Beitr. Ent. 39 (1989) 2, S. 343–366

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Some Aspects of Ecology and Biogeography of Termites of Peninsular India

With 6 text figures

I. Introduction

KÖNIG (1779) was perhaps the first naturalist to carry out scientific observations on termites in Southern India and Sri Lanka. Subsequently WASMANN (1893, 1896 & 1902), DESNEUX (1904—1908), HOLMGREN (1911—1913), HOLMGREN & HOLMGREN (1917), KEMNER (1926), SNYDER (1933—34), BEESON (1941) and GARDNER (1944) made important contributions to the then known knowledge of termite fauna from the Indian region. Of these, more important works are those of WASMANN (1902), HOLMGREN (1911—1913) and HOLMGREN & HOLMGREN (1917). In the postindependence period, termites as a group, received the due attention and attracted many good taxonomists, who made significant contributions to the study of termite fauna of India. The most comprehensive taxonomic and zoogeographic account of termites from South India has been given by BOSE (1975). Apart from this, scattered information on the taxonomy, biology, bioecology and zoogeography is available in the publications by ROONWAL & CHHOTANI (1962, 1966), CHATTERJEE & THAKUR (1963—1964), PRASHAD & SEN-SARMA (1959—1960 & 1966), PRASHAD et al. (1966), SEN-SARMA et al. (1975), ROONWAL (1979), THAKUR (1975—1982). SEN-SARMA (1974) has summarised the existing knowledge on the ecology and biogeography of termites in India.

The present paper is based primarily on the observations made by the author during the last five years. The information available in literature and ledger files of Forest Research Institute & Colleges, Dehra Dun have also been incorporated to make it comprehensive.

II. Physiography (Fig. 1)

SPATE and LEARMOUTH (1967) divided the Indian subcontinent into three major geomorphological components Viz. (i) the Himalaya, (ii) the great plains and (iii) the peninsular India. The region as covered here, forms a part of the peninsular India and includes all areas below 16° N lat. It comprises some parts of Andhra Pradesh (ca. 40 %), Goa, Karnataka (ca. 70 %), Kerala and Tamilnadu (30 %). The region forms a part of the Gondwana system and is one of the most stable ancient landmass of the world, except for some marine transgression at a few places. The whole terrain comprises of large and small undulating plateaus, valleys and plains.

The region is subtriangular in shape, representing characteristic physiographic configurations with varied climatic, soil and vegetational complexities and is bounded

DOI: 10.21248/contrib.entomol.39.2.343-366

by sea on three sides, viz. The Arabian sea on the West, Indian ocean on the South and Bay of Bengal on the East. The northern boundary is marked by peninsular land mass across the 16° N lat., a line passing somewhere a little above Belgaon in Karnataka, Alampur and Atmakur (near Karnool) and Nizampatnam in Andhra Pradesh.

Physiographically, the peninsular India is divisible into plains (Andhra Pradesh, part), Tamilnadu (east coast), Kerala plain and Karnataka coast on the west coast, Central plataeus of Karnataka, Telangana (Andhra Pradesh) and Tamilnadu upland, Eastern and Western Ghats. The western hills consist of Central Sahyadri, Nilgiris and South Sahyadri, running parallel to west coast. The Eastern hills are highly dissected and run in a semi-circular fashion (Eastern Ghats and Tamilnadu upland). The Eastern and Western coastal plains run along the Bay of Bengal and the Arabian sea respectively.

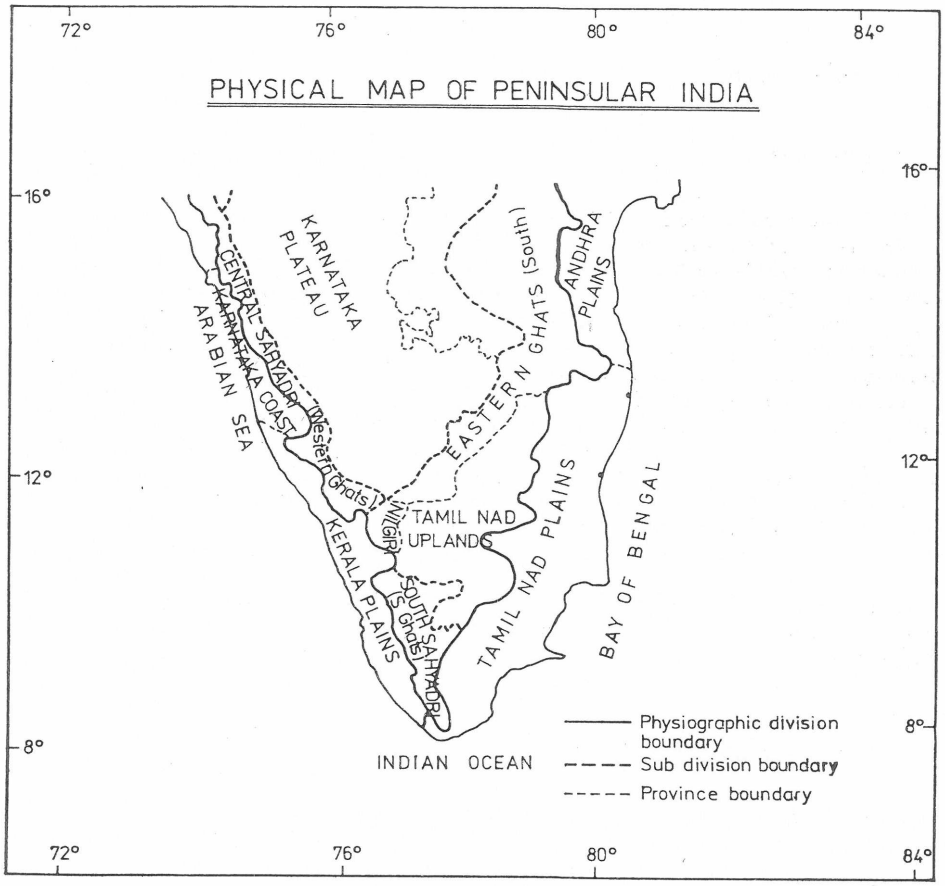

Fig. 1: Physical map of India: Physiographic divisions

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III. Ecological Characterisation of the Region (Fig. 2)

The peninsular India represents typically a tropical climate, influenced largely by sea. The summer N. W. monsoon causes heavy rainfall (well over 2500 mm) in Kerala, parts of Karnataka and N. W. parts of Tamilnadu, along the Western Ghats. The central plains come under the rain shadow region and suffer from insufficient rainfall. The climate of this (central) pertion is, therefore, dry arid (Anantapur, Andhra Pradesh) to semi-arid in South-West Tamilnadu. The rainfall occurs mainly in the winter months, from the retreating N. E. Monsoon winds. The summer is hot and dry, whereas the winter is mild except for the hill regions. The monthly mean maximum temperature varies from 25 °C to 32 °C, rarely going beyond 35 °C in extreme South Kerala. Minimum mean temperature varies from 22.5 °C to 27.5 °C. The number of rainy days varies from 40 in Ramnad district and Coimbatore plateau to 150 days in Cochin (Ernakulam), Kerala and Mangalore (Karnataka).

Based on Kendrew and stamp classification, SINGH (1971) has divided the peninsular India into three major ecological zones.

(a) Humid Tropical Zone (Fig. 2, Zone 1)

Humid tropical zone runs along the Western Ghats and includes all the Western Ghat ranges, areas lying West and South-West of Ghats, covering whole of Kerala,

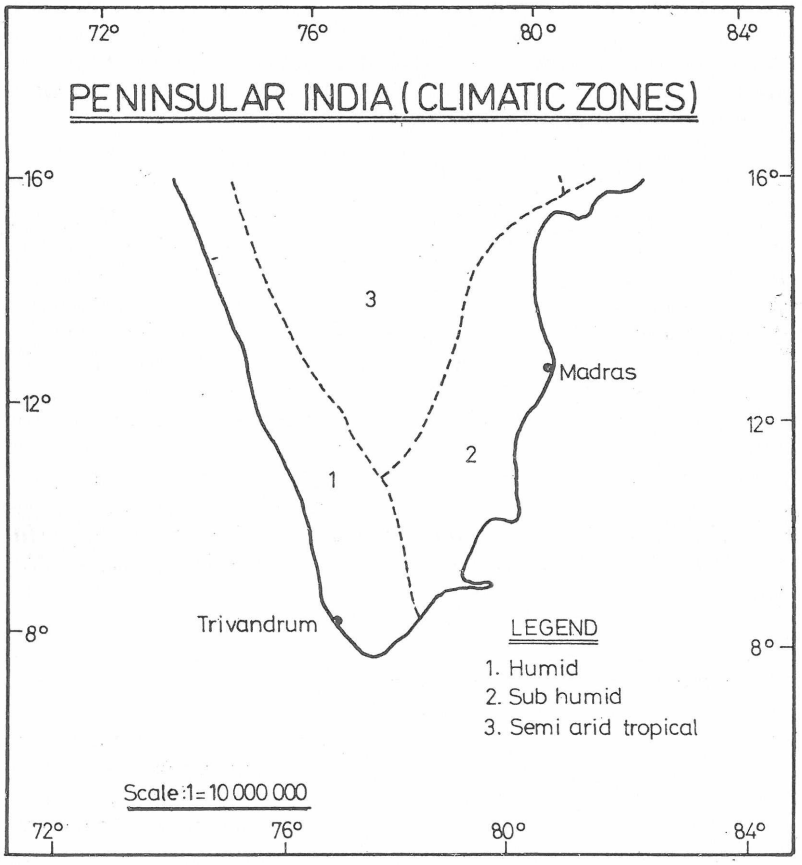

Fig. 2: Outline of penisular India: climatic zones

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Karnataka Coast and Goa. The climate is humid tropical. Mean annual rainfall is about 1500 mm, and above, reaching up to nearly 3500 mm, in Mangalore (Karnataka), with 100—175 rainy days. The mean annual temperatures varies from 25 °C to 30 °C. Soil is generally red sandy to sandy loam, with large patches of laterite soil. It is well drained and acidic in nature. The vegetation consists of moist tropical forests, with dense canopy of tall and medium size trees, shrubs and include tropical evergreen, semi-evergreen and moist deciduous forests. The dominant plant species comprise of ***Artocarpus heterophyllus***, ***Atrocarpus hirsuta***, ***Callophyllum elatum***, ***Cullenia excelsa***, ***Dipterocarpus indicus***, ***Dysoxylum malabaricus***, ***Hopea darviflora***, ***Lophopetalum wightianum***, ***Tectona grandis*** and ***Xylia xylocarpa***.

(b) Sub-humid Tropical Zone (Fig. 2, Zone II)

Sub-humid tropical zone runs along the Eastern Ghats and includes all areas lying on the eastern and south-eastern aspects of Eastern Ghats, covering plains of Andhra Pradesh (below 16° N. lat.). Tamilnadu, parts of Tamilnadu upland and deep southern Tamilnadu. The climate is sub-humid tropical, with mean annual rainfall of 750 mm and above but below 1500 mm. The mean annual temperatures ranges from 23 °C to nearly 29 °C, with prolonged dry season and with little or no rain for nearly six months. The soil is red sandy in Eastern Ghats, Coastal alluvium along the coast, with irregular wide strips of red loamy, laterite shallow clay and deltic alluvium. The vegetation consists of dry evergreen forests on the east coast from Tirunelveli to Nellor, where the annual rainfall is 100 mm and above. The major tree species are ***Acacia leucocephala***, ***Anogeissus latifolia***, ***Boswellia serrata***, ***Diospyros melanoxylon***, ***Grewia tiliaefolia***, ***Madhuca indica***, ***Pterocarpus marsupium***, ***Tectona grandis*** and ***Terminalia tomentosa***, etc.

(c) Semi-arid Zone (Fig. 2, Zone III)

Semi-arid zone is somewhat triangular in shape and includes the central portion, comprising the lowland areas of Tamilnadu, some parts of Andhra Pradesh and Karnataka, which receive less than 750 mm rainfall. The outer lateral margins, of course, are not clearly demarcated, as they get diffused with the transitional peripheral margins of humid and subhumid tropical zones. This zone has the characteristics of arid and semi-arid desertic conditions with more than 200 physiological dry days. May—June are the hottest months, but the winter is very mild in the plains, with December—January being slightly cold. Soil texture is varied and complex, being mostly alluvial, laterite shallow clayey red and yellow and with patches of dark grey black soils. The zone comprises mostly of plain cultivated land, interspersed with dry deciduous forests and thorny bushy semi-arid vegetation. Important forest species are ***Adina cordifolia***, ***Anogeissus latifolia***, ***Boswellia serrata***, ***Grewia tiliaefolia***, ***Madhuca latifolia***, ***Prosopis*** spp. ***Sterculia villosa***, ***Pterocarpus marsupium*** and ***Tectona grandis***.

IV. Ecological Relationships of Termites

Except for a very few true temperate and warm temperate genera, termites are largely tropical insects and have not radiated to different climatic and food habitats. The principal ecological factors which influence the abundance, distribution and dispersion of termites in any ecosystem, are rainfall, atmospheric temperature, vegetation and soil types. Of these, vegetation and soil types are perhaps more important than others (SEN-SARMA, 1974; THAKUR, 1980). However, the role played by soil

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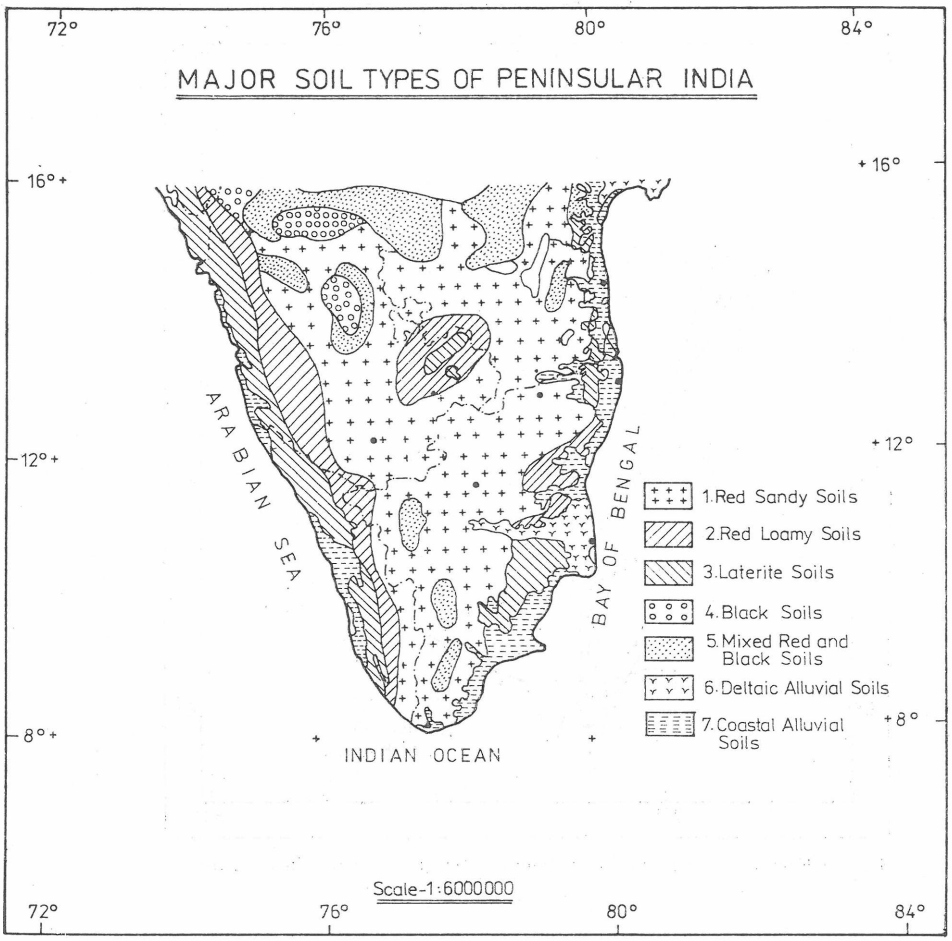

Fig. 3: Map of peninsular India: Soil types

types alone, particularly under forest cover, is difficult to assess independent of vegetation. The ecological relationship of termites of peninsular India are discussed within the parameters of these factors.

(i) Relationship with Rainfall (Table 1)

The distribution pattern of species component in the various ecological zones (Table 1) shows that majority of the species (38.20 %) are from the sub-humid zone, followed by humid zone (32.59 %) and semi-arid zones (29.21 %) each. The humid tropical zone has eight species of primitive family Kalotermitidae, which are exclusively wood-dwelling termites, seven species of ***Capritermes*** complex (viz. ***Pseudocapritermes fontanelleus, Pseudocapritermes goanicus; Discuspiditermes fontanelleus, Discuspiditermes pername, Labiocapritermes distortus, Pericapritermes topslipensis*** and ***P. vythirii***), eight species of carton nest building nasute termites of Nasutitermitinae, followed by three non mound building species of genus ***Odontotermes (Odontotermes ceylonicus, Odontotermes malabaricus*** and ***Odontotermes yadevi)***. Genera ***Heterotermes, Eurytermes*** and ***Micro-***

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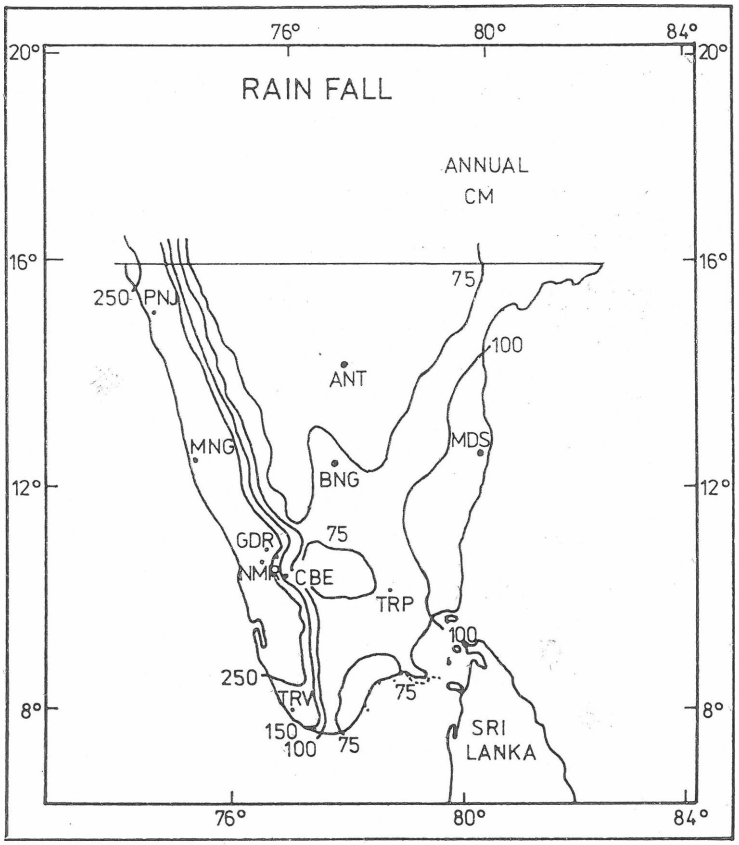

Fig. 4: Map of peninsular India: Geophytes (annual rainfall contours)

termes are represented by a single species each. Mound building termites of Macrotermitidae are conspicuous by their rarity in the humid zone.

The sub-humid tropical zone is richly represented with fourteen genera and 34 species of genera ***Neotermes***, ***Procryptotermes***, ***Glyptotermes*** (Kalotermitidae), ***Coptotermes*** (Rhinotermitidae), ***Odontotermes***, ***Hypotermes***, ***Microtermes*** (Macrotermitidae), ***Angulitermes***, ***Homallotermes***, ***Dicuspiditermes***, ***Eurytermes***, ***Microcerotermes***, ***Nasutitermes*** and ***Hospitalitermes*** (Termitidae). Of these, genera ***Odontotermes*** (10-species) and ***Nasutitermes*** (5-species) are commonly encountered in the subhumid zone and are conspicuous by their high nest building activities.

The semi-arid zone is represented by 12 genera and 26 species. Of these, three species of genera, ***Neotermes*** (2-species) and ***Procryptotermes*** (1-species) are exclusively wood-dwelling termites. Species of these genera obtain their moisture requirement from the living tissues of the host plant. Sub-terranean wood-destroying termites, ***Heterotermes*** and ***Coptotermes*** are represented by one species each. Fungus growing genera of Macrotermitidae are represented by ***Macrotermes*** (1-species) and ***Odontotermes*** (4-species). The humus feeding termites, ***Speculitermes*** (5-species), ***Euhamitermes*** (2-species) and ***Eremotermes*** (3-species), harvester termites, ***Anacanthotermes*** (1-species) and ***Trinervitermes*** (4-species) prefer

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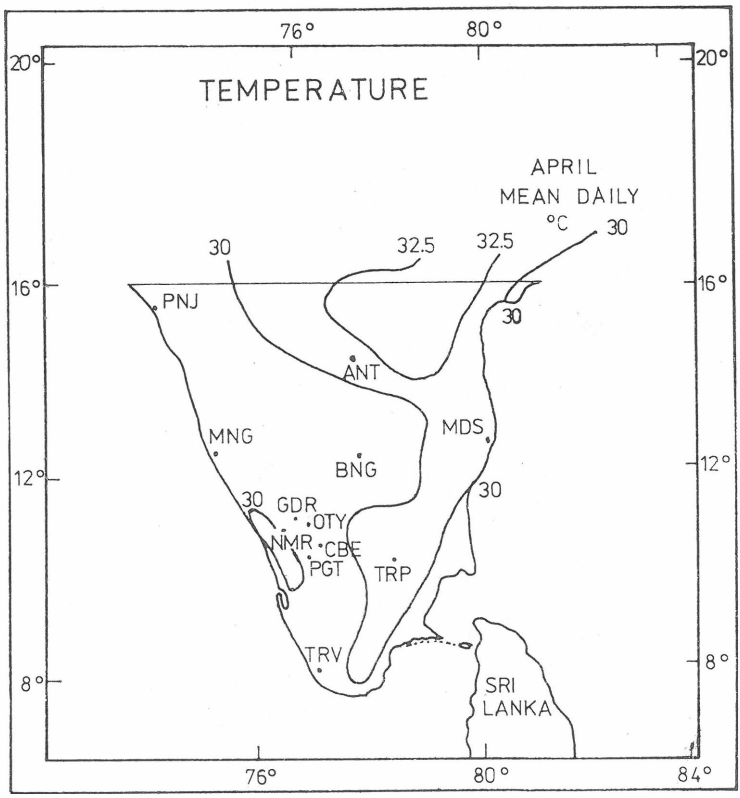

Fig. 5: Map of peninsular India: Isotherm belts (degrees centrigrades, April)

and thrive well in semi-arid conditions, though straying at times into the adjoining sub-humid areas falling within their distributional range.

(ii) Relationship with Vegetation (Table 1)

Forty-two species have been recorded from dry tropical vegetation, followed by moist tropical with 33 species and scrub thorny vegetation with only 14 species. The wood-dwelling termites of family Kalotermitidae and Stylotermitidae (7 + 6 species), carton nest building termites of Nasutitermitinae (12 + 3 species) and to some extent humus feeding termites of *Capritermes* complex (8 + 5 species) constitute the dominant component of termites occurring in moist tropical and dry tropical vegetation respectively, whereas scrub thorny vegetation harbours only a small percentage of termites. Many species of nasutitermitid genera build arboreal nests on tree trunk, high branches on the top of the trees in the evergreen tropical rain forests probably to avoid high water drainage conditions on the ground and higher water table.

Termite genera *Neotermes*, *Procryptotermes* and *Cryptotermes* (family Kalotermitidae) tend to occur in the modified environment of man and avoid dense forest vegetation, even though such vegetations are not very far off from the places of occurrance of these genera. *Anacanthotermes viarum*, all species of termite genera ***Eremotermes*** and ***Trinervitermes*** and some species of genera ***Microcerotermes***, ***Odontotermes*** and ***Speculitermes*** seem to prefer open scrubby vegetation, though some species have also been recorded from the peripheral regions of forest vegetations

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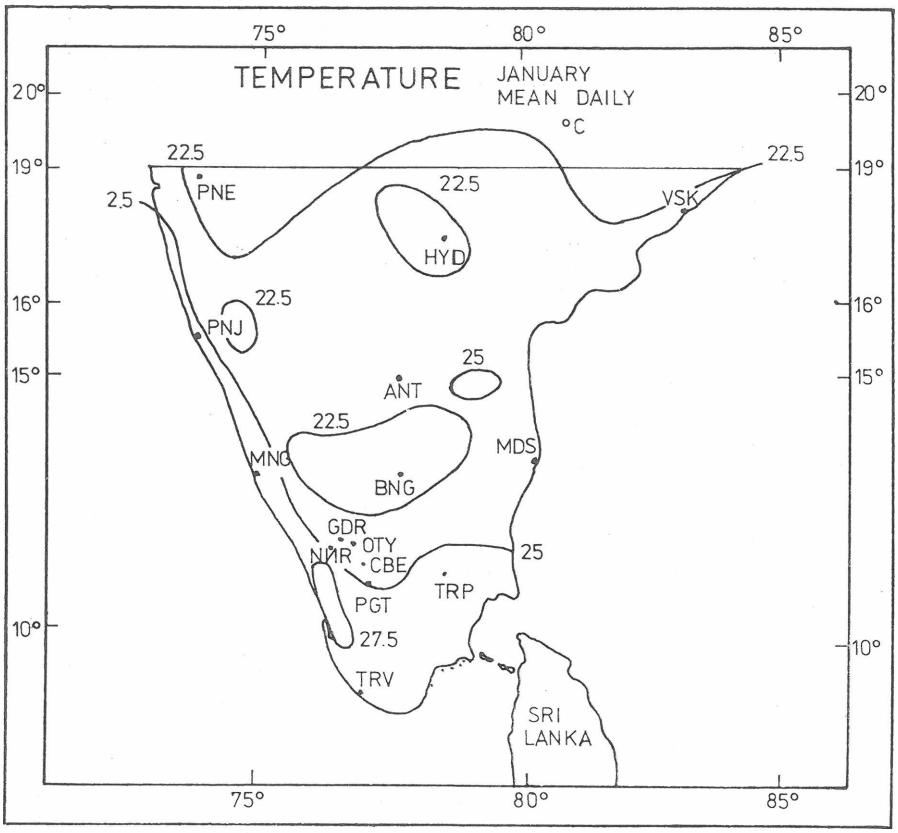

Fig. 6: Map of peninsular India: Isotherm belts (degrees centrigrades, January)

in some localities. Species of various nasute genera seem to prefer forest vegetation, making carton nest on the tree trunks, top branches as well as in the stumps. For keeping contact with the soil for their moisture requirement, they construct covered runways on the trunk of trees and going deep in the soil. Species of humus feeding genera, ***Angulitermes***, ***Pseudocapritermes***, ***Dicuspiditermes*** and ***Pericapritermes*** are encountered under the forest cover in the dry as well as moist vegetation, though at times, they are also found under stones, wood debris, etc., in the moist localities of open grassland vegetation. However, many species are versatile and occur in several types of vegetation in all the three zones, some of them occurring in cultivated areas as well, where they are serious pests of agricultural crops and orchards.

(iii) Relationship with Soil (Table 1)

Since majority of the species are subterranean in habit and carry out various activities underground, soil types coupled with vegetation influence the distribution and abundance of termites (THAKUR, 1982). Though it is difficult to ascertain the influence of any single soil type, some broad conclusions can be drawn from the existing pattern of their occurrence under various soil types available in peninsular India. Of the 74 soil dwelling termites, majority of the species (nearly 84 %) have been recorded from red soil followed by nearly 21.5 % species from laterite soil. Black clayey and coastal alluvial soils are comparatively less preferred. Mound building termites of family

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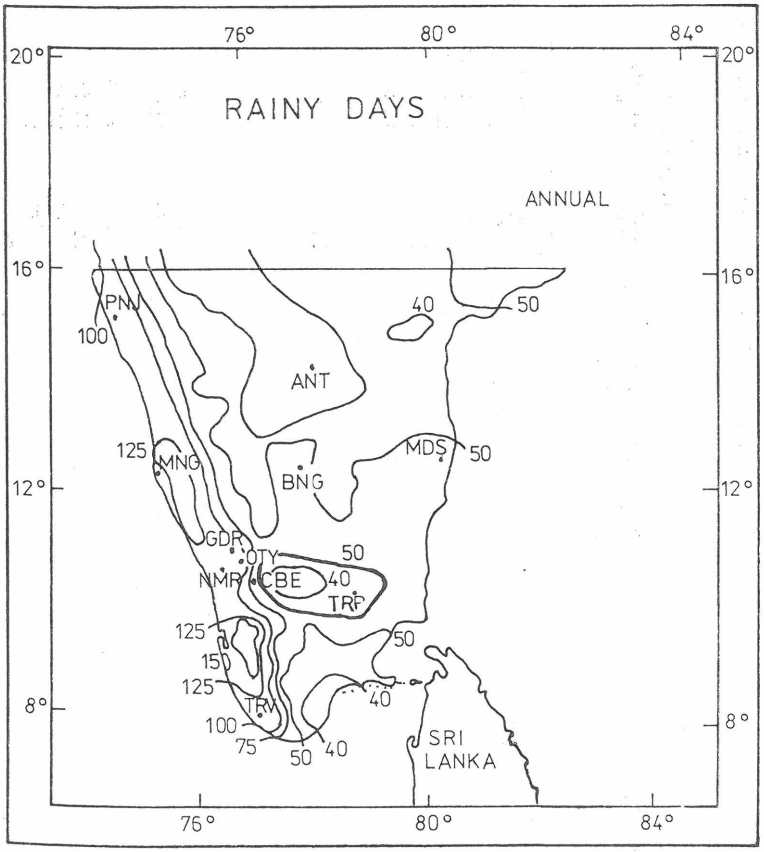

Fig. 7: Map of peninsular India: Anual rainy days belts

Macrotermitidae and subterranean non-carton nest building termites are rare in laterite soil. Unlike its sister species of the desert, ***Anacanthotermes macrocephalus***, which constructs low conical mounds in Gujrat and Rajasthan, ***A. viarum*** lives underground without any manifestation of mound building activity in South India. However, most of the species are versatile and are found in more than one soil types.

V. Composition and Zoogeography (Table 2+3)

The peninsular India, as treated here, has well defined boundaries, except for the northern boundary, where it gets merged and diffused towards the periphery with the boundary of northern zone, and which in some respects, is transitional in the context of distribution of Indian termites. As of today, out of nearly 280 and odd species and 48 genera known so far from the Indian region, peninsular India is represented by 89 species and 32 genera under six families. This represents nearly 32 % of the total Indian termite fauna.

The primitive wood dwelling family Kalotermitidae is fairly represented with 5 genera (15.63 %) and 14 species (15.73 %). The genus ***Postelectrotermes*** is tropicopolitan in distribution and is represented by two species from the humid tropical zone in Kerala. The members of this genus live in dampwood and survive only in Islands or

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Table 1:

Ecological preference of termites of peninsular India (Families Kalotermitidae, Hodotermitidae, Stylotermitidae, Rhinotermitidae, Macrotermitidae and Termitidae).

Sl. No.	Family/Genus	No. of sp.	Vegetation types			Soils					Rainfall			Air Temperature (°C)	
			Moist tropical.	Dry tropical.	Scrub/ Thory	Black soils.	Red soils.	Mixed Black soils.	Laterite soils.	Coastal Alluvial.	Humid tropical.	Sub-Humid tropical.	Semi-Arid.	April Mean.	January Mean.
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.
I–Family Kalotermitidae														Below.	Below.
1.	*Postelectrotermes*	2	2	—	—	—	—	—	2	—	2	—	—	30°	28°
2.	*Neotermes*	6	3	2	1	1	2	—	3	—	3	1	2	30°	22.5° Above
3.	*Glyptotermes*	1	—	1	—	—	1	—	—	—	—	1	+	30°	22.5° "
4.	*Procryptotermes*	2	—	2	+	—	1	1	—	—	—	1	1	30°	22.5° "
5.	*Cryptotermes*	3	2	1	—	—	1	—	—	2	2	+	1	30°	27.5° "
II–Family Hodotermitidae															
6.	*Anacanthotermes*	1		+	1	—	1	+	—	—	—	+	1	30°	25° "
III–Family Stylotermitidae															
7.	*Stylotermes*	1	—	+	1	+	—	1	—	—	—	+	1	30°	25° "
IV–Family Rhinotermitidae															
8.	*Heterotermes*	1	—	1	+	+	+	+	1	+	1	+	+	30°	27.5° "
9.	*Coptotermes*	2	+	1	1	+	1+	+	+	1	+	1	1	32.5°	25° "
IV–Family Macrotermitidae														Below.	Above.
10.	*Macrotermes*	1	—	1	+	+	—	1	—	—	—	+	1	30°	22.5°
11.	*Odontotermes*	16	3+	12+	1+	+	13+	+	3+	+	3+	9+	4+	32.5°	22.5°
12.	*Hypotermes*	1	1—	—	—	—	1	—	—	—	—	1	—	30.5°	25°
13.	*Microtermes*	3	1+	2	+	—	3	+	—	—	1	2	+	30°	
VI–Family Termitidae															
i) Sub-family Amitermitidae															
14.	*Eurytermes*	2	1	1	+	—	2	—	—	—	1	1	+	30°	22.5° Above
15.	*Speculitermes*	5	—	+	5	+	5	+	—	—	—	+	5	"	" "
16.	*Euhamitermes*	3	—	3	+	—	3	+	—	—	—	+	3	"	" "

17. *Eremotermes*	2	—	2	+	—	2	—	—	—	—	+	2	"	"	"
18. *Microcerotermes*	4	—	4	+	—	4	—	—	—	—	4	+	"	"	"
ii) Sub-family Termitinae															
19. *Angulitermes*	3	+	3+	+	+	2	1	—	—	—	3	+	32.5 °	25°	"
20. *Pseudocapritermes*	2	2	+	—	—	2	—	—	—	2	+	—	30°	22.5°	"
21. *Homallotermes*	1	1	—	—	—	1—	—	—	—		1	—	"	25°	"
22. *Dicuspiditermes*	4	2+	2+	+	+	4	+	+	—	—2	2	—	"	27.5°	"
23. *Labiocapritermes*	1	1	—	—	—	—	—	1	—	1	—	—	"	"	"
24. *Pericapritermes*	2	2	—	—	—	1	+	—	1	2	—	—	"	25°	"
iii) Sub-family Nasutitermitinae															
25. *Nasutitermes*	9	6	3+	—	—	6	+	2—	1	2+	6+	1+	"	25°	Below.
26. *Ceylonitermes*	1	1	—	—	—	—	—	1	—	1	—	—	"	"	"
27. *Grallatotermes*	2	2	—	—	—	1	—	1	—	2	—	—	"	22.5°	"
28. *Hospitalitermes*	1	—	1	—	—	—	—	—	1	—	1	—	"	25°	"
29. *Ampoulitermes*	1	1	—	—	—	—	—	1	—	1	—	—	"	27.5°	"
30. *Alstonitermes*	11	1	—	—	—	1	—	—	—	1	—	—	"	25°	"
31. *Emersonitermes*	1	1	—	—	—	—	—	1	—		+	—	"	27.5°	"
32. *Trinervitermes*	4	—	+	4	+	4	+	+	—	—	+	4	"	25°	"
TOTAL =	89	33	42	14	1	62	4	16	6	28	34	27			

continental edges. Genus ***Neotermes*** is well represented with six species, occurring in humid tropical zone (4-species), one shares distribution with Bangla Desh ***(Neotermes fletcheri)*** and one with Sri Lanka ***(Neotermes greeni)***. Genus ***Procryptotermes*** is represented by one native species ***(C. roonwali)*** and two introduced species ***(C. domesticus*** and ***C. dudleyi)***, both restricted to the modified environment of man in the coastal region, where they are serious pests of woodworks in buildings and other timber structures. The genus is poorly explored and more intensive surveys may reveal its occurrence in many more localities all along the coastal region. The sole representative of genus ***Glyptotermes (G. coorgensis)*** has been recorded from semi-arid zone of Karnataka.

Family Hodotermitidae is represented by the sole palaearctic element, ***Anacanthotermes***, with only one species ***(A. viarum)*** from the semi-arid areas of peninsular India. This desert termite is postulated to have migrated from the Central Asia quite early, probably in Miocene or Pliocene (Emerson, 1952, 1955; Sen-Sarma, 1974 & Thakur, M. L., 1980) through the desertic and drier regions of Afghanistan, Pakistan and penetrated further deep down to the drier parts of southern India (Coimbatore plataeu through the westernmost pocket state of Gujarat and dry semi-arid region of Karnataka. Thakur, R. K. (1982) has recorded ***A. macrocephalus*** from the arid zone of Gujarat, straying at times into the adjoining semi-arid areas within its distributional range. More intensive surveys of drier parts of peninsular India (Karnataka & Andhra Pradesh) will ultimately reveal its presence and provide a link to the so far discontinuous distribution of this genus in India.

Family Stylotermitidae has only one living genus ***Stylotermes***, with about a dozen species (some of them having been described recently from the Indian and Ind o-Chinese subregions), occurring mostly in the hilly areas of the Oriental region.

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The only species ***Stylotermes fletcheri*** has been recorded from the Shevaroy hills in South India. The occurrence of a fossil genus ***Parastylotermes***, north of 30° N. lat. in Europe and America (Nearctic region) indicates that the living elements of the family in the Oriental region represent probably the relic surviving remnants of once widely distributed family. This is further confirmed by their dampwood dwelling habitat in the temperate zone.

Family Rhinotermitidae, which includes some of the important and major wood-destroying genera, is very poorly represented in this region, with only two genera (6.25 %) and three species (3.37 %). ***Heterotermes malabaricus*** is widely distributed in peninsular India, penetrating further north, where it meets its sister species, ***Heterotermes indicola*** near the 20° N lat (BECKER, 1962). ***Coptotermes*** is represented by two species only, one of which ***(C. heimi)*** is a versatile species and occurs in many areas outside the boundaries of this region as well.

The fungus growing family Macrotermitidae is very well represented with four genera (12.5 %) and 21 species (23.60 %). Of the 4 genera, ***Hypotermes*** is a small genus with only 5 species, all occurring within the Oriental region. The sole representative of this genus from the peninsular India ***(H. obscuriceps)*** has a very wide distribution and is common to Sri Lanka, India (south India) and Assam and Meghalaya (Indo-Chinese subregion). The remaining three genera, ***Macrotermes***, ***Odontotermes*** and ***Microtermes*** are Ethiopian in origin and are postulated to have migrated to the Oriental region sometimes during the Miocene period, availing the ecological bridges provided by the land connections between the tropical Africa, India and beyond, long after the Cretaceous invasion of the sea (THAKUR, M. L. 1980, 1982, THAKUR, R. K. 1982).

The genus ***Macrotermes*** is the most primitive genus among the above Ethiopian genera and is represented by only a single species from Coimbatore in peninsular region. The other two species (***M. aleemi*** and ***M. khajuriai***) have been reported from Bangla Desh and Meghalaya. The present day distribution of some of the species of this genus in the forest habitations in the Oriental region gives good evidence of forest continuity or extension of grassland between the Ethiopian and Oriental region during the early Tertiary period (THAKUR, M. L. 1980). Paucity of species and lack of mound building activities in the Indian subregion is probably due to the biotic competition from its sister genus ***Odontotermes***, which is the most successful and predominant mound building genus in the Indian subcontinent.

The genus ***Odontotermes*** is well represented with 17 species (19.10 %). Of these, six species (viz. ***O. anamallensis***, ***O. feaeoides***, ***O. meturensis***, ***O. malabaricus***, ***O. roonwali*** and ***O. yadevi*** are endemic to this region.

Nine species, namely, ***O. asmuthi***, ***O. bellahunisensis***, ***O. brunneus***, ***O. ceylonicus***, ***O. distans***, ***O. indicus***, ***O. obesus***, ***O. redemanni*** and ***O. wallonensis*** have wide distribution outside the boundary of this region, some of them share distribution with Bhutan, Pakistan and Sri Lanka.

The genus ***Microtermes*** is represented by 3 species only. Of these, ***M. globicola*** shares distribution with Sri Lanka, the remaining 2 species have very wide distribution and have been recorded from Pakistan, Peninsular, India and Vietnam ***(M. incertoides)*** and Burma, Bangla desh, India, Pakistan, Sri Lanka and Thailand ***(M. obesi)***.

The family Termitidae, as usual, is the most richly represented family, with 3 subfamilies, 19 genera (59.38 %) and 49 species (55.06 %). Of these, Amitermitinae is represented by 5 genera (15.63 %) and 16 species (17.98 %), Termitinae by 6 genera (18.75 %) and 13 species (14.60 %) and Nasutitermitinae by 8 genera (25 %) and 20 species (22.48 %). The humus feeding and carton nest building (particularly arboreal) genera dominate the faunal component. The genera best represented are ***Nasu-***

DOI: 10.21248/contrib.entomol.39.2.343-366

Table 2:

Distribution of termites of peninsular India

S. No.	Family	Sub Family	No. of genera	%	No. of species	%
1.	Kalotermitidae		5	15.63	14	15.73
2.	Hodotermitidae		1	3.12	1	1.12
3.	Stylotermitidae		1	3.12	1	1.12
4.	Rhinotermitidae		2	6.25	3	3.37
		(i) Heterotermitinae	1	3.125	1	1.12
		(ii) Coptotermitinae	1	3.125	2	2.24
5.	Macrotermitidae		4	12.50	21	23.60
6.	Termitidae		19	59.38	49	56.06
		(i) Amitermitinae	5	15.63	16	17.98
		(ii) Termitinae	6	18.75	13	14.60
		(iii) Nasutitermitinae	8	25.00	20	22.48

Table 3:

Zoogeographical origin and affinities of termites of peninsular India

(A)	Zoogeographical origins present status (no of species)		origin	No. of genera	%	No. of species	%
	Indian	64	Oriental	17	53.13	29	32.58
	Oriental	23	Ethiopian	6	18.75	31	34.83
	Cosmopolitan	2	Neotropical	4	12.50	20	22.41
			Palaearctic	1	3.12	1	01.12
			Doubtful	4	12.50	8	09.00
(B)	Zoogeographical affinities						
	1. Element Common with Srilanka			8	25.00	9	10.11
	2. Element Common with Oriental Region			6	18.75	12	13.48
	3. Element Common with Northern Zone			3	09.38	3	03.37
			(C) Endemism				
			i) Peninsular India	4	12.50	61	68.4
			ii) Assam Region (Tropical Rain Forest)	—	—	27*	58.70
			iii) Andaman And Nicobar Islands	—	—	27	58.70

* Figures modified after including termites of Tripura By SEN-SARMA & THAKUR, 1979.

DOI: 10.21248/contrib.entomol.39.2.343-366

titermes (8-species), ***Speculitermes*** (5-species), ***Dicuspiditermes***, ***Microcerotermes*** and ***Trinervitermes*** (4-species each). The remaining genera are represented by 1—3 species.

The composition of termite fauna of this region is overwhelmingly Oriental in origin (17-genera, 53.13 %; 29 species, 32.58 %), followed by Ethiopian element (6 genera, 18.75 %; 31-species, 34.83 %), Neotropical element (4-genera, 12.50 %; 20-species, 22.47 %), with only a small fraction being of Palaearctic origin (1-genus, 3.12 %; 1-species, 1.12 %), while 09.00 % is of doubtful origin. The region exhibits a very high degree of endemism with 61 species (68.40 %) which is comparatively very much higher as compared to the condition encountered in tropical rain forest areas of Eastern India (Assam and Tripura) and Andaman & Nicobar Islands (58.70 %). Further more, out of 17 Oriental genera, 4 genera, viz. ***Labiocapritermes*** (Termitinae), ***Alstonitermes***, ***Ampoulitermes*** and ***Emersonitermes***, all monotypic genera (Nasutitermitinae), are endemic to this region.

The region exhibite a great deal of affinity with termite fauna of Sri Lanka (8-genera, 25 % and 9-species, 10.11 %). The Oriental element is represented by 6-genera (18.75 %) and 12 species (13.48 %) and a small percentage (3-genera, 9.38 %; 3-species 3.37 %) is common with Northern zone.

VI. Discussion

The peninsular India, which comprises an ancient land mass of Gondwana system, supports very rich and varied vegetation, from scrubby xerophytic vegetation of the arid and semi-arid zone to impenetrable thick, nearly virgin tropical evergreen rain forests of the Western Ghats. The humid tropical climate of this region has had afforded an ideal ecological habitat for the great majority of the species. Though the present day composition of the fauna does not reflect the full component complex available in this region, particularly when some of the areas under the arid zone of Andhra Pradesh and evergreen forest vegetation in the Ghat regions are still not fully explored and where many new taxa seem to await discovery, but nevertheless, data accumulated so far, are sufficient enough to draw some broad conclusions.

The termite genera ***Neotermes*** and ***Glyptotermes*** (Kalotermitidae), ***Speculitermes*** and ***Nasutitermes*** (Termitidae) in all probability, have had their origin in the Neotropical region from where they moved and spread to the Oriental region sometimes during the Cretaceous period when the landmass between South America, Africa, Oriental region and beyond were still contiguous and before they had started to drift apart according to WEGNER's hypothesis of continental drift (WEGNER, 1922). The genus ***Speculitermes*** after its dispersal to the Oriental region got established and evolved independently in the Oriental region. Alternatively, the ***Speculitermes*** complex of the Oriental region represents a different group and needs reassignment (KRISHNA, 1970). That in all probability it may so, but the evidence is very meagre at present. The occurrence of soldier caste in one of the species of ***Speculitermes (S. sinhalensis)*** in India and Sri Lanka indicates that the soldier caste, which is supposed to have been lost secondarily in the ***Anoplotermes*** complex in the Neotropical region, is probably in a process of extinction in ***Speculitermes*** complex of the Oriental region. However, the evidence as yet is insufficient and must await accumulation of more data.

The sole Palaearctic element, the genus ***Anacanthotermes*** came from Central Asia quite early, probably in Miocene or early Pliocene (EMERSON, 1955; ROONWAL & VERMA, 1977 & THAKUR, M. L., 1980), and penetrated deep further down to South India (Coimbatore Plateau) through an ecological corridore in the westernmost pocket state of Gujarat, Karnataka, and Andhra Pradesh (THAKUR, R. K., 1982).

DOI: 10.21248/contrib.entomol.39.2.343-366

The genus has not been recorded so far from any locality in the above states where it is likely to be discovered, when more intensive surveys are carried out in dry desertic and semi-desertic areas of these States.

The Ethiopian element, particularly the genera of the fungus growing family Macrotermitidae (***Macrotermes***, ***Odontotermes*** and ***Microtermes***) migrated to the Oriental region during the Tertiary period. The present day distribution of some of the species of genus ***Macrotermes*** in the forest vegetation of the Oriental region is indicative of the forest continuity or extension of grassland between the Ethiopian and the Oriental regions and suggests that long after the sea had retreated, the belt of land between north Africa and the western India, had a climate more different than at present. It was moist, covered with grass, bushes and had forests here and there. The more successful genus ***Odontotermes*** is considered to have given rise to two endemic Oriental genera, ***Euscaiotermes*** and ***Hypotermes*** in the tropical belt of the Indian subcontinent (THAKUR, M. L., 1980).

Dispersal, of nasute termites westward probably occurred sometimes in late Mesozoic times (EMERSON, 1952, 1955). The genus ***Nasutitermes*** has worldwide distribution in Australian, Pappuan, Oriental, Ethiopian, Neotropical and Malagassy regions. The occurrence of some of the species of this genus in Madagascar and in the neighbouring islands in the Indian Ocean points to the fact that the genus ***Nasutitermes*** probably migrated to tropical Africa atleast by early Tertiary or late Mesozoic times, when Madagascar had land connections with Africa. The failure of the ancestral stock of advanced nasute genera (i.e. genera with well developed mandibles and their ancestors), which surely existed at the time of world wide dispersal of nasute genera, was probably due to certain biotic factors which prevented the dispersal of these primitive genera. (EMERSON, 1955).

EMERSON (1952 & 1955) favours faunal exchange between South America and other continents, including Australia over the Bering land bridge with tropical climate during Mesozoic times, particularly for termites confined to tropical terrestrial habitats, however, more and more data are accumulating favouring continental drift hypothesis and the present author agrees with ROONWAL, et al. (1962) and opines that most of the termite genera with an indicated Mesozoic origin dispersed to various zoogeographical regions within the context of WEGNERS hypothesis (vide supra). Following this tropicoplitan dispersion of the basic stock, many genera arose in late Cretaceous or early Tertiary period, and possibly still others which arose in mid Tertiary period, followed the route of dispersion through Ethiopian and west Asia desert region of the Oriental region.

Four genera of termites, namely ***Labiocapritermes***, ***Alstonitermes***, ***Ampoulitermes*** and ***Emersonitermes*** (all monotypic) are endemic to peninsular India, whereas the Oriental region as a whole, has nearly forty endemic genera. Further, of all the sub-families, Termitinae and Nasutitermitinae have achieved a very high degree of diversity and speciation. The process is not yet complete and is still active in the peninsulas of the Oriental region. Such a high rate of endemism in the tropical continental areas in the Oriental and other zoogeographical regions is indicative of the fact that once a faunal component got established in the ecologically favourable niches in these areas, their further evolution and speciation occurred locally as a result of isolation or absence of free exchange of genetical material between the closely related stock. The occurrence of such a large number of genera in the Oriental region, supports the evidence that the zoogeographically Oriental region has been the secondary centre of origin and evolution of majority of the termite genera in this region. Furthermore, the faunal exchange of termites and their distribution pattern in the peninsular India, eastern and western boderlands conforms to the known pattern of distribution and exchange of fauna of other groups of animals.

DOI: 10.21248/contrib.entomol.39.2.343-366

Appendix:

Zoogeographical distribution of termites of peninsular India

Sl. No.	Name of species	Sub-divisions of Indian sub-region				Rest of Oriental region	Zoogeographical status	Origin of genus	Endemism	Remarks
		Peninsular India	Northern India	Rest of India	Sri Lanka					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	I–Family Kalotermitidae									
1.	*Postelectrotermes bhimi* ROONWAL & MAITI	+	—	—	—	—	Ind.	?	+	
2.	*Postelectrotermes nayari* ROONWAL & VERMA	+	—	—	—	—	Ind.	?	+	
3.	*Neotermes assmuthi* HOLMGTEN	+	—	—	—	—	Ind.	Neo.	+	
4.	*Neotermes fletcheri* HOLMGREN & HOLMGREN	+	—	—	—	+ Bangladesh	OR.	Neo.	—	
5.	*Neotermes greeni* DESNEUX	+	—	—	+	—	OR.	Neo.	—	
6.	*Neotermes Keralai* ROONWAL & VERMA	+	—	—	—	—	Ind.	Neo.	+	
7.	*Neotermes nilamburensis* THAKUR	+	—	—	—	—	Ind.	Neo.	+	
8.	*Neotermes shimogensis* THAKUR	+	—	—	—	—	Ind.	Neo.	+	
9.	*Glyptotermes coorgensis* HOLMGREN & HOLMGREN	+	—	—	—	—	Ind.	Neo.	+	
10.	*Procryptotermes dhari* ROONWAL & CHHOTANI	+	—	—	—	—	Ind.	?	+	
11.	*Procryptotermes hunsurensis* THAKUR	+	—	—	—	—	Ind.	?	+	
12.	*Cryptotermes domesticus* HAVILAND	+	—	—	+	—	Tropicopolitan	?	—	Wide spread through introduction in

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13. *Cryptotermes dudleyi* Banks	+	−	+	+
14. *Cryptotermes roonwali* Chhotani	+	−	−	−
II–Hodotermitidae				
15. *A. viarum* (König)	+	−	−	−
III–Family Stylotermitidae				
16. *Stylotermes fletcheri* Holmgren & Holmgren	+	−	−	−
IV–Family Rhinotermitidae				
Subfamily (i) Heterotermitinae				
17. *Heterotermes malabaricus* Snyder	+	+ below 20° lat	−	−
Subfamily (ii) Coptoterminae				
18. *Coptotermes beckeri* Mathur & Chhotani	+	−	−	−
19. *C. heimi* (Wasmann)	+	+	+	−
V–Family Macrotermitidae				
20. *Macrotermes estherae* Desneux	+	−	−	+
21. *Odontotermes anamallensis* Holmgren & Holmgren	+	−	−	−
22. *O. assmuthi* (Holmgren)	+	+	+	−
23. *O. bellahunisensis* Holmgren & Holmgren	+	+	+	−
24. *O. brunneus* (Hagen)	+	+	+	+
25. *O. ceylonicus* (Wasmann)	+	−	−	+

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				Neotropical, Oriental & Pappuan regions
+ Bangla-desh	Almost Cosmo-politan	?	—	Wide spread through intro-duction.
—	Ind.	?	+	Native species
—	Ind.	Pal.	+	
—	Ind.	OR.	+	
—	Ind.	?	—	
—	Ind.	OR.	+	
+ Bangladesh Pakistan	OR.	OR.	—	
—	OR.	Eth.	—	
—	Ind.	Eth.	+	
+ Pakistan	OR.	Eth.	—	
+ Pakistan	OR.	Eth.	—	
—	OR.	Eth.	—	
—	OR.	Eth.	—	

Appendix (Continued)

Sl. No.	Name of species	Sub-divisions of Indian sub-region				Rest of Oriental region	Zoogeographical status	Origin of genus	Endemism	Remarks
		Peninsular India	Northern India	Rest of India	Sri Lanka					
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
26.	*O. distans* HOLMGREN & HOLMGREN	+	+	+	—	+ Bhutan	OR.	Eth.	—	
27.	*O. feaeoides* HOLMGREN & HOLMGREN	+	—	—	—	—	Ind.	Eth.	+	
28.	*O. horni* (WASMANN)	+	—	—	+	—	OR.	Eth.	—	
29.	*O. indicus* THAKUR	+	+	+	—	—	Ind.	Eth.	—	
30.	*O. malabaricus* HOLMGREN & HOLMGREN	+	—	—	—	—	Ind.	Eth.	+	
31.	*O. meturensis* ROONWAL & CHHOTANI	+	—	—	—	—	Ind.	Eth.	+	
32.	*O. microdentatus* ROONWAL & SEN-SARMA	+	+	+	—	—	Ind.	Eth.	—	
33.	*O. obesus* (RAMBUR)	+	+	+	—	+ Bhutan	OR.	Eth.	—	wide spread in Bhutan, India and Pakistan
34.	*O. redemanni* (WASMANN)	+	+	+	+	—	OR.	Eth.	—	
35.	*O. roonwali* BOSE	+	—	—	—	—	Ind.	Eth.	+	
36.	*O. wallonensis* (WASMANN)	+	+	+	—	—	Ind.	Eth.	—	
37.	*O. yadevi* THAKUR	+	—	—	—	—	Ind.	Eth.	+	
38.	*Hypotermes obscuriceps* WASMANN	+	—	+	+	—	OR.	OR.	—	
39.	*Microtermes globicola* WASMANN	+	—	—	+	—	OR.	Eth.	—	
40.	*M. incertoides* HOLMGREN	+	+	+	—	+	OR.	Eth.	—	Wide spread Pakistan, Peninsular India & Indo-China (Vietnam)
41.	*M. obesi* HOLMGREN	+	+	+	+	+	OR.	Eth.	—	Wide spread in S & Se. Asia, Burma, Pakistan, Sri Lanka & Thailand

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VI—Family Termitidae

Sub-family Amitermitinae

42. *Eurytermes budha* Bose & Maiti	+	—	—	—
43. *E. topslipansis* Chatterjee & Thapa	+	—	—	—
44. *Speculitermes cyclops* Wasmann	+	+	+	—
45. *S. decanensis decanensis* Roonwal & Chhotani	+	—	—	—
46. *S. dharwarensis* Roonwal & Chhotani	+	—	—	—
47. *S. göeswaldi* Roonwal & Chhotani	+	—	—	—
48. *S. sinhalensis* Roonwal & Sen-Sarma	+	+ Below 20° lat.	—	+
49. *Euhamitermes indicus* Holmgren & Holmgren	+	—	—	—
50. *E. karnatakensis* Roonwal & Chhotani	+	—	—	—
51. *Eremotermes fletcheri* Holmgren & Holmgren	+	—	—	—
52. *E. madrasi* Roonwal & Sen-Sarma	+	—	—	—
53. *E. paradoxalis* Holmgren	+	+	—	—
54. *Microcerotermes cameroni* Snyder	+	—	—	—
55. *M. fletcheri* Holmgrem & Holmgren	+	—	—	—
56. *M. heimi* (Wasmann)	+	—	—	—
57. *M. minor* (Wasmann)	+	—	—	+
58. *Arguliternes acutus* Mathur & Sen-Sarma	+	—	—	—
59. *A. fletcheri* Holmgren & Holmgren	+	—	—	—
60. *A. obtuses* Holmgren & Holmgren	+	—	—	—

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—	Ind.	OR.	+
—	Ind.	OR.	+
—	Ind.	Neo.	—
—	Ind.	Neo.	+
—	Ind.	Neo.	+
—	Ind.	Neo.	+
—	OR.	Neo.	—
—	Ind.	OR.	+
—	Ind.	OR.	+
—	Ind.	OR.	+
—	Ind.	OR.	+
+ Pakistan	OR.	OR.	—
—	Ind.	Eth.	+
—	Ind.	Eth.	+
—	Ind.	Eth.	+
—	OR.	Eth.	—
—	Ind.	OR.	+
—	Ind.	OR.	+
—	Ind.	OR.	+

Appendix (Continued)

Sl. No.	Name of species	Sub-divisions of Indian sub-region: Peninsular India	Northern India	Rest of India	Sri Lanka	Rest of Oriental region	Zoogeographical status	Origin of genus	Endemism	Remarks
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
61.	*Pseudocapritermes fontanelleus* MATHUR & THAPA	+	—	—	—	—	Ind.	OR.	+	
62.	*P. goanicus* THAKUR & CHATTERJEE	+	—	—	—	—	Ind.	OR.	+	
63.	*Homallotermes pilosus* (MATHUR & THAPA)	+	—	—	—	—	Ind.	OR.	+	
64.	*Dicuspiditermes fletcheri* (HOLMGREN & HOLMGREN)	+	—	—	—	—	Ind.	OR.	+	
65.	*D. fontanelleus* THAKUR & CHATTERJEE	+	—	—	—	—	Ind.	OR.	+	
66.	*D. incola* (WASMANN)	+	—	+	+	—	OR.	OR.	—	
67.	*D. pername* THAKUR & CHATTERJEE	+	—	—	—	—	Ind.	OR.	+	
68.	*Labiocapritermes distortus* (SILVESTRI)	+	—	—	—	—	Ind.	OR.	+	
69.	*Pericapritermes topslipensis* THAKUR	+	—	—	—	—	Ind.	Eth.	+	
70.	*Pericapritermes vythirii* VERMA	+	—	—			Ind.	Eth.	+	
	Sub.-family (iii) Nasutitermitinae									
71.	*Nasutitermes anamalaiensis* SNYDER	+	—	—	—	—	Ind.	Neo.	+	
72.	*N. beckeri* PRASHAD & SEN-SARMA	+	—	—	—	—	Ind.	Neo.	+	
73.	*N. brunneus* SNYDER	+	—	—	—	—	Ind.	Neo.	+	
74.	*N. crassicornis* HOLMGREN & HOLMGREN	+	—	—	—	—	Ind.	Neo.	+	
75.	*N. fletcheri* HOLMGREN & HOLMGREN	+	—	—	—	—	Ind.	Neo.	+	
76.	*N. indicola* HOLMGREN & HOLMGREN	+	—	—	—	—	Ind.	Neo.	+	

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77. *N. processionarius* Schmitz	+	—	—	—
78. *N. salemensis* (Sen-Sarma)	+	—	—	—
79. *Ceylonitermes indicola* Thakur	+	—	—	—
80. *Grallatotermes nigar* Mathur & Thapa	+	—	—	—
81. *Grallatotermes grallatoriformis* Holmgren & Holmgren	+	—	—	—
82. *Hospitalitermes madrasi* Prashad & Sen-Sarma	+	—	—	—
83. *Ampoulitermes wynaadensis* Mathur & Thapa	+	—	—	—
84. *Alstonitermes flavescens* Thakur	+	—	—	—
85. *Emersonitermes thekadensis* Mathur & Sen-Sarma	+	—	—	—
86. *Trinervitermes biformis* (Wasmann)	+	+	+	+
87. *T. fletcheri* Chatterjee & Thakur	+	—	—	—
88. *T. nigrirotris* Mathur & Sen-Sarma	+	—	—	—
89. *T. rubidus* (Hagen)	+	—	—	+

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—	Ind.	Neo.	+
—	Ind.	OR.	+
—	Ind.	OR.	+
—	Ind.	OR.	+
—	Ind.	OR.	+
—	Ind.	OR.	+
—	Ind.	OR.	+
—	Ind.	OR.	+
+ Pakistan	OR.	Eth.	—
—	Ind.	Eth.	+
—	Ind.	Eth.	+
—	OR.	Eth.	—

Summary

The characteristic physiographic configurations, varied agroclimatic and vegetational complexities of the peninsular Indian region have, to a great extent, been responsible for the great deversity and abundance of termites with a high degree of endemism. The region is represented by 32 genera and 89 species. The majority of the species (38,20 %) are from the subhumid zone, followed by the humid zone (32,59 %) and the semiarid zone (29,21 %).

Mound building termites of the family Macrotermitidae are conspicuous by their rarity in the humid zone; hower, in the subhumid zone these termites are more common, and here the mound building activity of these termites is encountered most. The harvester termites of genera *Anacanthotermes* (1 species) and *Trinervitermes* (4 species) prefer and thrive well in semiarid conditions, though straying at times into the adjoining subhumid areas falling within their distributional range. Similarly nearly 47,19 % of the species have been recorded from dry tropical vegetation followed by moist tropical (37,08 %) and scrub thorny vegetation (15,73 %). Zoogeographically the composition of the termite fauna of this region is overwhelmingly Oriental in Origin (Genera 53,13 %; species 32,58 %), followed by the Ethiopian element (Genera 18,75 %; species 34,83 %), and the Neotropical element (Genera 12,50 %; species 27,47 %), with only a small fraction being of Palaearctic Origin (Genera 3,12 %; species 1,12 %), while four genera (12,50 %) and eight species (9 %) are of doubtful origin. The region exhibits a high degree of endemision (68,54). The region also exhibits a great degree of affinity with the Sri Lanka fauna (Genera 25″; species 10,11 %), followed by the Oriental element (Genera 18,75 %; 13,43).

The paper also discusses the origin and the possible routes of dispersal of the fauna.

Zusammenfassung

Die charakteristischen physiographischen Strukturen und verschiedenartigen agroklimatischen Vegetationsverhältnisse Vorderindiens sind weitgehend verantwortlich für die große Vielfalt und Häufigkeit von hochgradig endemischen Termiten. In dem Gebiet sind 32 Gattungen und 89 Arten vertreten. Die Mehrzahl der Arten (38,2 %) kommen aus der subhumiden Zone, gefolgt von der humiden Zone (32,59 %) und der semi-ariden Zone (29,21 %). Es fällt auf, daß die hügelbauenden Termiten der Familie Macrotermitidae in der humiden Zone selten sind; in der subhumiden Zone hingegen sind diese Termiten stärker verbreitet, und hier trifft man ihre Hügelbauten am häufigsten an. Die Erntetermiten der Gattungen *Anacanthotermes* (1 Art) und *Trinervitermes* (4 Arten) bevorzugen semi-aride Gebiete und gedeihen dort am besten, stoßen aber gelegentlich auch in die an ihren Verbreitungsbereich angrenzenden subhumiden Gebiete vor. Ähnlich sind 47,19 % der Arten in trockener tropischer Vegetation festgestellt worden, gefolgt von feucht-tropischer Vegetation (37,08 %) und Dornbuschvegetation (15,73 %). Zoogeographisch gesehen ist die Zusammensetzung der Termitenfauna dieses Gebiets überwiegend orientalen Ursprungs (Gattungen 53,13 %; Arten 32,58 %), gefolgt von dem äthiopischen Element (Gattungen 18,75 %; Arten 34,83 %), dem neotropischen Element (Gattungen 12,5 %; Arten 27,47 %), während nur ein geringer Bruchteil paläarktischen Ursprungs ist (Gattungen 3,12 %; Arten 1,12 %). Bei vier Gattungen (12,5 %) und acht Arten (9 %) ist der Ursprung zweifelhaft. Das Gebiet zeigt einen hohen Grad von Endemie (68,54 %). Es zeigt auch einen hohen Grad von Verwandtschaft mit der Fauna von Sri Lanka (Gattungen 25 %; Arten 10,11 %), gefolgt vom orientalen Element (Gattungen 18,75 %; Arten 13,43 %). In dem Artikel werden auch der Ursprung und die möglichen Verbreitungswege der Fauna erörtert.

Резюме

Характерная физиографическая конфигурация, разные агроклиматические и вегетационные комплексы индийского субконтинента в значительной мере обуславливают большое разнообразие и численность термитов с высокой степенью эндемизма. Установлено 32 рода и 89 видов на этой территории. Большинство видов (38,20 %) из субгумидной зоны, 32,59 % из гумидной зоны и 29,21 % из полуаридной зоны. Сооружающие надземные гнезда термиты семейства Macrotermitidae отличаются своей редкостью в гумидной зоне, а в субгумидной зоне эти термиты встречаются чаще и там их активность строения гнезд (термитников) больше всего выражена. Термиты родов *Anacanthotermes* (1 вид) и *Trinervitermes* (4 вида) предпочитают

DOI: 10.21248/contrib.entomol.39.2.343-366

полуаридные зоны и хорошо развиваются в них, временно они тоже заселяют примыкающие к ним области. Аналогично этому было зарегистрировано примерно 47,19 % видов из сухой тропической зоны, 37,08 % из влажной тропической зоны и 15,73 % из колючекустарниковой зоны. С зоогеографической точки зрения большая часть фауны термитов этой области происходит с Востока (53,13 % родов; 32,58 % видов), за ними следует эфиопский элемент (18,75 % родов; 34,83 %), неотропический элемент (12,50 % родов; 27,47 % видов) и только незначительная часть термитов палеарктического происхождения, а происхождение 4 родов (12,50 %) и 8 видов (9 %) неясное. Территория характеризуется высокой степенью эндемизма (68,54). Одновременно территория отличается большим сходством с фауной Шри Ланки (25 % родов; 10,11 % видов), затем следует восточный элемент (18,75 %; 13,43 %). В работе тоже обсуждаются происхождение и возможные направления распространения фауны.

References

Beeson, C. F. C.: The ecology and control of forest insects of India and neighbouring countries. — 1941. — S. 1—1007 (Manger of Publication, Gouvernment of India, reprinted 1961).

Bose, G.: Taxonomy and Zoogeography of termites of South India. — 1975. — Calcutta submitted to the University of Calcutta, Ph. D. Thesis.

Chatterjee, P. N. & Thakur, M. L.: Revision of termite genus *Hypotermes* Holmgren (Isoptera: Termitidae: Macrotermitinae) from the Indo-Malayam Region. — In: Indian Forest. Rec. — Dehra Dun **10** (1963) 9. — S. 171—203.

— Revision of termite genus *Microtermes* Wasmann (Isoptera: Termitidae: Macrotermitinae) from the Indian Region. — In: Indian Forester. Rec. — Dehra Dun **10** (1964) 11. — S. 219—260.

— A new termite *Trinervitermes fletcheri* sp. nov. (Isoptera: Termitidae: Nasutitermitinae) from South India. — In: Bull. Syst. Zool. — **1** (1965) 1. — S. 11—19.

— A new species of termite genus *Pseudocapritermes* from Goa, India. — In: Oriental Insects. — Delhi 3 (1969) 1. — S. 29—31.

— Two new species of termite genus *Dicuspiditermes krishna* (Isoptera: Termitidae: Termitinae) from Goa. — Zool. Anz. — Leipzig 187 (1971). — S. 72—81.

Emerson, A. E.: The biogeography of termites. — In: Bull. Am. Mus. Nat. Hist. — Washington **99** (1952) 3. — S. 217—225.

— Geographical origions and dispersions of termite genera. — In: Fieldiana (zool.). — Chicago **37** (1955). — S. 465—521.

Govindarajan, S. V. & Datta Biswas, N. R.: Classification of Indian soils & their mapping. — In: Intern Geogr. Congr. — India. **1** (1968). — S. 374—376.

Holmgren, N.: Termitenstudien. Systematik der Termiten. Die Familien Mastotermitidae, Porotermitidae and Mesotermitidae. — In: K. Svenska Vetensk. Akad. Handl. — Stockholm **46** (1911a) 6. — S. 1—88.

— Ceylon-Termiten. — In: Escherich Termitenleben auf Ceylon. — Jena, 1911b. — S. 185—212.

— Termitenstudien. 3. Systematik der Termiten. Die Familie Metatermitidae. — K. Svenska Vetensk. Akad. Handl. — Stockholm **48** (1912). — S. 1—166.

— On some termites collected by Hr. Green in Ceylon. — In: Spolia Zeylanica. — Colombo 8 (1913a). — S. 277—284.

— Termitenstudien — 4. Versuch einer systematischen Monographie der Termiten der Orientalischen Region. — In: K. Svenska Vetensk. Akad. Handl. — Stockholm **50** (1913b) 2. — S. 1—276.

Holmgren, N. & Holmgren, K.: On a collection of termites from India. — In: Mem. Dept. Agri India. — Delhi **5** (1917) 3. — S. 138—171.

Kemner, N. A.: On some termites from Ceylon. — Bull. Ent. Res. London. — London **16** (1926) 4. — S. 379—392.

— Revision der Termiten Afrikas. 3. Monographie. — In: K. Svenska Vetensk. Akad. Handl. — Stockholm (3) **3** (1926b) I. — S. 1—419.

König, J. C.: Beschäftigungen der Berlinischen Gesellschaft Naturforschender Freunde (English translation by T. B. Fletcher). — In: Proc. 4th Ent. Mtg., Pusa (1979) 1921. — S. 312—313.

Manoria, C. B.: Geography of India, agricultural geography. — 1979, Agra: Shiwalala Agarwala & Co.

National Bureau of Soil Survey and Land use. Description and classification of Benchmark soils. In: Benchmark soils of India. — 1982, Chapter 6. — S. 105—374 (Ed. Murthy et al.).

DOI: 10.21248/contrib.entomol.39.2.343-366

PRASHAD, B. & SEN-SARMA, P. K.: Revision of termite genus *Nasutitermes* BANKS (Isoptera: Termitidae: Nasutiterminae) from the Indian Region. — In: Indian Counc. Agric. Res. — New Delhi (1959) 10.23. — 66 S.

— Revision of genus *Hospilalitermes* HOLMGREN (Isoptera: Termitidae: Nasutitermitinae) from the Indian Region. — In: Indian Counc. Agric. Res. — New Delhi (1960) 10.29. — 37 S.

— Review of the genus *Trinervitermes* HOLMGREN for the Indian Region (Isoptera: Termitidae: Nasutiterminae). — In: Indian For. Bull. (N. S.) (Ent.) No. 246. — S. 1–56.

PRASHAD, B.; THAPA, R. S. & SEN-SARMA, P. K.: Revision of Indian species of genus *Microcerotermes* SILVESTRI (Isoptera: Termitidae: Amitermitinae). In: Indian For. Bull. (N. S.) (Ent.). — Dehra Dun (1966) 246. — 56 S.

ROONWAL, M. L. & CHHOTANI, O. B.: Termite fauna of Assam region. Eastern India. — In: Proc. Nath. Inst. Sci. India. — (B) **28** (1962a) 4. — S. 281—406.

— Indian species of termite genus *Coptotermes*. — In: Indian Counc. Agric. Res. — (1962b) Monogr. 2. — IX + 115 S.

ROONWAL, M. L. & VERMA, S. C.: Resurvey of termite fauna of Rajasthan. — In: Rec. Zool. Surv. India. — Calcutta **72** (1977b). — S. 425—480.

SEN-SARMA, P. K.: Ecology and bioecography of the termites of India. In: Ecology and biogeography of India. — (1974) — S. 421—471 (Ed. M. S. MANI).

SEN-SARMA, P. K.; THAKUR, M. L.; MISRA, S. C. & GUPTA, B. K.: Wood destroying termites of India. — In: Final Tech. Rept. PL 480 Projekt No. A 7-FS-58 (Grant No. FC-IN-377) 1975. — VIII + S. 1—187.

SINGH, R. L.: India, a regional geography. — In: Nath. Geo. Soc., Varnasi. — 1971.

SNYDER, T. E.: New termites from India. — In: Proc. U. S. Nat. Mus., **82** (1933) 16. — S. 1—15.

— New termites from India. — In: Indian Forester. Rec. — Dehra Dun **20** (1934) 11. — S. 1—28.

SPATE, O. H. K. & LEARMONTH, A. T. A.: India and Pakistan: a general and regional geography. — 1976; London: METHUEN & Co. Ltd.

THAKUR, M. L.: Further records of occurrence of termite genus *Procryptotermes* (Isoptera: Kalatermitidae) in the Indian Region with new species from South India. — In: J. Indian Acad. Wood Sci. **6** (1975) 1. — S. 29—36.

— A new termite *Pericapritermes topslipensis* sp. nov. (Isoptera: Termitidae: Termitinae) from South India. — In: Timber. Dev. Assoc. India. — Dehra Dun **22** (1976a) 1. — S. 11—14.

— Further records of occurrence of termite genus *Ceylonitermes* HOLMGREN in India, with a new species from Kerala (Isoptera: Termitidae: Nasutitermitinae). — Timber Dev. Assoc. India, Dehra Dun **22** (1976b) 1. — S. 15—22.

— A new nasute termite *Alstonitermes* gen. nov. et sp. nov. from Tamilnadu, South India (Isoptera: Termitidae: Nasutitermitinae). — In: J. Bombay nat. Hist. Soc. — Bombay **72** (1976c) 3. — S. 781—785.

— Ecobiogeography of termites in Indian Arid Ecosystem. — In: Sociobiology. — New York **5** (1980) 2. — S. 115—131.

— Origin. dispersion and distribution of subfamily Macrotermitinae (Isoptera: Termitidae). — In: J. Entomol. Res. — New Delhi **5** (1982) 1. — S. 79—89.

THAKUR, M. L. & THAKUR, R. K.: Studies on the termite fauna (Insecta: Isoptera) of Gujrat, India. — 1982. — I—IV + 292 S. — Jodhpur, Univ. of Jodhpur, Ph. D. Thesis (Zoology).

WASMANN, E.: Neue Termitophiten und Termiten aus Indien. Viaggo di LEONARDO FEA in Birmania & Region Vivine. — In: Anna del. Mus. Civ. di. Stor. Nat. — Genova (2) **16** (1896) 36. — LXXII. — S. 613—630.

— Termiten, Termitophilen und Myrmecophilen. Gesammelt auf Ceylon von Dr. W. HORN. — In: Zool. Jahrb. Abt. Syst. — Jena **17** (1902) 1. — S. 99—160.

DOI: 10.21248/contrib.entomol.39.2.343-366