *C. verruculosus* for imago caste. The soldier of *C. fatulus* and *C. longicollis* are very similar but can be easily separated. In *C. fatulus* the frontal horn is a very short knob and the genal horn is scarcely developed whilst in *C. longicollis* the frontal horn is longer and larger than the genal horn.

Material examined. Paratypes imagos, MARIA MADRE ISLAND: 14.v.1925 (*Keifer*) (AMNH;USNM).
 CENERAY BAY: Playa Grande 26.x.1935 (*von Hagen*). SANTA CRUZ: Pelican Bay, 10.vii.1935-12.ix.1935,
 six vials (*von Hagen*); Redeu Minx, 10.vii.1935, two vials (*von Hagen*). ECUADOR: Palmar, 25.iii.1935 (*von Hagen*) (AMNH).

***Cryptotermes havilandi* (Sjöstedt)**

(Figs 1, 2, 3, 28, 29, 60, 61, 109 and 127; Tables 1 and 2)

Calotermes havilandi Sjöstedt, 1897b: 212. LECTOTYPE imago (specimen No. 11) FERNANDO PO (NR) here designated [examined].
Calotermes lamanianus Sjöstedt, 1911: 137. LECTOTYPE soldier, CONGO (NR) here designated [examined]. [Synonymised by Snyder, 1949: 42.]

Cryptotermes senegalensis Silvestri, 1914: 7. LECTOTYPE soldier, SENEGAL (IDEA) here designated [examined]. [Synonymised by Snyder, 1949: 42.]

Cryptotermes lamanianus subspecies *senegalensis* Silvestri; Grassé 1937: 8.

Imago. Head capsule yellow, yellowish-brown, paler anteriorly, clypeus yellow-white; antennae and labrum yellow; antennae concolorous; pronotum and tergites pale yellow to yellowish-brown paler than head. Sternites pale yellow to yellow. Legs usually same colour as sternites, occasionally tibiae darker than femora. Wings hyaline, faintly tinged brown, anterior veins darker.

Head capsule with few short distinct setae, posterior margin evenly rounded; stem of Y-suture only visible; eyes and ocelli oval to nearly round; ocelli very near to or touching eyes; antennae with 14-17 segments, segment 1 longer than 2, segments 2-4 or 2-5 equal in length. Pronotum moderately pilose with median suture, width broader, narrower or same as head width across eyes; anterior margin variably concave, sides convex, posterior margin moderately emarginate. Mesonotum and metanotum with distinct median suture. Fore wing with only subcosta, radius and radial sector sclerotised, radial sector with five to six forward branches to costa, median joining radial sector beyond middle of wing. Arolium present.

Measurements (26 specimens from 21 nest series) in millimetres

	Range	Mean	Type
Head length to lateral base of mandibles	0.89-0.99	0.92	0.87
Maximum width of head with eyes	0.89-1.04	0.97	0.93
Maximum length of labrum	0.11-0.26	0.17	0.22
Maximum width of labrum	0.33-0.52	0.40	0.41
Maximum diameter of compound eye	0.29-0.35	0.32	0.30
Minimum diameter of compound eye	0.24-0.30	0.27	0.26
Maximum diameter of lateral ocellus	0.09-0.13	0.11	0.09
Minimum diameter of lateral ocellus	0.06-0.09	0.08	0.06
Minimum ocellus/antennal distance	0.13-0.20	0.17	0.17
Minimum eye/antennal distance	0.04-0.06	0.05	0.06
Minimum distance of eye from lateral base of head	0.12-0.17	0.14	0.15
Maximum length of pronotum	0.59-0.74	0.67	0.63
Median length of pronotum	0.50-0.67	0.58	0.56
Maximum width of pronotum	0.85-1.05	0.95	0.89
Length of hind tibia	0.70-0.85	0.78	0.74
Length of fore wing scale	0.78-0.99	0.86	0.85

Soldier. Head capsule generally glossy, reddish-brown shading to black in anterior third, antennae pale yellow to yellow; labrum, legs and body yellow to yellowish-brown; mandibles reddish-brown, basal third usually black; pronotum yellow, anterior margin brown.

Head subrectangular slightly to moderately constricted laterally at anterior third, posterior margin evenly rounded. Frontal ridge variably prominent; anterior margin weakly to moderately concave, recurving above antennal sockets. Frons sharply inclined and concave. Vertex with very weak median depression. Frontal horns short, broadly rounded, shorter than genal horns. Genal horns prominent and thumb-like. Eyes oval and prominent. Antennae with 11-14 segments, segment 4 smallest. Mandibles short, strongly shouldered about middle region, teeth slightly to moderately developed. Pronotum with anterior margin variably concave, smooth or serrated, sides convex, posterior margin straight or weakly concave.

Measurements (58 specimens from 44 nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.91-1.22	1.05
Height of head excluding postmentum	0.81-1.04	0.92
Length of head to cephalic ridge 1	1.16-1.44	1.28
Length of head to cephalic ridge 2	1.04-1.30	1.15
Maximum width of head	1.09-1.39	1.20
Maximum length of labrum	0.10-0.22	0.15
Maximum width of labrum	0.19-0.30	0.24
Maximum length of pronotum	0.70-1.00	0.82
Median length of pronotum	0.55-0.80	0.68
Maximum width of pronotum	1.04-1.30	1.15
Maximum width of mesonotum	0.81-1.11	1.01
Maximum width of metanotum	0.86-1.15	1.03

Length of hind tibia	0.60-0.81	0.70
Length of left mandible	0.59-0.65	0.62
Left mandible, apical to first marginal	0.15-0.21	0.17
Left mandible, first to third marginal	0.12-0.17	0.14
Right mandible, apical to first marginal	0.16-0.23	0.19
Right mandible, first to second marginal	0.09-0.13	0.11

Alate nymph 2. Head capsule pale yellow to yellow; antennae and legs pale yellow; pronotum always paler than head; tergites paler than head; sternites paler than tergites.

Head capsule subcircular, broader than long, with short distinct setae; frons weakly depressed; cranial suture not visible, brain distinct. Antennae with 12-15 segments, 3-6 about same size, segment 1 twice length of 2. Apical teeth very short to long, L_A/L_1 0.36-0.67, R_A/R_1 1.50-2.00. Pronotum more hairy than head, width usually narrower, occasionally broader than head width; anterior margin broadly concave, sides strongly convex with posterior ends moderately angled, posterior margin almost straight. Legs very short to short, hairy; apical spur formula 3:3:3, tarsi four-jointed. Arolium absent.

Measurements (19 specimens from 10 nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.96-1.11	1.01
Maximum width of head	1.00-1.17	1.10
Length of pronotum	0.56-0.70	0.61
Median length of pronotum	0.44-0.63	0.51
Width of pronotum	0.89-1.11	0.96
Left mandible, apical to first marginal	0.04-0.06	0.06
Left mandible, first to third marginal	0.09-0.11	0.10
Left mandible, third marginal to molar	0.09-0.11	0.10
Left mandible, length of apical tooth	0.04-0.07	0.05
Left mandible, posterior cutting edge of first marginal	0.03-0.04	0.04
Left mandible, anterior cutting edge of third marginal	0.07-0.09	0.08
Right mandible, apical to first marginal	0.06-0.07	0.06
Right mandible, first to second marginal	0.03-0.04	0.04
Right mandible, posterior cutting edge of second marginal	0.17-0.19	0.18
Right mandible, left of apical tooth	0.04-0.07	0.05
Right mandible, posterior cutting edge of first marginal	0.03-0.04	0.03
Length of right mandible	0.30-0.39	0.32
Basal width of right mandible	0.31-0.37	0.33
Right mandible, length of molar plate	0.13-0.17	0.15
Right mandible, width of molar plate	0.07-0.09	0.08
Length of hind tibia	0.59-0.74	0.67

Biology. *C. havilandi* is found in four of the geographical regions of the world and collection records refer to colonies in hardwood, for example, mahogany, and soft woods of structural timbers such as rooves, window and door frames, doors, flooring boards, interior walls, in shutters, shelves, beams and bannisters; in furniture, such as rediffusion speakers, chest of drawers, writing desks, wardrobes, school desks, armchairs, bookcases, chairs and stools and the mahogany organ in a church; in plywood cases; in indoor ladders; in mangrove stumps, in dead logs and trunks and dead or rotten branches of trees of *Acacia* and thicket woodlands on low hill or bottom of hill and riverine and tall dense forests. The woods attacked include *Heeria mucronota* Bernh., *Flacourtia indica* (Burm. F.) Merr., *Sedera* sp., *Mitragyna stipulosa* Kuntze, *Obeche* sp. and ? *Ficus*.

Comparisons. The imago of *C. havilandi* is similar to that of *C. kororensis*, *C. silvestrii* and *C. naudei*. It can be separated from the latter in that only the stem of the Y-suture is visible, while in *C. naudei* the Y-suture is faint or distinct. For the soldier caste see comments under *C. bengalensis*. For the alate nymph 2 see comments under *C. brevis*.

Material examined. LECTOTYPE imago, FERNANDO PO: i.1873 (*Buckholz*) (NR). LECTOTYPE of *Iamanianus* soldier, CONGO: Mukimbungo, 14.ix.1911 (*Laman*) (NR). LECTOTYPE of *senegalensis* soldier, SENEGAL: Thies, (*Silvestri*) (IDEA).

Paralectotypes imagos, soldiers, FERNANDO PO: CONGO: SENEGAL: same data as lectotypes (NR; IDEA). BRAZIL: Sao Paulo, 26.ii.1952, three vials (*Araujo*). Mozambique: Beira Port, 9.ii.1935 (*Kirby*) (AMNH). CAMEROON: Victoria Town, 18.v.1957 (*Wilkinson*). THE GAMBIA: Banjul and near Kartung, xi.1973, three vials (*Williams, Ocloo* and *Lamb*), GHANA: Accra (*Wilkinson*); Accra, Takoradi, Sha Hills and Sekondi, x and xi. 1973 (*Williams, Ocloo* and *Lamb*). GUYANA: Fyrish, 18.xii.1979, two vials (*Bacchus*); Kartabo, 19.vii. and 19.v.1924 (*Emerson*). KENYA: near Mombasa, 2.ii.1935 (*Emerson*) (AMNH); Kilifi-Malindi, 7.iv.1976 (*Williams* and *Pearce*); 13 miles south of Likom ferry, 5.viii.1954 (*Williams*). MOZAMBIQUE: Lorenzo Marques, 11.iii.1935 (*Kirby*); 26.vi.1973 (*Sheasby*). MADAGASCAR: Mandabe near Majungar, 20 miles east of Majunga, south of Mahabo, 4.vi.1935, 20.v.1935, 21.v.1935, 3.vi.1935, 16.v.1935, six vials

(Kirby) (AMNH). NIGERIA: Port Harcourt, Onitsha, Avarome, Lagos, Obanokoro, ii.1956, (*Emerson, Sands and Wilkinson*). SOUTH AFRICA: Sordana Beach, 19.xi.1955 (*Coaton*); Zululand, Lower Mmuzi Drift, 14.x.1923 (*Emerson*); near Mkuzi, 24.iv.1935 (*Kirby*) (AMNH). SIERRA LEONE: Kinema, Bo, 1967 (*Wilkinson*). SURINAM: Paramarinbo v.1923 (*Reyne*). SWAZILAND: near Gollel, 22.iv.1935 (*Kirby*) (AMNH). TANZANIA: Amani, 12.iii.1951 (*Kemp*); Tanga, 5.iv.1952 (*Kemp*); Lake Province, 31.viii.1953 (*Sands*); Zanzibar, Kizimkazi road junction, 12.x.1953 (*Wilkinson*). TRINIDAD: Maracas Valley, 12.vi.1936 (*Emerson*) (AMNH).

Cryptotermes hemicyclus n.sp.

(Figs 31, 68, 69 and 103; Table 2)

Imago. Head capsule yellowish-brown, not paler anteriorly; clypeus pale yellow; narrow band above antennal sockets brown, central area behind clypeus pale; labrum and antennae yellow; pronotum slightly paler than labrum. Tergites pale yellow; sternites and cerci paler than tergites. Legs and wings absent in single specimen examined.

Head noticeably longer than wide, with few short distinct setae, posterior margin evenly rounded, sides narrow slightly in front; cranial suture not visible. Eyes large and nearly round, ocelli oval and very near eyes; antennae broken, nine segments present on right side; segment 1 longest and twice length of 2, 2 shorter than 3, segments 4 and 5 equal, 3 longer than 4. Pronotum hairy, same width as head width across eyes, anterior margin slightly concave, sides just convex, posterior margin moderately emarginate; median suture not visible.

Measurements (one specimen from one nest series) in millimetres

Head length to lateral base of mandibles	0.96
Maximum width of head with eyes	1.15
Maximum length of labrum	0.13
Maximum width of labrum	0.52
Maximum diameter of compound eyes	0.35
Minimum diameter of compound eye	0.31
Maximum diameter of lateral ocellus	0.11
Minimum diameter of lateral ocellus	0.07
Minimum ocellus/antennal distance	0.19
Minimum eye/antennal distance	0.04
Minimum distance of eye from lateral base of head	0.19
Maximum length of pronotum	0.74
Median length of pronotum	0.70
Maximum width of pronotum	1.15
Length of hind tibia	-
Length of fore wing scale	1.00

Soldier. Head capsule reddish-brown anteriorly, yellow posteriorly; frontal ridge and frons very dark brown, mandibles nearly black; antennae and labrum yellow; pronotum pale yellowish-brown darker anteriorly; abdomen and legs pale yellow.

Head in dorsal view squarish, rounded behind, with a small depression above each antennal socket, slightly rugose behind frontal ridge. Frontal ridge narrow, slightly rough, anterior margin deeply concave almost forming a semi-circle, recurving in line with antennal sockets. Frons sloping gently to postclypeus, moderately rugose. Labrum pointed at tip, sides strongly convex. Frontal horns larger and longer than genal horns. Eyes oval unpigmented and distinct. Antennae with 15 segments, segment 1 longer than 2, 2 equals 3, 3 and 4 nearly equal. Mandibles long and robust, strongly shouldered just below half way from apical tooth, dentition weak. Pronotum narrower than head width, anterior margin serrated, deeply V-shaped, sides rounded slightly convex, posterior margin straight.

Measurements (five specimens from one nest series) in millimetres

	Range	Mean	Type
Head length to lateral base of mandibles	1.13-1.22	1.17	1.15
Height of head excluding postmentum	0.96-1.04	0.98	0.96
Length of head to cephalic ridge 1	1.33-1.41	1.38	1.33
Length of head to cephalic ridge 2	1.04-1.07	1.06	1.07
Maximum width of head	1.39-1.44	1.41	1.39
Maximum length of labrum	0.26-0.33	0.29	0.26
Maximum width of labrum	0.37-0.44	0.40	0.41
Maximum length of pronotum	0.96-1.05	1.01	1.00
Median length of pronotum	0.79-0.85	0.81	0.81
Maximum width of pronotum	1.30-1.37	1.34	1.37
Maximum width of mesonotum	1.11-1.18	1.16	1.18
Maximum width of metanotum	1.15-1.26	1.24	1.26
Length of hind tibia	0.91-0.98	0.95	0.98
Length of left mandible	0.85-0.89	0.87	0.89
Left mandible, apical to first marginal	0.22	0.22	0.22
Left mandible, first to third marginal	0.15-0.19	0.17	0.19
Right mandible, apical to first marginal	0.37	0.37	0.37
Right mandible, first to second marginal	0.13-0.15	0.15	0.15

Biology. *C. hemicyclus* is known only from the type locality, Portland Ridge, Jamaica, and was collected from a dead standing tree.

Comparisons. The imago of *C. hemicyclus* is near to that of *C. sumatrensis*. In the former the head capsule is yellowish-brown and the Y-suture is not visible, while in the latter the head capsule is yellowish-brown, paler anteriorly and the Y-suture is distinct. The soldier is nearly unique in that the anterior margin of the frontal ridge is deeply concave forming almost a semicircle. The nearest species to this is *C. kirbyi*.

Material examined. Holotype soldier, JAMAICA: Portland Ridge, 3.v.1941 (*Chapin*) (AMNH). Paratypes imago, soldiers, nymphs, 3.v.1941 (*Chapin*) (AMNH).

***Cryptotermes karachiensis* Aktar**
(Figs 2, 82 and 111; Table 2)

Cryptotermes karachiensis Aktar, 1974: 33-37. Holotype soldier, PAKISTAN: Karachi, 3.iii.1971 (*Malik*) [not examined].

As no material of the imago of this species was available for study, the original description by Aktar is given.

Imago. Head light reddish-brown; anteclypeus yellowish-white; labrum yellowish-brown; antennae brownish-yellow; pronotum as dark as head.

Head sparsely hairy; labrum with a row of bristles at anterior margin and a few in middle; pronotum with a few scattered bristles and short hairs along periphery and on disc. Head with lateral sides nearly parallel; postero-lateral sides rounded; posterior margin weakly convex; Y-suture indistinct. Eyes large, slightly bulging, elongately oval. Ocelli oval, almost touching the eyes. Labrum wider than long; lateral sides converging posteriorly, antero-lateral sides rounded, convex; anterior margin weakly convex. Left mandible with posterior cutting edge of first plus second marginal tooth half the length of anterior cutting edge of third marginal tooth; right mandible with posterior margin of second marginal tooth distinctly longer than molar plate. Antennae broken; segments 2 and 3 subequal; 4 shorter than 2. Pronotum nearly as broad as head; anterior margin shallowly concave; lateral sides convex; posterior margin slightly emarginate. Tibial spurs 3:3:3, tarsi four-jointed.

Measurements in millimetres	Range	Mean	Paratype
Length of head to tip of labrum	1.19-1.31	1.25	1.31
Length of head to side base of mandibles	0.95-0.97	0.96	0.97
Width of head	1.00-1.01	1.00	1.00
Long diameter of eye	0.33-0.36	0.34	0.36
Short diameter of eye	0.26-0.27	0.26	0.27
Eye from lower margin of head	0.17	0.17	0.17
Length of ocellus	0.13-0.15	0.14	0.15
Width of ocellus	0.09-0.11	0.10	0.11
Length of pronotum	0.59	0.59	0.59
Width of pronotum	0.98-1.01	0.99	1.01

Soldier. Head dark reddish-brown, becoming darker anteriorly; frontal ridge, frons and postclypeus black; mandibles dark reddish-brown, darker basally. Labrum, antennae, body and legs very pale yellow-brown; anterior margin of pronotum brown.

Head in dorsal view strongly phragmotic, short, nearly as long as wide, deeply depressed in mid-vertex region and above eyes just behind frontal ridge, weakly wrinkled in front, rest of head smooth. Frontal ridge prominent, narrow and slightly rugose; anterior margin broadly V-shaped, not overhanging frons, recurved above antennal sockets. Frons sloping almost steeply to postclypeus, slightly rugose. Labrum tip triangularly pointed with two long setae. Eyes oval, unpigmented, distinct. Antennae with 10-13 segments, 3 shortest (after Aktar). Mandibles short, strongly shouldered about middle, dentition weak. Genal and frontal horns well developed and of same length. Pronotum slightly narrower than head, anterior margin deeply concave, antero-lateral corners smooth and rounded, lateral sides just convex, posterior margin almost straight.

Measurements (one specimen from one nest series) in millimetres

Head length to lateral base of mandibles	0.96
Height of head excluding postmentum	0.81
Length of head to cephalic ridge 1	1.17
Length of head to cephalic ridge 2	1.00
Maximum width of head	1.22
Maximum length of labrum	0.11
Maximum width of labrum	0.22
Maximum length of pronotum	0.74
Median length of pronotum	0.59
Maximum width of pronotum	1.11
Maximum width of mesonotum	0.96
Maximum width of metanotum	1.04
Length of hind tibia	0.74
Length of left mandible	0.56

Biology. *C. karachiensis* is known only from the type locality, Karachi, and has been collected from *Ficus* sp. in March and May.

Comparisons. The imago of *C. karachiensis* comes close to that of *C. havilandi*, but differs from it in having larger and elongately oval eyes. *C. sumatrensis* has differently shaped eyes. In *C. domesticus* the eyes are smaller. *C. cynocephalus* and *C. perforans* are smaller species (after Aktar). The soldier of *C. karachiensis* is close to that of *C. cynocephalus* but is easily separated as the frontal ridge is more pronounced and elevated in the former and the frontal and genal horns are of the same length, while in the latter the frontal ridge is less elevated and the frontal horns are longer than the genal horns.

Material examined. Paratype soldier, PAKISTAN: 17. iii. 1971 (*Malik*).

***Cryptotermes kirbyi* Moszkowski**
(Figs 1, 35, 36, 70, 71 and 104; Table 2)

Cryptotermes kirbyi Moszkowski, 1955: 15. Holotype imago, MADAGASCAR (AMNH) [examined].
[*Cryptotermes parasita* (Wasmann) *sensu* Cachan, 1949: 214-216. Misidentification.]

Imago. Head dark yellowish-brown or reddish-brown occasionally paler anteriorly; clypeus yellow; labrum yellow to yellowish-brown; antennal segments yellowish-brown, distal segments darker than proximal segments; pronotum and abdominal tergites yellowish-brown to dark yellowish-brown, almost same colour as head or distinctly paler; sternites yellowish-brown to brown; femora yellow to dark yellowish-brown; tibiae and tarsi pale yellow to yellow, always paler than femora. Wings hyaline; costal margin to radial sector brown.

Posterior margin of head evenly rounded; capsule with numerous short setae; cranial suture indistinct, sometimes faint; eyes and ocelli oval; ocelli not touching eyes; antennae with 13-16 segments, 2 subequal to 3 and 4. Pronotum usually narrower than maximum width of head across eyes; anterior margin widely and shallowly concave, lateral margins convex, posterior margin slightly emarginate. Fore wing with costal, radius and radial sector sclerotised; radial sector with four to six forward simple branches; media joining radial sector beyond middle of wing. Cubitus with simple and forked veins. Arolium absent.

Measurements (14 specimens from 11 nest series) in millimetres

	Range	Mean	Type
Head length to lateral base of mandibles	1.00-1.09	1.04	1.07
Maximum width of head with eyes	1.04-1.12	1.08	1.10
Maximum length of labrum	0.14-0.31	0.23	0.31
Maximum width of labrum	0.41-0.57	0.48	0.46
Maximum diameter of compound eye	0.27-0.33	0.32	0.33
Minimum diameter of compound eye	0.24-0.29	0.27	0.28
Maximum diameter of lateral ocellus	0.08-0.10	0.09	0.10
Minimum diameter of lateral ocellus	0.06-0.09	0.07	0.08
Minimum ocellus/antennal distance	0.20-0.23	0.21	0.23
Minimum eye/antennal distance	0.04-0.09	0.06	0.08
Minimum distance of eye from lateral base of head	0.13-0.18	0.15	0.13
Maximum length of pronotum	0.61-0.74	0.67	0.74
Median length of pronotum	0.55-0.64	0.60	0.64
Maximum width of pronotum	0.87-1.07	1.01	1.07
Length of hind tibia	0.68-0.78	0.72	0.77
Length of fore wing scale	0.68-0.90	0.79	0.82

Soldier. Head capsule very dark brown to black anteriorly, yellowish-brown to brown posteriorly; anteclypeus, labrum, antennae, body and legs yellow; pronotum yellowish-brown, anterior margin brown.

Head in dorsal view slightly longer than wide, strongly depressed about level of antennal sockets and moderately so in middle region just behind frontal ridge. Vertex and sides of head moderately to strongly wrinkled. Frontal ridge narrow, weak to prominent, rough, incurved moderately to deeply in the middle and recurved above antennal sockets. Frons rough and sloping steeply. Frontal and genal horns distinct; frontal horns longer than genal horns. Eyes oval, unpigmented and distinct. Mandibles moderately long, with or without basal external hump; dentition weak. Antennae with 13-14 segments. Pronotum narrower than head, sometimes as wide to wider, anterior margin smooth or finely serrated, deeply V-shaped, sides and posterior margins rounded, sides bent down slightly.

Measurements (14 specimens from 14 nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	1.10-1.35	1.20
Height of head excluding postmentum	0.89-1.10	0.98
Length of head to cephalic ridge 1	1.33-1.56	1.41
Length of head to cephalic ridge 2	1.07-1.20	1.16
Maximum width of head	1.22-1.42	1.33
Maximum length of labrum	0.08-0.18	0.14
Maximum width of labrum	0.20-0.38	0.30
Maximum length of pronotum	0.92-1.25	1.04
Median length of pronotum	0.66-0.87	0.79
Maximum width of pronotum	1.17-1.43	1.29
Maximum width of mesonotum	1.05-1.29	1.17
Maximum width of metanotum	1.05-1.28	1.18

Length of hind tibia	0.74-0.94	0.84
Length of left mandible	0.71-0.82	0.75
Left mandible, apical to first marginal	0.16-0.26	0.20
Left mandible, first to third marginal	0.15-0.23	0.18
Right mandible, apical to first marginal	0.22-0.33	0.25
Right mandible, first to second marginal	0.10-0.15	0.13

Alate nymph 2. Head pale orange-yellow, other parts of body paler than head.

Head capsule subcircular, broader than long, cranial suture not visible, brain distinct. Antennae with 12-13 segments, segment 1 longest and almost twice length of 2, 2 just longer than 3, segment 3 equals 4. Apical teeth of mandible very short to short, L_A/L_1 0.44-0.67, R_A/R_1 1.50. Pronotum broader than long; anterior margin moderately concave, sides slightly convex, posterior ends sharply rounded into posterior margin. Posterior margin slightly emarginate or almost straight. Legs moderately hairy, apical spur formula 3:3:3, tarsi four jointed. Arolium absent.

Measurements (six specimens from six nest series) in millimetres		
	Range	Mean
Head length to lateral base of mandibles	0.98-1.07	1.04
Maximum width of head	1.03-1.13	1.10
Length of pronotum	0.50-0.59	0.54
Median length of pronotum	0.44-0.51	0.46
Width of pronotum	0.78-1.00	0.87
Left mandible, apical to first marginal	0.04-0.06	0.05
Left mandible, first to third marginal	0.09	0.09
Left mandible, third to molar plate	0.09-0.11	0.10
Left mandible, length of apical tooth	0.04-0.06	
Left mandible, posterior cutting edge of first marginal	0.04	0.04
Left mandible, anterior cutting edge of third marginal	0.07	0.07
Right mandible, apical to first marginal	0.06	0.05
Right mandible, first to second marginal	0.04	0.04
Right mandible, posterior cutting edge of second marginal	0.17-0.19	0.18
Right mandible, length of apical tooth	0.06-0.07	0.05
Right mandible, posterior cutting edge of first marginal	0.03-0.04	0.04
Length of right mandible	0.28-0.31	0.30
Basal width of right mandible	0.33-0.35	0.34
Right mandible, length of molar plate	0.15-0.17	0.16
Right mandible, width of molar plate	0.07-0.09	0.08
Length of hind tibia	0.56-0.67	0.64

Biology. *C. kirbyi* is endemic to Madagascar and collection records refer to colonies in dead wood in xerophytic forests in the lowland of the southwestern region of the island. This area has a subdesertic climate with mean annual rainfall about 350 mm (Sibree and Cana, 1943).

Comparisons. The imago of *C. kirbyi* is similar to that of *C. albipes* and *C. brevis*. Some soldiers of *C. kirbyi*, probably immature forms, resemble *C. naudei* but can be separated from the latter in that the frons is steeply inclined and rough in *C. kirbyi* while in *C. naudei* the frons is smooth and convex. In mature soldiers of *C. kirbyi* the head is strongly wrinkled behind the frontal ridge while it is smooth in *C. naudei*.

Material examined. Holotype imago, MADAGASCAR: Ambovombe, 19. vi. 1935 (*Kirby*) (AMNH).

Paratypes imagos, soldiers, nymphs, MADAGASCAR: same data as holotype (AMNH); near Ambovombe, 19.vi.1935, two vials (*Kirby*); 14 and 100 kilometres southeast and east of Tulear, nine vials (*Kirby*); 27 miles south of Bitioky (*Kirby*) (AMNH).

Cryptotermes kororensis n. sp.

(Figs 37, 38, 83 and 105; Table 2)

Imago. Head yellowish-brown or orange-yellow paler anteriorly; pronotum and tergites paler than head; clypeus yellow-white; labrum, antennae and legs yellow; tibiae and tarsi just paler than femora; sternites paler than tibiae. V-mark on frons very faint. Wings absent in specimen examined.

Head capsule evenly rounded behind, moderately hairy; cranial structure faint to distinct. Eyes and ocelli oval; ocelli very near eyes. Antennae broken, seven segments present only, segment one twice length of 2, 2 equals 3, all cylindrical in shape, rest with rounded sides. Clypeus subtrapezoidal. Labrum with two long setae and few shorter ones. Pronotum with median suture, anterior margin deeply V-shaped, sides rounded, posterior margin moderately emarginate; periphery with few long setae. Mesonotum and metanotum with median sutures.

Measurements (one specimen from one nest series) in millimetres	
Head length to lateral base of mandibles	0.96
Maximum width of head with eyes	0.96
Maximum length of labrum	0.19
Maximum width of labrum	0.35
Maximum diameter of compound eye	0.30
Minimum diameter of compound eye	0.26
Maximum diameter of lateral ocellus	0.13
Minimum diameter of lateral ocellus	0.07
Minimum ocellus/antennal distance	0.19
Minimum eye/antennal distance	0.06
Minimum distance of eye from lateral base of head	0.13
Maximum length of pronotum	0.70
Median length of pronotum	0.57
Maximum width of pronotum	0.94
Length of hind tibia	0.85
Length of fore wing scale	0.89

Soldier. Head dark reddish-brown, mandibles, frontal ridge and frons very dark brown, pronotum yellowish-brown; antennae, labrum, abdomen and legs about same colour slightly paler than pronotum.

Head just longer than wide, sides narrowing slightly in front or behind or nearly parallel sided, faintly rugose above eyes, flattened in mid-vertex region, with few short distinct hairs. Frontal ridge prominent, anterior margin moderately concave, recurved in line with antennal sockets, with distinct median groove. Frons slightly concave, rough and falling gently to postclypeus. Frontal and genal horns distinct, about same size, frontal just longer. Labrum tongue-shaped, tip with three to four long setae and two shorter ones behind. Antennae with 11 segments, segment 1 nearly equals 2, 3 equals 4. Mandibles short to moderately long and slender, dentition weakly developed, moderately shouldered about half way up its length. Pronotum narrower than head; anterior margin smooth to slightly serrated, shallow to moderately V-shaped, sides rounded, posterior corners sharply cut into straight posterior margin.

Measurements (four specimens from two nest series) in millimetres			
	Range	Mean	Holotype
Head length to lateral base of mandibles	0.93-1.07	0.97	0.93
Height of head excluding postmentum	0.76-0.81	0.78	0.76
Length of head to cephalic ridge 1	1.11-1.22	0.96	0.89
Length of head to cephalic ridge 2	0.89-1.04	0.96	0.89
Maximum width of head	1.05-1.13	1.09	1.05
Maximum length of labrum	0.09-0.20	0.16	0.13
Maximum width of labrum	0.26-0.30	0.28	0.30
Maximum length of pronotum	0.70-0.87	0.77	0.72
Median length of pronotum	0.56-0.70	0.63	0.59
Maximum width of pronotum	0.93-1.11	1.02	0.93
Maximum width of mesonotum	0.81-1.00	0.93	0.81
Maximum width of metanotum	0.81-1.04	0.96	0.81
Length of hind tibia	0.63-0.74	0.69	0.63
Length of left mandible	0.67-0.70	0.69	0.67
Left mandible, apical to first marginal	0.19-0.20	0.19	0.19
Left mandible, first to third marginal	0.19	0.19	0.19
Right mandible, apical to first marginal	0.22-0.26	0.25	0.22
Right mandible, first to second marginal	0.11-0.15	0.13	0.11

Biology. *C. kororensis* is known only from the type locality, Koror Island, Palau Islands, and was found in palm logs.

Comparisons. The imago of *C. kororensis* is similar to that of *C. havilandi* and *C. silvestrii*. The Y-suture is distinct in *C. kororensis* and *C. silvestrii* while in *C. havilandi* only the stem of the Y-suture is visible. In *C. kororensis* the pronotum sides are sharply rounded posteriorly while in *C. silvestrii* the sides of the pronotum are nearly parallel. The soldier is similar to *C. merwei* but is much smaller. The dentition is weakly developed in *C. kororensis* and moderately developed in *C. merwei*.

Material examined. Holotype soldier, KOROR ISLAND: Limestone Ridge, 18.1.1948 (*Dybas*) (AMNH).

Paratypes imago, nymphs, KOROR ISLAND: 18.i.1948 (*Dybas*) (AMNH); Palau Islands, 15.ii.48 (*Dybas*) (AMNH).

Cryptotermes longicollis Banks (Figs 3, 39, 40, 62, 63 and 112; Table 2)

Cryptotermes longicollis Banks, 1918: 661. LECTOTYPE soldier, PANAMA (AMNH) here designated [examined].

Imago. Head pale yellow to pale yellowish-brown paler anteriorly, with or without Y-shaped mark on frons; postclypeus pale yellow; antennae pale yellow; occasionally distal segments darker than first four proximal segments; pronotum and tergites nearly

same colour and just paler than head; sternites and legs pale yellow to yellow; tibiae and tarsi darker than femora. Wings hyaline, anterior veins yellow.

Head capsule with few short distinct setae, posterior margin evenly rounded; cranial suture faint to distinct; eyes oval, sometimes tapering behind; ocelli oval and touching eyes; antennae with 14-16 segments, segment 1 longer than 2, 3 just shorter than 2, segments 2-7 about same length. Pronotum moderately pilose, with median suture, with or without T-shaped mark; anterior margin shallow concave sides subparallel, posterior margin emarginate. Mesonotum and metanotum with distinct median suture. Fore wing with only subcosta, radius and radial sector sclerotised, radial sector with four to five simple forward branches to costa. Median joining radial sector just beyond middle of wing. Arolium present.

Measurements (12 specimens from nine nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.78-0.95	0.83
Maximum width of head with eyes	0.87-0.96	0.90
Maximum length of labrum	0.10-0.22	0.16
Maximum width of labrum	0.33-0.41	0.39
Maximum diameter of compound eye	0.26-0.31	0.29
Minimum diameter of compound eye	0.22-0.25	0.23
Maximum diameter of lateral ocellus	0.09-0.13	0.11
Minimum diameter of lateral ocellus	0.07-0.09	0.08
Minimum ocellus/antennal distance	0.13-0.17	0.15
Minimum eye/antennal distance	0.04-0.07	0.06
Minimum distance eye from lateral base of head	0.11-0.15	0.12
Maximum length of pronotum	0.61-0.70	0.64
Median length of pronotum	0.56-0.61	0.57
Maximum width of pronotum	0.78-0.96	0.86
Length of hind tibia	0.67-0.78	0.71
Length of fore wing scale	0.70-0.81	0.75

Soldier. Head capsule reddish-brown posteriorly, anterior third to half almost black, frons black; anteclypeus, labrum, antennae, thorax, abdomen and legs yellow-white to pale yellow; anterior margin of pronotum brown; mandibles dark reddish-brown.

Head in dorsal view slightly longer than broad, usually just broader in front than behind, shallowly or scarcely depressed in mid-vertex region; sides faintly constricted, dorsal and lateral surfaces of anterior third to nearly half slightly wrinkled. Frontal ridge scarcely prominent, anterior margin very shallowly V-shaped with median notch, recurved above antennal sockets. Frons concave, weakly rugose. Anteclypeus a narrow strip. Labrum broadly rounded. Frontal horns larger and longer than genal horns. Eyes oval and sometimes just visible. Antennae with 12-13 segments, segment 1 twice length of 2, 3 shorter than 2 and equals 4. Mandibles short, moderately curving inwards from middle region to tip of apical tooth, moderately shouldered externally, teeth well developed. Pronotum broader, same width or narrower than head width, anterior margin slightly serrated and moderately concave, sides just convex and rounded into posterior margin.

Measurements (25 specimens from 17 nest series) in millimetres

	Range	Mean	Type
Head length to lateral base of mandibles	0.78-1.04	0.88	0.87
Height of head excluding postmentum	0.81-0.94	0.85	0.84
Length of head to cephalic ridge 1	1.07-1.28	1.10	1.15
Length of head to cephalic ridge 2	0.99-1.22	1.07	1.10
Maximum width of head	0.99-1.20	1.07	1.07
Maximum length of labrum	0.08-0.15	0.12	0.13
Maximum width of labrum	0.19-0.26	0.25	0.23
Maximum length of pronotum	0.68-0.84	0.74	0.69
Median length of pronotum	0.59-0.77	0.65	0.61
Maximum width of pronotum	0.88-1.18	1.01	1.00
Maximum width of mesonotum	0.70-1.05	0.85	0.77
Maximum width of metanotum	0.73-1.07	0.89	0.82
Length of hind tibia	0.60-0.78	0.66	0.71
Length of left mandible	0.52-0.57	0.54	0.56
Left mandible, apical to first marginal	0.13-0.18	0.15	0.15
Left mandible, first to third marginal	0.08-0.16	0.13	0.13
Right mandible, apical to first marginal	0.16-0.20	0.18	0.18
Right mandible, first to second marginal	0.08-0.11	0.10	0.09

Alate nymph 2. Head capsule pale yellow to yellow, rest of body pale yellow.

Head capsule subcircular, broader than long, with short distinct setae mainly on sides; cranial suture not visible, brain distinct. Antennae with 12-15 segments, segment 1 longest, almost twice length of 2, 2 longer than 3, 4 equals 5. Apical teeth of mandibles very short to short, L_A/L_1 0.44-0.66, R_A/R_1 1.50-2.00. Pronotum width narrower than head width, more hairy than head with slightly longer hairs; anterior margin broadly concave, sides almost straight, posterior margin slightly incurved medially. Legs with few hairs; apical spur formula 3:3:3, tarsi four-jointed. Arolium absent.

Measurements (11 specimens from five nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.85-0.93	0.90
Maximum width of head	0.91-1.04	0.99
Length of pronotum	0.56-0.63	0.59
Median length of pronotum	0.44-0.57	0.53
Width of pronotum	0.76-0.96	0.88
Left mandible, apical to first marginal	0.04-0.06	0.05
Left mandible, first to third marginal	0.09	0.09
Left mandible, third marginal to molar	0.09	0.09

Left mandible, length of apical tooth	0.04-0.06	0.05
Left mandible, posterior cutting edge of first marginal	0.02-0.04	0.03
Left mandible, anterior cutting edge of third marginal	0.07	0.07
Right mandible, apical to first marginal	0.06	0.06
Right mandible, first to second marginal	0.04	0.04
Right mandible, posterior cutting edge of second marginal	0.17	0.17
Right mandible, length of apical tooth	0.04-0.05	0.04
Right mandible, posterior cutting edge of first marginal	0.02-0.03	0.03
Length of right mandible	0.24-0.29	0.27
Basal width of right mandible	0.30	0.30
Right mandible, length of molar plate	0.11-0.15	0.13
Right mandible, width of molar plate	0.07-0.09	0.08
Length of hind tibia	0.56-0.65	0.62

Biology. *C. longicollis* is essentially a rain forest species, but occurs as well in forest type plantations, such as cocoa, and transitional zones with pine trees. It attacks mainly sound or slightly infected wood.

Comparisons. The imago of *C. longicollis* is closest to that of *C. cavifrons*. The soldier is extremely similar to *C. rhicnocephalus* and *C. fatulus*. In *C. longicollis* the frontal horns are longer and larger than the genal horns. In *C. rhicnocephalus* the frontal horns are of the same length as the genal horns. For comparison with *C. fatulus* see under this species. The alate nymph 2 of *C. longicollis* is close to that of *C. cavifrons*. For comments see under that species.

Material examined. LECTOTYPE soldier, PANAMA (Banks) (AMNH).

Paralectotype imago, PANAMA (AMNH).

PANAMA: Ancon Hill, 22. v. 1935, 12. v. 1935, 22. v. 1935 (*Emerson*); Aguadulce, 11. v. 1935 (*Emerson*). TABOGA ISLAND: 11. ix. 1925 and 11. ix. 1925 and 11. ix. 1921, five vials (*Emerson*) (AMNH). GUATEMALA: Pecten, various dates, four vials (*Williams*). BRITISH HONDURAS: Belize, 16. v. 1960 (*Williams*). MEXICO: Cordenas—P. Ceiba, Presidio, 25. vi. 1961 (*Williams*). EL SALVADOR: Sansonate, 13. v. 1942 (*Marshall*) (AMNH).

Cryptotermes luodianis Xia, Gao & Deng

(Figs 32, 85 and 113; Table 2)

Cryptotermes luodianis Xia, Gao & Deng 1983: 247. Holotype soldier, CHINA: Luodian, Guihou Province, 19. viii. 1981 (SIE) [examined].

Imago. Head capsule dark brown slightly paler anteriorly; frons pale Y-shaped mark in middle and round white spot above each antennal sockets; clypeus pale yellow; labrum yellow; antennal segments pale yellowish-brown, concolorous; pronotum with T-shaped mark, same colour as back of head; tergites slightly paler than pronotum; posterior margin of last four abdominal tergites darker than anterior margin; sternites and cerci yellowish-brown. Coxae and femora almost same colour as head. Tibiae and tarsi yellow-white, distinctly paler than femora. Wings tinged brown, anterior veins darker.

Posterior margin of head evenly rounded; stem of Y-suture distinct, V not visible; eyes nearly round, ocelli oval and close to eyes; antennae broken, 12-15 segments (Xia, Gao and Deng), segment 1 twice length of 2 or 3, segments 2-4 equal in length, rectangular in shape. Pronotum with a median suture, anterior margin widely and shallowly concave, sides slightly rounded, posterior margin just concave medially. Mesonotum and metanotum with distinct median sutures. Fore wing with anterior veins darker; radial sector with eight forward branches. Arolium present.

Measurements (one specimen from one nest series) in millimetres

Head length to lateral base of mandibles	1.00
Maximum width of head with eyes	1.04
Maximum length of labrum	0.19
Maximum width of labrum	0.41
Maximum diameter of compound eye	0.30
Minimum diameter of compound eye	0.28
Maximum diameter of lateral ocellus	0.12
Minimum diameter of lateral ocellus	0.07
Minimum ocellus/antennal distance	0.19
Minimum eye/antennal distance	0.07
Minimum distance of eye from lateral base of head	0.19
Maximum length of pronotum	0.70
Median length of pronotum	0.63
Maximum width of pronotum	1.04
Length of hind tibia	-
Length of fore wing scale	0.81

Soldier. Head capsule yellow posteriorly, becoming reddish-brown to nearly black behind frontal ridge; frontal ridge and frons nearly black; mandibles dark reddish-brown; anteclypeus and labrum yellow; antennae, abdomen and legs pale yellow, segments 1 and 2 of antennae darker than other segments. Pronotum same colour as back of head, anterior region darker.

Head short and thick nearly truncate in front, posterior margin evenly rounded; shallowly depressed in mid-vertex region and behind frontal ridge above eyes. Stem of Y-suture distinct. Frontal ridge prominent, narrow in middle region, broader above eyes, anterior margin wavy recurving about antennal sockets. Frons moderately concave and rugose. Labrum tongue-shaped with three long setae. Frontal horns longer than genal horns. Eyes oval, unpigmented. Antennae with 12 segments, segment 1 twice length 2, 3 shorter than 1 and same length as 4, segment 5 onwards progressively longer than 4. Mandibles moderately shouldered about middle region, dentition well developed. Pronotum with median suture, anterior margin finely serrated, with V-shaped notch in middle, sides just convex, posterior margin almost straight.

Measurements (one specimen from one nest series) in millimetres

Head length to lateral base of mandibles	1.11
Height of head excluding postmentum	0.93
Length of head to cephalic ridge 1	1.33
Length of head to cephalic ridge 2	1.18
Maximum width of head	1.33
Maximum length of labrum	0.11
Maximum width of labrum	0.30
Maximum length of pronotum	0.93
Median length of pronotum	0.74
Maximum width of pronotum	1.33
Maximum width of mesonotum	1.22
Maximum width of metanotum	1.30
Length of hind tibia	0.81
Length of left mandible	0.67
Left mandible, apical to first marginal	0.19
Left mandible, first to third marginal	0.15
Right mandible, apical to first marginal	0.22
Right mandible, first to second marginal	0.11

Biology. The species is known only from its type locality, Luodian, Guihou Province, China, and was collected from within a plank.

Comparisons. The imago and soldier are similar to that of *C. angustinotus*.

Material examined. Paratype holomorphotype imago, CHINA: Luodian, 19.viii.1981 (*Gao and Gong*) (SIE).

***Cryptotermes merwei* Fuller**

(Figs 1, 41, 42, 72, 73, 114 and 130; Tables 1 and 2)

Cryptotermes merwei Fuller, 1921: 29. LECTOTYPE soldier, NATAL (AMNH) here designated [examined].

Imago. Head pale yellowish-brown, yellowish-brown, orange-yellow, paler anteriorly, usually with a paler V-shaped mark in the middle of the frons, and a round mark near each antero-lateral corner; clypeus yellow-white, labrum and pronotum yellow; antennal segments pale yellowish-brown, concolorous. Abdominal tergites pale yellowish-brown, legs yellow, occasionally pale yellow. Wings distinctly tinged with brown, anterior veins darker.

Posterior margin of head evenly rounded, distinctly longer than wide; cranial suture faint to distinct; eyes subcircular; ocelli near or touching eyes; antennae with 13-17 segments, segment 3 as long as or slightly longer than 2, longer than or about as long as 4. Pronotum with median suture, as wide, wider or narrower than maximum width of head with eyes; anterior margin widely and shallowly concave, lateral margins convex, postero-lateral corners broadly rounded; posterior margin slightly incurved. Fore wing with costa, radius and radial sector sclerotised; radial sector with five to eight simple or forked branches to costal margin; media curving upwards to join radial sector in distal half of wing. Arolium present.

Measurements (24 specimens from 16 nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.91-1.04	1.01
Maximum width of head with eyes	0.93-1.16	1.10
Maximum length of labrum	0.10-0.21	0.17
Maximum width of labrum	0.37-0.47	0.43
Maximum diameter of compound eye	0.26-0.36	0.33
Minimum diameter of compound eye	0.24-0.31	0.28
Maximum diameter of lateral ocellus	0.07-0.13	0.12
Minimum diameter of lateral ocellus	0.06-0.09	0.08
Minimum ocellus/antennal distance	0.18-0.22	0.20
Minimum eye/antennal distance	0.06-0.09	0.07
Minimum distance of eye from lateral base of head	0.11-0.22	0.21
Maximum length of pronotum	0.63-0.81	0.75
Median length of pronotum	0.57-0.68	0.65
Maximum width of pronotum	0.94-1.14	1.08
Length of hind tibia	0.85-0.99	0.93
Length of fore wing scale	0.70-0.96	0.91

Soldier. Head reddish-yellow to yellowish-brown paler posteriorly; frontal ridge and frons dark blackish-brown; mandibles dark brown; anteclypeus white, remainder of body yellow; anterior margin of pronotum edged with brown.

Head in dorsal view, short, thick, squarish to subrectangular; vertex flattened medially behind frontal ridge and just above the eyes. Frontal ridge narrow and prominent, evenly and slightly incurved medially, with median groove, recurved slightly above antennal sockets not markedly overhanging frons. Head slightly rugose behind frontal ridge, rest of capsule smooth posteriorly. Frons rugose, steeply inclined, bordered on either side by an elevated roughened ridge. Frontal and genal horns well developed, about same size, genal slightly longer than frontal. Antennae with 11–16 segments, segment 3 and/or 4 usually very short. Mandibles short to moderately long, almost straight, moderately shouldered about middle region. Teeth moderately developed. Pronotum with median suture, anterior margin deeply concave, unevenly serrated, sides almost straight, angularly rounded into posterior margin; posterior margin straight.

Measurements (27 specimens from 14 nest series) in millimetres

	Range	Mean	Type
Head length to lateral base of mandibles	0.91–1.33	1.14	1.18
Height of head excluding postmentum	0.75–1.04	0.88	1.04
Length of head to cephalic ridge 1	1.14–1.40	1.28	1.25
Length of head to cephalic ridge 2	0.96–1.25	1.12	1.07
Maximum width of head	1.12–1.35	1.26	1.22
Maximum length of labrum	0.10–0.23	0.18	0.11
Maximum width of labrum	0.25–0.36	0.29	0.26
Maximum length of pronotum	0.83–1.09	0.92	0.85
Median length of pronotum	0.69–0.91	0.76	0.67
Maximum width of pronotum	1.07–1.35	1.24	1.15
Maximum width of mesonotum	0.94–1.35	1.15	1.00
Maximum width of metanotum	1.04–1.27	1.18	1.04
Length of hind tibia	0.78–1.04	0.90	0.78
Length of left mandible	0.65–0.78	0.73	0.70
Left mandible, apical to first marginal	0.18–0.26	0.21	0.20
Left mandible, first to third marginal	0.13–0.20	0.16	0.13
Right mandible, apical to first marginal	0.22–0.27	0.14	0.10
Right mandible, first to second marginal	0.10–0.17	0.14	0.10

Alate nymph 2. Head yellow to orange-yellow, clypeus yellow-white, labrum yellow. Antennae, body and legs paler than head.

Head capsule subcircular, moderately hairy, hairs short and distinct; cranial suture not visible; brain distinct. Antennae with 13–15 segments, segment 1 twice length of 2, segments 3–5 equal. Apical teeth of mandibles very short to short, L_A/L_1 0.66–0.85, R_A/R_1 1.50. Pronotum broader than long, mainly narrower than head width, occasionally same width; anterior margin shallowly concave, sides slightly convex, posterior margin almost straight. Legs short and hairy; apical spur formula 3:3:3; tarsi four-jointed. Arolium absent.

Measurements (10 specimens from six nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	1.00–1.04	1.02
Maximum width of head	1.04–1.11	1.08
Length of pronotum	0.57–0.63	0.60
Median length of pronotum	0.49–0.52	0.51
Width of pronotum	0.94–1.00	0.88
Left mandible, apical to first marginal	0.06	0.06
Left mandible, first to third marginal	0.07–0.09	0.08
Left mandible, third marginal to molar	0.08–0.09	0.07
Left mandible, length of apical tooth	0.04–0.05	0.04
Left mandible, posterior cutting edge of first marginal	0.02	0.02
Left mandible, anterior cutting edge of third marginal	0.07	0.07
Right mandible, apical to first marginal	0.06	0.06
Right mandible, first to second marginal	0.04	0.04
Right mandible, posterior cutting edge of second marginal	0.15–0.17	0.16
Right mandible, length of apical tooth	0.04–0.06	0.05
Right mandible, posterior cutting edge of first marginal	0.02–0.03	0.02
Length of right mandible	0.28–0.30	0.29
Basal width of right mandible	0.30	0.30
Right mandible, length of molar plate	0.13	0.13
Right mandible, width of molar plate	0.07–0.08	0.06
Length of hind tibia	0.63–0.70	0.66

Biology. *C. merwei* nests most frequently in dead stubs and branches on growing trees and is especially common in dune scrub near the seashore. Colonies have also been collected in the indigenous forests of the Transkeian coastal belt and it is widely distributed over the Port Elizabeth city area where it was found in dry stubs and branches of *Eucalyptus*, *Oleander*, *Tacoma* trees and shrubs, and of fig and peach trees. Sneezewood fencing posts and pine timber used for fencing, hoardings, rustic benches and unpainted timbers of buildings, for example, verandah poles and railings, and doors of outbuildings have been attacked.

The nest system consists of a series of irregular flattened cells excavated with the grain of the wood and communicating by narrow passages. Any piece of infested wood may contain large numbers of independent colonies due to annual reinfestation during the swarming season.

Alates have been found in nests during July to November in Port Elizabeth, July at Illovo and Durban and July to October in Hluhluwe, St Lucia and Sordwana in Zululand (Coaton, 1950).

Comparisons. The imago and soldier are similar to those of *C. dudleyi* and *C. kororensis*. The alate nymph 2 is similar to that of *C. brevis*. See comments under that species.

Material examined. LECTOTYPE soldier, NATAL: Illovo, vii.1916. (*Fuller*) (AMNH).

Paralectotype imago, NATAL: same data as lectotype (AMNH).

REPUBLIC OF SOUTH AFRICA: 15.ii.1943, 18.x.1956, 19.x.1957, 20.x.1962, 24.x.1962, 22.x.1962, 20.x.1957, eight vials; Museum Street, Willowvale—Qora River mouth, Morgans Bay, Qolora River Mouth, The Haven—Elliotdale, 17 miles from Willowvale—Kentam (*Coaton* and *Sheabsy*) (NCI); Port Elizabeth, 20.x.1947 (*Hepburn*); 23.x.1952 (*Harris*).

Cryptotermes naudei Coaton

(Figs 1, 43, 44, 74, 75 and 115; Table 2)

Cryptotermes naudei Coaton, 1950: 24–27. LECTOTYPE soldier, ZULULAND (NCI) here designated [examined].

Imago. Head capsule yellowish-brown to near reddish-brown, distinctly paler anteriorly, occasionally darker about central region; clypeus yellow-white; labrum yellow; antennae, pronotum and abdominal tergites yellow to yellowish-brown; sternites pale yellow; tibiae and tarsi darker than femora; wing membrane very faintly tinged brown; anterior veins darker; median and cubitus unpigmented.

Head capsule evenly rounded posteriorly; cranial suture distinct; eyes and ocelli oval to subcircular; ocelli touching eyes; antennae with 13–16 segments, segment 2 longer than 3, 4 and 5 subequal and shorter than segments 3 or 6. Pronotum with anterior margin slightly concave, sides just convex to nearly parallel, posterior margin slightly emarginate. Mesonotum and metanotum with median suture. Fore wing with radial sector having five simple branches, cubitus and media weak and unsclerotised; media joining radial sector beyond middle of wing. Arolium present.

Measurements (14 specimens from six nest series) in millimetres

Head length to lateral base of mandibles	0.92–1.01	0.97
Maximum width of head with eyes	0.96–1.04	1.00
Maximum length of labrum	0.18–0.26	0.24
Maximum width of labrum	0.42–0.44	0.43
Maximum diameter of compound eye	0.29–0.34	0.31
Minimum diameter of compound eye	0.23–0.27	0.26
Maximum diameter of lateral ocellus	0.10–0.16	0.12
Minimum diameter of lateral ocellus	0.08–0.10	0.09
Minimum ocellus/antennal distance	0.14–0.18	0.17
Minimum eye/antennal distance	0.05	0.05
Minimum distance of eye from lateral base of head	0.14–0.20	0.16
Maximum length of pronotum	0.68–0.81	0.74
Median length of pronotum	0.57–0.68	0.63
Maximum width of pronotum	0.88–1.07	0.98
Length of hind tibia	0.78–0.91	0.85
Length of fore wing scale	0.91–0.95	0.93

Soldier. Head capsule brown posteriorly, black anteriorly; frontal ridge and frons black; mandibles reddish-brown to black; anteclypeus white, labrum yellowish-brown, antennae and legs yellow, thorax and abdomen brownish-yellow.

Head short and thick, nearly truncate in front; sides above eyes depressed and slightly rugose. Frontal ridge not well defined, scarcely noticeable; anterior margin only just concave not overhanging the frontal area. Frons wrinkled, not concave. Genal horns slightly longer than frontal horns. Eyes unpigmented and distinct. Mandibles short, slender, moderately shouldered, curving inwards from about middle region to tip of apical tooth. Teeth moderately developed. Antennae with 11–14 segments. Pronotum narrower than head width, sometimes as wide or wider, anterior margin finely serrate, concave with median notch, sides rounded, posterior margin just emarginate or straight.

Measurements (22 specimens from 22 nest series) in millimetres

	Range	Mean	Type
Head length to lateral base of mandible	0.89–1.07	0.95	1.04
Height of head excluding postmentum	0.80–1.00	0.86	0.94
Length of head to cephalic ridge 1	1.00–1.30	1.13	1.14
Length of head to cephalic ridge 2	0.96–1.15	1.06	1.09
Maximum width of head	1.11–1.30	1.19	1.27
Maximum length of labrum	0.08–0.19	0.14	0.13
Maximum width of labrum	0.15–0.30	0.23	0.29
Maximum length of pronotum	0.74–0.91	0.81	0.88
Median length of pronotum	0.59–0.78	0.68	0.75
Maximum width of pronotum	0.96–1.30	1.14	1.30
Maximum width of mesonotum	0.85–1.12	0.98	1.12
Maximum width of metanotum	0.85–1.15	0.99	1.09
Length of hind tibia	0.63–0.89	0.75	0.78
Length of left mandible	0.56–0.63	0.60	0.62

Left mandible, apical to first marginal	0·15-0·19	0·18	0·16
Left mandible, first to third marginal	0·09-0·15	0·13	0·13
Right mandible, apical to first marginal	0·15-0·22	0·19	0·18
Right mandible, first to second marginal	0·09-0·11	0·10	0·13

Biology. Collection records refer to colonies of *C. naudei* in tree grassland, in low woodland and in mangroves. Colonies were found in snags and dead branches of trees such as *Flacourtia indica*, *Lecaniodiscus fraxinifolius*, *Mangifera indica* L. and *Terminalia* sp.

Comparisons. The alate of *C. naudei* is similar to that of *C. havilandi*. For the soldier caste see comments under *C. kirbyi*.

Material examined. LECTOTYPE soldier, ZULULAND: Maputa, 22.xi.1939 (*Coaton*) (NCI).

Paralectotype imago, ZULULAND: same data as lectotype (NCI).

KENYA: 10 miles from Kilifi ferry 30.iii.1976 (*Williams and Pearce*); 7 miles from Kilifi, 9.vii.1954 (*Wilkinson*); 9 and 10 miles from Kilifi Forest, 30.iii.1976 (*Williams and Pearce*); 17 km Kwale, 26.iii.1976 (*Williams and Pearce*); 2, 6 and 10 miles beyond Kwale, 3.vii.1954 (*Wilkinson*); Kwale, 12.vi.1952 (*Wilkinson*); near Malindi, 10.viii.1950 (*Harris*); 32 km from Malindi, 1.iv.1976 (*Williams and Pearce*); Magadi road, 21.vii.1973 (*Sands*); Mombasa Island, 26.iii.1976, two vials (*Williams and Pearce*); south of Mombasa, 16.viii.1950 (*Harris*); near Mangea Hills, 8.vii.1966 (*Wilkinson*); Marsabit, 4.iii.1953 (*Sands*); Meru, 20.ii.1953 (*Sands*); Moyale road, 10.iii.1953 (*Sands*); 13 miles from Mtwapa, 6.vii.1954 (*Wilkinson*). TANZANIA: 13 miles from Dar-es-salaam on Morogoro road, 25.vii.1954 (*Wilkinson*); Zanzibar, Kizimbi road junction, 12.x.1954; 1.5 miles from Fumba, 11.x.1954 (*Wilkinson*).

Cryptotermes pallidus (Rambur)

(Fig. 92; Table 2)

Termes pallidus Rambur, 1842: 303. Imago, Isle de France (Mauritius).

Kalotermes (Cryptotermes) pallidus Moutia, 1936: 9. Imago, soldier.

As no material of this species was available for study the description of the imago and soldier by Moutia (1936) is given here.

Imago. Head light brown; thorax dark ochraceous; legs and antennae light ochraceous; wing scales suffused with light brown.

Head scantily clothed with short hairs; rounded at base, broadest nearly behind eyes; labrum nearly membranous, longer than broad, tip round and strongly convex, covering entirely tip of mandibles; clypeus short, about three times as broad as long; eyes black, nearly round, not very prominent, separated from lower margin by a distance nearly equal to half the diameter of the eye, ocellus round to oblong, close to eye (nearly touching it). Antennae pubescent, with 17 segments, 1 segment short and cylindrical, 2 and 3 segments nearly subequal to 1, 4 about half length to 1, segments 5 subequal to 4. Pronotum wider than head, broadened posteriorly; anterior margin slightly concave, antero- and postero-lateral angles round, posterior margin slightly notched medially, borders clothed with few long and short hairs. Meso- and metanotum without evaginate posterior margin.

Wing costa and subcosta light ochraceous, media nearer to cubitus than the radial sector, short and bent up to the radius sector a little beyond the middle of the wings, at a point before the first branch of the radial sector; cubitus distinct with about 14 branches, some terminate just below the apex of the wings; radial sector long with about four superior branches which join the costa before the apex of the wings; wing membrane and the principal veins with a scaly appearance. Abdomen clothed with short hairs, tip broadly rounded. Legs scantily hairy, tibial spurs long and slender, 3:3:3.

Measurements in millimetres

Length of entire winged insect	4·50
Length of dealated insect	3·20
Length of head (base to apex of labrum)	1·26
Length of head (base to clypeus frontal suture)	1·06
Length of pronotum	0·62
Length of clypeus	0·16
Length of labrum	0·18
Length of antennae	1·08
Length of anterior wings	9·10
Length of wing scale	0·70
Length of hind tibia	0·74
Diameter of eye	0·25
Diameter of ocellus	0·09
Distance of eye from lower margin of head	0·12
Width of head	0·90
Width of labrum	0·36
Width of pronotum	1·10
Width of anterior wings	2·00
Width of abdomen	1·10

Soldier. Front of head dark brown; remainder of head shading from reddish-brown to brown; labrum light yellow; mandibles reddish-brown at base; tip dark brown; pronotum whitish-yellow; abdomen whitish; legs white-yellow.

Head longer than wide, broadly rounded behind, sides parallel; whole surface finely shagreened and bearing some scattered hairs; tuberculate at anterior angles, edge of ridge smooth, notched in the middle; clypeus membranous, indistinct, labrum broader than long with apex bluntly pointed covering tip of mandibles; mandibles without teeth, slender; antennae slightly hairy with 11-13 segments, segment 1 cylindrical, 2 subequal to 1, 3 and 4 fused, 3 one half length of 2, segment 4 subequal to 3, 5 monoliform as well as remaining segments, last with tip rounded; a small, oblique, oval eye spot, on the sides at back of antennae. Pronotum as broad as the head, broadest anteriorly, clothed with scarce setae on anterior borders, anterior margin elevated, deeply concave in middle, antero-lateral angles elevated, sides nearly parallel, postero-lateral edges broadly rounded, posterior margin nearly straight. Meso- and metanotum with posterior margins nearly as same as in pronotum. Legs scantily hairy, tibial spurs stout, 3:3:3. Abdomen scantily hairy, tip broadly rounded.

Measurements in millimetres	
Length of entire soldier	4.00
Length of head with mandibles	1.90
Length of head from base to anterior margin of truncate front	1.10
Depth of head	0.64
Length of head (from posterior margin to labial suture)	1.52
Length of labrum	0.16
Length of clypeus	0.08
Length of left mandible	0.56-0.60
Length of antennae	0.84
Length of hind tibia	0.74
Length of pronotum	0.54
Width of head at widest part	1.16
Width of pronotum	0.98
Width of abdomen	1.32
Width of labrum	0.26
Width of clypeus	0.41
Width of gula, at narrowest part	0.22
Width of gula, at widest part	0.30

***Cryptotermes perforans* Kemner**
(Figs 2, 45, 46, 84, 116 and 131; Tables 1 and 2)

Cryptotermes perforans Kenmer, 1932: 153-155. LECTOTYPE soldier, SRI LANKA (NR) here designated [examined].

Cryptotermes cynocephalus Light. Misidentification. Ahmad, 1953: 35. SRI LANKA: Colombo. Material examined by Chhotani and found to be identical with lectotype of *C. perforans* [not examined].

Imago. Head, pronotum and tergites pale yellow-brown, last three abdominal tergites slightly darker than rest; antennae, labrum, sternites and legs pale yellow. Wings weakly tinged brown, anterior veins darker.

Posterior margin of head evenly rounded, capsule subsquarish, sides subparallel; cranial suture faint; eyes oval, narrowing slightly posteriorly; ocelli oval, touching eyes; antennae with 13-14 segments, segment 1 longest, cylindrical, 2 shorter than 1, 3 longer than 2 or 4. Pronotum narrower than maximum width of head with eyes, broader than long; anterior margin weakly concave, sides weakly convex, rounded behind into posterior margin; posterior margin weakly emarginate medially. Fore wing with anterior margin sclerotised, radial sector with six simple branches to costa; media joining radial sector just beyond middle of wing. Arolium present.

Measurements (three specimens from one nest series) in millimetres		
	Range	Mean
Head length to lateral base of mandibles	0.76-0.78	0.78
Maximum width of head with eyes	0.78-0.81	0.80
Maximum length of labrum	0.11-0.19	0.17
Maximum width of labrum	0.30-0.33	0.30
Maximum diameter of compound eye	0.26-0.28	0.27
Minimum diameter of compound eye	0.20	0.20
Maximum diameter of lateral ocellus	0.09-0.13	0.11
Minimum diameter of lateral ocellus	0.07-0.11	0.08
Minimum ocellus/antennal distance	0.13-0.15	0.14
Minimum eye/antennal distance	0.04-0.05	0.04
Minimum distance of eye from lateral base of head	0.09-0.12	0.10
Maximum length of pronotum	0.50-0.56	0.53
Median length of pronotum	0.44-0.52	0.48
Maximum width of pronotum	0.70-0.73	0.72
Length of hind tibia	0.67	0.67
Length of fore wing scale	0.67-0.70	0.69

Soldier. Head capsule black, blackish-brown posteriorly, antennae, labrum, body and legs pale brown, anterior margin of pronotum dark brown; mandibles black basally, dark reddish-brown distally.

Head in dorsal view short and thick, depressed slightly medially behind frontal ridge and above eyes, faintly rugose; frontal ridge a prominent ribbon-like band, broader in middle with central groove, anterior margin deeply concave. Frontal horns stout

and longer than genal horns. Frons concave, slightly rugose. Eyes oval. Antennae with 10-11 segments, segment 1 longest, cylindrical, about twice length of 2, 3 either subequal or shorter than 2. Anteclypeus very narrow, apilose strip; postclypeus subrectangular; labrum subtriangular with a few setae on the tip. Mandibles very short and broad with prominent shoulder about middle of length, dentition moderately developed. Pronotum flat, anterior margin raised slightly, broader than long, narrower or as wide as head capsule, anterior margin convex with a deep and broad median notch, sides slightly convex, sharply rounded into posterior margin; posterior margin weakly emarginate medially.

Measurements (seven specimens from two nest series) in millimetres			
	Range	Mean	Type
Head length to lateral base of mandibles	0.78-0.87	0.80	0.78
Height of head excluding postmentum	0.67-0.74	0.70	0.70
Length of head to cephalic ridge 1	0.92-1.05	0.98	0.96
Length of head to cephalic ridge 2	0.71-0.89	0.82	0.85
Maximum width of head	0.89-1.00	0.95	0.93
Maximum length of labrum	0.09-0.15	0.13	0.09
Maximum width of labrum	0.19-0.22	0.20	0.19
Maximum length of pronotum	0.51-0.63	0.57	0.57
Median length of pronotum	0.43-0.52	0.48	0.48
Maximum width of pronotum	0.85-0.94	0.90	0.91
Maximum width of mesonotum	0.61-0.85	0.75	0.74
Maximum width of metanotum	0.74-0.87	0.80	0.74
Length of hind tibia	0.56-0.59	0.57	0.56
Length of left mandible	0.48-0.49	0.48	0.48
Left mandible, apical to first marginal	0.09-0.15	0.11	0.11
Left mandible, first to third marginal	0.07-0.13	0.09	0.07
Right mandible, apical to first marginal	0.11-0.13	0.12	0.13
Right mandible, first to second marginal	0.07-0.09	0.08	0.07

Alate nymph 2. Head yellow to pale brown, paler anteriorly, labrum, antennae and legs yellow-brown.

Head capsule subcircular, broader than long with many distinct setae; cranial suture not visible, brain distinct. Antennae with 11-13 segments, segment 1 and 2 cylindrical, 2 shorter than 1, 3 long and subequal to 2. Pronotum hairy, subrectangular, flat, narrower than head capsule, anterior margin shallowly to moderately concave, sides weakly convex, posterior ends sharply angled; posterior margin emarginate medially. Abdomen moderately pilose. Legs short and hairy; apical spur formula 3:3:3; tarsi four-jointed. Arolium absent.

Measurements (two specimens from two nest series) in millimetres	
Head length to lateral base of mandibles	0.88-0.89
Maximum width of head	0.88-0.89
Length of pronotum	0.46-0.48
Median length of pronotum	0.44-0.46
Width of pronotum	0.72
Left mandible, apical to first marginal	0.04
Left mandible, first to third marginal	0.07
Left mandible, third marginal to molar	0.09
Left mandible, length of apical tooth	0.04
Left mandible, posterior cutting edge of first marginal	0.03
Left mandible, anterior cutting edge of third marginal	0.07
Right mandible, apical to first marginal	0.06
Right mandible, first to second marginal	0.04
Right mandible, posterior cutting edge of second marginal	0.15
Right mandible, length of apical tooth	0.04
Right mandible, posterior cutting edge of first marginal	0.03
Length of right mandible	0.22
Basal width of right mandible	0.26
Right mandible, length of molar plate	0.13
Right mandible, width of molar plate	0.07
Length of hind tibia	0.52

Biology. Collection records of this termite refer to colonies from timber of a factory and from the wood of a sewing machine.

Comparisons. The imago and soldier of *C. perforans* are close to that of *C. cynocephalus*. The head capsule of the imago of *C. perforans* is yellowish-brown while in *C. cynocephalus* it is yellowish-brown to brown; the radial sector of the force wing has six simple branches to the costa while in *C. cynocephalus* the radial sector has four to five forward branches. The soldier of *C. perforans* has a ribbonlike frontal ridge, broader in the middle with a central groove, while in *C. cynocephalus* the frontal ridge is a narrow strip, complete and overhanging the frons. The sides of the head above the eyes are more depressed in *C. cynocephalus* than in *C. perforans*. For comparison with *C. roonwali*, see under this species. In the alate nymph 2, the posterior margin of the pronotum is moderately emarginate, a feature shared with *C. domesticus*. It can be separated from other pest species in that the width of the pronotum is 0.72 mm compared with 0.76-1.30 mm.

Material examined. LECTOTYPE soldier, SRI LANKA: Colombo, 7.v.1929 (*Jepson*) (NR.)

Paralectotype imago, SRI LANKA: same data as lectotype (NR); 6.iii.1929 (*Jepson*) (NR).

Cryptotermes pingyangensis He & Xia

(Figs 33, 86 and 117; Table 2)

He and Xia (1982) in describing this new species, designated their material 'cotype' and 'paratype'. It seems that the former is their best nest series of soldiers, imagos and nymphs and as it was not practicable to examine these specimens a lectotype could not have been designated. The description here is based on a 'paratype'-soldier and imago examined. (The previous description is in Chinese.)

Imago. Head capsule brown, slightly paler anteriorly; frons with pale Y-shaped mark in middle and crescent-shaped white mark above each antennal sockets, clypeus pale yellow; labrum yellow; antennal segments pale yellowish-brown and concolorous; pronotum with T-shaped mark, posterior half slightly darker than head; tergites, coxae and femora same colour as back of head, sternites much paler. Tibiae and tarsi pale yellow, distinctly paler than femora. Wings absent in specimen examined.

Posterior margin of head capsule evenly rounded; stem of Y-suture distinct, V faint, eyes nearly round, ocelli round and close to eyes; antennae broken, segment 1 slightly longer than 2, rectangular, 3 and 4 about same length as 2. Pronotum suture incomplete, visible to nearly half way along length; anterior margin widely and shallowly concave, sides slightly rounded, posterior margin moderately emarginate medially. Mesonotum and metanotum with distinct median sutures. Fore wing absent. Arolium present.

Measurements (one specimen from one nest series) in millimetres

Head length to lateral base of mandibles	0.98
Maximum width of head with eyes	1.00
Maximum length of labrum	0.19
Maximum width of labrum	0.41
Maximum diameter of compound eye	0.26
Minimum diameter of compound eye	0.26
Maximum diameter of lateral ocellus	0.06
Minimum diameter of lateral ocellus	0.06
Minimum ocellus/antennal distance	0.17
Minimum eye/antennal distance	0.06
Minimum distance of eye from lateral base of head	0.15
Maximum length of pronotum	0.67
Median length of pronotum	0.59
Maximum width of pronotum	0.96
Length of hind tibia	0.93
Length of fore wing scale	0.74

Soldier. Head capsule yellow posteriorly, becoming progressively reddish-brown to nearly black behind frontal ridge. Frontal ridge and frons nearly black; mandibles dark reddish-brown; anteclypeus pale yellow; labrum, antennae, body and legs yellow; segments 1 and 2 of antennae darker than other segments. Pronotum same colour as back of head, anterior margin darker.

Head short and thick nearly truncate in front, rounded posteriorly; deeply depressed in mid-vertex region and behind frontal ridge above eyes; latter area slightly rugose; stem of Y-suture distinct. Frontal ridge prominent, broad in middle and above eyes, narrowing between the two broadest points; anterior margin almost straight, recurving above antennal sockets. Frons moderately concave and rugose. Labrum tongue-shaped with two long setae. Frontal horns longer than genal horns. Eyes oval, unpigmented. Antennae with 12 segments, segment 1 twice length of 2, 3 and 4 much shorter than 2 and ring-like. Mandibles strongly shouldered half way externally, dentition well developed. Pronotum with median suture, anterior margin deeply V-shaped and coarsely serrated, sides slightly convex and rounded into posterior margin, posterior margin slightly concave.

Measurements (one specimen from one nest series) in millimetres

Head length to lateral base of mandibles	1.11
Height of head excluding postmentum	0.89
Length of head to cephalic ridge 1	1.22
Length of head to cephalic ridge 2	1.11
Maximum width of head	1.31
Maximum length of labrum	0.22
Maximum width of labrum	0.30
Maximum length of pronotum	0.89
Median length of pronotum	0.70
Maximum width of pronotum	1.17
Maximum width of mesonotum	1.11
Maximum width of metanotum	1.15
Length of hind tibia	0.89
Length of left mandible	0.56
Left mandible, apical to first marginal	0.15
Left mandible, first to third marginal	0.11
Right mandible, apical to first marginal	0.15
Right mandible, first to second marginal	0.07

Biology. This species is known only from the type locality Zhejiang Province, Pingyang and was collected in September 1979 and January 1976 in the pillars of a house.

Comparisons. This species is similar to *C. luodianis* and for separation of the species see imago and soldier keys.

Material examined. Paratype imago, soldier # 09005083, Zhejiang Province, Pingyang (*He Xiu-song* and *Liu Xian-wei*) (SIE).

***Cryptotermes pyrodomus* n.sp.**

(Figs 87 and 118; Table 2)

Imago. Unknown.

Soldier. Head capsule reddish-brown posteriorly, anterior three-quarters very dark brown; frontal ridge and frons black, mandibles dark brown; labrum dull white; antennae and pronotum yellow; anterior margin of pronotum brown.

Head in dorsal view squarish, sides slightly constricted in middle; almost three-quarters of dorsal surface heavily wrinkled. Frontal ridge broad and prominent, anterior margin moderately V-shaped with median groove, recurving above antennal sockets. Frons concave and rough. Genal horns hardly developed. Frontal horns large and thumb-like. Eyes oval and prominent. Mandibles very short and broad, dentition weak. Antennae with 12-13 segments, segment 1 longer than 2, 2-4 about same length. Pronotum width narrower than head width, anterior margin serrated, moderately concave, sides slightly convex, posterior margin straight.

Measurements (two specimens from one nest series) in millimetres

	Range	Mean	Type
Head length to lateral base of mandibles	0.85-0.96	0.91	0.96
Height of head excluding postmentum	0.96-1.00	0.98	0.96
Length of head to cephalic ridge 1	1.22	1.22	1.22
Length of head to cephalic ridge 2	1.04-1.07	1.06	1.04
Maximum width of head	1.20-1.22	1.21	1.20
Maximum length of labrum	0.04	0.04	0.04
Maximum width of labrum	0.17-0.19	0.18	0.17
Maximum length of pronotum	0.74-0.81	0.78	0.74
Median length of pronotum	0.63-0.74	0.69	0.63
Maximum width of pronotum	1.04	1.04	1.04
Maximum width of mesonotum	0.85-0.89	0.87	0.85
Maximum width of metanotum	0.89-0.96	0.93	0.89
Length of hind tibia	0.63	0.63	0.63
Length of left mandible	0.52	0.52	0.52
Left mandible, apical to first marginal	0.13	0.13	0.13
Left mandible, first to third marginal	0.13	0.13	0.13
Right mandible, apical to first marginal	0.15	0.15	0.15
Right mandible, first to second marginal	0.11	0.11	0.11

Alate nymph 2. Head capsule yellow, paler anteriorly; antennae, clypeus, labrum pale yellow, pronotum, body and legs pale yellow.

Head capsule nearly circular with sparse distinct setae, brain partly visible, Y-suture not visible. Antennae with 13 segments, segment 1 twice length of 2, both cylindrical, segment 3 slightly pear-shaped, 4 ring-like and smallest segment. Labrum broader than long. Pronotum width narrower than head width, periphery with several long setae, anterior margin slightly concave, sides rounded, posterior margin straight. Legs moderately long with short sparse hairs; apical spur formula 3:3:3. Abdomen sparsely hairy, sternites with long setae in middle region; cerci two-jointed; styli single jointed. Arolium absent.

Measurements (one specimen from one nest series) in millimetres

Head length to lateral base of mandibles	1.00
Head width	1.07
Length of pronotum	0.59
Median length of pronotum	0.56
Width of pronotum	1.04
Hind tibia	0.72

Biology. This species is known only from the type locality, Highland, Barbados and was collected from a hardwood window frame of a boiling house.

Comparisons. The head shape and rugosity of the soldier of *C. pyrodomus* is similar to that of the soldier of *C. brevis*. The two species can be separated from one another in that the genal horns in *C. pyrodomus* are hardly developed and the frontal horns are large and thumb-like while in *C. brevis* the genal and frontal horns are squat and rounded and scarcely prominent.

Material examined. Holotype soldier, BARBADOS: Highland boiling house, 12.xii.1938 (*Government Entomologist*) (AMNH).

Paratypes, soldier, nymphs, BARBADOS: 12.xii.1938 (*Government Entomologist*) (AMNH).

***Cryptotermes rhinocephalus* n.sp.**

(Figs 88 and 119; Table 2)

Imago. Unknown.

Soldier. Head capsule third to half very dark brown to black, yellowish-reddish-brown posteriorly; frons same colour as front of head; antennae, pronotum, abdomen and legs yellow, anterior margin of pronotum brown; mandibles dark reddish-brown; labrum yellow-white.

Head slightly longer than wide, weakly constricted about eye level, flattened slightly about level of antennal sockets; dorsal and lateral surfaces of anterior three-quarters very rugose. Frontal ridge weakly defined, anterior margin moderately V-shaped, recurved above antennal sockets. Frons slightly concave, tuberculate, falling almost vertical to postclypeus. Labrum tongue-shaped with two long setae at tip. Frontal and genal horns about same size, genal horns just longer. Eyes not visible. Antennae with 12 segments, segment 1 just longer than 2, 3 twice length of 4, 4 smallest segment. Mandibles short and broad, angled halfway from base, dentition weak. Pronotum narrower than head, with median suture, anterior margin deeply and broadly V-shaped, and serrated, sides nearly parallel with several long setae; posterior margin moderately emarginate.

Measurements (one specimen from one nest series) in millimetres

Head length to lateral base of mandibles	0.81
Height of head excluding postmentum	0.81
Length of head to cephalic ridge 1	1.07
Length of head to cephalic ridge 2	1.04
Maximum width of head	1.02
Maximum length of labrum	0.07
Maximum width of labrum	0.19
Maximum length of pronotum	0.67
Median length of pronotum	0.59
Maximum width of pronotum	0.89
Maximum width of mesonotum	0.81
Maximum width of metanotum	0.87
Length of hind tibia	0.59
Length of left mandible	0.44

Pseudoworker. Head capsule yellow paler anteriorly; clypeus, labrum, antennae pale yellow. Pronotum, tergites and sternites same colour and paler than back of head.

Head capsule subcircular with few short setae, brain distinct; stem of Y-suture only visible. Antennae with 14 segments, 1 longer than 2, segment 2 longer than 3, 4-6 ring-like. Labrum tip with several long setae. Pronotum broader than long with few setae; anterior margin broadly and shallowly concave, sides nearly parallel, rounded moderately behind into straight posterior margin. Abdomen sparsely hairy. Legs short, with few hairs, apical spur formula 3:3:3. Arolium absent.

Measurements (two specimens from one nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.87-0.89	0.88
Maximum width of head	0.95-0.96	0.96
Length of pronotum	0.56	0.56
Median length of pronotum	0.46	0.46
Width of pronotum	0.80-0.81	0.81
Length of hind tibia	0.56	0.56

Biology. This species is known only from the type locality, Balandra Bay, Trinidad and no information is available on its biology.

Comparisons. The head shape and its rugosity of the soldier of *C. rhinocephalus* are similar to that of the soldier of *C. verruculosus* and *C. longicollis*. The size of the soldier is almost the same as the beginning of the size range of *C. verruculosus*. However, in *C. verruculosus* the head is depressed in the middle and above the eyes, a feature not seen in *C. rhinocephalus*. The anterior margin of the frontal ridge is deeply V-shaped in *C. verruculosus* and shallowly V-shaped in *C. rhinocephalus*. The eyes are distinct in the former and hardly visible in the latter. For differences between *C. rhinocephalus* and *C. longicollis* see comments under the latter species.

Material examined. Holotype soldier, TRINIDAD: Balandra Bay, 17.i.1937 (*Adamson*) (AMNH).

Paratype, nymphs, TRINIDAD: 17.i.1937 (*Adamson*) (AMNH).

Cryptotermes roonwali Chhotani (Figs 89 and 120; Table 2)

Cryptotermes roonwali Chhotani, 1970: 61. Holotype soldier, INDIA: Beliapatam, 23.viii.1941 (*Khan*) (FRI) [not examined].

Imago. Not known.

Soldier. Head capsule almost black anteriorly, blackish-brown posteriorly; antennae, labrum and body pale yellowish-brown; pronotum brown at anterior margin; mandibles dark reddish-brown, base black.

Head subrectangular and thick, longer than broad, depressed slightly medially behind frontal ridge and above eyes; anterior two-thirds weakly wrinkled. Frontal ridge moderately raised in middle, weak at sides; broader above antennal sockets than in middle region; frons concave. Eyes suboval. Antennae broken in specimens examined, segment 1 long, cylindrical, twice length of 2. Anteclypeus narrow and apilose. Labrum, subtriangular, broad basally, tip with two short setae. Genal horns small, frontal horns thumb-like and longer than genal horns. Mandibles very short and almost triangular, weakly shouldered, dentition weak. Pronotum flat, slightly raised at anterior margin, broader than long, anterior margin smooth to slightly serrated with a deep median notch, sides rounded, posterior margin straight.

Measurements (one specimen from one nest series) in millimetres

	Paratype
Head length to lateral base of mandibles	0.04
Height of head excluding postmentum	0.79
Length of head to cephalic ridge 1	1.12
Length of head to cephalic ridge 2	1.01
Maximum width of head	1.01
Maximum length of labrum	0.16
Maximum width of labrum	0.18
Maximum length of pronotum	0.68
Median length of pronotum	0.55
Maximum width of pronotum	0.99
Maximum width of mesonotum	0.81
Maximum width of metanotum	0.86
Length of hind tibia	0.57
Length of left mandible	0.44
Left mandible, apical to first marginal	0.10
Left mandible, first to third marginal	0.10
Right mandible, apical to first marginal	0.13
Right mandible, first to second marginal	0.10

Pseudoworker. Head capsule yellowish-brown; antennae, labrum, legs and body pale yellow.

Head capsule evenly rounded behind, longer than wide, sides sub-straight, weakly narrowed in front. Eyes broadly oval, hardly visible. Antennae with 12–13 segments, 1 and 2 cylindrical, 3 pear-shaped, segment 3 shorter than 2, 4–6 ring-like and very short. Clypeus subtrapezoidal. Anteclypeus narrow and apilose; postclypeus pilose. Labrum broader than long, fairly pilose at anterior margin and on body. Pronotum flat, subrectangular, narrower than head capsule, anterior margin weakly concave, sides rounded and slightly narrowing behind, posterior margin weakly emarginate. Legs short, thick and pilose, apical tibial spur formula 3:3:3. Abdomen hairy, cerci two-jointed; styli single-jointed and finger-like. Arolium absent.

Biology. *C. roonwali* nests primarily in dead and dry portions of living trees in wild habitat. Its recorded hosts are *Ficus religiosa* L. and *Syzygium cumini*. The attack though extending to the living tissues of the host does not go deeper. Though not recorded so far from man-made structures, the possibility of its becoming a serious pest at a later date cannot be ruled out (Thakur, 1980).

Comparisons. The soldier of *C. roonwali* is very similar to that of *C. perforans*. The head of the former is just longer and the frontal ridge is broader above the antennal sockets than in the middle region while in the latter the frontal ridge is broader in the middle than above the antennal sockets.

Material examined. Paratype, INDIA: Beliapatam, 23.vii.1941 (*Khan*) (ZSI).

Cryptotermes silvestrii n.sp.

(Figs 1, 47, 48, 93 and 121; Table 2)

Cryptotermes silvestrii n.sp. Holotype soldier, NIGERIA, Nkpoku, 13.viii.1957 (*Sands*) (BMNH) [*Cryptotermes havilandi* Sjostedt *sensu* Silvestri, 1914:6. Misidentification].

Imago. Head capsule yellowish-brown to near reddish-brown, paler anteriorly, clypeus pale yellow; labrum yellow; antennae yellow and concolorous, pronotum yellow or nearly same colour as back of head; tergites same colour as pronotum or slightly darker; sternites paler than tergites; tibiae and tarsi just darker than femora; wings hyaline, costal and radial veins darker.

Posterior margin of head evenly rounded, cranial suture faint to distinct. Eyes and ocelli oval, ocelli very near or touching eyes; antennae with 12–16 segments, segment 1 twice length of 2, 2 and 3 subequal, 4 and 5 equal. Pronotum, mesonotum, metanotum with median suture; anterior margin of pronotum weakly to moderately concave, sides just convex. Posterior margin slightly emarginate. Fore wing with costal, radius and radial sector sclerotised, radial sector with five forward branches to costa, media joining radial sector beyond middle of wing. Arolium present.

Measurements (16 specimens from nine nest series) in millimetres

	Range	Mean	Type
Head length to lateral base of mandibles	0.89–0.94	0.90	0.89
Maximum width of head with eyes	0.94–1.00	0.97	0.94
Maximum length of labrum	0.11–0.22	0.17	0.15
Maximum width of labrum	0.37–0.46	0.40	0.41
Maximum diameter of compound eye	0.27–0.33	0.30	0.30
Minimum diameter of compound eye	0.22–0.28	0.20	0.24
Maximum diameter of lateral ocellus	0.09–0.11	0.08	0.09
Minimum diameter of lateral ocellus	0.06–0.09	0.07	0.06
Minimum ocellus/antennal distance	0.15–0.17	0.16	0.15
Minimum eye/antennal distance	0.06	0.06	0.06
Minimum distance of eye from lateral base of head	0.15–0.17	0.16	0.17
Maximum length of pronotum	0.56–0.70	0.64	0.63

Median length of pronotum	0.48-0.61	0.57	0.56
Maximum width of pronotum	0.78-1.02	0.91	0.93
Length of hind tibia	0.70-0.78	0.75	0.78
Length of fore wing scale	0.78-0.93	0.84	0.85

Soldier. Head capsule reddish-brown, sometimes paler at back of head; frontal ridge and just behind ridge very dark brown to black; antennae yellow-white; mandibles dark reddish-brown, basal half generally black, pronotum yellow, anterior margin dark brown; body and legs yellow, legs occasionally darker than abdomen.

Head in dorsal view rounded behind, narrows slightly in front, strongly depressed above eyes behind frontal ridge, moderately rugose; vertex slightly flattened. Frontal ridge prominent, slightly rough with median groove; anterior margin moderately V-shaped and recurved above antennal sockets. Frons almost vertical forming a shallow cavity with postclypeus, weakly rugose. Labrum tongue-shaped. Frontal and genal horns well developed; genal horns longer. Eyes oval and unpigmented, sometimes absent. Antennae with 10-13 segments, segment 1 longer than 2, 2 twice length of 3, 3-5 equal. Mandibles short, sometimes not shouldered externally in basal third. Pronotum with median suture, wider, narrower or same width as head, anterior margin deeply V-shaped, sometimes serrated and elevated, sides rounded, posterior margin straight.

Measurements (23 specimens from 17 nest series) in millimetres

	Range	Mean	Type
Head length to lateral base of mandibles	0.93-1.20	1.02	0.98
Height of head excluding postmentum	0.74-1.01	0.87	0.81
Length of head to cephalic ridge 1	1.04-1.33	1.24	1.18
Length of head to cephalic ridge 2	0.87-1.17	1.06	1.00
Maximum width of head	1.00-1.27	1.19	1.18
Maximum length of labrum	0.07-0.16	0.11	0.07
Maximum width of labrum	0.19-0.29	0.22	0.19
Maximum length of pronotum	0.63-0.94	0.80	0.81
Median length of pronotum	0.44-0.78	0.63	0.59
Maximum width of pronotum	0.89-1.30	1.14	1.15
Maximum width of mesonotum	0.78-1.15	0.99	0.96
Maximum width of metanotum	0.89-1.15	1.02	0.96
Length of hind tibia	0.56-0.81	0.69	0.70
Length of left mandible	0.56-0.65	0.58	0.56
Left mandible, apical to first marginal	0.13-0.15	0.14	0.15
Left mandible, first to third marginal	0.11-0.13	0.14	0.09
Right mandible, apical to first marginal	0.14-0.17	0.16	0.17
Right mandible, first to second marginal	0.07-0.11	0.09	0.09

Biology. This species has been collected in hard wood of living and partially dead trees in *Acacia* woodland and in riverine forests.

Comparisons. The imago of *C. silvestrii* is similar to that of *C. havilandi* and *C. kororensis*, see comments under these species. The soldier is close to that of *C. verruculosus*. In the latter the frontal and genal horns are of the same length while in *C. silvestrii* the genal horns are longer.

Material examined. Holotype soldier, NIGERIA: Nkpoku, 13.viii.1937 (*Sands*) (BMNH).

Paratypes, imagos, soldiers, NIGERIA: 13.viii.1937 (*Sands*) (BMNH). BELGIAN CONGO: 22.v.1948 (*Emerson*).

ZAIRE: Brazzaville: 1.iv.1948 (*Emerson*) (AMNH). NIGERIA: Wellington Rock, 4.iii.1956; 43 miles east of Kano, 17.iii.1956; 12 miles from Port Harcourt, 18.iii.1956; 18 miles from Yola on Numan Road, 14.v.1967; 40 miles from Joson Bauchi Road, 11.ii.1957; 20 miles northwest of Zaria; 10 miles north of Zaria, 23.xii.1956 (*Sands*); 12 miles from Port Harcourt, 1967 (*Wilkinson*); on Owerri Road, 1967 (*Wilkinson*).

Cryptotermes sukauensis Thapa

(Fig. 94; Table 2)

Cryptotermes sukauensis Thapa, 1977: 23-25. Holotype soldier, SABAH, Sukau, Lamag, 29.ix.70 (*Low Min Teck*) [not examined]. (Type depository not known.)

As no material of this species was available for study the description of the soldier by Thakur (1980) is given below.

Imago. Unknown.

Soldier. Head-capsule reddish-brown, frons and frontal ridge black; antennae, labrum, abdominal tergites and legs pale; mandibles dark reddish-brown; pronotum pale yellow, anterior lobe brown with reddish tinge. Head with scattered long and short bristles; tip of labrum with a few short and two long bristles; pronotum with short and long bristles along margins and on disc; abdominal tergites with short bristles and a row of a few long and short bristles.

Head capsule strongly phragmotic, thick, slightly longer than broad; frons deeply concave; frontal ridge prominent, greatly elevated with a shallow V-shaped median notch; vertex depressed in middle behind frontal ridge; Y-suture indistinct; one pair of lobe-like projections on either side, one smaller one on lateral margin of postclypeus and in front of antennal socket and the other larger one below antennal socket. Eyes larger, oval. Antennae with 12–14 segments; segment 2 longer than 3 and nearly one-and-a-half to twice as long as 4; segments 5–14 gradually increasing in length in that order. Anteclypeus trapezoid. Labrum nearly twice as wide as long; sides parallel, antero-lateral margins converging anteriorly into narrowly rounded tip. Mandibles with weak basal hump, tips incurved, slightly more than half as long as head capsule, mandible head index 0.54–0.58; left mandible with two well-developed marginal teeth, first longer than second, second broad based; right mandible with two well-developed marginal teeth, posterior margin of first marginal tooth concave. Pronotum narrower than head, anterior margin finely serrated and broadly V-shaped; antero-lateral corners narrowly rounded or notched; lateral margins weakly convex; postero-lateral corners broadly rounded; posterior margin nearly straight. Legs short; length of hind tibia 0.67–0.70 mm; apical tibial spurs 3:3:3.

Measurements (in millimetres) of six soldiers of *Cryptotermes sukauensis* new species

	Holotype	Range	Mean
Length of head to side base of mandibles	1.20	1.17–1.25	1.20
Length of head up to frontal ridge	1.20	1.17–1.27	1.21
Median length of head up to frontal ridge	1.05	1.02–1.10	1.06
Maximum width of head	1.08	1.08–1.15	1.10
Height of head	0.87	0.82–0.90	0.86
Length of left mandible	0.65	0.65–0.70	0.67
Mandible-head index	0.54	0.54–0.58	0.55
Maximum diameter of eye	0.10	0.08–0.12	0.10
Minimum diameter of eye	0.06	0.06–0.08	0.07
Length of labrum	0.12	0.10–0.12	0.11
Width of labrum	0.21	0.20–0.22	0.21
Maximum length of pronotum	0.71	0.70–0.80	0.74
Median length of pronotum	0.57	0.57–0.67	0.61
Width of pronotum	1.02	1.00–1.10	1.05

Comparisons. The soldier of *C. sukauensis* closely resembles that of *C. dudleyi* but the head is much smaller and the left mandible has two well-developed marginal teeth. *C. sukauensis* soldier also resembles *C. sumatrensis* but in *C. sumatrensis* the soldier has larger eyes, the mandibles are bent near the middle with weakly developed marginal teeth and the frontal ridge has a deep median notch. In comparison with *C. sukauensis* the soldier of *C. thailandis* has a wider head and pronotum and is without a median notch in the frontal ridge.

Type locality and distribution. Sakau, District Lamag, Sabah.

Cryptotermes sumatrensis Kemner

(Figs 34, 90 and 122; Table 2)

Cryptotermes sumatrensis Kemner 1930: 301. LECTOTYPE soldier, SUMATRA (ZI) here designated [examined].

Imago. Head capsule dull yellowish-brown to orange, paler anteriorly; antennae pale yellow, labrum yellow; pronotum yellow, distinctly paler than back of head; tergites same colour as pronotum; sternites paler; tibiae and tarsi yellow, darker than femora. No wings on specimens examined.

Head capsule sparsely hairy, evenly rounded. Stem of Y-suture only visible. Eyes and ocelli oval, ocelli very near eyes. Antennae with 16–17 segments, segment 1 nearly twice length of 2, segments 2–5 about same length. Pronotum with median suture, narrower than maximum width of head across eyes, anterior margin moderately concave, sides moderately convex, posterior margin just emarginate. Meso- and metanota with distinct median suture. Arolium present.

Measurements (two specimens from one nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.96–0.99	0.96
Maximum width of head with eyes	1.00–1.05	1.03
Maximum length of labrum	0.33	0.33
Maximum width of labrum	0.41–0.44	0.43
Maximum diameter of compound eye	0.31	0.31
Minimum diameter of compound eye	0.26	0.26
Maximum diameter of lateral ocellus	0.11	0.11
Minimum diameter of lateral ocellus	0.09	0.09
Minimum ocellus/antennal distance	0.17	0.17
Minimum eye/antennal distance	0.06	0.06
Minimum distance of eye from lateral base of head	0.15–0.17	0.16
Maximum length of pronotum	0.68–0.73	0.71
Median length of pronotum	0.57–0.64	0.61
Maximum width of pronotum	0.89–0.91	0.90
Length of hind tibia	0.81–0.89	0.85
Length of fore wing scale	0.92–0.96	0.94

Soldier. Head capsule reddish-brown, paler posteriorly; frons and frontal ridge dark brown; mandibles dark reddish-brown; antennae, labrum, legs and body pale yellow; pronotum yellow, anterior margin pale brown.

Head capsule subrectangular, evenly rounded posteriorly. Frontal ridge very thick and prominent, thicker in middle than at sides; anterior margin cut at an acute angle medially and recurving above antennal sockets. Vertex with a deep median and two shallow lateral depressions just behind frontal ridge. Frons incurved and sharply descending in front at an angle just greater than a right angle. Frontal and genal horns of same length. Eyes oval. Mandibles short and thick, shouldered near base, dentition weak. Antennae with 11-12 segments, segment 1 longest, twice length of 2, 3 slightly shorter than 2, 4 shortest. Pronotum subrectangular with median suture, anterior margin with deep median V, then curving upwards and sloping to sides, sides parallel, posterior margin straight.

Measurements (one specimen from one nest series) in millimetres

Head length to lateral base of mandibles	1.04
Height of head excluding postmentum	0.88
Length of head to cephalic ridge 1	1.20
Length of head to cephalic ridge 2	0.96
Maximum width of head	1.07
Maximum length of labrum	0.13
Maximum width of labrum	0.21
Maximum length of pronotum	0.73
Median length of pronotum	0.59
Maximum width of pronotum	1.07
Maximum width of mesonotum	0.88
Maximum width of metanotum	0.91
Length of hind tibia	0.73
Length of left mandible	0.62
Left mandible, apical to first marginal	0.16
Left mandible, first to third marginal	0.16
Right mandible, apical to first marginal	0.21
Right mandible, first to second marginal	0.12

Pseudoworker. Head capsule yellow; antennae, labrum, thorax and body pale yellow.

Head capsule subcircular, Y-suture present. Brain distinct. Antennae with 11 segments, segment 1 longest, 2 shorter than 1, segments 3-5 ring-like. Clypeus subtrapezoidal. Labrum broader than long, dome-shaped. Pronotum subrectangular, broader than long and narrower than head capsule; anterior margin broadly concave, sides weakly convex and narrowing behind; posterior margin convex and incurved medially. Legs short and hairy; apical spur formula 3:3:3; tarsi four-jointed. Abdomen hairy; cerci two-jointed; styli single-jointed.

Measurements (one specimen from one nest series) in millimetres

	Range	Mean
Head length to lateral base of mandibles	0.93-0.96	0.95
Head width	0.98-1.03	1.01
Length of pronotum	0.37-0.48	0.43
Median length of pronotum	0.32-0.41	0.37
Width of pronotum	0.72-0.80	0.76
Length of hind tibia	0.56-0.59	0.58

Biology. Collection record refers to a colony collected from galleries in dead branches of a tree.

Comparisons. The imago of *C. sumatrensis* is very close to that of *C. hemicyclius* and is also near to that of *C. thailandis*. The pronotum in *C. thailandis* is subrectangular with a short T-shaped mark while in *C. sumatrensis* the pronotum is less rectangular without a T-shaped mark. The soldier is unique in that the anterior margin of the frontal ridge is deeply cut at an acute angle medially. It is close in size to *C. bengalensis* and *C. havilandi*.

Material examined. LECTOTYPE soldier, SUMATRA: Fort Kock (ZI) (*Kemner*).

Paralectotypes imagos, nymphs: same data as lectotype.

Cryptotermes thailandis Ahmad (Figs 2, 51 and 95; Table 2)

Cryptotermes thailandis Ahmad, 1965: 15. Holotype soldier, THAILAND: Klang Dong [not examined].

As no material of this species was available for study, the original description of Ahmad is given below.

Imago. Head reddish-brown; anteclypeus yellowish; labrum light brownish-yellow; mandibles brownish-yellow, teeth reddish-brown; antennae brownish-yellow; pronotum slightly darker than head, with a T-shaped marking. Wings light smoky brown.

Head sparsely hairy; pronotum with scattered, short and long bristles on antero-lateral and lateral margins and on disc. Head posterior to eyes semicircular; Y-suture with median arm distinct, rest indistinct. Eyes moderately bulging. Ocellus small, oval, almost touching eye. Anteclypeus trapezoid. Labrum broad, dome shaped; sides converging posteriorly. Left mandible with posterior cutting edge of first marginal tooth distinctly shorter than anterior cutting edge of second marginal tooth; right mandible with posterior cutting edge of second marginal tooth longer than molar plate. Antennae with 14-15 articles; in specimen with 14 articles, article 2 as long as 3, 4 a little shorter than 2. Pronotum slightly broader than head, more than one and a half times as long as broad; anterior margin shallowly concave; lateral margins weakly convex; posterior margin depressed in middle; entero-lateral corners broadly rounded.

Measurements in millimetres	Range
Length of head to tip of labrum	1.19-1.26
Length of head to side base of mandibles	0.96-0.98
Width of head	0.93-0.96
Long diameter of eye	0.27-0.30
Short diameter of eye	0.21-0.23
Eye from lower margin of head	0.18-0.19
Length of ocellus	0.09-0.10
Width of ocellus	0.08
Length of pronotum	0.57-0.61
Width of pronotum	1.02

Soldier. Head reddish-brown in posterior region, becoming darker anteriorly; forehead almost black; labrum yellow; pronotum light yellowish-brown, with darker patches on disc; legs pale; abdominal tergites pale brown.

Head scantily hairy, antero-lateral corners with a few bristles; pronotum with short bristles along anterior margin, long, scattered bristles on disc. Head strongly phragmotic, short, thick, about as long as wide; Y-suture present, but not distinct; frontal phalanx (ridge) prominent, concave, without any notch in middle; profile of front nearly vertical, not overhanging; two lobe-like projections at base of antenna, one above and one below. Eyes whitish, oval; 0.10 mm long and 0.03 mm wide. Mandibles short, broadly rounded apically. Antennae short, with 11 articles; basal three articles more strongly sclerotised than the rest, second almost as long as third, fourth shortest. Pronotum as broad as head, slightly longer than half its width; anterior margin broadly V-shaped, finely serrated; antero-lateral lobes notches; lateral margins moderately convex, depressed behind antero-lateral corners; posterior margin almost straight.

Measurements in millimetres	Holotype
Length of head to side base of mandibles	1.30
Width of head	1.26
Length of mandibles	0.64
Length of pronotum	0.68
Width of pronotum	1.26

Comparisons. Both the imago and the soldier of *C. thailandis* resemble those of *C. bengalensis* except that the pronotum of the imago of the former is broader. In the soldier the frontal ridge is unincised in the middle and the pronotum is somewhat rectangular rather than being subcircular. *C. cynocephalus* and *C. perforans* are smaller in both imago and soldier. The imago of *C. sumatrensis* has the anterior margin of the pronotum notched in the middle, and the soldier of this species has a deeply incised frontal phalanx.

Cryptotermes verruculosus (Emerson) (Figs 3, 49, 50, 91 and 123; Table 2)

Kalotermes (Cryptotermes) verruculosus Emerson, 1925: 329-330. Holotype soldier, GUYANA (AMNH) [examined].

Imago. Head capsule orange-yellow, not paler anteriorly; frons with pale Y-shaped mark; clypeus pale yellow; labrum, antennae, thorax and tergites yellow; cerci, sternites pale yellow; legs and wings absent.

Head capsule broader than long, evenly and broadly rounded behind; cranial suture present or only stem visible; eyes oval; ocelli nearly round and almost touching eyes. Antennae broken in specimens examined, four segments present; segment 3 shorter than segment 2, 2 equals 4. Pronotum narrower or same width as head, anterior margin widely and moderately concave, sides slightly convex, posterior ends broadly rounded into posterior margin; posterior margin emarginate medially. Specimens without legs and wings.

Measurements (two specimens from one nest series) in millimetres	Range	Mean
Head length to lateral base of mandibles	0.87-0.93	0.90
Maximum width of head with eyes	0.93-0.98	0.96
Maximum length of labrum	0.17-0.20	0.19
Maximum width of labrum	0.35-0.37	0.36
Maximum diameter of compound eye	0.30	0.30
Minimum diameter of compound eye	0.26	0.26
Maximum diameter of lateral ocellus	0.07	0.07

Minimum diameter of lateral ocellus	0.07	0.07
Minimum ocellus/antennal distance	0.19	0.19
Minimum eye/antennal distance	0.06	0.06
Minimum distance of eye from lateral base of head	0.09-0.13	0.11
Maximum length of pronotum	0.59-0.70	0.65
Median length of pronotum	0.52-0.59	0.56
Maximum width of pronotum	0.85-0.98	0.92
Length of hind tibia	-	-
Length of fore wing scale	0.65-0.78	0.72

Soldier. Head capsule reddish-yellow brown; frontal ridge and just behind ridge, black. Frons very dark brown, mandibles very dark reddish-brown; pronotum same colour as back of head, rest of body yellow.

Head in dorsal view moderately tuberculate in front third, slightly constricted behind antennal sockets; vertex moderately depressed medially behind frontal ridge and slightly above antennal sockets. Frontal ridge prominent, rugose, incurved in middle, slightly V-shaped; frons concave and tuberculate. Labrum triangularly pointed, tip with four long setae. Frontal and genal horns well developed, about same size. Eyes, oval, unpigmented, distinct. Antennae with 11-12 segments, segment 3 equals 4, both very short; mandibles short and broad not shouldered, dentition weak. Pronotum, broader, narrower or same width as head, anterior margin weakly concave, sides rounded, posterior margin straight.

Measurements (four specimens from three nest series) in millimetres

	Range	Mean	Type
Head length to lateral base of mandibles	0.89-1.00	0.97	1.00
Height of head excluding postmentum	0.84-0.92	0.90	0.92
Length of head to cephalic ridge 1	1.10-1.28	1.18	1.17
Length of head to cephalic ridge 2	0.97-1.15	1.04	1.02
Maximum width of head	1.10-1.15	1.13	1.10
Maximum length of labrum	0.05-0.14	0.12	0.14
Maximum width of labrum	0.15-0.26	0.22	0.26
Maximum length of pronotum	0.66-0.84	0.76	0.71
Median length of pronotum	0.59-0.74	0.69	0.69
Maximum width of pronotum	0.95-1.15	1.06	1.00
Maximum width of mesonotum	0.82-0.94	0.88	0.84
Maximum width of metanotum	0.84-0.97	0.90	0.89
Length of hind tibia	0.66-0.69	0.68	0.69
Length of left mandible	0.51-0.54	0.53	0.54
Left mandible, apical to first marginal	0.13-0.15	0.14	0.13
Left mandible, first to third marginal	0.10-0.13	0.12	0.13
Right mandible, apical to first marginal	0.18	0.18	0.18
Right mandible, first to second marginal	0.05-0.08	0.07	0.08

Alate nymph 2. None available for study.

Biology. This species is known only from the type locality, Kartabo, Guyana and was collected from a standing dead tree.

Comparisons. The alate of *C. verruculosus* is close to that of *C. fatulus*. For comments see under the latter species. The soldier is close to *C. brevis*, *C. silvestrii* and *C. rhicnocephalus*. See comments under these species.

Material examined. Holotype soldier, GUYANA: Kartabo, 3.xi.1920 (*Emerson*) (AMNH).

Paratypes imago, soldiers, GUYANA: Kartabo, 3.xi.1920 (*Emerson*) (AMNH; BMNH).

NUMERICAL METHODS AND RESULTS

The numerical methods employed here are principal component analysis, canonical variate analysis and hierarchical cluster analysis. These methods are typical of those commonly used in multivariate morphometric studies and were undertaken with three objectives in mind. The genus *Cryptotermes* appears to have some discontinuities in it that one is intuitively aware of, and that create a feeling that there may be possible convergence by adaptations to a similar ecological niche from different parts of the Kalotermitidae. The primary objective of the multivariate study, therefore, was to test whether a constellation of characters would substantiate any sort of subdivision of the genus on phenetic grounds. The second objective was to try and distinguish any otherwise 'difficult' species, and the third, to select characters which contribute to taxonomic groupings for use in diagnostic keys.

Stroud (1953) was one of the first to use multivariate analysis in a taxonomic problem. He used the centroid method of factor analysis (a close approximation to principal component analysis) with sets of measurements of the imago and soldier castes of *Kaloterme* species. Similar methods have subsequently been applied in many plant and animal groups and for the first time in termite systematics by Sands (1972) to develop a classification of the soldierless termites of Africa. Principal component analysis was applied in the study of the functional morphology of termite legs (Bacchus, 1976), and Van der Werff (1980) used principal component analysis, cluster analysis and discriminant functions to distinguish between inhabitants of two mound types of *Macrotermes* near Kajiado, Kenya. Springhetti and Rossi (1983) used canonical variate analysis and cluster analysis in a study of the morphogenesis of soldiers and intercastes of *Kaloterme flavicollis* Fabricius.

R-mode principal component analysis

In the present study R-mode principal component analyses were carried out on the unstandardised and standardised data for the imago, soldier and alate nymph 2. The purpose of standardisation (characters expressed in SD units) was to reduce the variance due to mere size which in unstandardised analyses accounts for the greater part of the first eigenvalue. Ten components were extracted from the 16 × 16 (imago), 18 × 18 (soldier) and 21 × 21 (alate nymph) covariance and correlation matrices. They accounted for 98.05 and 93.76% (imago), 97.19 and 95.55% (soldier) and 99.16 and 89.98% (alate nymph) of the total variance of the trace. The first three components extracted 83.73 and 68.69% (imago), 82.76 and 76.56% (soldier) and 92.93 and 66.03% (alate nymph).

Despite standardisation, vector 1 in both analyses showed no contrasts between characters for all three castes, all characters being similarly weighted. This suggests that some aspect of size, such as heterogony was involved and a logarithmic transformation should have been used. Sands' (1972) experience, however, was that little was gained by this procedure.

Vectors 2 and 3 show appreciable contrast in the signs of the vector elements for both unstandardised and standardised data for all castes. This appears to represent covariation along axes that reflect differences in shape rather than size and fewer characters are positively or negatively correlated to make major contributions in these directions. Figures 132-134 give comparisons of the eigenvector values of unstandardised and standardised data for all castes obtained from R-mode principal component analyses.

PRINCIPAL COMPONENT WEIGHTINGS

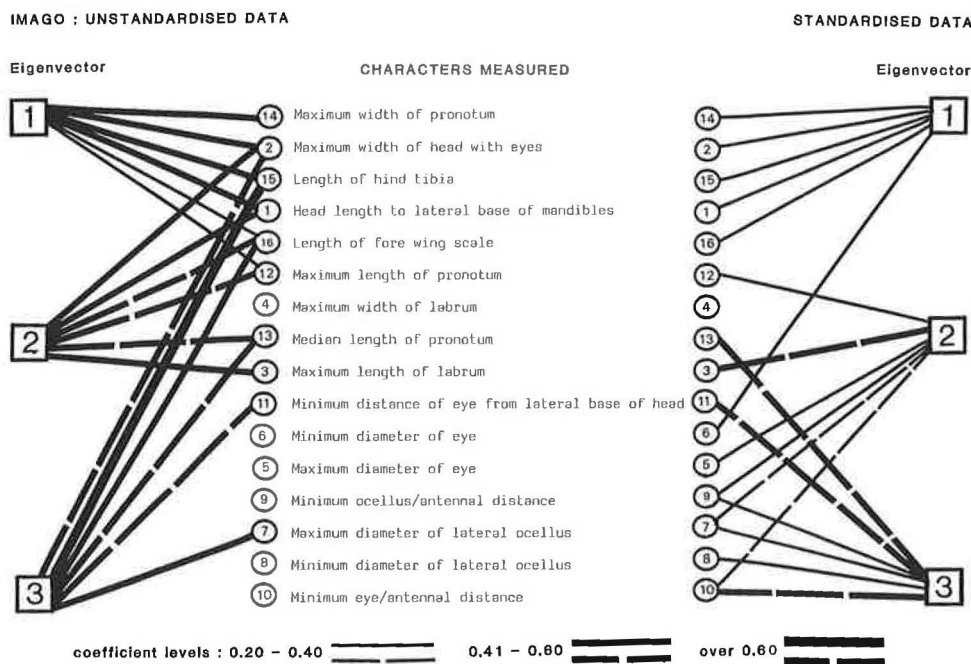


Fig. 132. Imago caste highest weightings of measured characters for vectors 1-3 of unstandardised and standardised data (positive weightings are shown by unbroken lines and negative weightings by broken lines).

PRINCIPAL COMPONENT WEIGHTINGS

SOLDIER : UNSTANDARDISED DATA

STANDARDISED DATA

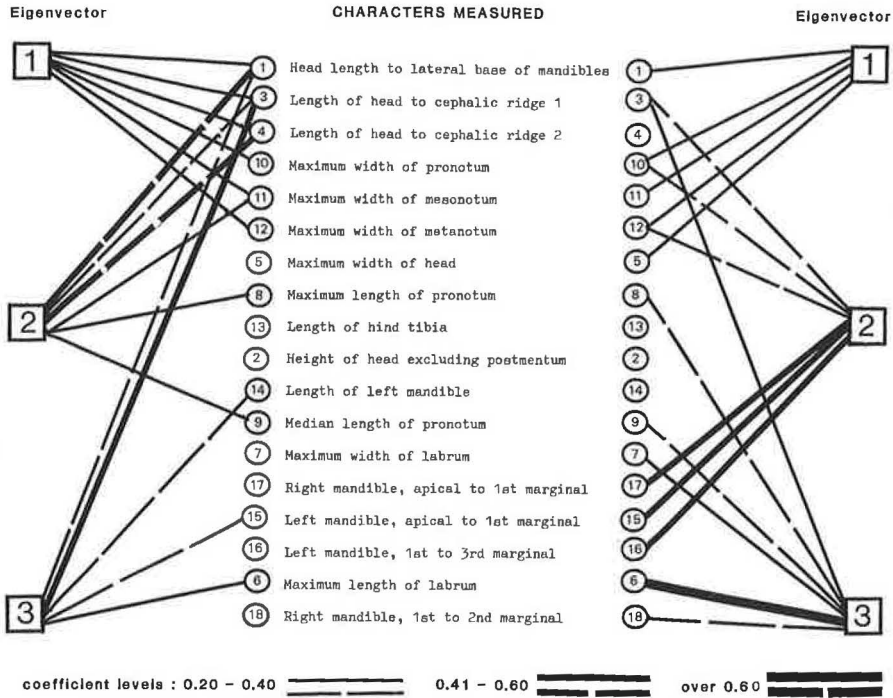


Fig. 133. Soldier caste highest weightings of measured characters for vectors 1-3 of unstandardised and standardised data (positive and negative weightings are as in 132).

PRINCIPAL COMPONENT WEIGHTINGS

ALATE NYMPH 2 : UNSTANDARDISED DATA

STANDARDISED DATA

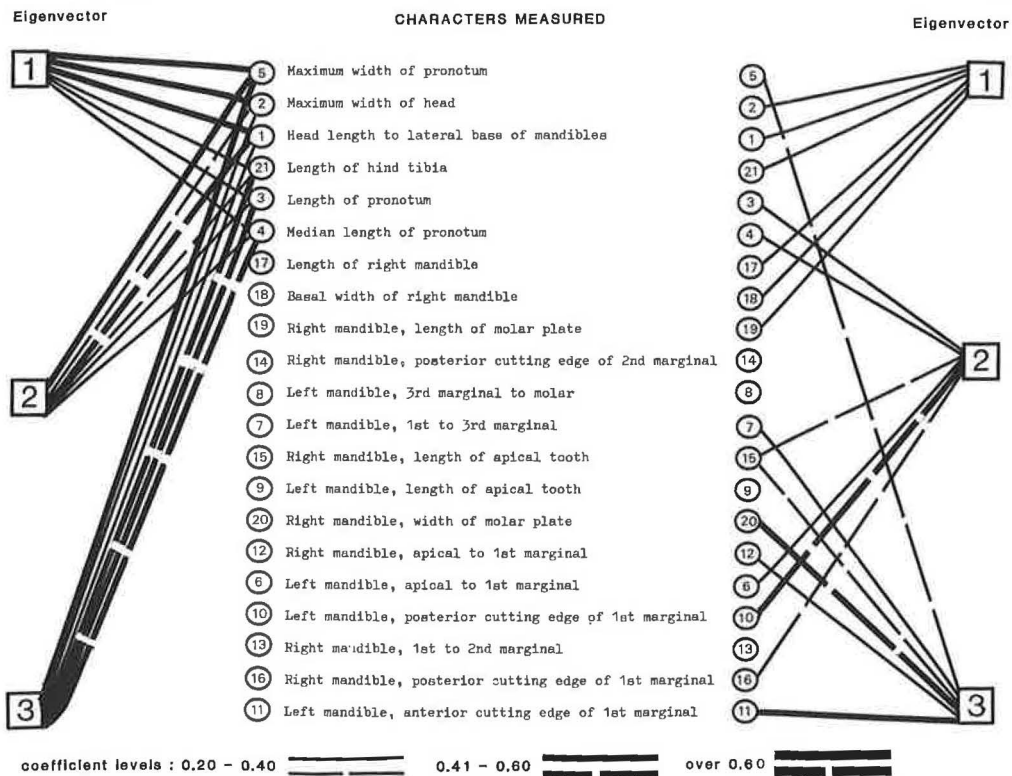


Fig. 134. Alate nymph 2 highest weightings of measured characters for vectors 1-3 of unstandardised and standardised data (positive and negative weightings are as in 132).

No clearly defined groups emerged in plots of component scores of the imago castes corresponding to the first three roots despite some contrasts in eigenvector weights that provided useful taxonomic indices for specific identifications.

In the soldier caste although certain groupings were detectable in some of the plots most of these varied between standardised and unstandardised data, and no clear pattern appeared that would suggest natural subdivisions within the genus. The groups derived from standardised data were slightly better and apart from the 'size' factor were defined by contrasts between characters 10, 12 and 3 with 15, 17 and 16, and 18, 9 and 8 with 7, 3 and 7 in the second and third components respectively (Fig. 133). One or two groups of closely related species such as that including *C. cynocephalus*, *C. perforans*, *C. fatulus* and *C. roonwali* appeared to be congruent across several analyses and castes.

In the alate nymph 2, insufficient species were represented to compare groupings for congruence with other castes. Some feature of size dominated the weights in vector 1 of both standardised and unstandardised analyses. The second and third components contrasted important characters such as 1, 2 and 21 with 5, 3 and 4; 21, 3 and 4 with 5, 1 and 2 (unstandardised data) and 10, 16 and 15 with 6, 3 and 4; 20, 15 and 5 with 11, 7 and 12 (standardised data, Fig. 134).

Canonical variate analysis

In principal component analysis no *a priori* decision is taken to assign individuals to species and discontinuities in the scatter cloud of points are likely to be obscured by intraspecific variation. It was decided therefore, to apply canonical variate analysis to the same unstandardised data.

Canonical variate analysis has somewhat similar purposes to principal component analysis, except that it requires all individuals to be assigned beforehand to species and each species to be represented by more than one individual; hence a few species had to be left out. Transformed axes are again produced but their object here is to maximise the ratio of the variance between species to the variance within species. The weighting of variables is, therefore, directed to those providing the best discrimination between the species. Thus the characters weighted by the two types of analyses, i.e. principal component analysis and canonical variate analysis, will not necessarily be the same. The first canonical variate axis is in the direction of the greatest variability between species centroids. The second canonical variate axis is inclined in the direction of the next greatest variability, but not necessarily orthogonal, i.e. at right angles to the first, and so on for the other axes.

The primary data matrix consists of n individuals with p characters, assigned to y taxa. The latent roots and vectors of the product matrix $W^{-1}B$ must be extracted where B is the between-group sums of squares and cross-products and W is the pooled within-group sums of squares and cross-products. The latent roots provide a measure of the discriminatory power associated with each canonical axis and the latent vectors give the required multiple discriminant functions. Ten canonical variates were extracted and the first three accounted for 85.50% (imago), 81.19% (soldier), and 79.42% (alate nymph) of the total discrimination. The contributions made by the included characters of the first three canonical variates are shown graphically in Figs 135-137. None of the groupings of species indicated by the canonical variate analyses were sufficiently distinctive to suggest subdivisions of the genus; the close association of *C. cynocephalus*, *C. fatulus* and *C. perforans* again showed up in both imago and soldier castes (although *C. fatulus* could not be included in the former) and there was again a tendency for *C. dolei*, *C. dudleyi* and *C. hemicyclius* to come out as a related group.

In the analysis of the data on the alate nymphs, no clear groupings emerged. The directions of canonical axes were almost entirely defined by contrasts between mandibular measurements.

Cluster analysis

Three methods of clustering, single linkage, complete linkage and the unweighted pair group method using averages (UPGMA), were applied to a matrix of inter-OTU distances. Figures 138-140 show that for the soldier caste, the overall patterns of relationship produced by the three methods are very similar although the levels at which corresponding stems join differ. This concordance is supported by approximate values of cophenetic correlations of .7458 (single linkage), .7245 (complete linkage) and .7499 (UPGMA).

CANONICAL VARIATE WEIGHTINGS

IMAGO

Eigenvector

CHARACTERS MEASURED

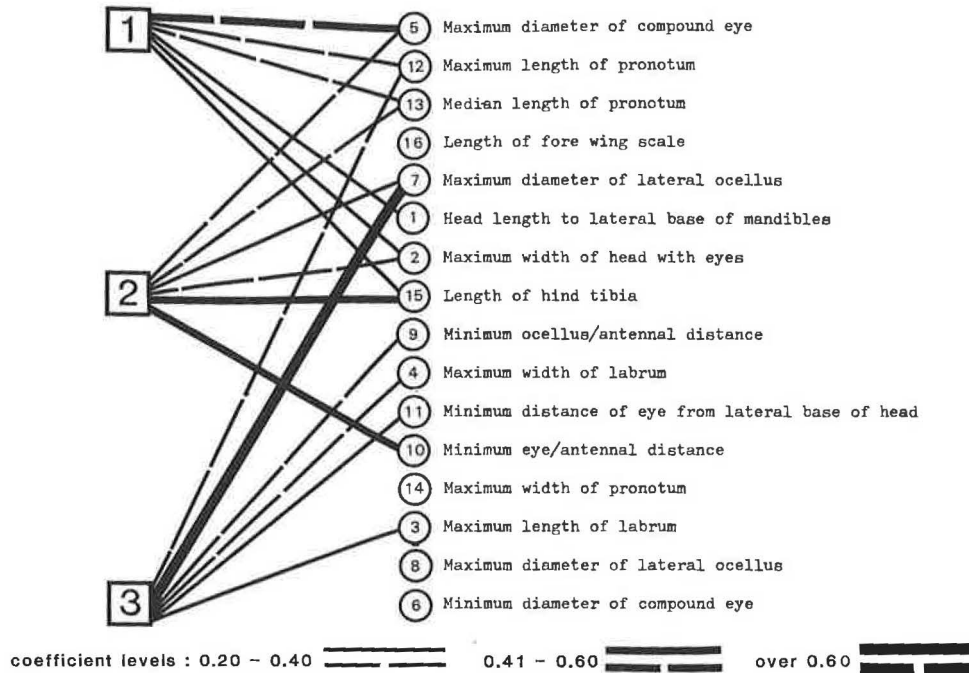


Fig. 135. Imago caste highest weightings of measured characters for vectors 1-3 (positive and negative weightings are as in 132).

CANONICAL VARIATE WEIGHTINGS

SOLDIER

Eigenvector

CHARACTERS MEASURED

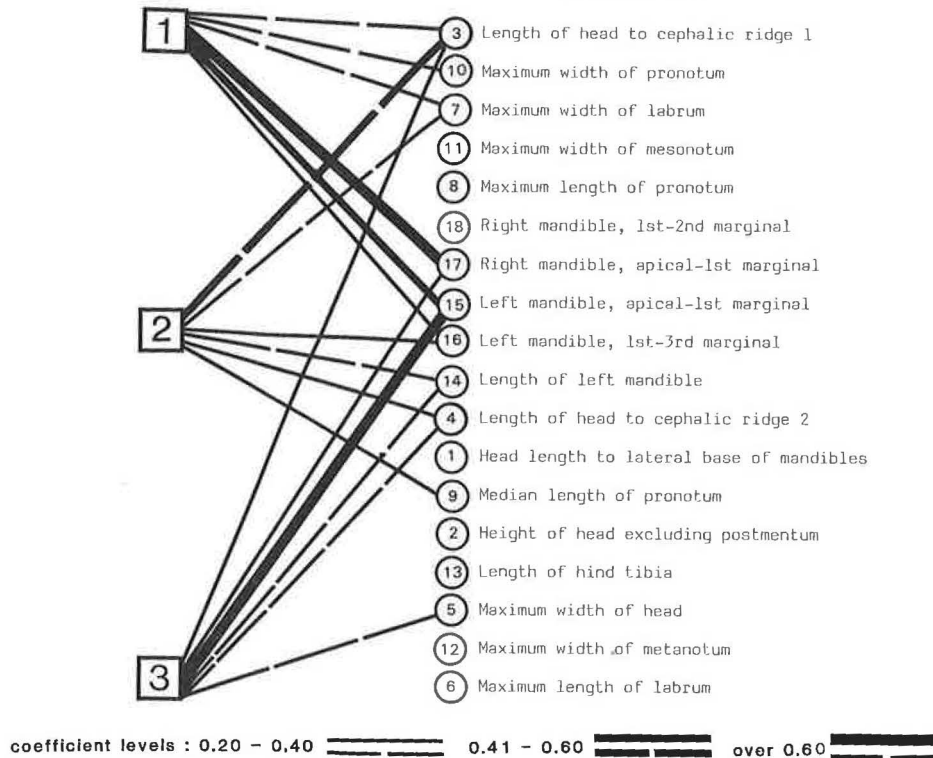


Fig. 136. Soldier caste highest weightings of measured characters for vectors 1-3 (positive and negative weightings are as in 132).

CANONICAL VARIATE WEIGHTINGS

ALATE NYMPH 2

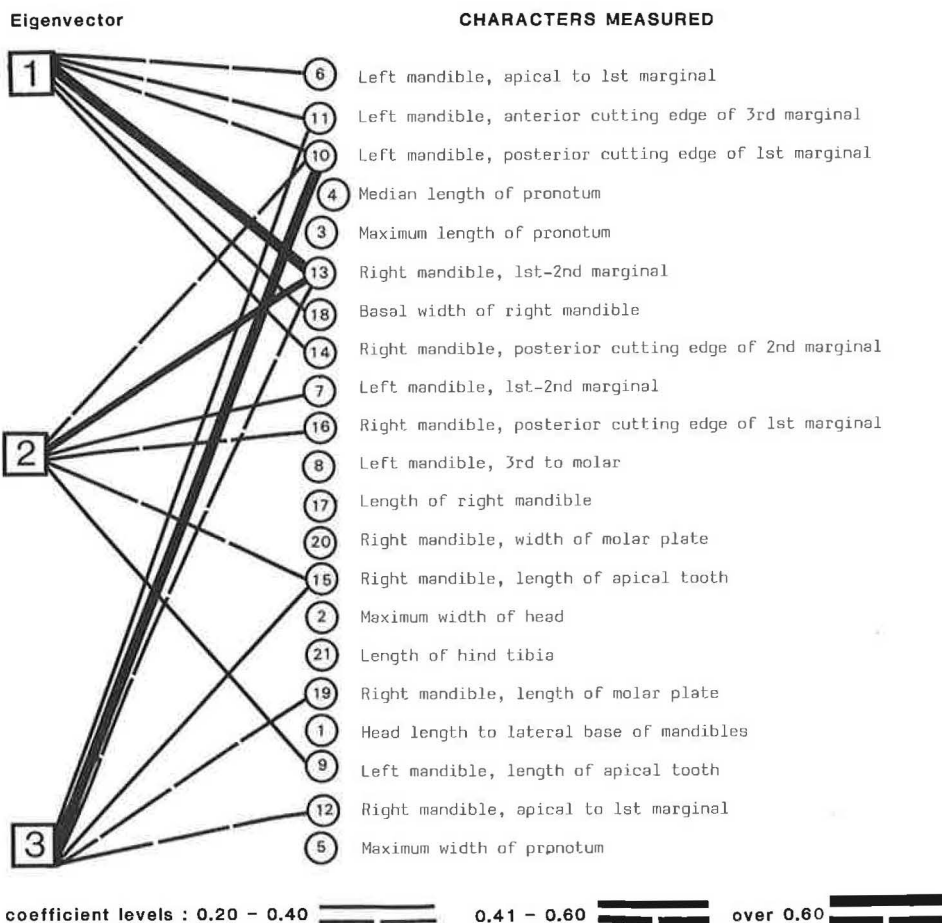


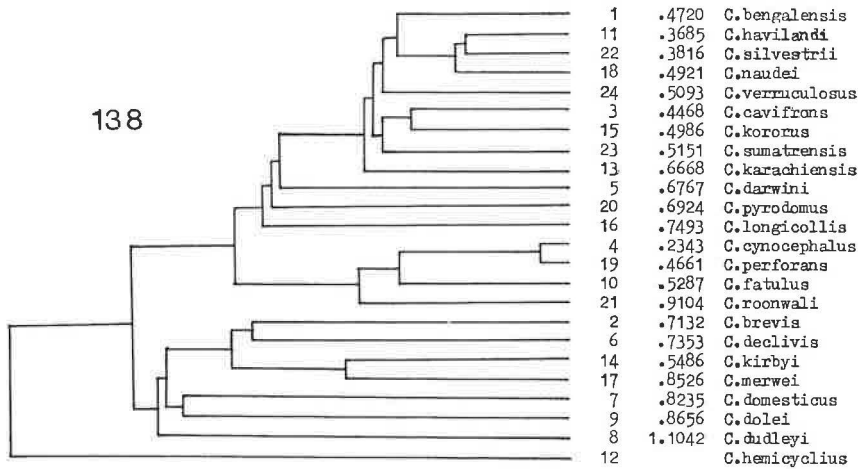
Fig. 137. Alate nymph 2 highest weightings of measured characters for vectors 1-3 (positive and negative weightings are as in 132).

On the other hand, for the imago caste, the topological similarity of the dendograms (Figs 141-143) is rather less and this is associated with different cophenetic correlations among them, $\cdot 6225$ (single linkage), $\cdot 5968$ (complete linkage) and $\cdot 7279$ (UPGMA).

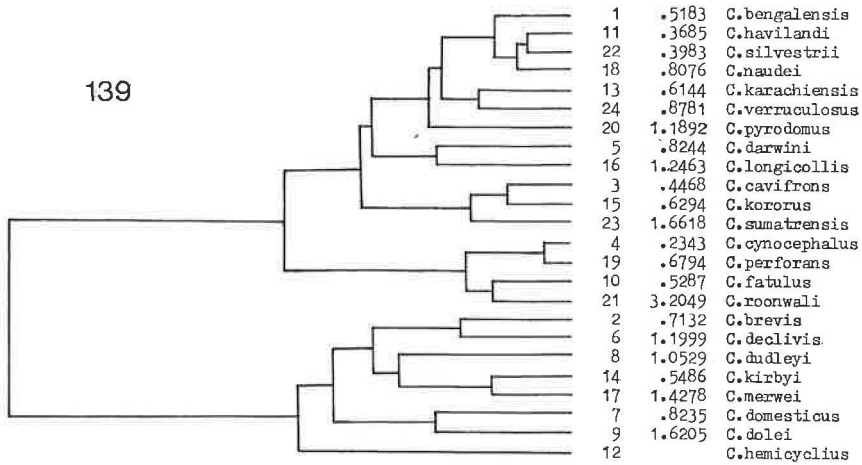
For the alate nymph 2, the dendograms produced by single linkage and UPGMA are again almost identical although with corresponding stems joining at different levels. The similarity level of the linking of OTU's by complete linkage to that of single linkage and UPGMA is 70% and this is accompanied by a low cophenetic correlation of $\cdot 5839$ compared with $\cdot 7731$ (single linkage) and $\cdot 8094$ (UPGMA) (Figs 144-146).

A few relationships shown up by the cluster analyses, such as the proximity of *C. cynocephalus* and *C. perforans* with *C. fatulus* and *C. roonwali* nearby, were closely similar to those found by ordination. The relationship of *C. dolej*, *C. dudleyi* and *C. domesticus* was not clear, all of them clustering rather late as outliers rather than having close similarity. *C. hemicyclius* was an outlier in all analyses.

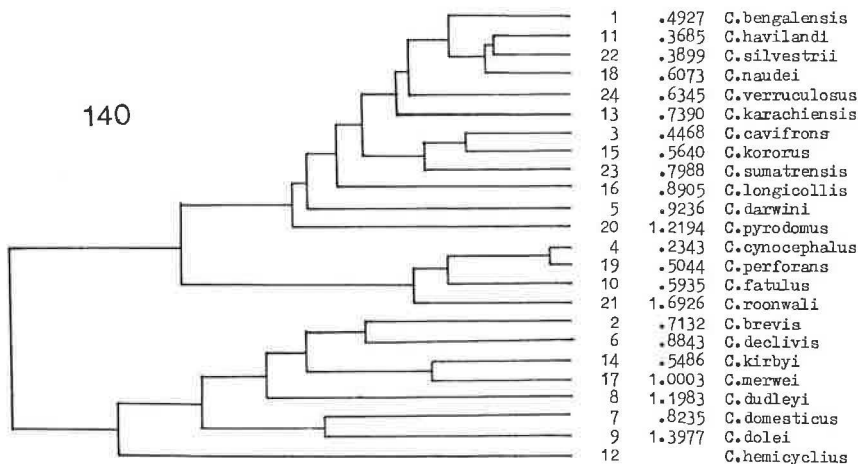
14390 1.0451 .9511 .8572 .7632 .6693 .5753 .4814 .3674 .2935 .1995



3.3237 3.0029 2.6821 2.3612 2.0404 1.7196 1.3988 1.0779 .7571 .4363 .1155

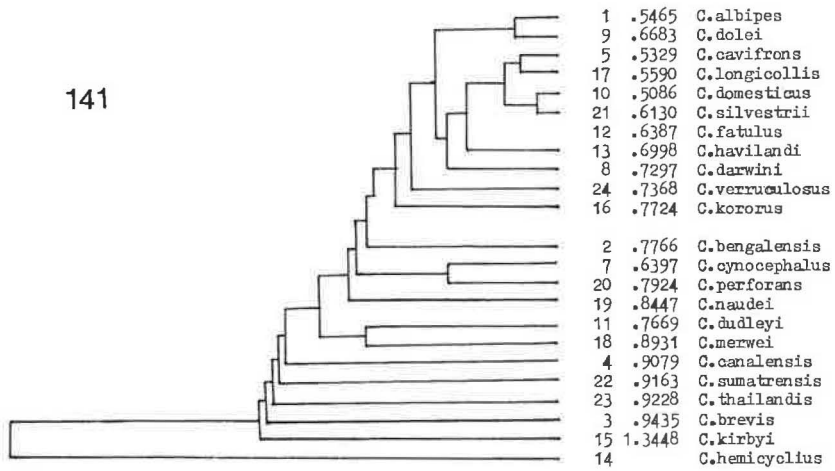


1.7510 1.5935 1.4360 1.2785 1.1210 .9635 .8060 .6485 .4910 .3335 .1760

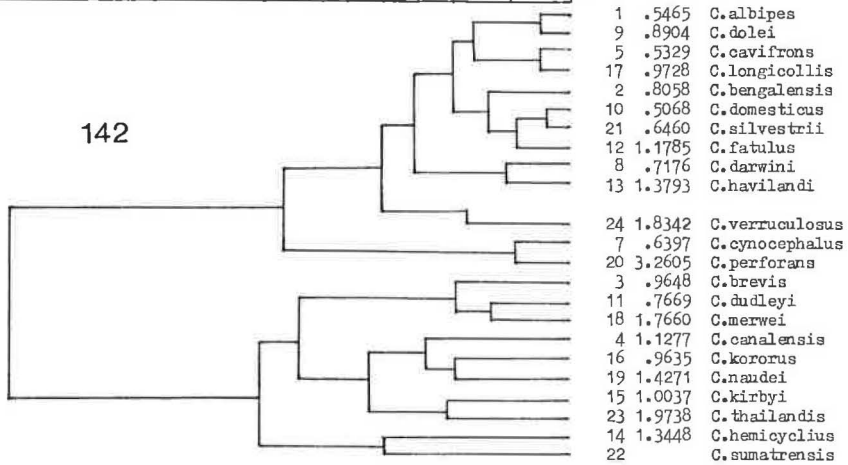


Figs 138-140. Dendograms showing phenetic relationships between species of soldiers of *Cryptotermes* as indicated by (138) single linkage, (139) complete linkage, (140) UPGMA-cluster analysis.

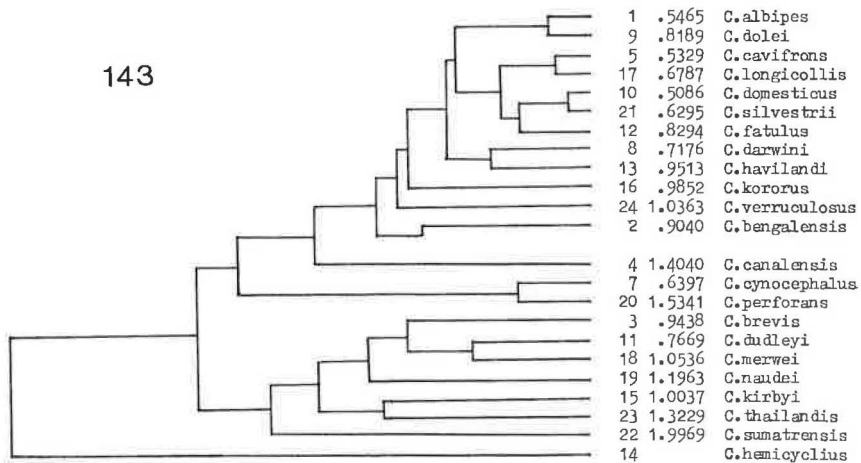
13783 12880 11976 11073 10170 .9267 .8364 .7461 .6558 .5655 .4752



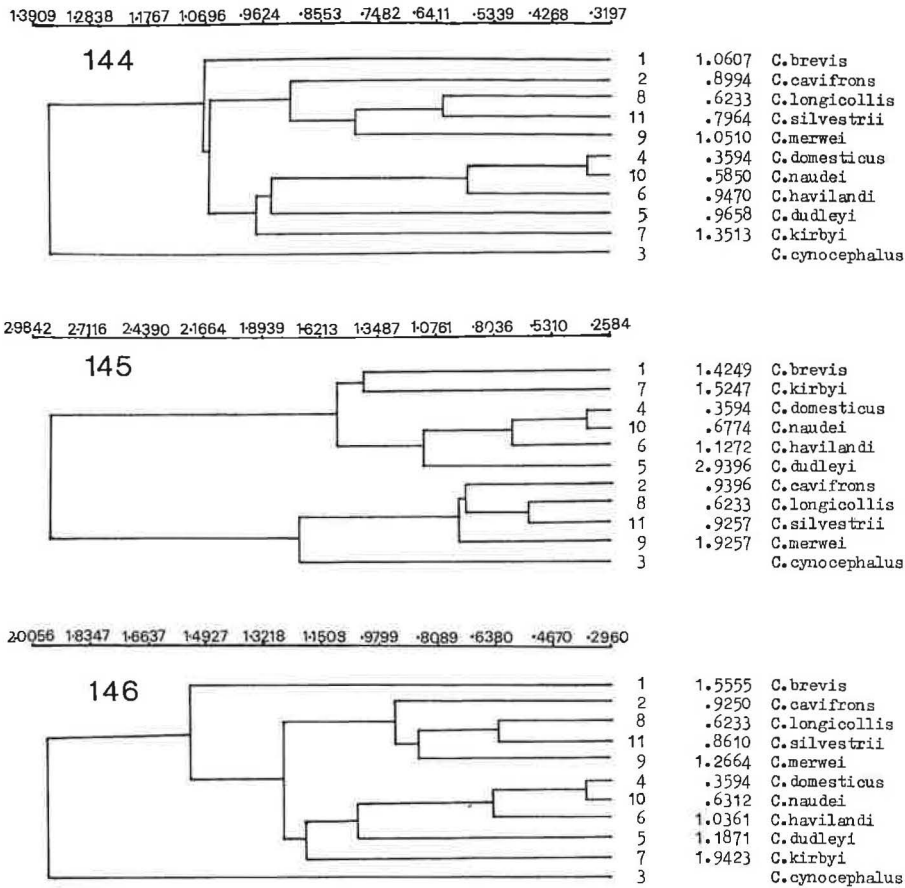
33705 30733 27761 24789 21817 18845 15873 12901 .9929 .6957 .3986



20564 18957 17349 15742 14135 12527 10920 .9313 .7706 .6098 .4491



Figs 141-143. Dendograms showing phenetic relationships between species of imagos of *Cryptotermes* as indicated by (141) single linkage, (142) complete linkage, (143) UPGMA-cluster analysis.



Figs 144-146. Dendograms showing phenetic relationships between species of alate nymphs 2 of *Cryptotermes* as indicated by (144) single linkage, (145) complete linkage, (146) UPGMA-cluster analysis.

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