

STUDIES ON THE DIGESTIVE TUBE OF THE GENUS *AMITERMES* *SILVESTRI* WITH A NOTE ON ITS DISTRIBUTION

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Abstract: Configuration of digestive tube and enteric valve armature of termite species, *Amitermes belli* (Desneux), *A. dentatus* (Haviland) and *A. paradenatus* Ahmad are described. In genus *Amitermes*, the enteric valve seating is mid-dorsal. Enteric valve cushions are tube like with nipple like scales. Scales at anterior end are with longer spines than at posterior end, and tips of the scales are provided with pimple like projection. *Amitermes belli* (Desneux) and *A. paradenatus* Ahmad have almost the same configuration of the digestive tube; but in *A. dentatus* (Haviland) mixed segment is present. Zoogeographical distribution of 81 species of genus *Amitermes* is listed. The species of genus *Amitermes* are distributed as follow: Australian region (27), Ethiopian region (30), Indomalayan (6), Nearctic (8), Neotropical (7), Palaearctic (3). It is postulated that the genus *Amitermes* originated in the Ethiopian region.

Key words: *Amitermes*, enteric valves, zoogeographical distribution.

INTRODUCTION

In Pakistan, genus *Amitermes* is represented by three species; *A. baluchistanicus* Akhtar, *A. belli* (Desneux) and *A. paradenatus* Ahmad. Akhtar (1972) described *A. baluchistanicus* from Baluchistan, since then it has not been reported from any other part of Pakistan. Similarly, *A. paradenatus* was recorded only once from Karachi. On the other hand, *A. belli* (Desneux) is widely distributed in Pakistan and shows great adaptability to different ecological conditions. According to Emerson (1955), genus *Amitermes* is cosmopolitan, and the centre of origin of genus is obscure, because most of the species are found in Africa, but the most primitive are Indomalayan.

In the present paper digestive tube features have been studied in detail and the study is based upon following species: *A. belli* (Desneux), *A. dentatus* (Haviland) and *A. paradenatus* Ahmad. Besides, zoogeographical is discussed.

MATERIALS AND METHODS

The study is based on the material collected by Dr. Muzaffar Ahmad and Dr.

Muhammad Saeed Akhtar, University of the Punjab, Lahore. The specimens are presently in the custody of first author.

The position of alimentary canal of the worker was observed through the body wall of an unopened specimen. Later on, specimen was dissected under Leitz stereoscopic microscope with built-in magnification changer, and the gut was exposed. After noting the coiling of the gut and malpighian tubules attachment, the gut was uncoiled and straightened for making diagram with the help of Camera Lucida. To study the armature of enteric valve cushions, slides of the cuticle were prepared.

RESULTS

Systematic accounts

Genus Amitermes

Amitermes belli (Desneux)

Configuration of digestive tube

Dorsal view (Fig. 1a)

The following structures are visible in the digestive tube (*in situ*), oesophagus (O); crop (cp); gizzard (G); major part of mesenteron (M) forming anticlockwise loop; dilated portion of P₁ towards the left side of abdomen; U-shaped narrow P₂ located towards the right dorsal side of abdomen visible; some part of P₃ below P₂ visible; colon starting within mesenteron loop visible; half part of colon visible on right side; passage of colon into rectum (R) visible in dorsal view.

Ventral view (Fig. 1b)

The following structure are visible (*in situ*) in ventral view: oesophagus; crop; posterior part of mesenteron; dilated portion of P₁ is visible on right side of abdomen, P₃ located on left side clearly visible, rectum passing below paunch visible.

Configuration (Fig. 1a-c)

Oesophagus (O) leads into a distinct crop (cp); Armed chitinized gizzard (G); Crop asymmetrical main bulge on the right side of abdomen; Gizzard enters into mesenteron by narrow tube; Mesenteron (M) loops anticlockwise from left to right side of abdomen; P₁ dilated before the narrower P₂ portion; Enteric valve seating mid-dorsal, U-shaped; P₃ dilated anteriorly and tapering posteriorly; Colon lying above the paunch runs backward into rectum.

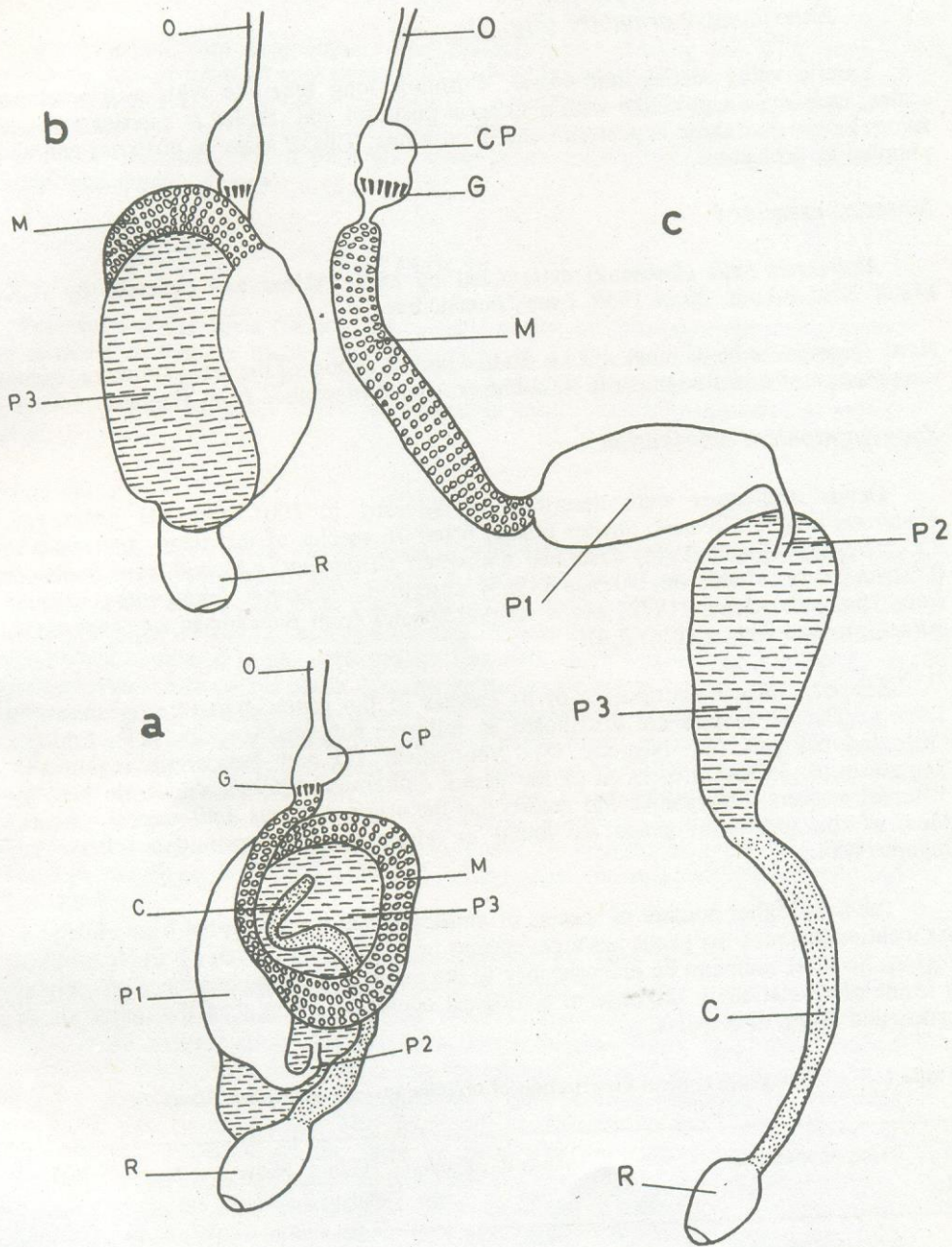


Fig.1(a): Configuration of the digestive tube (*in situ*) of *Amitermes belli*. Dorsal view (X294): O. Oesophagus; Cp. Crop; G. Gizzard; P¹. First proctodeal segment; P². Second proctodeal segment; P³. Third proctodeal segment; C. Colon; R. Rectum.
 (b) Ventral view (X294).
 (c) Structure of digestive tube of *Amitermes belli* uncoiled (X294).

Enteric valve armature (Fig. 2)

Enteric valve seating mid-dorsal; Cushions long tube-like with well-developed scales, each scale nipple-like with a spine at posterior end. Scales at anterior end with spines longer than those at posterior end of cushions. Tips of scales at posterior end with pimple like projection.

Material examined

Amitermes belli (Desneux) determined by M.S. Akhtar and collected by N.K. Malik, Sind Sukkur, 20.iii.1969, from "Jamen" tree.

Note: Digestive tube of other species studied here is almost of the same structure, except the presence of mixed segment in *A. dentatus* Ahmad (described from Thailand).

Zoogeographical distribution

Genus *Amitermes* were described by Silvestri in 1901 with the generitype, *Amitermes amifer* Silvestri. Snyder (1949) listed 76 species of the genus *Amitermes* in his catalogue. Ahmad (1955) described *Amitermes parodontatus* Ahmad from Budhapur (District Dadu). Later on, Ahmad (1965) described *Amitermes longignathus* Ahmad from Thailand. Akhtar (1972) added another species from Baluchistan i.e., *Amitermes baluchistanicus* Akhtar (Figs.3,4).

Zoogeographical distribution of 81 species of the genus *Amitermes* is shown in Table 1. The 81 species are distributed as follows: Notogea/Australia (27), Ethiopia (30), Indomalayan (6), Nearctic (8), Neotropical (7) and Palaearctic region (3). Regarding origin and dispersion of the genus *Amitermes* different views are held by different workers. Emerson (1955) reports that the origin of genus *Amitermes* is obscure. Most of the species of genus are found in Africa but more primitive relative are Indomalayan.

The next higher number of species of *Amitermes* has been reported from Australia. As mentioned above the genus has eight species in Nearctic and seven (7) in Neotropical region. So there seems to be inconsistency in the order of species abundance possibly as a result of speciation in response to ecological condition rather than the indication of centre and origin of dispersal.

Table 1: Zoogeographical distribution of termite species of Genus: *Amitermes*.

Sr. No.	Name of species	Austral-ian	Ethiop-ian	Indo-malayan	Nearctic	Neo-tropical	Pala-earctic
1	<i>A. amifer</i> Silvestri	-	-	-	-	+	-
2	<i>A. atlanticus</i> Fuller	-	+	-	-	-	-
3	<i>A. baluchistanicus</i> Akhtar	-	-	+	-	-	-

4	<i>A. beaumonti</i> Banks	-	-	-	-	+	-
5	<i>A. bechuana</i> Fuller	-	+	-	-	-	-
6	<i>A. beli</i> (Desneux)	-	-	+	-	-	-
7	<i>A. braunsi</i> Fuller	-	+	-	-	-	-
8	<i>A. capicola</i> Silvestri	-	+	-	-	-	-
9	<i>A. capite</i> Hill	+	-	-	-	-	-
10	<i>A. coachellae</i> Light	-	-	-	+	-	-
11	<i>A. colonus</i> Hill	+	-	-	-	-	-
12	<i>A. cryptodon</i> Light	-	-	-	-	+	-
13	<i>A. darwini</i> Hill	+	-	-	-	-	-
14	<i>A. dentatus</i> (Haviland)	-	-	+	-	-	-
15	<i>A. dentosus</i> Hill	+	-	-	-	-	-
16	<i>A. desertoerum</i> (Desneux)	-	-	-	-	-	+
17	<i>A. elongatus</i> Silvestri	-	+	-	-	-	-
18	<i>A. emersoni</i> Light	-	-	-	+	-	-
19	<i>A. ensifer</i> Light	-	-	-	-	+	-
20	<i>A. eucalypti</i> Hill	+	-	-	-	-	-
21	<i>A. evuncifer</i> Silvestri	-	+	-	-	-	-
22	<i>A. evuncifer-varheterocera</i> Silvestri	-	+	-	-	-	-
23	<i>A. excellens</i>	-	-	-	-	+	-
24	<i>A. exillis</i> Hill	+	-	-	-	-	-
25	<i>A. foreli</i> Wasmann	-	-	-	-	+	-
26	<i>A. gallagheri</i> Chhotani	-	+	-	-	-	-
27	<i>A. germanus</i> Hill	+	-	-	-	-	-
28	<i>A. gunni</i> Fuller	-	+	-	-	-	-
29	<i>A. hartmeyeri</i> Silvestri	+	-	-	-	-	-
30	<i>A. hastatus</i> (Haviland)	-	+	-	-	-	-
31	<i>A. herbertensis</i> Mjoberg	+	-	-	-	-	-
32	<i>A. heterognathus</i> Silvestri	+	-	-	-	-	-
33	<i>A. kellyi</i> Fuller	-	+	-	-	-	-
34	<i>A. kenhardi</i> Fuller	-	+	-	-	-	-
35	<i>A. lacertosus</i> Ghidini	-	+	-	-	-	-
36	<i>A. latidens</i> Mjoberg	+	-	-	-	-	-
37	<i>A. lativentris</i> Mjoberg	+	-	-	-	-	-
38	<i>A. laurensis</i> Mjoberg	+	-	-	-	-	-
39	<i>A. libertatis</i> Fuller	-	+	-	-	-	-
40	<i>A. lompopensis</i> Fuller	-	+	-	-	-	-
41	<i>A. londonensis</i> Fuller	-	+	-	-	-	-
42	<i>A. longignathus</i> Ahmad	-	-	+	-	-	-
43	<i>A. lonnbergianus</i> (Sjostedt)	-	+	-	-	-	-
44	<i>A. macrocephalus</i> Ghidini	-	+	-	-	-	-
45	<i>A. meridionalis</i> (Froggatt)	+	-	-	-	-	-
46	<i>A. meruensis</i> (Sjostedt)	-	+	-	-	-	-

47	<i>A. messinae</i> Fuller	-	+	-	-	-	-
48	<i>A. minimus</i> Light	-	-	-	+	-	-
49	<i>A. minor</i> Holmgren	-	-	+	-	-	-
50	<i>A. modicus</i> Hill	+	-	-	-	-	-
51	<i>A. murraysburgi</i> Fuller	-	+	-	-	-	-
52	<i>A. neogermanus</i> Hill	+	-	-	-	-	-
53	<i>A. obeuntis</i> Silvestri	+	-	-	-	-	-
54	<i>A. obtusidens</i> Mjoberg	+	-	-	-	-	-
55	<i>A. pallidus</i> Light	-	-	-	+	-	-
56	<i>A. paradentatus</i> Ahmad	-	-	+	-	-	-
57	<i>A. parvidus</i> Hill	+	-	-	-	-	-
58	<i>A. parvulus</i> Light	-	-	-	+	-	-
59	<i>A. parvus</i> Hill	+	-	-	-	-	-
60	<i>A. paucinervius</i> (Silvestri)	-	+	-	-	-	-
61	<i>A. perarmatus</i> (Silvestri)	+	-	-	-	-	-
62	<i>A. perelegans</i> Hill	+	-	-	-	-	-
63	<i>A. ravus</i> Hill	+	-	-	-	-	-
64	<i>A. runconifer</i> Silvestri	-	+	-	-	-	-
65	<i>A. santschi</i> Silvestri	-	-	-	-	-	+
66	<i>A. schoombiensis</i> Fuller	-	+	-	-	-	-
67	<i>A. sciangallorum</i> Ghidni	-	+	-	-	-	-
68	<i>A. scopulus</i> Mjoberg	+	-	-	-	-	-
69	<i>A. seminotus</i> (Silvestri)	-	+	-	-	-	-
70	<i>A. silvestrianus</i> Light	-	-	-	+	-	-
71	<i>A. snyderi</i> Light	-	-	-	+	-	-
72	<i>A. somaliensis</i> Sjostedt	-	+	-	-	-	-
73	<i>A. spinifer</i> Silvestri	-	+	-	-	-	-
74	<i>A. stephensoni</i> Harris	-	+	-	-	-	-
75	<i>A. unidentatus</i> (Wasmann)	-	+	-	-	-	-
76	<i>A. vilis</i> (Hagen)	-	-	-	-	-	+
77	<i>A. vitiosus</i> Hill	+	-	-	-	-	-
78	<i>A. westraliensis</i> Hill	+	-	-	-	-	-
79	<i>A. wheeleri</i> (Desneux)	-	-	-	+	+	-
80	<i>A. xylophagus</i> Hill	+	-	-	-	-	-
81	<i>A. zuurbergi</i> Hill	-	+	-	-	-	-
Total species in each region		27	30	6	8	7	3

As maximum number of species have been reported from the Ethiopian region, it should be considered its place of origin.

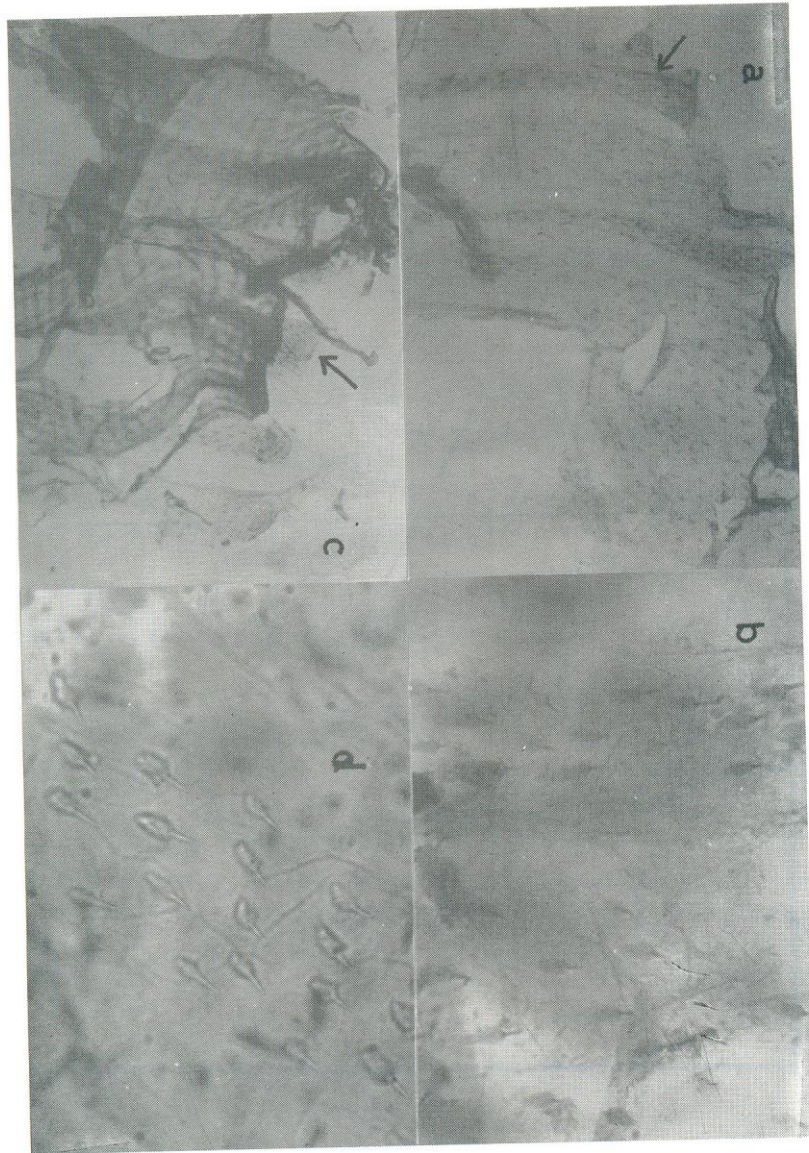


Fig. 2 a) Enteric valve armature of cushions of *Amitermes belli* under low magnification (X200); b) Enteric valve armature of cushions of *Amitermes belli* under high magnification (X1000); c) Enteric valve armature of cushions of *Amitermes dentatus* under low magnification (X200); d) Enteric valve armature of cushions of *Amitermes parviventris* under high magnification (X1000).

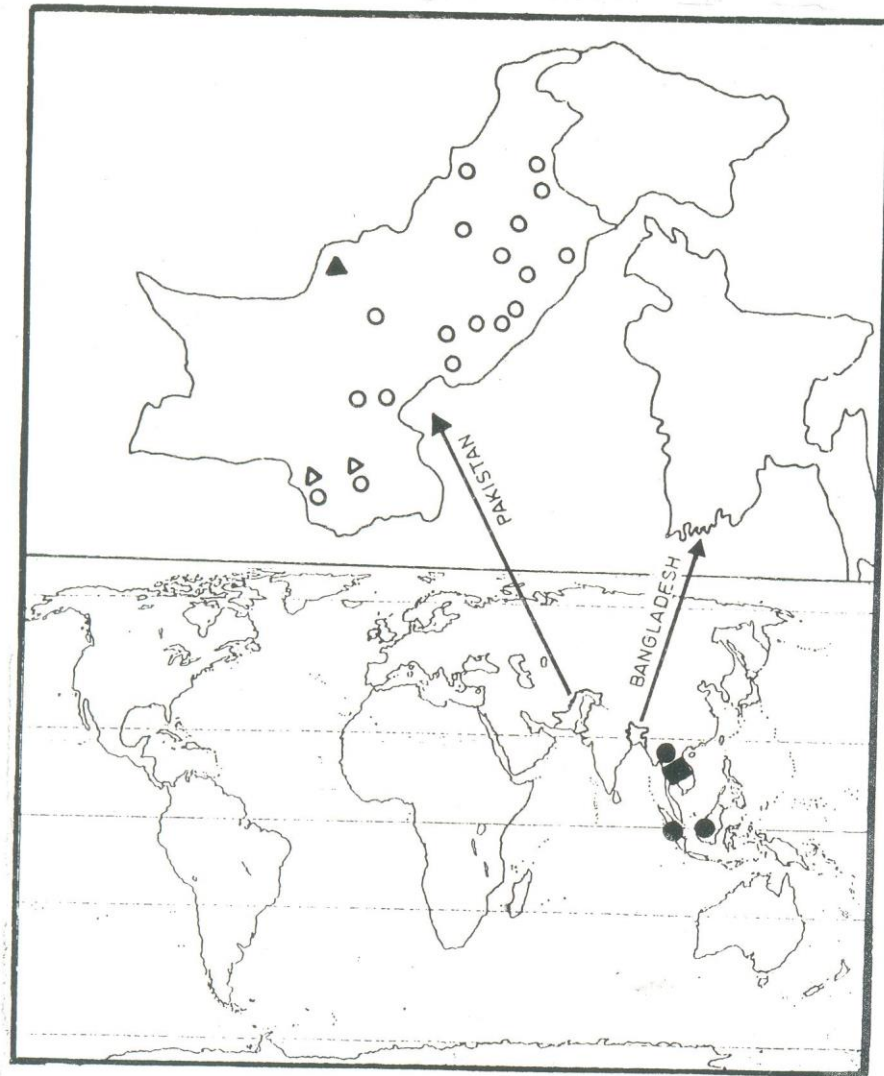


Fig. 3: Distribution of the genus *Amitermes* in the Oriental region.
 ▲, *Amitermes baluchistanicus* Akhtar; ○, *Amitermes belli* (Desneux); ●, *Amitermes dentatus* (Haviland); ■, *Amitermes longignathus* Ahmad; △, *Amitermes paradentatus* Ahmad.

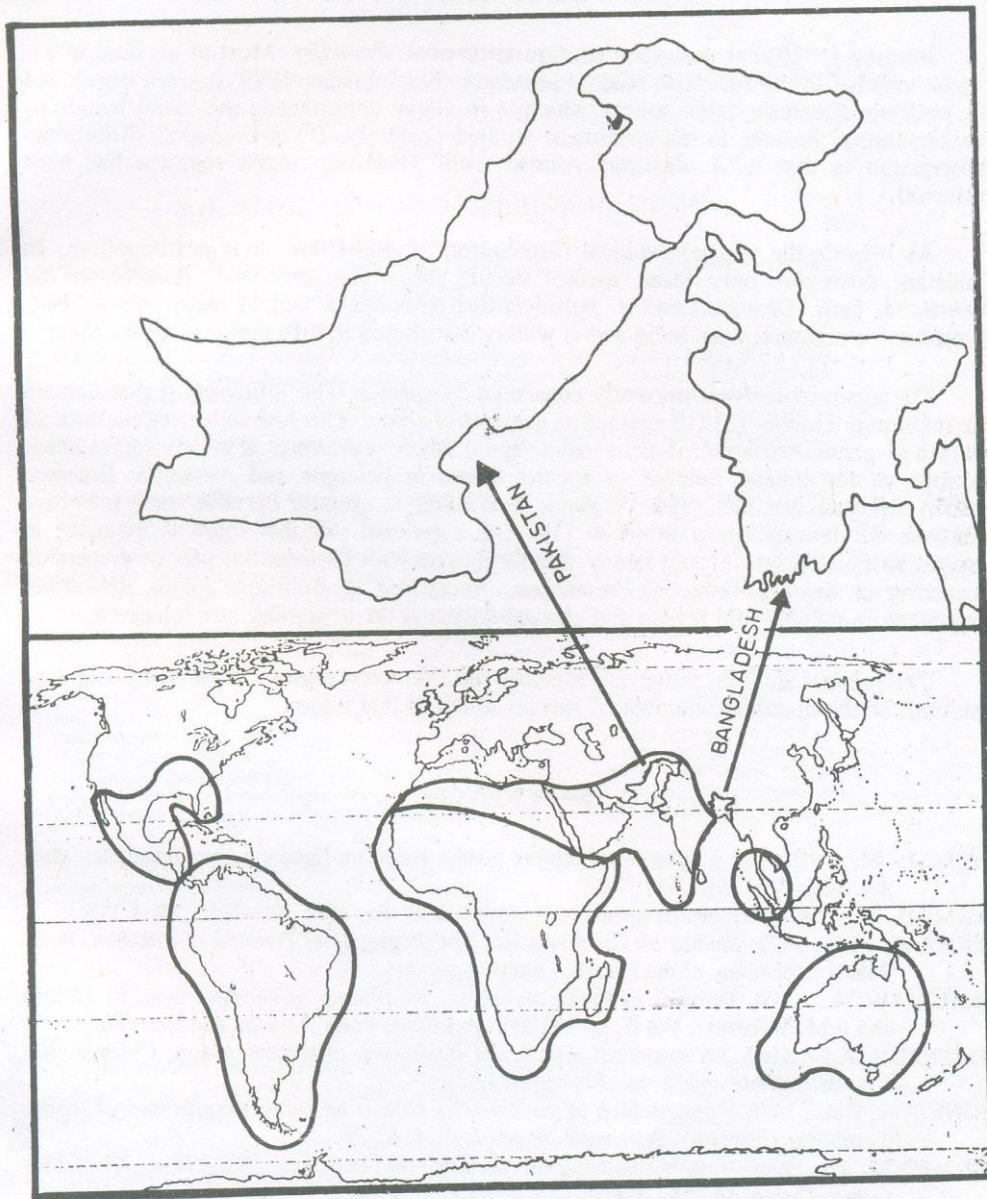


Fig. 4: Distribution of the genus *Amitermes* in different zoogeographical regions.

DISCUSSION

Johnson (1979) has described configuration of *A. evuncifer*. Most of his description can be verified in the specimen studied presently. But Johnson (1979) has not mentioned the location of enteric valve seating which is in a way important in the identification of worker castes. Besides in the specimens studied presently, P² is U-shaped. Additional information is that in *A. dentatus* Ahmad from Thailand, mixed segment has been observed.

As regards the zoogeographical distribution of *Amitermes*, it is cosmopolitan. In Pakistan, however, only three species occur, these are *Amitermes baluchistanicus* Akhtar, *A. belli* (Desneux) and *A. paradentatus* (Haviland). Out of these only *A. belli* (Desneux) is common with India and is widely distributed in different ecological zone.

The genus *Amitermes* presently consist of 81 species. The Ethiopian region contain the maximum number (31) of species of genus *Amitermes*. The Australian region with 27 species of genus *Amitermes* is the second region where *Amitermes* is widely represented. In spite of the greater number of species found in Ethiopia and Australia, Emerson (1955) reported that the origin of genus *Amitermes* is obscure because more primitive relatives are Indomalayan. Bouillon (1970) has pointed out that there is evidence to suggest oriental origin of sub-family Amitermitinae with its essential part of dispersion occurring at the beginning of Cretaceous. According to Bouillon, genus *Amitermes* originated in the Oriental region and entered Africa at the beginning of Cretaceous.

The present authors, however, consider the Ethiopian region, its place of origin on the basis of the maximum number of species found in that region.

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