

THE MOUND-STRUCTURE AND PRIMARY REPRODUCTIVES (KING AND QUEEN) OF THE TERMITE *ODONTOTERMES KUSHWAHAI* (TERMITIDAE)

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ABSTRACT

(1) The mature earthen mounds of *Odontotermes kushwahi* Roonwal and Bose (Isoptera, Termitidae, Macrotermitinae), as studied at Pune (Maharashtra), are dome-shaped to subconical (ratio Height/Diameter ca. 0.4—0.5), and have a broad, round base (ca. 2m or more in diameter) and a hard outer surface with several rounded holes (ca. 4-7mm in diameter). The holes lead to blind tunnels. At the basal periphery there is a flat platform, ca. 80 cm. in radius, having several small holes ; it represents the extent of the underground nest. (2) Large, rounded vaults are scattered throughout the mound, each usually contains one, sometimes two, fungus-combs. (3) The royal chamber is a spindle-shaped cavity in the soil without any hard-walled defences, and contains a king and a physogastric queen. It lies eccentrically at, or well above, the ground level. (4) Nymphs are found in the fungus-combs and elsewhere, and are not confined to separate "nurseries". (5) The primary reproductives (imagoes) are described from dealates (kings and physogastric queens), and are compared with those of the allied species, *O. brunneus*. (6) The Pune record fills a gap in the hitherto discontinuous distribution of the species.

INTRODUCTION

The termite, *Odontotermes kushwahi* Roonwal and Bose 1964 (Isoptera, Termitidae, Macrotermitinae), was originally described from soldiers and workers as a subspecies of *O. brunneus* (Hagen) ; it has now been raised to a full species (Roonwal, 1976 ; Roonwal and Verma, 1977). The primary reproductives were hitherto unknown. A 45-cm high mound was mentioned by Roonwal and Bose (1964) but its structure is unknown (Roonwal, 1970). In the present account we describe mound-structure and the primary reproductives. It is interesting to observe that at Pune mounds of both *O. kushwahi* and its near ally, *O. brunneus*, occur in the same area.

MATERIAL

Recently (March 1977) one of us (M. L. R.) studied mound-structure in the field and made

collections of all associated castes (soldiers, workers and primary reproductives, e.g. kings and large physogastric queens) at Pune (= Poona), Maharashtra (latitude 18°31' N, longitude 73°55' E, altitude above mean sea-level 570 m) in Peninsular India. The type material (soldiers) of *O. kushwahi* was used for comparison.

MOUND-STRUCTURE

(Fig. 1 ; and Pls. 1, 2)

Except for the bare mention of a 45-cm high mound in the Udaipur District, Rajasthan, by Roonwal and Bose (1964, p. 33), nothing is known of the mound of *O. kushwahi*. Mounds were common in the open scrub and fallow land at Gokhalenagar on the outskirts of Pune City a little south of the National Chemical Laboratory. They formed a characteristic feature of this 10,000 m²

area where 9 mounds (one per 1,111 m²) were found. An occasional mound of *O. brunneus* (Hagen) was also present in the same area.

cm, etc.), some of which are empty, but others contain one, or occasionally two, fungus-combs (Pls. 1c, 2b). The combs are brownish grey, rounded to oblong, flat, cake-like, concave,

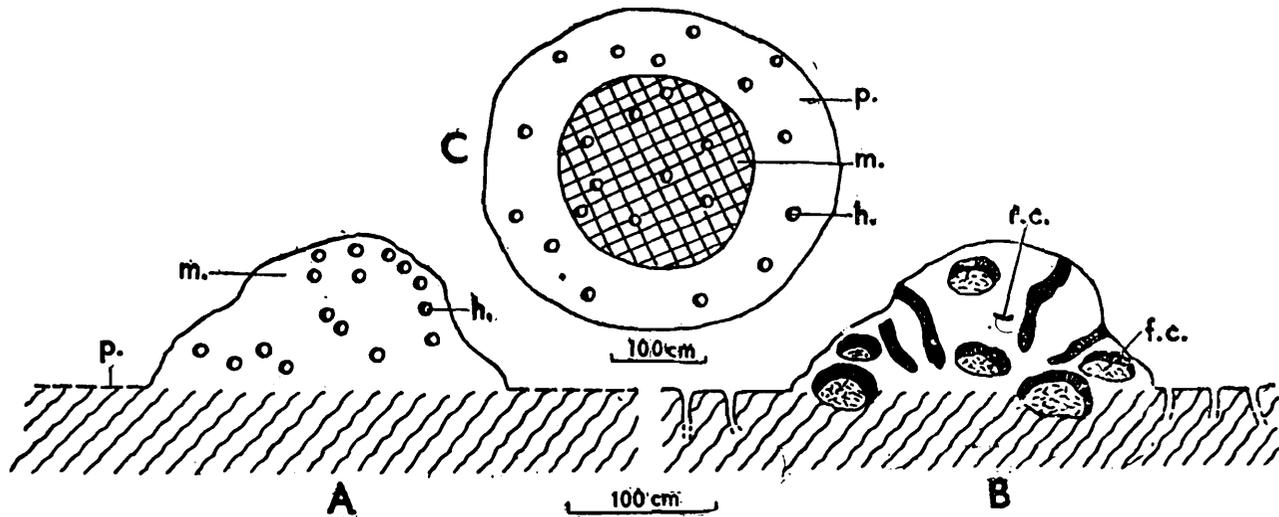


Fig. 1. Mound-structure of *Odontotermes kushwahi*. Semi-diagrammatic. (A) External view, as seen from one side. (B) Same, in vertical section. (C) Same, as seen from above. Note the mound proper and the basal platform.

f.c., fungus-combs ; h., holes on mound surface and on platform ; m., mound proper ; p., basal platform on mound periphery ; r.c., royal chamber.

Mounds of *O. kushwahi* are dome-shaped to subconical, about a metre high, and with a rounded basal diameter of about twice the height (ratio height / diameter *ca.* 0.4-0.5). All around the basal periphery there is generally present a flat platform of about 80 cm radius, at ground-level, marked by numerous small holes, 2-4 cm in diameter ; these holes lead into underground tunnels. The platform represents the extent of the underground nest area.

The mound proper is thick-walled and is made of hard, compacted, dark grey earth which is difficult to dig into without a pickaxe. The mound surface is rough and is covered all over with numerous rounded holes (diameter 4-7 mm) which lead into oblique blind tunnels up to a depth of 30-35 cm. Throughout the mound, right down to the base and a little below, are found rounded, smooth-walled vaults (sizes *ca.* 18×12, 13×12, 28×14

spongy bodies (diameters *ca.* 6 cm×7 cm to 13 cm×27 cm ; height 3-5 cm) composed of soft, granular material ; sinuous lamellae divide the combs into numerous chambers which contain eggs and young larvae besides soldiers and workers.

The royal chamber is a spindle-shaped cavity (length *ca.* 15-16 cm, width 8-9 cm, height 4-5 cm) with a flat floor and an arched roof ; it has no discrete walled structure or defences (cf. *Odontotermes brunneus* and *O. obesus* for example). It lies somewhat eccentrically at the ground-level or well above it nearly in the middle of the mound. Its inside is smooth, almost polished, and is marked by numerous small holes, each leading out to a narrow passageway for the entry and exit of soldiers and workers. In two cases examined, it contained a king, a large physogastric queen (length *ca.* 9 cm), and a few soldiers and workers. No discrete "nurseries" were

found, but larvae were present in small masses either in the fungus-combs or scattered elsewhere in the mound.

The Height/Diameter Ratio : Mature mounds are relatively high, with an H/D ratio of *ca.* 0.4-0.5, thus :

	<i>Mound 1</i>	<i>Mound 2</i>
Height (H) (cm)	89	107
Max. basal diameter (D) (cm)	212	217
Ratio H/D	0.420	0.498

Comparison (Table 1) : The mature mounds of an allied species, *O. brunneus* (Hagen), are much flatter, with an H/D ratio of 0.15—0.28 (Roonwal, 1973, 1977, and in press). Younger mounds, though smaller, are tall and have a high ratio (0.42—0.75). A mature mound of *O. brunneus* occurring in Pune in the same area as *O. kushwahi* also gave a low ratio, as follows : Height 100 cm ; diameter 484 cm ; H/D 0.21.

vicinity : Holmgren (1912, *O. brunneus*, Khadki (=Kirkee, near Pune), Deoras (1962, "*O. malabaricus*") and Ketkar (1962, "*O. redemanni*"). We suspect that the last two are misidentifications (see also Roonwal, 1973).

DESCRIPTION OF PRIMARY REPRODUCTIVES
(Fig. 2 ; and Table 2)

***Odontotermes kushwahi* Roonwal and Bose, 1964.**

Odontotermes brunneus kushwahi Roonwal and Bose 1964, p. 33 ; 1969, p. 442 ; Roonwal, 1970, p. 361.

O. kushwahi R. & B., Roonwal, 1976, p. 494 ; Roonwal and Verma, 1977, p. 451.

Material : 3 vials, Pune (=Poona), Maharashtra : (i) Field No. R1/31.3.77. King, queen, several soldiers and workers, ex mound. (ii) R2/31.3.77. Soldiers and workers, ex earthy termite encrustation on ground. (Both M. L. Roonwal coll. 31.iii.1977). (iii) King,

TABLE 1. Comparison of *mature* earthen mounds of *Odontotermes kushwahi* and *O. brunneus*.

<i>O. kushwahi</i>	<i>O. brunneus</i>
1. Broad-based but relatively higher (ratio Height/Diameter high, <i>ca.</i> 0.4—0.5). Height 89-107 cm ; basal diameter 212-217 cm.	1. Broad-based but low and sprawling (ratio Height/Diameter low, <i>ca.</i> 0.15—0.28). Height 50—100 cm ; basal diameter 320—390 cm.
2. Semi-dome-shaped to sub-conical ; rather high.	2. Dome-shaped, rather flat.
3. A flat platform at ground level (radius <i>ca.</i> 80 cm ; with small 5 cm wide surface holes) generally present all around the mound-base.	3. No such platform around the mound-base.
4. Outer surface smooth, without papillae or turrets, and with small 4-7 cm wide holes.	4. Structure varies greatly. Outer surface either smooth, or very rugose, with small papillae or turrets ; either without holes, or with small to large (up to 25 cm wide) holes.
5. Royal chamber lying at or well above ground-level.	5. Royal chamber lying variously (at, below, or above ground level).

There are three other accounts of *Odontotermes* termite mounds - from Pune and its

queen, several soldiers and workers, ex mound, M. S. Malhotra coll., 23.iii. 1977.

Imago (dealate kings and queens) (Fig. 2. and Table 2.). Sexes alike. Dorsum of head dark brown, peripheral area paler; anteclypeus whitish, postclypeus and legs pale fuscous; rest of body dark brown; eyes almost black. Head and body rather densely hairy, with small hairs all over. Total length without wings: ♂♂ 16-17 mm; ♀♀ (physogastric queens) 73-75 mm.

edges; broken, with 11-15 segments only; segment 2 longer than 3 or 4, 3 shortest, 4 smaller than 2. Anteclypeus narrow, whitish, translucent. Postclypeus swollen and very hairy; medially divided by a dark longitudinal line; maximum width (1.13 mm) about twice the median length (0.57 mm). Labrum tongue-shaped, hairy, broader than long; with a rounded, hyaline distal edge and a horizontal

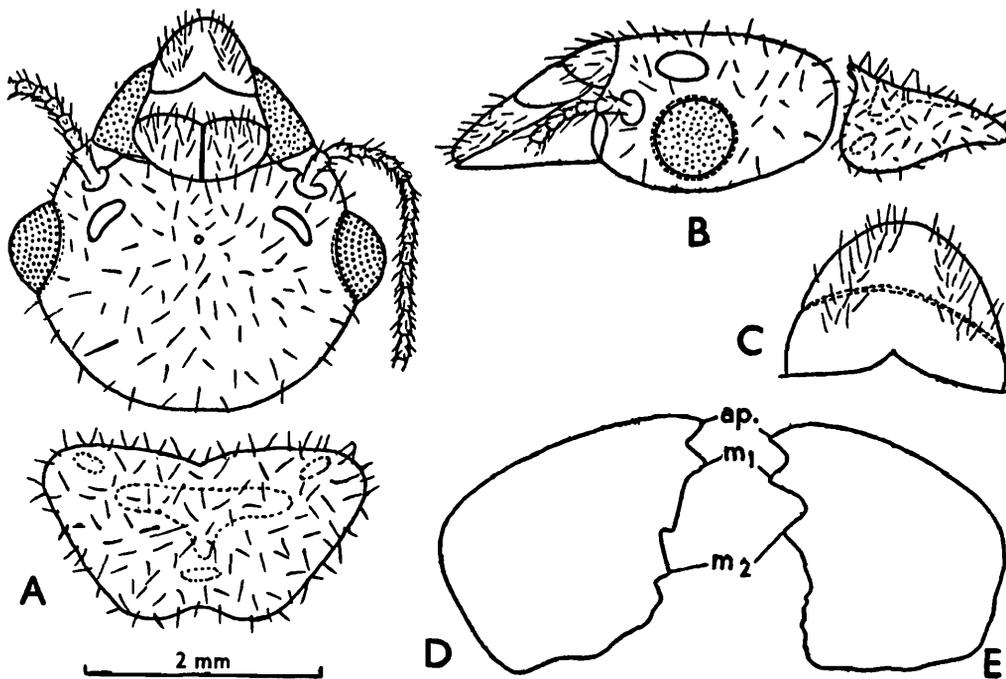


Fig. 2. *Odontotermes kushwahai*, ♀ imago (queen). Pune. (A) Head and pronotum, dorsal view. (B) Same, side view. (C) Labrum. (D) Left mandible. (E) Right mandible.

Head subround, narrowing anteriorly and posteriorly; densely covered with numerous short hairs; sides rounded; Y-suture absent. Fontanelle minute, point-like, submedial, not raised; below this lies a pale subcircular area. Eyes rounded, bulging considerably (cf. *O. brunneus* where they are flatter); maximum diameter 0.93-0.94 mm. Ocelli whitish translucent, roundish-oval (0.24-0.30 × 0.30-0.36 mm; lying obliquely; minimum eye-ocellus distance 0.13 mm, less than half the maximum diameter of ocellus, index 0.36-0.43; minimum eye-antennal distance 0.06 mm. Antennal segments pale brown with whitish anterior

groove-like depression about its middle. Mandibles of typical *Odontotermes*-type, with an apical and two marginal teeth; the apical and 1st marginal large and subequal. Left mandible with 2nd marginal separated from 1st by a wide distance; in right mandible these two teeth much closer. Pronotum trapezoidal, densely hairy, and with well rounded corners; with a median subtriangular whitish patch in anterior half and a roundish patch at the antero-lateral angles; anterior margin with a deep, and posterior one with a weak, median notch. Legs slender and longish. Apical tibial spur formula 3:2:2. Tarsi 4-

TABLE 2. *Odontotermes kushwahi*. Some measurements (in mm.) of imagoes (dealate kings and queens, from Pune).

Body-part	Measurements (mm) (4 exs.)
1. Length of head to mandible-base.	1.45—1.71
2. Max. width of head (with eyes)	2.94—3.00
3. Max. height of head	1.24—1.30
4. Labrum (Length × Width)	0.60 × 0.72
5. Eyes (Min. × Max. diameters)	0.71-0.78 × 0.93—0.94
6. Ocelli (Min. × Max. diameters).	0.24—0.30 × 0.30—0.36
7. Min. eye ocellus distance	0.13
8. Min. eye-antennal distance	0.06
9. Pronotum (Length × width)	1.24-1.33 × 2.70-281
10. Max. length of forewing scale	1.58 (1 ex.)
11. Max. length of hindwing scale	1.30 (1 ex.).

segmented, ending in a pair of short blackish claws. Arolium between claws absent. Wings ; only scales present. Abdomen longish, very hairy, Cerci short, 0.30 mm. long, 2-segmented. Styli short, lengthⁿ 0.10 mm.

Comparison

O. kushwahi is close to *O. brunneus* of which it was originally described as a subspecies (on the basis of soldiers) but subsequently raised to a full species (*vide supra*) ; the comparison of imagoes confirm this separation. It differs from *O. brunneus* as follows :

Imagoes : (i) Smaller (head-width 2.94—3.00 vs. 2.81 mm). (ii) Much paler (*O. brunneus* much darker almost deep chestnut). (iii) Eyes flatter (vs. more bulging). (iv) Head and body densely hairy (vs. very weakly hairy).

Soldiers (Fig. 3) : (i) Head-capsule and thorax sparsely hairy (vs. densely hairy). (ii)

Mandibles longer and more slender and more strongly curved in front (index Mandible length/Head-length to mandible base 0.61—0.87

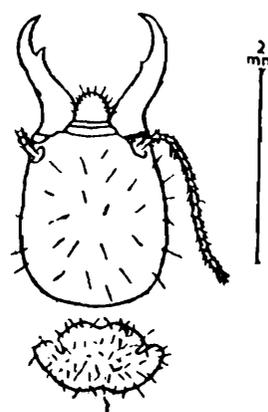
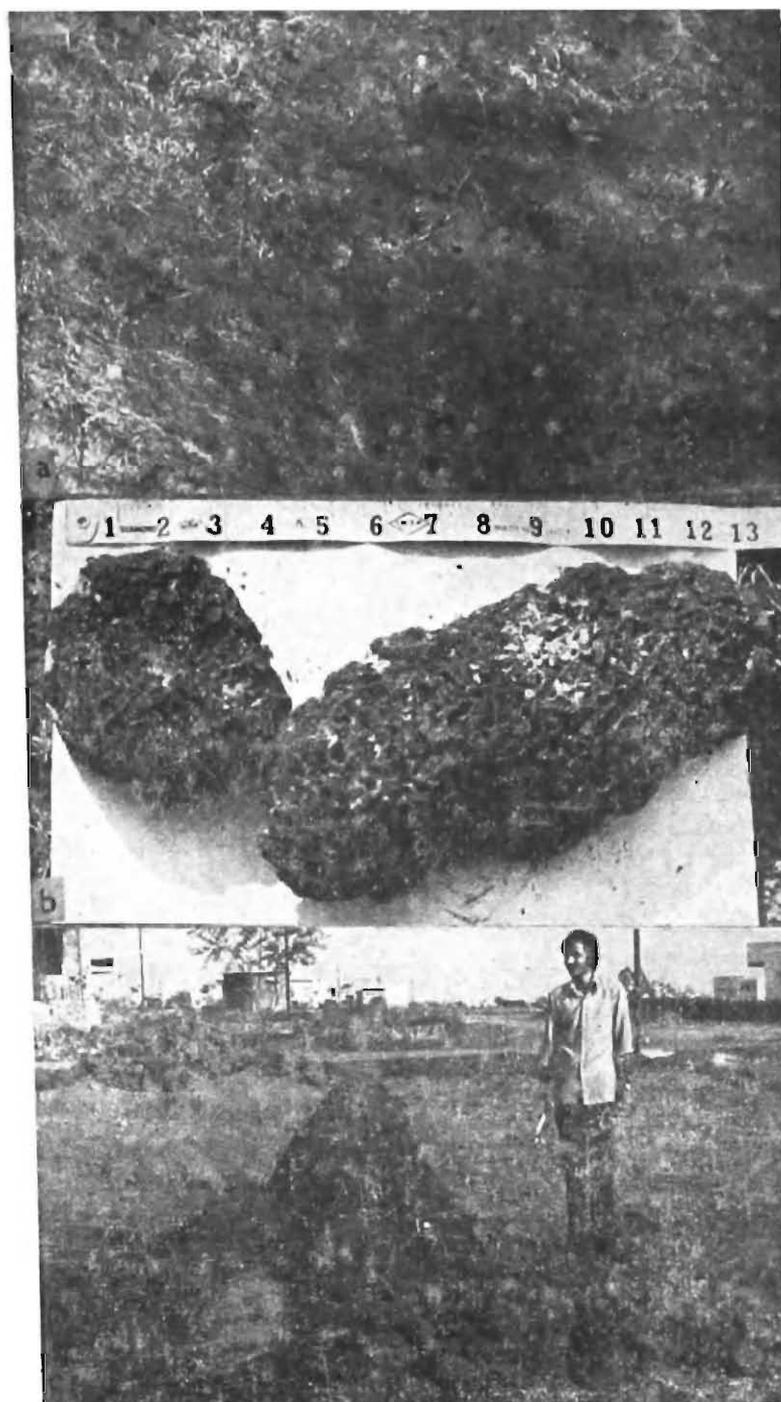


Fig. 3. *Odontotermes kushwahi*. Soldier, head and pronotum, Pune.

vs. 0.52—0.70). (Soldiers from Pune are slightly larger than those from elsewhere, e.g., Rajasthan Gujarat and Tamil Nadu : head-width 1.45—1.71 vs. 1.33—1.48 mm ; head-height 1.00—1.13 vs. 0.83—0.93 mm ; mandible-length 1.24—1.30 vs. 1.08—1.18).



Mound-structure of *Odontotermes kushwahi*
Roonwal & Bose. Pune (Field No. R1/31.3.77).
(a) Mound (height 89 cm). (b) same, closer view.
Note the holes. (c) Part, in vertical section to
show vaults, fungus-combs and royal chamber
(white arrowhead),



Mound-structure of *Odontotermes kushwahi* Roonwal & Bose. Pune. (a) Mound Field No. R 1/31.3.77. (same as in Plate I). Part of basal peripheral platform. Note the holes. (b) Two fungus-combs from mound No. R1/31.3.77 (scale is in inches). (c) Another mound (No. R3/31.3.77), partly scrapped vertically. Note its subconical shape.

DISTRIBUTION AND ECOLOGY

(Fig. 4)

O. kushwahi was hitherto known from Western India (Rajasthan : Udaipur District ; and Gujarat : Kaira District) and then deep south (Tamil Nadu : Salem District) and Roonwal and Verma (1977 p. 451) had remarked on its curiously "discontinuous distribution". The present new record from Pune Maharashtra fills a gap in the discontinuity.

in hilly regions and has been recorded up to about 600 m altitude.

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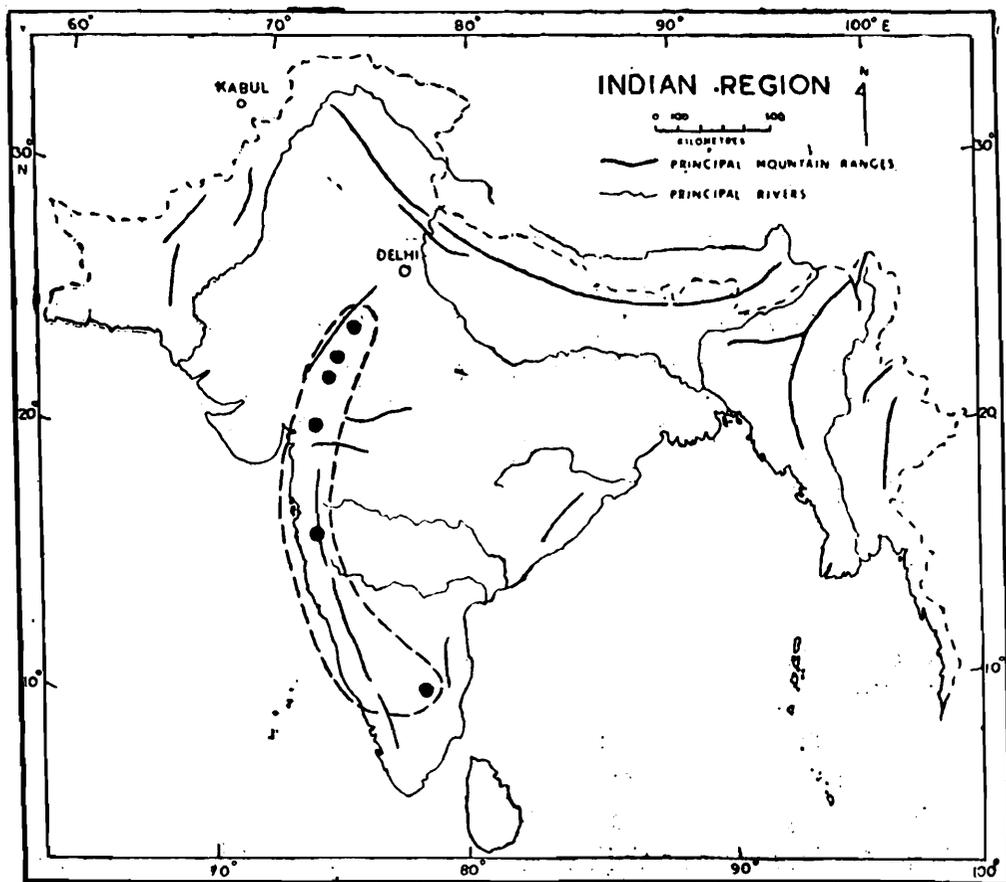


Fig 4.. Distribution (solid circles) of *Odontotermes kushwahi*.

Roonwal (1976) has shown (p. 494) that "it occurs in hot and humid areas with an annual rainfall above *ca.* 60 cm."; and that it "prefers moderate temperatures (mean May below 34°C; mean January above 16°C)". To this may be added that it tends to occur

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