

TAXONOMY AND ZOOGEOGRAPHY OF THE TERMITE FAUNA OF ANDAMAN AND NICOBAR ISLANDS, INDIAN OCEAN

By

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(With 9 Tables, 15 Text-figures and 4 Plates)

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I—INTRODUCTION

1. *Topography, climate and geology of Andamans and Nicobar*

The Andaman and Nicobar Islands form a narrow, curved chain of islands in the Bay of Bengal between Cape Negrin in Lower Burma and the north-western tip of Sumatra, and represent the exposed portions of a long submarine mountain chain which is a continuation of the Arakan

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Yomas of Burma. The Andaman group forms the northern of the two chains and the Nicobar group the Southern. The two groups stretch north-south from about 13°34' N. (the northernmost point of the Andamans) to 6°45' N. (the southernmost point of the Nicobars). The entire chain covers a distance of about 700 miles and consists of 223 islands (204 in the Andamans group and 19 in the Nicobars group). The total land area of these islands is about 3,143 sq. miles—2,508 sq. miles in the Andamans and 635 in the Nicobars. The islands form a mass of hills enclosing narrow valleys. About 75 per cent. of the territory is covered with dense evergreen tropical forests. The highest point is Saddle Peak (2,400 ft.) in the North Andamans. In the Andamans about 5,000 hectares are under cultivation, entirely of paddy ; no cultivation is practised in the Nicobars.

The climate is hot and humid, the mean temperatures near sea-level in the Andamans being as follows :—

			January	May	
Mean	..	..	81·1°F	83·8°F
Diurnal range	10·8°F	10·7°F

The rainfall is heavy, and both the south-west (May-September) and the north-east (October-December) monsoons occur. The total annual rainfall is about 315 cm., most of it being received during the north-west monsoon. January and April are the dry months.

The soil varies from sandy (along the coastal strips) to heavy clayey loam further inland.

According to the account of Karunakaran (1962), the islands first arose from the ocean bed in the Cretaceous period (c. 110 million years ago) of the Mesozoic Era. During subsequent periods the islands underwent elevations and partial submergence several times. (Also *vide infra*, the Section on Zoogeography).

2. History of termite study of Andamans and Nicobars

Until very recent years the termites of the Andaman and Nicobar groups of islands received little attention. Brauer (1865, 1866) mentioned two species from the Nicobars. In his 1865 paper he mentioned two species from the Nicobars, thus : A "Termes" sp. close to "Termes australis" (which a year later, 1866, he described as a new species, *T. longirostris*) and a species with nasute soldiers [=Nasutitermitinae]. In his 1866 paper he described (pp. 47-48) the new species, *Termes longirostris* [=our *Schedorhinotermes longirostris*], based on soldiers (major and minor), workers and nymphs, from the Kondul Is. ; and also mentioned (p. 49) the unnamed species, with nasute soldiers, workers and nymphs, from the Nankauri Is.

Holmgren (1913, p. 86) referred to Brauer's specimens of *S. longirostris*, and described (p. 185) a new species, *Nasutitermes matangensis* [later on considered by Roonwal & Sen-Sarma, 1956, p. 27, as

a subspecies of *N. matangensis* (Haviland) from the Nicobars. Anandale (1924) briefly described the mounds of an *Odontotermes* species from the South Andamans ; this species was stated by him, on the authority of Silvestri's determination, as *Od. obesus* (Rambur), but is really *Od. latigula* (Snyder), a species first described by Snyder (1934) from the North Andamans. Earlier, Snyder (1933) had described a new species, *Neotermes andamanensis* (Sny.), based on imagos only, from the North Andamans. Rattan Lal & Menon (1953) referred in their catalogue to some of these species from the Andamans and Nicobars, but added no new information. Roonwal & Pant (1953) referred in their catalogue to 3 species, namely, *Neotermes andamanensis* (Snyder's record), *Schedorhinotermes longirostris* (new record from the Andamans) and *Odontotermes latigula* from the Andamans.

Thus, up to the year 1953, only four species were known from the Andamans and the Nicobars, namely, *Neotermes andamanensis*, *Schedorhinotermes longirostris*, *Odontotermes latigula* and *Nasutitermes matangensis matangensisformis*.

Roonwal & Sen-Sarma (1956) described a new species, *Hospitalitermes blairi*, from Port Blair, South Andamans. They also recorded *Nasutitermes matangensis matangensisformis* from another island (Camorta Is.) in the Nicobars (Prashad & Sen-Sarma, 1959, p. 51, evidently refer to the same specimens). Roonwal & Sen-Sarma (1960, pp. 144-145), in their revision of the oriental Kalotermitidae, referred briefly to *Neotermes andamanensis* and reproduced Snyder's (1933) description of the imago, the only caste so far known. Roonwal & Thakur (1963) described two new species, *Prorhinotermes shiva* and *Schedorhinotermes tiwarii*, from the Andamans, thus bringing the total number of species to seven.

In the present paper 17 species are recorded from the Andamans and the Nicobars. Of these, the following 4 species are new to science :—

Schedorhinotermes eleanorae sp. n.

Microcerotermes danieli sp. n.

Microcerotermes nicobarensis sp. n.

Nasutitermes krishna sp. n.

The following 5 species are new distributional records from these islands :—

Cryptoitermes dudleyi Banks

Cryptotermes havilandi (Sjöstedt)

Coptotermes heimi (Wasmann)

Coptotermes travians (Haviland)

Prorhinotermes flavus (Bugnion & Popoff)

In the next section a list of the 17 species so far known is given, together with a key for identification. In the Systematic Account which then follows, 14 species, which are present in the collections under study, are dealt with in some detail. Finally, the zoogeography of the termites of the Andamans and the Nicobars is discussed.

3. Collections studied and the collecting localities

(Table 1)

TABLE 1.—List of termite collecting localities in the Andaman and Nicobar Islands. (Also see Plates 11 and 12.)

Abbreviations.—AD, Dr. A. Daniel ; HSR, Dr. H. Srinivasa Rao ; KKT, Dr. K. K. Tiwari ; NA, Dr. N. Annandale ; OP, O. Paiva ; RBSS, Lt.-Col. R. B. Seymour Sewell.

Locality	Latitude (approx.)	Longitude (approx.)	Collector and date of collection
1	2	3	4
(A) ANDAMANS			
1. North Andamans			
1. Diglipur	13°17'N	92°59'E	KKT (2. ii. 1959)
2. Interview Island	12°47'N 12°60'N	92°40'E 92°44'E	KKT (7-8. ii & 8. iv. 1959)
3. Maya Bunder	12°52'N	92°57'E	KKT (28. ii. 1959)
4. Port Cornwallis	13°16' N	92°59'E	KKT (2. ii. 1959)
2. Middle Andamans			
5. Long Island	12°22'— 12°26'N	92°58'— 92°59'E	KKT (23. i. 1959)
3. South Andamans			
6. Aberdeen Bay	11°38'N 11°42'N	92°39'E 92°46'E	KKT (12. i. & 5. iii. 1959)
7. Chouldhari	11°38'N	92°39'E	KKT (26. ii. 1959)
8. Collinpur	11°43'N	92°42'E	KKT (15. iii. 1959)
9. Corbyn's Cove (South)	11°38'N	92°46'E	HSR (15. xii. 1934)
10. Garacharama	11°38'N	92°44'E	OP (30. iii. & 2-3. iv. 1911)
11. Herbertabad	11°43'N	92°37'E	KKT (15. iii. 1959)
12. Hope Town, Ranighat	11°48'N	92°44'E	RBSS (27. viii. 1928)
13. Mount Harriet Range (several Stations from base to summit, ca. 1193 ft.).	11°42'— 11°56'N	92°45'— 92°47'E	NA (xi. & xii. 1923)

TABLE 1—*contd.*

Locality	Latitude (approx.)	Longitude (approx.)	Collector and date of collection
1	2	3	4
14. Port Blair	11°41'N	92°46'E	KKT (5 & 8. iii. 1959) ; AD (8. ii. 1961)
15. Ross Island	11°40'N	92°46'E	OP (30. iii. 1911); KKT (14. iii. 1959)
16. Wright Myo	11°47'N	92°43'E	KKT (13. i. & 15. iii. 1959)
4. Little Andamans			
17. Bedeabdulu, 19 km. south of Tokoibuea.	10°43'N	92°35'E	AD (16. ii. 1961)
18. Benyabobera	10°33'N	92°27'E	AD (23. ii. 1961)
19. Bugenabera	10°40'N	92°31'E	AD (20. ii. 1960)
20. Chai River, 16 km. west of Tokoibuea.	10°47'N	92°32'E	AD (15. ii. 1961)
21. Dugong Creek near Tokoibuea	10°47'N	92°34'E	AD (1. iii. 1961)
22. Entizebera, 16 km. west of Tokoibuea.	10°47'N	92°32'E	AD (15. ii. 1961)
23. Gaje	10°40'N	92°26'E	AD (25. ii. 1961)
24. Ingatijala forest, 8 km. south of Gaje.	10°34'N	92°25'E	AD (25. ii. 1961)
25. Ingitekudda	10°49'N	92°29'E	AD (28. ii. 1961)
26. Ingoie	10°31'N	92°29'E	AD (21. ii. 1961)
27. Kwateneabo forest, near Bumila Creek.	10°52'N	92°33'E	AD (28. ii. 1961)
28. Kwate-tu-Kwage	10°40'N	92°32'E	AD (18. ii. 1961)
29. Laitora forest, 7 km. north of Tokoibuea.	10°50'N	92°34'E	AD (14. ii. 1961)
30. Nachugea	10°47'N	92°26'E	AD (28. ii. 1961)
31. Otirubera-Korale, 17 km. west of Ingoie.	10°33'N	92°26'E	AD (23. ii. 1961)
32. Taib-eh River (forest in between Taib-eh R. Taib-eh and Bugenabera, 16 km. south of Kwate-tu-Kwage).	10°40'N	92°31'E	AD (20. ii. 1961)

TABLE 1—concl'd.

Locality	Latitude (approx.)	Longitude (approx.)	Collector and date of collection
1	2	3	4
33. Taibalowe, 16 km. east of In- goie.	10°31'N	92°31'E	AD (22. ii. 1961)
34. Tailanda, ca. 24 km. north of Kwate-tu-Kwage.	10°40'N	92°35'E	AD (19. ii. 1961)
35. Tokoibuea . . .	10°47'N	92°34'E	AD (1. iii. 1961)
(B) NICOBARS			
1. Car Nicobar			
36. Arong village . . .	09°00'N	92°43'E	KKT (31. iii. 1959)
37. Malacca village . . .	09°09'N	92°50'E	KKT (23. iii. & 8. iv. 1959)
38. Mus village . . .	09°16'N	92°47'E	KKT (28. iii. 1959)
39. Sawi village . . .	09°15'N	92°43'E	KKT (5. iv. 1959)
40. Tamalu village . . .	09°13'N	92°50'E	KKT (24. iii. 1959)
2. Other islands of Nicobars			
41. Camorta Island . . .	08°03'— 08°15'N	93°27'— 93°34'E	
42. Kondul Island . . .	07°17'N	93°39'E	—

(i) Collections studied :

The following collections, present in the Zoological Survey of India, were studied :—(1) A small collection by O. Paiva, March and April, 1911, from the South Andamans. (2) A small collection by Dr. N. Annandale, November and December, 1923, from the South Andamans. (3) A small collection by Lt.-Col. R. B. Seymour Sewell, August, 1928, from the South Andamans. (4) A collection by Dr. K. K. Tiwari, January to April, 1959, from the Andamans (North, Middle and South Andamans) and the Nicobars (Car Nicobar Is. and Camorta Is.). (5) A collection by Dr. A. Daniel, January to March, 1961, from the Little Andamans. (6) The *Schedorhinotermes* material in the collection of the Forest Research Institute, Dehra Dun.

(ii) *Collecting localities (Table 1) :*

Collections were made from 43 different localities in the Andamans and the Nicobars (Table 1), and are summarised below :—

(A) ANDAMANS :	No. of localities
1. North Andamans	4
2. Middle Andamans	1
3. South Andamans	11
4. Little Andamans	19
 (B) NICOBARS :	
1. Car Nicobar	5
2. Other islands	2
	42

The bulk of the material is from the Andamans ; and here again the largest number of localities are from the South Andamans (11) and the Little Andamans (19).

4. *Abbreviations used*

The following abbreviations have been used :—

- Alt.*, altitude (above mean sea-level).
- Coll.*, collected by ; collection.
- Coll. Sta. No.*, Collecting Station Number.
- Det.*, determined (identified) by.
- Ex.*, from ; out of.
- F.R.I.*, Forest Research Institute, Dehra Dun.
- Fd. Coll. No.*, Field Collection Number.
- I.A.R.I.*, Indian Agricultural Research Institute, New Delhi.
- Im.*, imago.
- Ny.*, nymph.
- Pw.*, pseudoworker.
- Reg. No.*, Registered Number.
- S.*, soldier.
- W.*, worker.
- Z.S.I.*, Zoological Survey of India, Calcutta.

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II—LIST OF SPECIES AND KEY FOR IDENTIFICATION

1. List of species

(Pl. 13 and Text-figs. 1-15)

The following is a list of termites known from the Andamans and the Nicobars, together with the castes known and the geographical distribution.

Family 1. KALOTERMITIDAE

Subfamily *Kalotermitinae*

1. *Neotermes andamanensis* (Snyder, 1933).

Castes known : Im.—a dealated ♀ (holotype) and an apterous ♂ (morphotype)*. Snyder's (1933) original description of the imago has been reproduced by Roonwal & Sen-Sarma (1960, pp. 144-145).

Andamans only : North Andamans.

2. *Cryptotermes dudleyi* Banks, 1918.

Castes known : Im., S. and Pw.

Andamans : North Andamans (present record). *Nicobars* : Not yet recorded. *Elsewhere* : A widely distributed species, almost all over the world.

3. *Cryptotermes havilandi* (Sjöstedt, 1897). (Pl. 13, Fig. 1.)

Castes known : Im., S. and Pw.

Andamans : Little Andamans (present record). *Nicobars* : Not yet recorded. *Elsewhere* : A widely distributed species (India, Africa, Madagascar, etc.).

Family 2. RHINOTERMITIDAE

Subfamily (i) *Coptotermitinae*

4. *Coptotermes heimi* (Wasmann, 1902). (Pl. 13, Fig. 2.)

Castes known : Im., S. and W.

*Snyder (1933, p. 2) described the species from just a few nymphs and two imagos—a dealate ♀ (the holotype, now in the British Museum Nat. Hist., London) and an apterous ♂ (the morphotype stated to have been deposited in F.R.I., Dehra Dun, but not present there. *vide* Roonwal & Pant, 1953, p. 45, and Roonwal & Sen-Sarma, pp. 144-145). No other castes are so far known.

Andamans : Little Andamans (present record). *Nicobars* : Not yet recorded. *Elsewhere* : All over India ; West Pakistan ; and middle Java (the last needs confirmation).

5. *Coptotermes travians* (Haviland, 1898). (Pl. 13, Fig. 3.)

Castes known : Im., S. and W.

Andamans : North Andamans and Middle Andamans (Interview Is.) (present record). *Nicobars* : Car Nicobar. *Elsewhere* : Eastern India, East Pakistan, Burma, Malaya and Indonesia (Sumatra, Java, Borneo).

Subfamily (ii) *Rhinotermitinae*

6. *Prorhinotermes flavus* (Bugnion & Popoff, 1910). (Pl. 13, Fig. 4.)

Castes known : S. and W.

Andamans : Little Andamans (present record). *Nicobars* : Not yet recorded. *Elsewhere* : Ceylon.

7. *Prorhinotermes shiva* Roonwal & Thakur, 1963. (Pl. 13, Fig. 5.)

Castes known : S. and W. (major and minor).

Andamans only : Middle Andamans (Long Is.).

8. *Schedorhinotermes eleanorae* n. sp. (Tables 2 and 3 ; and Text-figs. 1-3.)

Castes known : Im., S. (minor) and W.

Andamans only : Little Andamans (present record).

9. *Schedorhinotermes longirostris* (Brauer, 1866). (Table 4 ; and Text-figs. 4-6.)

Castes known : S. (major and minor) and W.

Andamans : "Andaman Islands" (Roonwal & Pant, 1953, p. 49). *Nicobars* : Kondul Is. (Brauer, 1865).

10. *Schedorhinotermes medioobscurus* (Holmgren, 1914). (Text-figs. 7 and 8.)

Castes known : Im., S. and W.

Andamans : South Andamans (Mt. Harriet, alt. 900 ft., *vide* Roonwal & Thakur, 1963, p. 102) ; (also present account). *Nicobars* : Not yet recorded. *Elsewhere* : Malaya (Malacca, Kuala Lumpur and Singapore).

11. *Schedorhinotermes tiwarii* Roonwal & Thakur, 1963. (Pl. 13, Figs. 6 and 6a.)

Castes known : S. (major and minor) and W.

Andamans only : South Andamans and Little Andamans (Roonwal & Thakur, 1963).

Family 3. TERMITIDAE

Subfamily (i) *Amitermitinae*

12. *Microcerotermes danieli* n. sp. (Table 5 ; and Text-figs. 9 and 10.)

Castes known : S. and W.

Andamans only : North, South and Little Andamans (present record).

13. *Microcerotermes nicobarensis* n. sp. (Tables 6 and 7 ; Text-figs. 11-13 ; and Pl. 13, Fig. 7.)

Castes known : Im., S. and W. (major and minor).

Andamans : South Andamans (Ross Is., present record). *Nicobars* : Car Nicobar (present record).

Subfamily (ii) *Macrotermitinae*

14. *Odontotermes latigula* (Snyder, 1934). (Pl. 13, Fig. 8.)

Castes known : S. and W.

Andamans : North Andaman Is. (Snyder, 1934). Also Middle, South and Little Andamans (present record). *Nicobars* : Car Nicobar (present record).

Subfamily (iii) *Nasutitermitinae*

15. *Nasutitermes krishna* n. sp. (Table 8 ; and Text-figs. 14 and 15.)

Castes known : S. and W. (major and minor).

Andamans only : North Andamans (Interview Is.) and Little Andamans (present record).

16. *Nasutitermes matangensis matangensisformis* (Holmgren, 1913). (Pl. 13, Fig. 9.)

Castes known : Im., S. and W.

Andamans : Middle Andamans (present record). *Nicobars* : Nankaūri Is. (Holmgren, 1913), Camorta Is. (Roonwal & Sen-Sarma, 1956) and Car Nicobar Is. (present record). *Elsewhere* : Malaya, Java and Sumatra.

17. *Hospitalitermes blairi* Roonwal & Sen-Sarma, 1956. (Pl. 13, Fig. 10.)

Castes known : S. and W. (major and minor).

Andamans only : South Andamans.

2. Key for identification

KEY TO GENERA AND SPECIES OF TERMITES OF THE ANDAMANS AND THE NICOBARS, BASED ON SOLDIERS.

Note : The Soldier caste is not yet known in *Nectermes andamanensis*, and that species is, therefore, not included in the key.

1(20). Pronotum flat.

2(5). Head sharply truncated in front ; fontanelle absent .. Genus (1) *Cryptotermes*

3(4). Larger species ; head-length (to lateral base of mandibles) 1.58—1.71 mm. .. 1. *Cryptotermes dudleyi*

4(3). Smaller species ; head-length (to lateral base of mandibles) 1.03—1.42 mm. .. 2. *Cryptotermes havilandi*

5(2). Head not sharply truncated in front, fontanelle present.

6(13). Inner margins of mandibles without teeth but with a few weak basal crenulations on left mandible.

- 7(10). Fontanelle large, placed at anterior margin of head just below clypeus. Genus (2) *Coptotermes*
- 8(9). Postmentum narrower at waist (width at waist 0.20—0.29 mm. ; Contraction Index* 0.57—0.69) 3. *Coptotermes travians*
- 9(8). Postmentum broader at waist (width at waist 0.25—0.39 mm. ; Contraction Index* 0.63—0.79) 4. *Coptotermes heimi*
- 10(7). Fontanelle small, placed near middle or a little above the middle of head-dorsum .. Genus (3) *Prorhinotermes*
- 11(12). Smaller species. Head-length (to lateral base of mandibles) 1.55—1.79 mm. .. 5. *Prorhinotermes flavus*
- 12(11). Larger species. Head-length (to lateral base of mandibles) 1.85—1.88 mm. .. 6. *Prorhinotermes shiva*
- 13(6). Inner margins of mandibles with prominent teeth and without any basal crenulations on left mandible Genus (4) *Schedorhinotermes*
- 14(15). Antennae in soldier minor with 14 segments. . 7. *Schedorhinotermes eleanorae* sp.n.
- 15(14). Antennae in soldier minor with 15-16 segments.
- 16(17). Soldier minor larger (head-length to tip of mandibles 1.45—1.60 mm. ; to lateral base of mandibles 0.90—1.07 mm.). [Soldier major : Large and with 16 antennal segments (head-length with mandibles 2.51—2.80 mm. ; to base of mandibles 1.68—1.85 mm. ; head width 1.60—1.68 mm.).] 8. *Schedorhinotermes tiwarii*
- 17(16). Soldier minor smaller (head-length to tip of mandibles 1.30—1.40 mm. ; to lateral base of mandibles 0.77—0.88 mm.).
- 18(19) Soldier minor : Head smaller (length to base of mandibles 0.80 mm.). Pronotum narrower (width 0.43—0.47 mm. ; index Pronotum-width/Head-width 0.60—0.64). [Soldier major : Small and with 16 antennal segments (head-length with mandibles 2.03 mm., to base of mandibles 1.40 mm. ; head-width 1.33 mm.).] 9. *Schedorhinotermes longirostris*
- 19(18). Soldier minor : Head larger (length to base of mandibles 0.83—0.88 mm.). Pronotum broader (width 0.53—0.57 mm. ; index Pronotum-width/Head-width 0.71—0.78). [Soldier major : Large and with 17 antennal segments (head-length with mandibles 2.34—2.60 mm., to base of mandibles 1.45—1.80 mm. ; head-width 1.48—1.60 mm.).] .. 10. *Schedorhinotermes medioobscurus*

*Minimum width
of the postmentum.
Maximum width_h

- 20(1). Pronotum saddle-shaped.
- 21(26). Head not nasute ; mandibles well-developed and easily visible.
- 22(25). Mandibles with inner margins serrated but without definite dentition Genus (5). *Microcerotermes*
- 23(24). Labrum tongue-shaped, with a broad anterior tip 11. *Microcerotermes danieli* sp.n.
- 24(23). Labrum subpentagonal, with a pointed tip . 12. *Microcerotermes nicobaren- sis* sp.n.
- 25(22). Mandibles with inner margin not serrated but with definite dentition ; left mandible with a prominent tooth Genus (6). *Odontotermes*
13. *Odontotermes latigula*
- 26(21). Head nasute ; mandibles minute and not easily visible.
- 27(28). Head greatly produced behind and strongly constricted behind antennae Genus (7). *Hospitalitermes*
14. *Hospitalitermes blairi*
- 28(27). Head not greatly produced behind and not constricted behind antennae Genus (8). *Nasutitermes*
- 29(30). Larger and darker species ; antennae with 13 segments . .. 15. *Nasutitermes matangensis matangensisformis*
- 30(29). Smaller and paler species ; antennae with 12 segments 16. *Nasutitermes krishna* sp. n.

III—SYSTEMATIC ACCOUNT

Family 1. KALOTERMITIDAE

Subfamily *Kalotermitinae*

Genus (1) *Cryptotermes* Banks

1. *Cryptotermes dudleyi* Banks

1918. *Cryptotermes dudleyi* N. Banks, *Bull. Amer. Mus. nat. Hist.*, New York, 38(17), p. 660. Im. *Type-locality*: Panama (Central America).

(a) *Material*.—2 vials, from the Andamans as follows :—(i) Z.S.I. Reg. No. 8043/18, 1 Im., Ross Is., South Andamans, coll. O. Paiva, 24. iii. 1911. *Det.* Silvestri, as “*Cryptotermes domesticus* (Hav.)”. (ii) One vial, Fd. Coll. No. 373, 3 S. and several Pw., Coll. Sta. No. 14, Maya Bunder, North Andamans, coll. K. K. Tiwari, 28. ii. 1959.

(b) *Measurements* (in mm.).—*Imago* (1 example) :

1. Total body-length without antennae, <i>ca.</i>	..	..	5.9
2. Length of head to tip of labrum	..	..	1.23
3. Length of head to lateral base of mandibles	..	..	0.96
4. Maximum width of head with eyes	..	..	0.95
5. Maximum diameter of eye with ocular sclerite	..	..	0.34
6. Maximum diameter of ocellus	..	..	0.15
7. Minimum eye-ocellus distance	..	..	0.03
8. Maximum length of pronotum	..	..	0.60
9. Maximum width of pronotum	..	..	0.88
10. No. of antennal segments (antennae damaged)	..	..	(13 present)

Soldiers (3 examples) :

1. Total body-length without antennae, <i>ca.</i>	..	..	5.5—6.0
2. Length of head with mandibles	..	..	2.35—2.38
3. Length of head to lateral base of mandibles	..	..	1.58—1.60
4. Maximum width of head	..	..	1.25
5. Maximum length of pronotum	..	..	0.65—0.70
6. Maximum width of pronotum	..	..	1.10—1.15
7. No. of antennal segments	..	..	12

(c) *Geographical Distribution*.—*Andamans* : North Andamans (Maya Bunder) ; and South Andamans (Ross Is.). *Elsewhere* : A widely distributed species. Recorded from India, Ceylon, Sumatra, Java, the Philippines, Middle and South America, Australia and New Guinea.

 2. *Cryptotermes havilandi* (Sjöstedt)

(Pl. 13, Fig. 1)

1897. *Calotermes domesticus* Y. Sjöstedt, *Ent. Tidskr.*, Stockholm, 18(4), p. 212, Im. *Type-locality* : Fernando Po. Camerun, West Africa. *Name preoccupied.*

1900. *Calotermes havilandi*: Y. Sjöstedt, *K. Sv. Vet. Akad. Handl.*, Stockholm, 34(4), p. 43, pl. 1, figs. C 1-3. Im.

1926. *Cryptotermes havilandi*: Y. Sjöstedt, *K. Sv. Vet. Akad. Handl.*, Stockholm, (3) 3 (1), pp. 29-30, Im., S.

(a) *Material*.—3 vials, Im., S. and Pw., Little Andamans, coll. A. Daniel, February 1961, as follows :—(i) Fd. Coll. No. 140, Coll. Sta. No. 2, 2 km. inside the forest at Laitora (7 km. north of Tokoibuea), 14. ii. 1961, ex. "dead tree" (ii) Fd. Coll. No. 398, Coll. Sta. No. 4, Taibalowe, 16 km. east of Ingoie, 22. ii. 1961, ex. "dead log in ground". (iii) Fd. Coll. No. 437, Coll. Sta. No. 4, Otirubera-Korale, 17 km. west of Ingoie, 23. ii. 1961, ex. "dead tree".

(b) *Measurements* (in mm.).—*Imagos* (5 examples) :

1. Total body-length without antennae, <i>ca.</i>	..	..	4.6—4.7
2. Length of head to lateral base of mandibles	..	..	0.79—0.80
3. Maximum width of head		..	0.70—0.78
4. Maximum diameter of eye with ocular sclerite		..	0.28—0.30
5. Maximum diameter of ocellus	..	..	0.10
6. Minimum eye-ocellus distance	..	..	0.13—0.15
7. Maximum length of pronotum	..	..	0.53
8. Maximum width of pronotum	..	..	0.70—0.73
9. No. of antennal segments	.	.	14—16

Soldiers (9 examples) :

1. Total body-length without antennae, <i>ca.</i>	..	..	4.5—4.8
2. Length of head with mandibles	..	..	1.53—1.60
3. Length of head to lateral base of mandibles	..	..	1.05—1.08
4. Maximum width of head	..	..	1.00—1.08
5. Maximum length of pronotum	..*	..	0.53—0.58
6. Maximum width of pronotum	..	..	0.93—0.98
7. No. of antennal segments	..	..	10—13

(c) *Geographical Distribution*.—*Andamans* : Little Andamans (Laitora forest ; Otirubera-Korale and Taibalowe). *Elsewhere* : A widely distributed species. Known from India, Africa, Zanzibar, Madagascar, West Indies and South America.

(d) *Biological Remarks*.—The species was collected from a dead log on ground and from a dead tree.

Family 2. RHINOTERMITIDAE

Subfamily (i) *Coptotermitinae*Genus (2) *Coptotermes* Wasmann3. *Coptotermes heimi* (Wasmann)

(Pl. 13. Fig. 2)

1902. *Arrhinotermes heimi* E. Wasmann, *Zool. Jb. (Syst.)*, Jena, 17 (1), p. 104, pl. 4. Im. *Type-locality* : India : Wallon (Ahmednagar District, Maharashtra).

1962. *Coptotermes heimi*, M. L. Roonwal & O. B. Chhotani, *Indian Species of Termite Genus Coptotermes*, New Delhi (*I.C.A.R. Entom. Monogr.*, No. 2), pp. 38-57, pls. 11-14.

(a) *Material*.—5 vials, S. and W., Little Andamans, coll. A. Daniel, February 1961, as follows :—(i) Fd. coll. No. 165, Coll. Sta. No. 2, near Chai River, 16 km. west of Tokoibuea, 15. ii. 1961, ex. “dead tree”. (ii) Fd. Coll. No. 273, Coll. Sta. No. 3, Kwate-tu-Kwage, 18. ii. 1961, ex. “tree”. (iii) Fd. Coll. No. 315, Coll. Sta. No. 5, Tailanda, ca. 22 km. north of Kwate-tu-Kwage, 19. ii. 1961, ex. “dead wood”. (iv) Fd. Coll. No. 340, Coll. Sta. No. 3, forest in between Taib-eh River and Bugenabera, 16 km. south of Kwate-tu-Kwage, 20. ii. 1961, ex. “dead wood”. (v) Fd. Coll. No. 585, Coll. Sta. No. 6, Kwateneabo forest near Bumila Creek, 28. ii. 1961, ex. “dead tree”.

(b) *Measurements* (in mm.).—*Soldiers* (10 examples) :

1. Total body-length without antennae, ca.	..	..	4.5—4.7
2. Length of head with mandibles	..	..	2.11—2.14
3. Length of head to lateral base of mandibles	..	..	1.33—1.35
4. Maximum width of head	..	..	1.15
5. Maximum length of pronotum	..	..	0.45—0.46
6. Maximum width of pronotum	..	..	0.83—0.84
7. No. of antennal segments	..	..	14—15

(c) *Geographical Distribution*.—*Andamans* : Little Andamans (Tokoibuea ; Kwate-tu-Kwage ; Kwateneabo forest near Bumila Creek). *Elsewhere* : All over India ; West Pakistan ; Indonesia (Middle Java, needs confirmation).

(d) *Biological Remarks*.—The species was obtained from dead wood and dead trees in jungle.

4. *Coptotermes travians* (Haviland)

(Pl. 13, Fig. 3)

1898. *Termes travians* G. D. Haviland, *J. Linn. Soc. Lond. (Zool.)*, London, 26 (169), p. 391, pl. 23, figs. 19-22, Im. S. and W. *Type-localities* : Singapore (Malaya) and Sarawak (Borneo).

1962. *Coptotermes travians* : M.L. Roonwal & O. B. Chhotani, *Indian Species of Termite Genus Coptotermes*, New Delhi (I.C.A.R. Entom. Monogr. No. 2), pp. 61-69, pls. 17 and 18.

(a) *Material*.—3 vials, S. and W., Andamans and Nicobars, coll. K. K. Tiwari, 1959, as follows :—(i) Fd. Coll. No. 261, Coll. Sta. No. 11, Port Cornwallis (North Andamans), 31. i. 1959, ex. “decaying log of wood”. (ii) Fd. Coll. No. 323, Coll. Sta. No. 13, Interview Is. (North Andamans), 8. iv. 1959. (iii) Fd. Coll. No. 886, Coll. Sta. No. 30, Mus village, Car Nicobar Is. (the Nicobars), 28. iii. 1959, ex. “rotten wooden log”.

(b) *Measurements* (in mm).—*Soldiers* (7 examples) :

1. Total body-length without antennae, <i>ca.</i>	..	..	4.2—4.7
2. Length of head with mandibles	..	..	2.00—2.98
3. Length of head to lateral base of mandibles	..	..	1.20—1.33
4. Maximum width of head	..	..	1.06—1.15
5. Maximum length of pronotum	..	..	0.38—0.43
6. Maximum width of pronotum	..	..	0.73—0.83
7. No. of antennal segments	..	..	14

(c) *Geographical Distribution*.—*Andamans* : North Andamans (Port Cornwallis ; and Interview Is.). *Nicobars* : Car Nicobar (Mus village). *Elsewhere* : Eastern India ; E. Pakistan ; Burma, Malaya Peninsula ; Indonesia (Sumatra, Java and Borneo).

(d) *Biological Remarks*.—The species was obtained from decaying wood.

Subfamily (ii) *Rhinotermitinae*Genus (3) *Prorhinotermes* Silvestri5. *Prorhinotermes flavus* (Bugnion & Popoff)

(Pl. 13; Fig. 4)

1910. *Coptotermes flavus* E. Bugnion & N. Popoff, *Mem. Soc. Zool. Fr.*, Paris, 23 (8), pp. 117-120, pl. 2. S. and W. *Type-locality* : Ceylon : Border of Lake Ambalangoda.

(a) *Material*.—2 vials, S. and W., Little Andaman Is., coll. A. Daniel, February 1961, as follows :—(i) Fd. Coll. No. 357, Coll. Sta. No. 4, Ingoie, 21. ii. 1961, ex. "dead tree". (ii) Fd. Coll. No. 471, Coll. Sta. No. 5, Ingatijala forest, 8 km. south of Gaje, 25. ii. 1961, ex. "dead tree".

(b) *Measurements* (in mm).—*Soldiers* (6 examples) :

1. Total body-length without antennae, <i>ca.</i>	.	..	5.0—5.7
2. Length of head with mandibles	..	..	2.40—2.80
3. Length of head to lateral base of mandibles	..	..	1.55—1.75
4. Maximum width of head	..	..	1.30—1.48
5. Distance of fontanelle from posterior margin of head	..	..	0.40—0.53
6. Maximum length of pronotum	..	..	0.55—0.58
7. Maximum width of pronotum	..	..	1.05—1.13
8. No. of antennal segments	..	..	17—18

(c) *Geographical Distribution*.—*Andamans* : Little Andamans (Ingoie and Ingatijala). *Elsewhere* : Ceylon : Ambalangoda (the type-locality).

(d) *Biological Remarks*.—The species was obtained from "dead trees".

Genus (4) *Schedorhinotermes* Silvestri6. *Schedorhinotermes eleanorae** n. sp.

(Tables 2 and 3; and Text-figs. 1-3).

(a) *Material*.—One vial, Fd. Coll. No. 216 ; 2 dealate Im. (1♂, 1♀), 9 S. (minor) and several W., Bedeabdulu, 19 km. south of Tokoibuea, Little Andaman Is., coll. A. Daniel, 16.ii.1961, ex. "dead tree"

(b) *Description*.—1(a). IMAGO ♂ (Table 2; and Text-fig. 1) :

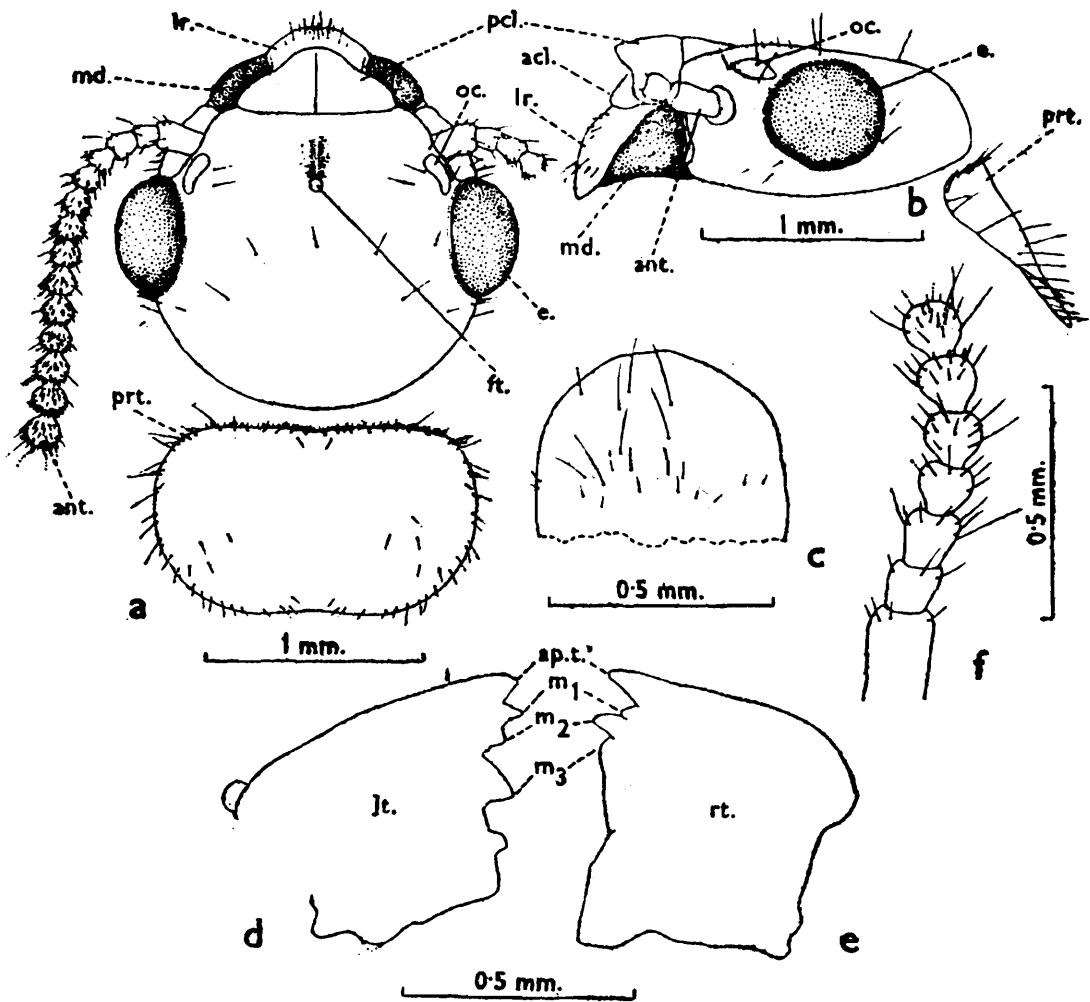
General : Head-capsule, mandibles, pronotum and wing-scales, golden brown ; mandibular teeth dark brown ; fontanelle and anteclypeus whitish ; postclypeus and labrum yellowish, antenna and legs paler : thorax and abdomen pale golden yellow. Head sparsely, and body fairly densely, pilose. Total length without wings, ca. 6.8-7.0 mm.

TABLE 2.—*Body-measurements (in mm.) of Schedorhinotermes eleanorae n. sp. (Roonwal & Bose). Caste : Imago.*

Body-parts.	Range (2 examples)
1. Total body-length (without wings) ca.	6.8—7.0
2. Head-length to tip of labrum	1.75—1.78
3. Head-length to lateral base of mandibles	1.38—1.40
4. Head-width (with eyes)	1.75
5. Maximum height of head	0.73
6. Maximum length of labrum	0.37
7. Maximum width of labrum	0.53
8. Maximum diameter of eye (with ocular sclerite)	0.50—0.53
9. Minimum diameter of eye (with ocular sclerite)	0.48
10. Maximum diameter of ocellus	0.18
11. Minimum diameter of ocellus	0.13
12. Minimum eye-ocellus distance	0.05—0.08
13. Minimum eye-antennal distance	0.10—0.13
14. Minimum distance between ocellus and antennal base	0.04
15. Length of pronotum	0.85—0.90
16. Width of pronotum	1.48—1.55
17. Length of forewing scale	1.30
18. Length of hindwing scale	0.78

* Named after Mrs. Eleanor Emerson, the wife of the well-known termitologist, Professor Alfred E. Emerson, and herself a collector of note.

Head : Subspherical, broader than long (length 1.38-1.40 ; width 1.75 mm.). **Fontanelle** : Distinct, circular, situated in middle of anterior half of headcapsule in level of ocelli. **Eyes** : A pair, one on either side ; large, round and bulging (maximum diameter 0.50-0.53 mm.). **Ocelli** : Small, suboval, paired, one on each side ; separated from the eye of its side by less than its short diameter (minimum eye-ocellus distance *ca.* 0.05-0.08 mm.). **Antennae** : Incomplete (tip broken), only 14 segments present ; segment 1 long, cylindrical ; 2 subequal to 3 ; 4 shortest, smaller than 2 or 3 ; 5 onward gradually increasing in size. **Clypeus** : Anteclypeus narrow, apilose and with a somewhat pointed tip ; hardly visible from above. Postclypeus large, sparsely pilose, distinctly demarcated from frons. **Labrum** : Subrectangular, with distal margin rounded ; broader than long ; with a few long and short hairs on body. **Mandibles** : Subsquamish. Right mandible with an apical and 3 marginal teeth on inner margin ; apical finger-like ; 1st marginal



TEXT-FIG. 1.—*Schedorhinotermes eleanorae* n. sp. Imago (paramorphotype), from the Little Andamans.

(a) Head and pronotum, in dorsal view. (b) Ditto, in lateral view. (c) Labrum, in dorsal view. (d) and (e) Left and right mandibles, respectively, in dorsal view. (f) Basal part of right antenna.

ac., anteclypeus ; *ant.*, antenna ; *e.*, eye ; *ft.*, fontanelle ; *lt.*, left ; *lr.*, labrum ; *md.*, mandible ; *oc.*, ocellus ; *pcl.*, postclypeus ; *prt.*, pronotum ; *rt.*, right.

rudimentary ; 2nd well developed, subequal to apical ; 3rd very short and blunt. Left mandible with an apical and 3 marginal teeth ; apical rather short, finger-like and blunt ; 1st marginal pointed, slightly longer than apical ; 2nd short and blunt ; 3rd well developed and triangular.

Thorax : Pronotum : Flat, sparsely pilose, subtrapezoidal, much broader than long (width 1.48-1.55 ; length 0.85-0.90 mm.) ; anterior and posterior corners rounded ; anterior margin substraight, without a median notch ; posterior margin with a weak median notch. *Wings* : Broken. *Legs* : Long, sparsely pilose ; apical tibial spur formula 3: 2: 2.

Abdomen : Oblong, fairly pilose. Cerci 2-jointed, 0.2 mm. long. Styli 1-jointed, 0.04 mm. long.

1 (b). IMAGO ♀: Same as ♂.

2. SOLDIER MAJOR : Unknown.

3. SOLDIER MINOR (Table 3 ; and Text-fig. 2) :

General : Head-capsule, labrum and antenna pale yellow ; mandibles deep yellowish brown ; legs and abdomen pale yellowish white. Head and thorax sparsely, and body moderately, pilose. Total body-length (including mandibles and to tip of labrum which extends beyond mandibles) ca. 2.95-3.30 mm.

Head : Subpentagonal, with posterior end rounded ; widest in anterior one-third ; longer than broad (length to lateral base of mandibles 0.73-0.79 ; maximum width 0.68-0.70 mm.). *Fontanelle* : Distinct, circular ; lying in anterior one-fourth of head ; with a narrow median

TABLE 3.—*Body-measurements (in mm.) of Schedorhinotermes eleanorae n. sp. (Roonwal & Bose) Caste : Soldier Minor.*

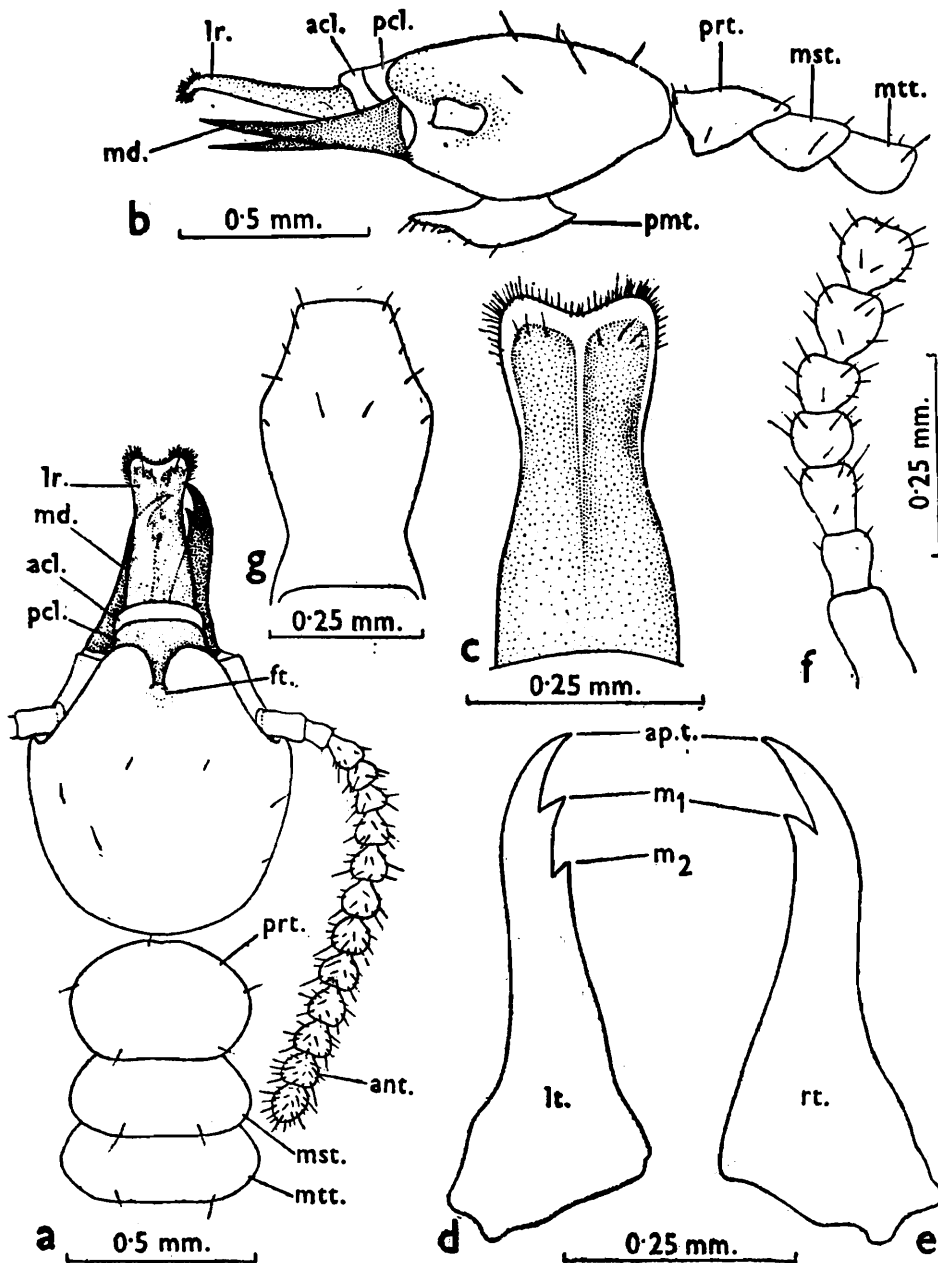
Body-parts	Range (5 examples)	Holotype
1. Total length to tip of labrum	2.95—3.30	3.30
2. Head-length to tip of labrum	1.25—1.30	1.30
3. Head-length to tip of mandibles	1.23—1.26	1.23
4. Head-length to lateral base of mandibles	0.73—0.79	0.78
5. Maximum width of head	0.68—0.70	0.68
6. Width of head at anterior end	0.47—0.50	0.47
7. Maximum height of head	0.43—0.48	0.44

TABLE 3.—*contd.*

Body-parts	Range (5 examples)	Holotype
8. Length of mandibles :		
(a) Right mandible	0.45—0.50	0.50
(b) Left mandible	0.45—0.50	0.50
9. Maximum length of labrum	0.38—0.43	0.40
10. Maximum width of labrum	0.15—0.20	0.15
11. Median length of postmentum	0.38—0.40	0.40
12. Maximum width of postmentum	0.28	0.28
13. Width at waist of postmentum	0.18—0.20	0.19
14. Width at anterior margin of postmentum	0.17—0.19	0.18
15. Head Index I (Width/Length)	0.86—0.91	0.87
16. Head Index II (Height/Width)	0.63—0.71	0.65
17. Head Index III (Height/Length)	0.55—0.62	0.56
18. Maximum length of pronotum	0.30	0.30
19. Maximum width of pronotum	0.43—0.48	0.43
20. Maximum width of mesonotum	0.43—0.48	0.44
21. Maximum width of metanotum	0.48—0.53	0.50
22. No. of antennal segments	14	14

dorsal groove running from fontanelle to the tip of labrum. *Antennae* : With 14 segments ; segment 1 longest, cylindrical ; 2 and 3 smaller and subequal ; 4 shortest ; 5 onward gradually increasing in size ; apical (14) club-shaped. *Clypeus* : Anteclypeus a narrow, apilose strip. Postclypeus pilose ; indistinctly separated from frons. *Labrum* : Long, flap-like and extending a little beyond mandibles ; much longer than broad ; distal end bifid, the two lobes fringed with numerous short hairs. *Mandibles* : Long, slender, broad basally and pointed distally ; distal end slightly incurved. Right mandible with a large, sharp-pointed tooth situated distally in anterior one-fourth of inner margin. Left

mandible with 2 such sharp teeth in distal third of inner margin. *Post-mentum* : Longer than broad and bulged in middle ; shorter than head-capsule ; broadest anteriorly at about its distal one-third, whence the sides converge anteriorly and posteriorly ; anterior margin narrow and substraight, posterior two-thirds with a waist near proximal end ; posterior margin weakly concave.



TEXT-FIG. 2.—*Schedorhinotermes eleanorae* n. sp. Soldier minor (paratype) from the Little Andamans.

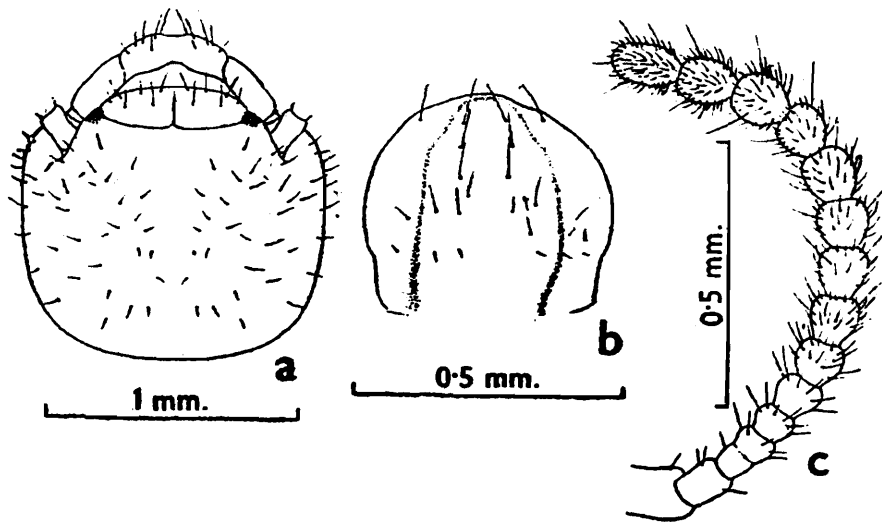
(a) Head and thorax, in dorsal view. (b) Ditto, in lateral view. (c) Labrum, in dorsal view. (d) and (e) Left and right mandibles, respectively, in dorsal view. (f) Basal part of left antenna. (g) Post mentum, in ventral view.

acl., anteclypeus ; *ant.*, antenna ; *ap.t.*, apical tooth of mandible ; *ft.*, fontanelle ; *lr.*, labrum ; *lt.*, left ; *m₁*, *m₂*, 1st and 2nd mandibular teeth respectively ; *md.*, mandible ; *mst.*, mesonotum ; *mtt.*, metanotum ; *pcl.*, postclypeus ; *prt.*, pronotum ; *rt.*, right.

Thorax : Pronotum : With very few hairs ; flat, rhomboidal, and narrowing anteriorly ; anterior and posterior angles rounded ; anterior and posterior margins with a weak median notch. *Mesonotum* : Sparsely pilose ; slightly broader than pronotum ; posterior margin straight. *Metanotum* : Sparsely pilose ; suboval ; slightly broader than mesonotum ; posterior margin straight. *Legs* : Long, fairly pilose ; apical tibial spur formula 3: 2: 2.

Abdomen : Oblong, hairy. Cerci 2-jointed, 0.10 mm. long. Styli minute single-jointed, ca. 0.03 mm. long.

4. WORKER (Text-fig. 3) : Generally pale yellow. Head subsquarish ; moderately hairy. Eyes and ocelli absent. Fontanelle indistinct. Antenna with 15 segments ; segment 1 longest ; 2 longer than 3 or 4 ; 3 and 4 smallest and subequal ; 5 to last (15) gradually increasing in size and becoming club shaped. Postclypeus separated from frons by clear suture. Labrum subsquarish, slightly broader than long ; distal



TEXT-FIG. 3.—*Schedorhinotermes eleanorae* n. sp. Worker, from the Little Andamans.

(a) Head, in dorsal view. (b) Labrum, in dorsal view. (c) Antenna.

end-rounded. Mandibles as in imago (*vide* above). Pronotum moderately hairy ; saddle-shaped ; anterior and posterior margins with a weak median notch ; mesonotum and metanotum slightly broader than pronotum. Legs long, pilose ; apical tibial spur formula 3: 2: 2. Abdomen oblong, fairly pilose ; cerci 2-jointed, ca. 0.13 mm. long ; styli 1-jointed, ca. 0.05 mm. long.

Body-measurements (in mm.) of workers of Schedorhinotermes eleanorae n. sp. (9 examples)

1. Total length including mandibles, ca.	..	..	..	..	..	3.9—4.4
2. Length of head to lateral base of mandibles	..	..	..	..	..	0.98—1.05
3. Maximum width of head	..	..	..	..	..	1.13—1.18
4. Maximum height of head	..	..	..	..	..	0.55
5. Maximum length of pronotum	..	..	..	..	..	0.23—0.25
6. Maximum width of pronotum	..	..	..	..	..	0.55—0.58

(c) *Type-Specimens* :—All types are from the holotype lot, *vide* "Material" above. *Holotype* : A soldier minor, in a vial, Z.S.I. Reg. No. 3716/H8 ; deposited in Z.S.I. *Morphotypes* : A dealate imago ♂ and a worker in a vial, Z.S.I. Reg. No. 3717/H8 ; deposited in Z.S.I. *Paratypes and paramorphotypes* : Deposited as follows : (i) 2 paratype soldiers minor, one paramorphotype dealate imago ♀ (its labrum, head, mandibles and 2 legs mounted on 3 slides under the same Reg. No. as the whole specimens) and 2 paramorphotype workers in a vial, Z.S.I., Reg. No. 3718/H8. (ii) A paratype soldier minor and a paramorphotype worker, in a vial, in F.R.I., Dehra Dun. (iii) A paratype soldier minor and a paramorphotype worker, in a vial, with Prof. A.E. Emerson, U.S.A.

(d) *Type-locality and Geographical Distribution*.—*Type-locality* : Bedeabdulu, 19 km. south of Toikoibuea, Little Andaman Is. Known only from the type-locality.

(e) *Comparisons*.—*Schedorhinotermes eleanorae* n. sp. is close to *S. tiwarii* (Roonwal & Thakur, 1963, from the South Andamans), *S. longirostris* (Brauer, 1865, from the Nicobars), *S. translucens* (Haviland, 1898 from Borneo), and *S. medioobosenus* Holmgren, 1914, from the Andamans, Nicobars and Malaya but is separable from these as follows :—

1. From *S. tiwarii*

SOLDIER MINOR : (i) Much smaller (head-length with mandibles 1.23—1.26 *vs.* 1.45—1.60 mm.; head-length to lateral base of mandibles 0.73—0.79 *vs.* 0.90—1.07 mm.). (ii) Antennae with 14 segments (*vs.* 15) ; segment 3 longer than 2 (*vs.* shorter). (iii) Sides of postmentum more bulged and with a more pronounced waist (*vs.* almost straight and with a less marked waist).

2. From *S. longirostris* (compared with types of *longirostris*).

SOLDIER MINOR : (i) Antennae with 14 segments (*vs.* 15-16, mostly 15) ; segment 3 subequal to 2 (*vs.* shorter than 2). (ii) Postmentum narrower at waist ; width at waist 0.18—0.20 *vs.* 0.23—0.25 mm.; postmentum contraction index *i.e.*, Width at waist/Maximum width 0.64—0.74 *vs.* 0.77—0.83. (iii) Somewhat smaller (head-length with mandibles 1.25—1.30 *vs.* 1.30—1.37 mm.; head-length to lateral base of mandibles 0.72—0.78 *vs.* 0.80 mm.; head-width 0.68—0.70 *vs.* 0.71—0.73 mm.).

3. From *S. translucens*

IMAGO : (i) Larger (head-length to lateral base of mandibles 1.38—1.40 *vs.* 1.30 mm.). (ii) Eyes larger (maximum diameter 0.50—0.53 *vs.* 0.49 mm.; minimum diameter 0.48 mm. *vs.* 0.41 mm.).

SOLDIER MINOR : (i) Much smaller (head-length with mandibles 1.25—1.30 mm. *vs.* 1.45—1.60 mm.; head-length to lateral base of mandibles 0.72—0.78 *vs.* 0.85—1.07 mm.; maximum head-width 0.68—0.70 *vs.* 0.73—0.91 mm.). (ii) Labrum extending beyond tip of mandibles (*vs.* up to tip of mandibles).

4. From *S. medioobscurus*

IMAGO*: (i) Generally larger (head-length without mandibles 1.38—1.40 vs. 1.27—1.32 mm.; head-width 1.75 vs. 1.61—1.71 mm.; pronotum-width 1.48—1.55 vs. 1.22—1.37 mm.). (ii) Eyes and ocelli larger (maximum diameter of eyes 0.50—0.53 vs. 0.41—0.44 mm., of ocelli 0.18 vs. 0.13—0.15 mm.). (iii) Ocelli separated from eyes by a distance of 0.05—0.08 mm. vs. 0.10 mm.

SOLDIER MINOR : (i) Somewhat smaller (head-length with mandibles 1.25—1.30 vs. 1.33—1.43 mm.; head-length to base of mandibles 0.72—0.78 vs. 0.83—0.88 mm., head-width 0.68—0.70 vs. 0.70—0.80 mm. (ii) Antennae with 14 (vs. 15-16) segments. (iii) Postmentum narrower at waist (Postmentum contraction index, i.e., Width at Waist/Maximum width 0.64—0.74 vs. 0.76—0.77 mm.).

(f) *Biological Remarks.*—The material was obtained from a dead tree.

7. *Schedorhinotermes longirostris* (Brauer)

(Table 4 ; and Text-figs. 4-6)

1865. *Termes* sp. F. Brauer, *Verh. zool. bot. Ges. Wien*, Vienna, 15, p. 977.

1866. *Termes longirostris* : F. Brauer, *Reise der Fregatte 'Novara' (Zool. Theil)*, Vienna, Bd. 2 (Abth. 1, Art. 4), pp. 47-48, S., W. and Ny. *Type-locality*: Kondul Is., Nicobars.

1949. *Schedorhinotermes longirostris* (Br.) (in part), T.E. Snyder, *Smiths. misc. coll.*, Washington, 112, p. 93.

1953. *Schedorhinotermes longirostris* (Br.), M.L. Roonwal & G.D. Pant, *Indiaⁿ Forest Leaflet* (Ent.), Delhi, No. 121 (3), p. 49. Andamans. (Now *det.* as *S. medioobscurus*.)

(a) *Material* :—In Naturhistorisches Museum, Vienna ; One vial, in spirit, with 2 Ny. 1 S. (major), 6 S. (minor, 1 immature) and 11 W (1 immature), Kondul Is. (Nicobars, Indian Ocean), 1857-59. *Types*. With the following label :

“*Termes* (= *Schedorhinotermes*) *longirostris* Brauer, *Reise der Fregatte 'Novara'*, “Nicobaren, 1857-59.”

(b) *Description.*—Brauer (1866), gave a brief description of nymphs, worker and soldier major and a fuller one of soldier minor, but gave no illustrations. We have here re-described the species, with illustrations.

1. IMAGO : Unknown.

2. SOLDIER MAJOR (Table 4 ; and Text-fig. 4)

General : Head-capsule yellowish, labrum, antennae, legs and body paler ; mandibles reddish brown, yellowish basally. Head and body sparsely hairy with long bristle-like hairs ; abdominal tergites with a row each of a few long hairs near posterior margin and a few short hairs elsewhere. Total body-length with mandibles *ca.* 4.8 mm.

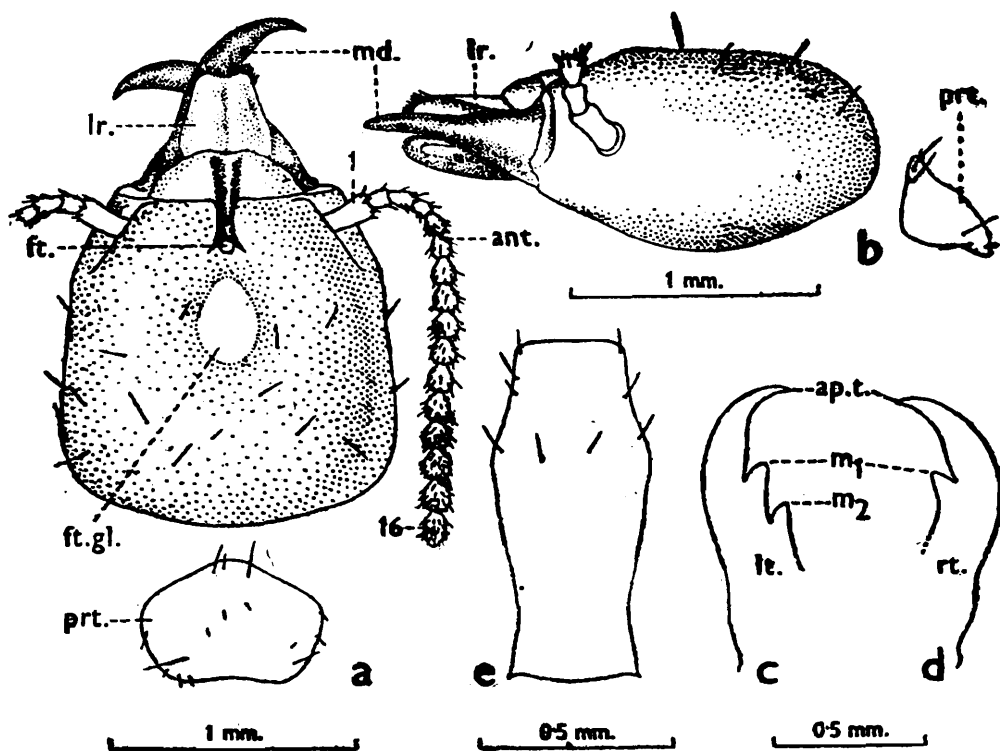
Head : Head-capsule subrectangular, with rounded hind angles ; a little longer than broad (length to lateral base of mandibles 1.40 mm.; maximum width 1.33 mm.); sides gradually narrowing anteriorly, but

* Measurements of *S. medioobscurus* imago are taken from Holmgren 1914 (original description) and Ahmad (*Biologia*, Lahore, 4, p. 79, 1958).

TABLE 4.—*Body-measurements (in mm.), etc., of Schedorhinotermes longirostris (Brauer) Caste : Soldier.*

Body-parts	Soldier major (Lectotype)	Soldier minor (5 examples)
1	2	3
1. Total body-length, excluding antennae, <i>ca.</i> ..	4.78 (to tip of mandibles)	3.30—3.80 (to tip of labrum)
2. Length of head including mandibles and/or labrum ..	2.03 (to tip of mandibles)	1.30—1.33 (to tip of labrum)
3. Length of head to lateral base of mandibles ..	1.40	0.80
4. Maximum width of head	1.33	0.71—0.73
5. Width of head-capsule at anterior end	0.70	0.49—0.50
6. Maximum height of head	0.80	0.41—0.43
7. Length of mandibles :		
(a) Right mandible	0.80	0.51—0.53
(b) Left mandible	0.80	0.51—0.53
8. Maximum length of labrum	0.37	0.37—0.40
9. Maximum width of labrum	0.37	0.17—0.20
10. Median length of postmentum	0.90	0.47—0.50
11. Maximum width of postmentum	0.40	0.30
12. Width at waist of postmentum	0.27	0.23—0.25
13. Width at anterior margin of postmentum	0.25	0.17
14. Head Index I (Width/Length)	0.95	0.89—0.91
15. Head Index II (Height/Width)	0.60	0.56—0.59
16. Head Index III (Height/Length)	0.57	0.51—0.54
17. Maximum length of pronotum	0.50	0.30—0.33
18. Maximum width of pronotum	0.70	0.43—0.47
19. Maximum width of mesonotum	0.66	0.47—0.50
20. Maximum width of metanotum	0.73	0.50—0.53
21. No. of antennal segments	16	15—16

abruptly narrowing near insertion of antennae ; posterior margin round. *Fontanelle* : Small, round, situated at about one-fifth of head-capsule from anterior end ; leading behind into a fontanelle gland, and in front on head-surface, into a groove to almost the front margin of labrum. *Eyes and ocelli* : Absent. *Antennae* : Only right antenna of specimen complete ; with 16-segments ; segments 1 and 2 sparsely, and the remainder fairly, pilose ; segment 1 longest, cylindrical ; 2 a little longer than half of 1, cylindrical ; 3 slightly longer than 2 and club-shaped ; 4 shortest ; 5-8 gradually increasing in length and becoming pyriform ; 9 to the penultimate one (15) subequal and pyriform ; last (16) ovate and smaller than 15. *Clypeus* : Subelliptical ; with a weak median notch in anterior margin ; not clearly differentiated into an ante- and a postclypeus. *Labrum* : Broadly tongue-shaped and reaching up to two-thirds of the length of mandibles ; broadest posteriorly ; length subequal to maximum width ; with a median longitudinal groove ; anterior margin weakly bifid and with a fringe of short hairs. *Mandibles* : Sabre-shaped, strongly incurved near apices. Left mandible with two prominent teeth in anterior half of inner margin. Right mandible with only one such tooth a little above the middle of mandible. *Postmentum* : Club-shaped ; with a few longish hairs on anterior one-third ; shorter than head-capsule ; broadest at anterior one-third ; waist lying a little below the hind two-third portion ; anterior margin substraight ; posterior margin weakly convex.



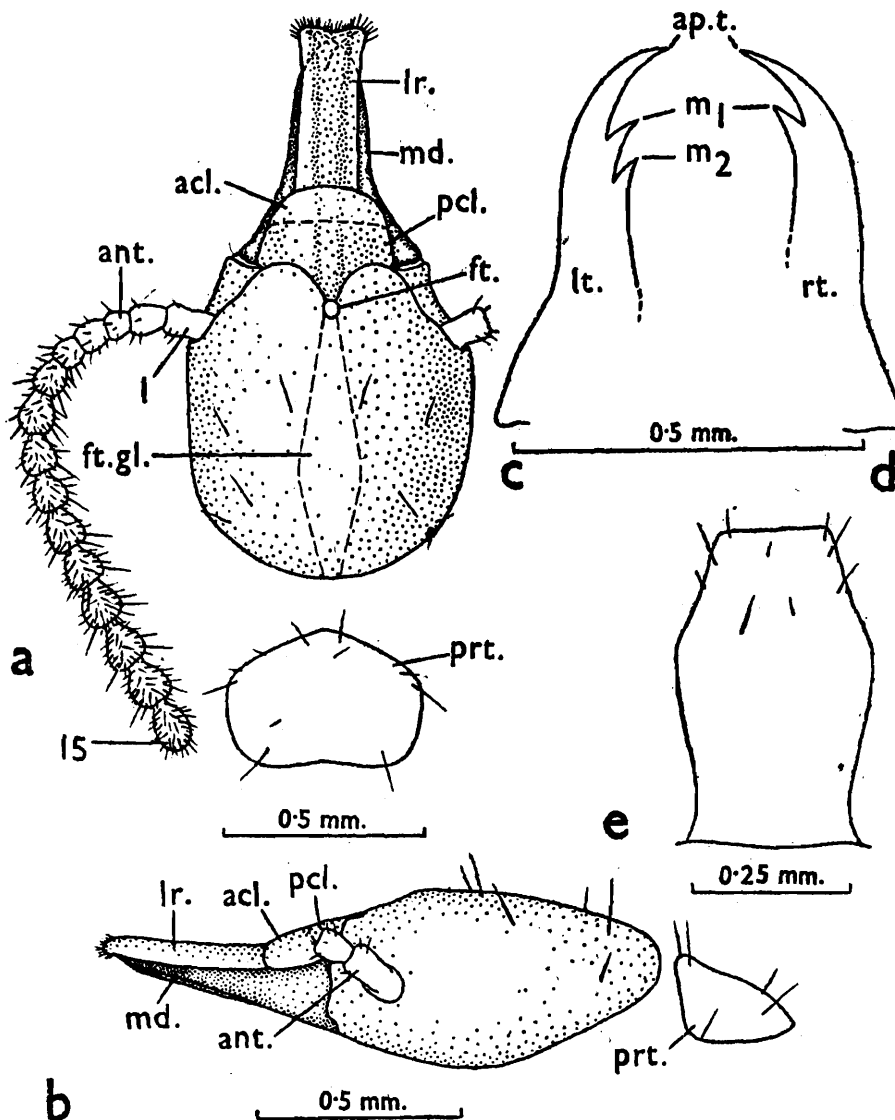
TEXT-FIG. 4.—*Schedorhinotermes longirostris* (Brauer). Soldier major, *lectotype*. Kondul Is., Nicobars.

(a) Head and pronotum, in dorsal view. (b) Ditto, in side view. (c) Left mandible, in dorsal view. (d) Ditto, right mandible. (e) Postmentum, in ventral view.

ant., antenna ; *ap. t.*, apical tooth of mandibles ; *ft.*, fontanelle ; *ft. gl.*, fontanelle gland ; *lr.*, labrum ; *lt.*, left ; *m₁*, *m₂* ; 1st and 2nd marginal teeth of mandibles respectively ; *md.*, mandible ; *prt.*, pronotum ; *rt.*, right.

Thorax : Pronotum : Rhomboidal ; broader than long (length 0.50; width 0.70 mm.); anterior margin weakly raised and projected forward medially ; sides rounded and somewhat narrowed behind ; posterior margin incurved medially. **Mesonotum :** Slightly narrower than pronotum ; posterior margin weakly incurved ; sides rounded. **Metanotum :** Slightly broader than pronotum ; posterior margin medially incurved ; sides rounded. **Legs :** Thin, long and hairy ; apical tibial spur formula 3 : 2 : 2. Tarsi 4-jointed.

Abdomen : Oblong, hairy. Cerci 2-jointed ; 0.13 mm. long. Styli small, 1-jointed, 0.03 mm. long.



TEXT-FIG. 5.—*Schedorhinotermes longirostris* (Brauer). Soldier minor, *lectromorphotype*. Kondul Is., Nicobars.

(a) Head and pronotum, in dorsal view. (b) Ditto, in side view. (c) Left mandible, in dorsal view. (d) Ditto, right mandible. (e) Postmentum, in ventral view.

acl., anteclypeus ; *ant.*, antenna ; *ap. t.*, apical tooth of mandibles ; *ft.*, fontanelle ; *ft. gl.*, fontanelle gland ; *lr.*, labrum ; *lt.*, left ; *m₁*, *m₂*, 1st and 2nd marginal teeth of mandibles respectively ; *md.*, mandible ; *pcl.*, postclypeus ; *prt.*, pronotum ; *rt.*, right.

3. SOLDIER MINOR (Table 4 ; and Text-fig. 5)

General : Head-capsule and labrum yellowish ; antennae, legs and body pale yellow ; mandibles pale brown distally, yellowish proximally. Head and thorax sparsely, and abdomen fairly hairy, with long bristle-like hairs ; abdominal hairs arranged in a row on posterior margin of each tergite. Total body-length *ca.* 3.3—3.8 mm.

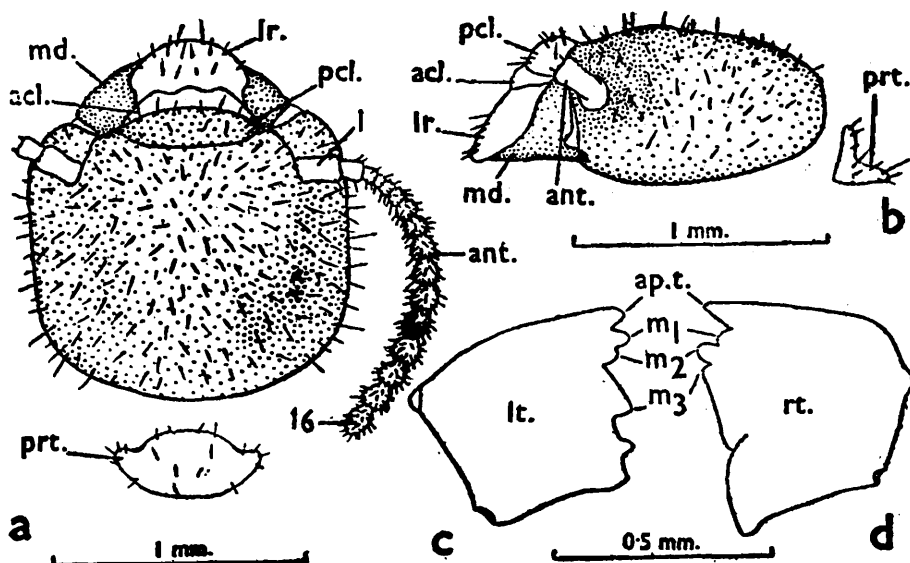
Head : Head-capsule suboval, converging sharply beyond the base of antennae ; slightly longer than wide (length to base of mandibles 0.80 ; width 0.71—0.73 mm.) ; sides weakly convex ; posterior margin strongly rounded. *Fontanelle* : Circular, small but clear, situated a little behind the clypeus ; maximum diameter 0.03—0.04 mm. ; leading behind into a fontanelle gland ; with a median dorsal groove running from fontanelle to the tip of labrum. *Eyes and ocelli* : Absent. *Antennae* : With 15-16 (mostly 15) segments (in one specimen the right antenna with 15 segments, the left with 16) ; segments 1 and 2 sparsely, and the remainder fairly, pilose ; segment 1 longest, cylindrical ; 2 smaller and narrower than 1 and subcylindrical ; 3 (in 15-segmented) and 4 (in 16-segmented antennae) shortest ; 4-9 pyriform and increasing in length gradually ; 10 to the penultimate one subequal and pyriform ; the last one ovate, narrower and slightly shorter than the penultimate one. *Clypeus* : Subtrapezoidal, rounded anteriorly ; demarcation of ante- and postclypeus not distinct. *Labrum* : Long, subrectangular, flap-like, extending up to or slightly beyond the tip of mandibles ; much longer than broad ; distal end weakly bifid and with a fringe of numerous short hairs. *Mandibles* : Long, sabre-shaped and slender, incurved distally. Left mandible with 2 sharp teeth directed forwards in the distal one-third. Right mandible with a single tooth in distal one-fifth of mandible. *Postmentum* : Longer than broad ; sides bulged in middle, and broadest at its distal one-third ; weakly narrowed at waist which lies near posterior end ; anterior margin substraight and small ; posterior margin weakly concave and wider.

Thorax : *Pronotum* : Flat, rhomboidal, broader than long (length 0.30—0.33 ; width 0.43—0.47 mm.) ; anterior and posterior corners rounded ; anterior margin projecting forward medially and without a median notch ; posterior margin with a weak median incurving. *Mesonotum* : As wide as pronotum ; posterior margin substraight or with a weak median incurving. *Metanotum* : Slightly wider than pronotum ; with a weakly incurved posterior margin. *Legs* : Long, fairly pilose ; apical tibial spur formula 3 : 2 : 2. Tarsi 4-jointed.

Abdomen : Long and hairy. Cerci 2-jointed, 0.10—0.13 mm. long. Styli absent (one specimen with a weak impression of their presence).

4. WORKER (Text-fig. 6) : Head yellowish, body paler. Head-capsule susquarish ; fontanelle indistinct. Eyes and ocelli absent. Antennae with 16 segments ; segment 1 longest ; 2 one-half of 1 and subequal to 3 and 4 combined ; 4 shortest ; 5 to the penultimate one pyriform and gradually increasing in length ; the last one ovate, shorter than the penultimate one. Clypeus divided into an ante- and a postclypeus, the latter clearly separated from the frons. Labrum broadly tongue-shaped and much wider than long. Mandibles of typically

Schedorhinotermes-type (Text-fig. 6). Pronotum much narrower than head ; weakly saddle-shaped, anterior lobe raised ; anterior and posterior margins substraight and without a notch. Legs long and pilose ; apical tibial spur formula 3 : 2 : 2. Tarsi 4-jointed. Abdomen long, hairy ; cerci 2-jointed, 0.1 mm. long ; styli 1-jointed, 0.07 mm. long.



TEXT-FIG. 6.—*Schedorhinotermes longirostris* (Brauer). Worker, *lectomorphotype*. Kondul Is., Nicobars.

(a) Head and pronotum, in dorsal view. (b) Ditto, in side view. (c) Left mandible, in dorsal view. (d) Ditto, right mandible.

acl., anteclypeus ; *ant.*, antenna ; *ap.t.*, apical tooth ; *lr.*, labrum ; *lt.*, left ; *m₁-m₃*, 1st to 3rd marginal teeth of mandibles respectively ; *md.*, mandible ; *pcl.*, postclypeus ; *prt.*, pronotum ; *rt.*, right.

Body-measurements (in mm.) of workers of Schedorhinotermes longirostris (Brauer). (5 examples.)

1. Total body-length (excluding antennae) <i>ca.</i>	..	..	..	..	..	3.4 —4.5
2. Length of head to lateral base of mandibles	..	..	..	..	..	1.03—1.07
3. Maximum width of head ...	..	..	..	..	..	1.20—1.30
4. Maximum height of head ..	..	..	..	..	..	0.60—0.63
5. Maximum length of pronotum ..	..	..	..	..	..	0.17—0.23
6. Maximum width of pronotum ..	..	..	..	..	..	0.50—0.57

(c) *Type-specimens*.—Cotypes present in the Naturhistorisches Museum, Vienna ; now designated by us as follows :—*Lectotype* : One soldier major, *vide* "Material" above. *Lectomorphotypes* : One soldier minor and one worker. *Paralectomorphotypes* : Five soldiers minor, 10 workers, and 2 nymphs (of them, 1 soldier and 1 worker has been deposited in the collection of the Zoological Survey of India, Calcutta).

(d) *Type-locality and Geographical Distribution*.—*Type-locality* : Kondul Is. (Nicobars, Indian Ocean), *c.* 7°17' N. lat. and 93°39' E. long. Known only from type-locality. Other records given in the literature really refer to other species.

(e) *Comparison*.—*Schedorhinotermes longirostris* is close to *S. medioobscurus* Holmg., *S. tiwarii* R. & T. and *S. translucens* (Havil.),

but the soldiers (major and minor) are generally smaller ; for other differences, *vide supra*, Key for Identification. It is also close to *S. eleanorae* n. sp.; for differences, see under that species above.

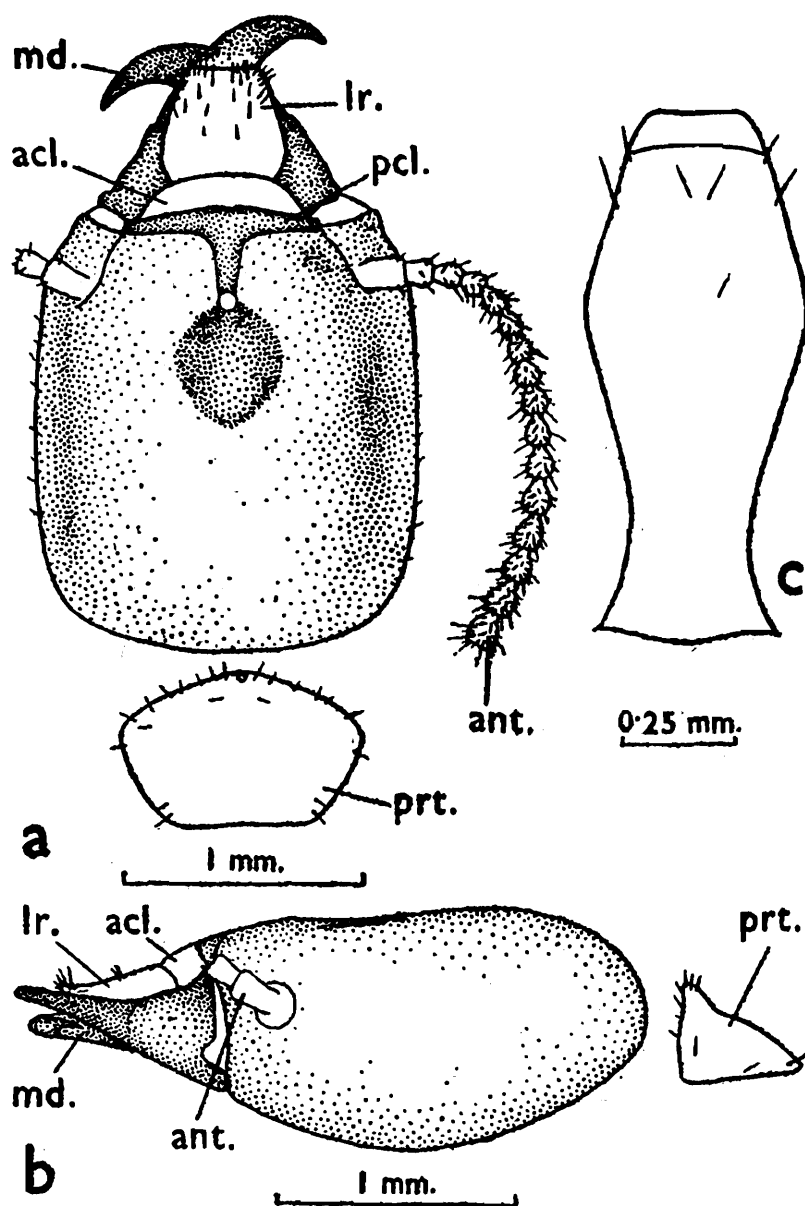
8. *Schedorhinotermes medioobscurus* Holmgren

1914. *Rhinotermes (Schedorhinotermes) brevialetus* f. *medioobscurus* N. Holmgren, *Zool. Jb. (Syst.)*, Jena, 36, p. 241. Im., S., W. *Type-locality*: Trong in Taiping, Malacca, only. (Specimens from Tandjong-Slamat, E. Sumatra, are not *medioobscurus*, *vide* Snyder, 1949, *infra*.)

1949. *Schedorhinotermes medioobscurus* (Holmg.), T.E. Snyder, *Smiths. misc. Coll.*, Washington, 112, p. 94., Malacca.

1953. *Schedorhinotermes longirostris*: M.L. Roonwal & G.D. Pant, *Indian Forest Leaflet (Ent.)*, Delhi, No. 121 (3), p. 49. (Now det. as *S. medioobscurus*.)

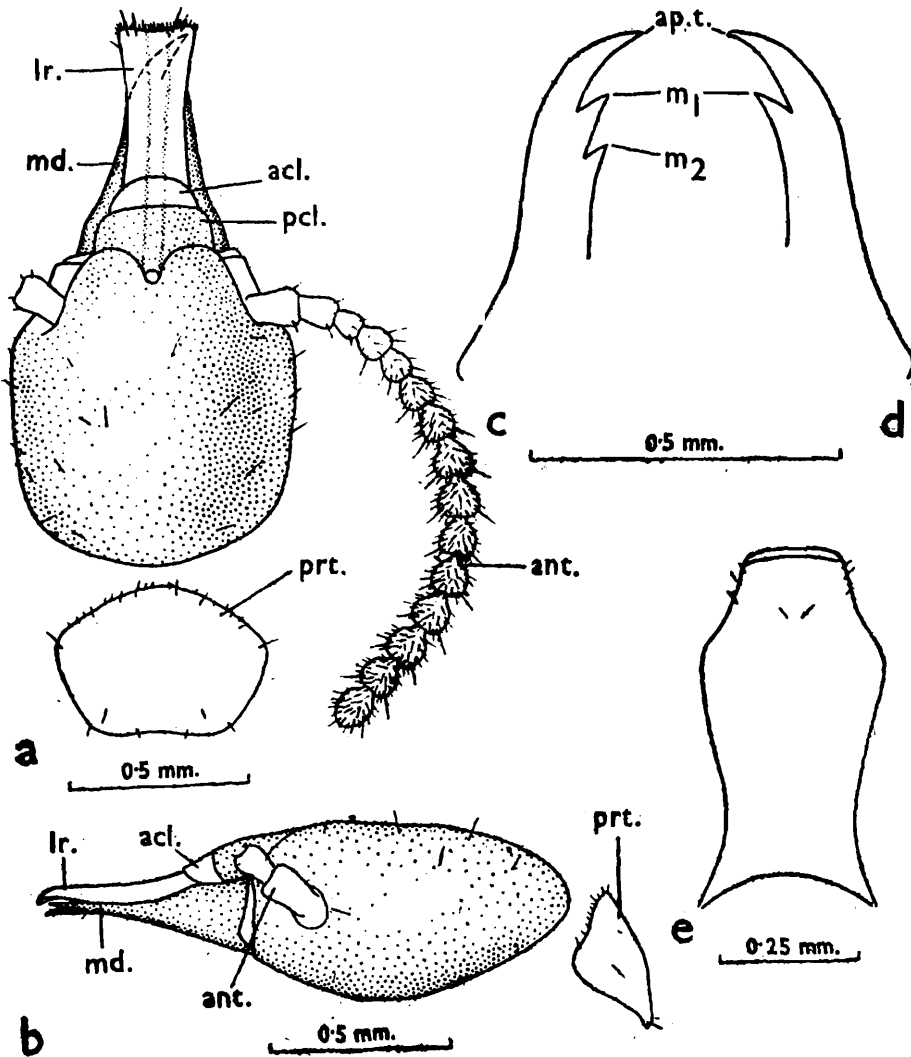
(a) *Material*.—(A) *Present in Z.S.I.* : (i) One vial, Z.S.I. Reg. No. 7378/H2, 5 S. (minor) and several W., Station 10, Mt. Harriet, c. 900 ft,



TEXT-FIG. 7.—*Schedorhinotermes medioobscurus* Holmgren. Soldier major from Malaya.

(a) Head and pronotum, in dorsal view. (b) Ditto, in lateral view. (c) Left mandible, in dorsal view. (d) Ditto, right mandible. (e) Postmentum, in ventral view. *acl.*, anteclypeus ; *ant.*, antenna ; *ap.t.*, apical tooth ; *ft.*, fontanelle ; *lr.*, labrum ; *lt.*, left ; *m₁*, *m₂* ; 1st and 2nd apical tooth of mandibles respectively ; *md*, mandible ; *pcl.*, postclypeus ; *prt.*, pronotum ; *rt.*, right.

South Andaman Is., coll. *N. Annandale*, December 1923, ex "dead log on jungle floor, very small soldiers. Collembola, white, abundant in galleries in the wood" *Det.* F. Silvestri as *S. longirostris*; *redet.* by us as *S. medioobscurus*.



TEXT-FIG. 8.—*Schedorhinotermes medioobscurus* Holmgren. Soldier minor from the South Andamans.

(a) Head and pronotum in dorsal view. (b) Ditto, in lateral view. (c) Left mandible, in dorsal view. (d) Ditto, right mandible. (e) Postmentum, in ventral view.

acl., anteclypeus; *ant.*, antenna; *ft.*, fontanelle; *lr.*, labrum; *lt.*, left; *m₁*, *m₂*; 1st and 2nd apical tooth of mandibles respectively; *md.*, mandible; *pcl.*, postclypeus; *prt.*, pronotum; *rt.*, right.

(B) *Present in F.R.I.*: (ii) One vial, M.C. No. 18813/1, 1 S. (minor) and 2 W., same data as in (i) above. (iii) One vial, M.C. No. 19204/1, 2 S. (minor) and 1 W., Singapore, coll. *H. Kirby* (T 4592), 29.vii.1935. (iv) One vial, M.C. No. 19204/2, 1, S. (major), Kuala Lumpur, Malaya, 21.ix.1931 (No. 7980, Ent. Div. Agr. Dept.).

(b) *Measurements (in mm.)*.—

				Soldiers major (1 ex., Kuala Lumpur)	Soldiers minor (5 exs.)
1. Total body-length (without antennae), <i>ca.</i>	..	..	..		3.5—4.3
2. Length of head to tip of mandibles	..	..	..	2.60	1.33—1.40
3. Length of head to lateral base of mandibles	..	..	..	1.83	0.83—0.88
4. Maximum width of head	..	..	..	1.60	0.70—0.80
5. Maximum length of pronotum	..	..	..	0.60	0.37—0.40
6. Maximum width of pronotum	..	..	..	1.00	0.53—0.57
7. No. of antennal segments	..	..	..		15—16

(c) *Geographical Distribution*.—*Andamans* : South Andamans : Mt. Harriet. *Nicobars* : Not yet recorded. *Elsewhere* : Malaya : Trong in Taiping, Malacca, (the type-locality) ; Kuala Lumpur and Singapore.

(d) *Biological Remarks*.—Found in dead log of wood in jungle. Small white spring-tails (*Collembola*) were abundant in the galleries and were probably associated with the termite.

(e) *Systematic Remarks*.—We have compared the soldiers minor from Mt. Harriet, Andamans (*vide* "Material (i) & (ii)" above) with types of *S. longirostris* (Brauer). They are a little larger than the latter and have a broader pronotum (head-length 0.83—0.88 mm. *vs.* 0.80 mm. pronotum width 0.53—0.57 *vs.* 0.43—0.47 ; pronotum-head index, *i.e.*, Pronotum-width/Head-width 0.71—0.78 *vs.* 0.60—0.64). They also closely agree with specimens, from Singapore, *vide* "Material (iii)" above.

9. *Schedorhinotermes tiwarii* Roonwal & Thakur

(Pl. 13, Figs. 6 and 6a)

1963. *Schedorhinotermes tiwarii*, M.L. Roonwal & M.L. Thakur, *Indian J. agric. Sci.*, Delhi, 33 (2), pp. 109-117, S. and W. *Type-locality* : Chouldhari, South Andaman Is.

(a) *Material*.—One vial, Fd. Coll. No. 139, several S. (minor) and W., Coll. Sta. No. 2, 1 km. inside forest at Laitora (15 km. north of Tokoibuea), Little Andamans, coll. A. Daniel, 14.ii.1961, ex. "log lying on ground".

(b) *Measurements* (in mm.) :—

Soldiers major (4 examples) (from Roonwal & Thakur, 1963) :

1. Total body-length without antennae, <i>ca.</i>	.. .. .	5.5—6.3
2. Length of head with mandibles	.. .. .	2.51—2.80
3. Length of head to lateral base of mandibles	.. .. .	1.60—1.75
4. Maximum width of head	.. .. .	1.58—1.60
5. Maximum length of pronotum	.. .. .	0.55—0.58
6. Maximum width of pronotum	.. .. .	1.00—1.05
7. No. of antennal segments	.. .. .	16

Soldiers minor (6 examples) :

1. Total body-length without antennae, <i>ca.</i>	.. .. .	3.5—4.9
2. Length of head to tip of labrum	.. .. .	1.50—1.60
3. Length of head to lateral base of mandibles	.. .. .	0.90—0.95
4. Maximum width of head	.. .. .	0.80—0.83
5. Maximum length of pronotum	.. .. .	0.38—0.40
6. Maximum width of pronotum	.. .. .	0.58—0.60
7. No. of antennal segments	.. .. .	15

(c) *Geographical Distribution.*—*Andamans only* : Little Andaman Is, (Laitora, near Tokoibuea) and South Andamans (Chouldhari, the type-locality).

Family 3. TERMITIDAE

Subfamily (i) *Amitermitinae*

Genus (5) *Microcerotermes* Silvestri

10. *Microcerotermes danieli** n. sp.

(Table 5 ; and Text-figs. 9 and 10)

(a) *Material.*—4 vials, 1 Ny., S. and W., Andaman Islands, as follows : Lot (A). (i) Fd. Coll. No. 323, 1 S., 1 W., Coll. Sta. No. 13, Interview Is. (North Andamans), coll. *K.K. Tiwari*, 8.iv.1959.

Lot (B). 3 vials, several S. and W., coll. *A. Daniel*, February-March 1961, as follows :—(ii) Fd. Coll. No. 9, 1 Ny. 6 S., several W., Coll. Sta. No. 1, near *nullah* (streamlet) near Phoenix Bay, Port Blair, South Andamans, 8.ii.1961, ex. (“2 ft. from ground level, from a fallen palm tree”). (iii) Fd. Coll. No. 614, 10 S., several W., Coll. Sta. No. 2, near camp at Tokoibuea, Little Andaman Is., 1.iii.1961, ex. “cocoanut tree” (iv) Fd. Coll. No. 588, 10 S., several W., Coll. Sta. No. 6, Kwateneabo forest, Little Andaman Is., 28.ii.1961, ex. “pillar of Onge hut”

* Named after the collector, Dr. A. Daniel, who made an excellent collection from the Little Andaman Is. and some other islands of the Andaman group.

(b) *Description.*—

1. IMAGO : Unknown.

2. SOLDIER (Table 5 ; and Text-fig. 9) :

General : Head-capsule yellowish, anterior part and labrum reddish yellow ; mandibles reddish at base, dark reddish brown distally ; anteclypeus whitish ; antenna and pronotum pale yellow ; rest of thorax, legs and abdomen pale creamish white. Head sparsely, and body moderately pilose. Total length with mandibles but excluding antenna, *ca.* 4.6—5.0 mm.

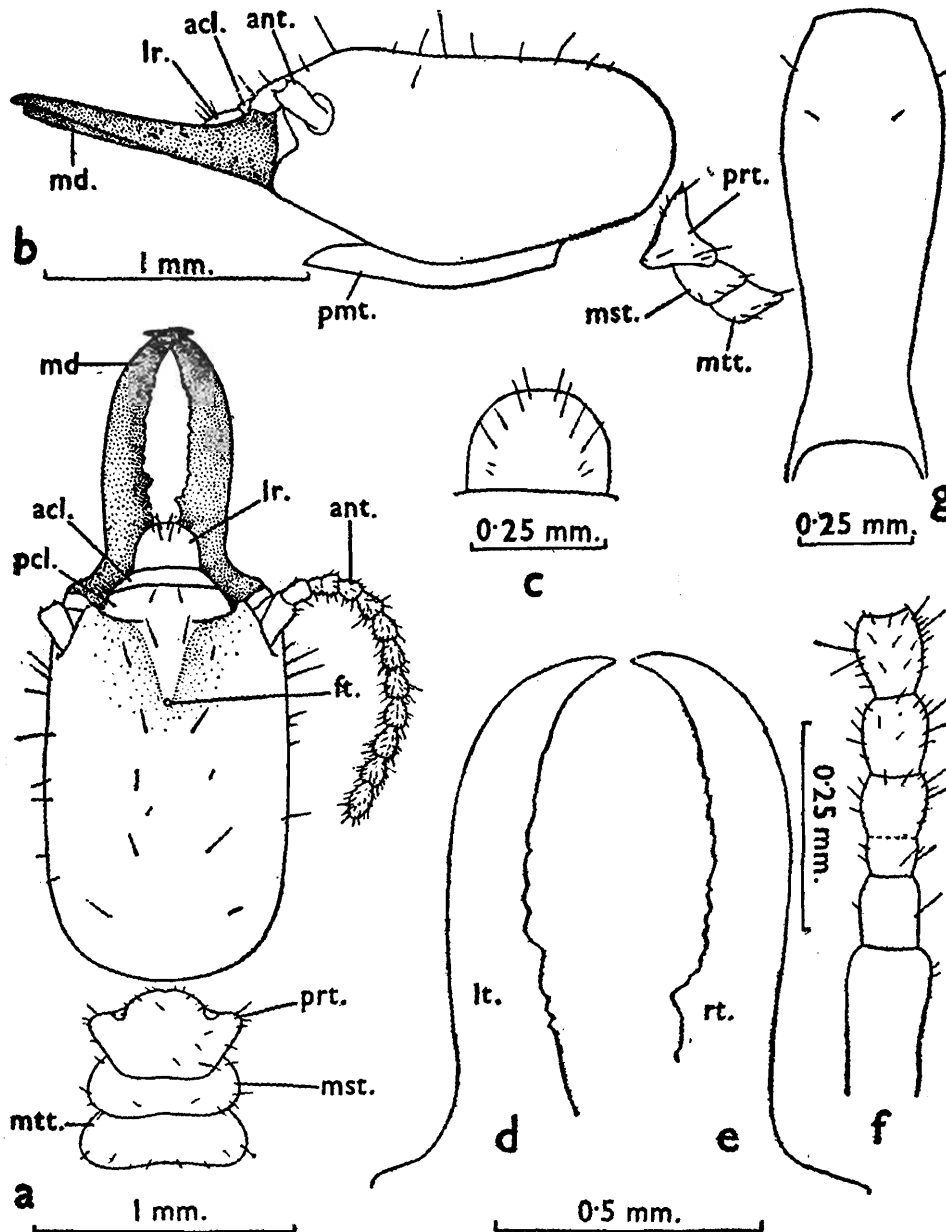
TABLE 5.—*Body-measurements (in mm.), etc. of Microcero-
termes danieli n. sp. (Roonwal & Bose). Caste : Soldier.*

Body-parts	Range (9 examples)	Holotype
1. Total length including mandibles, <i>ca.</i>	4.6 — 5.0	4.9
2. Length of head including mandibles	2.50—2.58	2.49
3. Length of head to lateral base of mandibles	1.54—1.63	1.54
4. Maximum width of head	0.95—1.00	0.95
5. Maximum height of head	0.73—0.78	0.73
6. Length of mandibles	0.95—1.03	0.95
7. Head Index I (Width/Length*)	0.58—0.63	0.62
8. Head Index II (Height/Width)	0.75—0.85	0.77
9. Head Index III (Height/Length*)	0.46—0.50	0.47
10. Maximum length of labrum	0.18—0.20	0.20
11. Maximum width of labrum	0.28—0.29	0.29
12. Median length of postmentum	0.85—0.98	0.90
13. Maximum width of postmentum	0.34—0.38	0.34
14. Width of postmentum at waist	0.20—0.23	0.20
15. Width of postmentum at anterior margin	0.20—0.23	0.20
16. Maximum width of pronotum	0.58—0.68	0.58
17. Maximum length of pronotum	0.30—0.34	0.33
18. Width of mesonotum	0.55—0.63	0.55
19. Width of metanotum	0.65—0.70	0.65
20. No. of antennal segments	13	13

Head: Subrectangular, much longer than broad (length to lateral base of mandibles 1.54—1.63 ; maximum width 0.95—1.00 mm.) ; head sloping down anteriorly ; anterior part with two indistinct grooves running on either side from fontanelle to base of postclypeus ; posterior end rounded. *Fontanelle* : Small but distinct, lying in middle of anterior half of head-capsule. *Eyes and ocelli* : Absent. *Antennae* : With 13 segments ; segment 1 longest, cylindrical ; 2 subequal to 3 and 4 combined ; 3 shortest ; 4 longer than 3 ; 5-12 subequal ; the apical (13) ovate ; longer than 12. *Clypeus* : Anteclypeus a narrow apilose strip. Postclypeus indistinctly demarcated from frons ; very sparsely pilose. *Labrum* : Subsquamish, with distal end rounded ; broader than long ; with a few long and a few short hairs on anterior part and on body. *Mandibles* :

*Length to lateral base of mandibles.

Long and apically pointed and incurved ; with inner margins coarsely serrated. Right mandible with a tooth-like projection at about two-thirds of the mandible length from the distal tip and many smaller coarse serrations above and a few below it. Left mandible similar to right, but the tooth, a little more distally situated. *Postmentum* : Long, club-shaped, sides convex ; with maximum width at its distal one-fourth whence the sides converging anteriorly and posteriorly ; with waist at its proximal one-fifth ; anterior margin substraight to weakly convex posterior margin strongly concave.



TEXT-FIG. 9.—*Microcerotermes danieli* n., sp. Soldier (paratype), from the South Andamans.

(a) Head and thorax, in dorsal view. (b) Ditto, in lateral view. (c) Labrum, in dorsal view. (d) and (e) Left and right mandibles, respectively, in dorsal view. (f) Base of right antenna. (g) Postmentum, in ventral view.

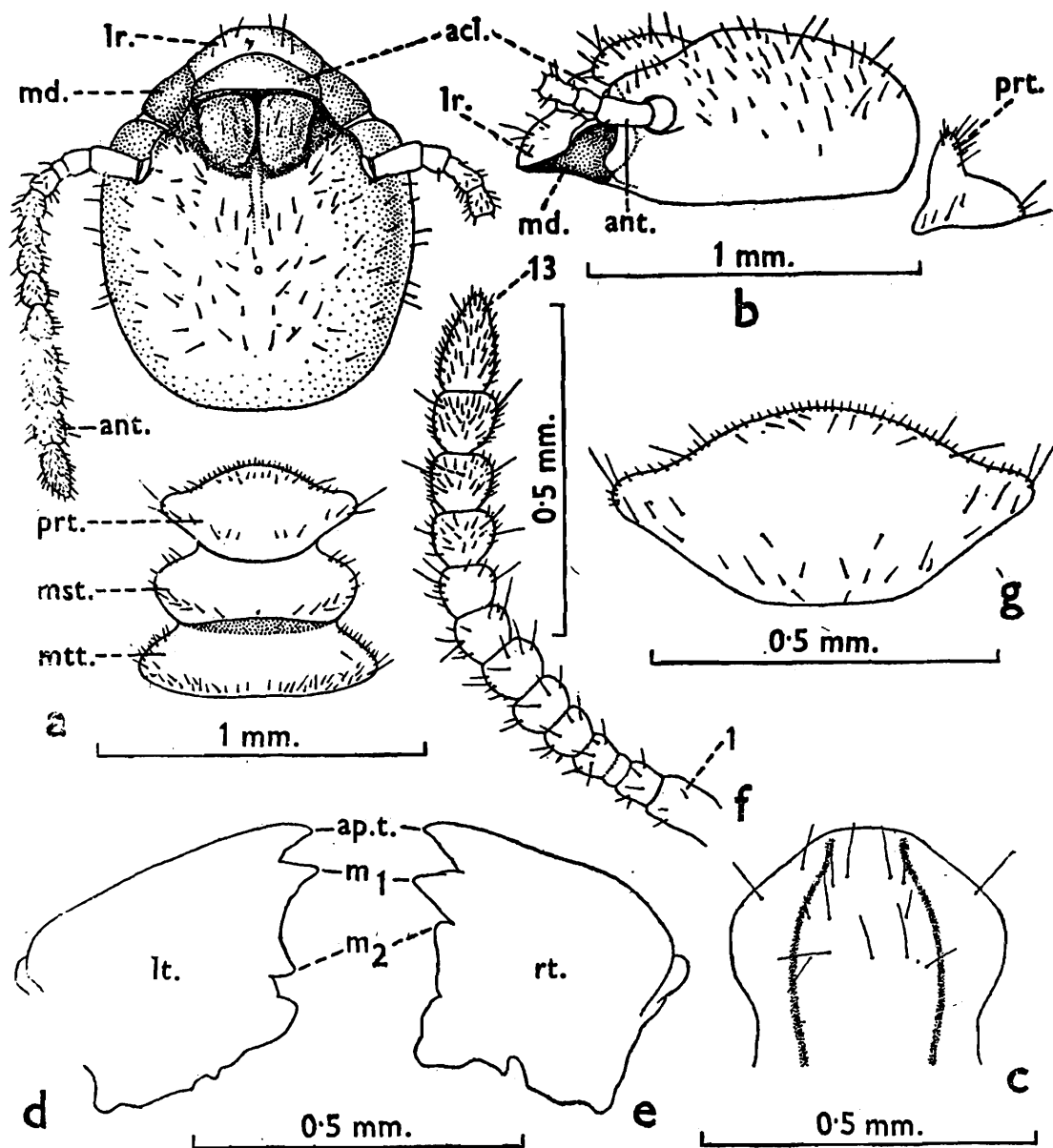
acl., anteclypeus ; *ant.*, antenna ; *ft.*, fontanelle ; *lr.*, labrum ; *lt.*, left ; *md.*, mandible ; *mst.*, mesonotum ; *mtt.*, metanotum ; *pcl.*, postclypeus ; *pmt.*, postmeritum ; *prt.*, pronotum ; *rt.*, right.

Thorax : Much narrower than head. **Pronotum** : Saddle-shaped, broader than long ; anterior lobe convex ; anterior and posterior margins with a very weak median notch ; anterior and posterior corners rounded. **Mesonotum** : Oval, broader than long, almost as broad as pronotum. **Metanotum** : Oval, much broader than long, broader than mesonotum. **Legs** : Long, fairly pilose ; apical tibial spur formula 3 : 2 : 2.

Abdomen : Oblong, pilose. Cerci 2-jointed, *ca.* 0.05 mm. long. Styli one-jointed, *ca.* 0.04 mm. long.

3. WORKER (Text-fig. 10) :

General : Posterior part of head-capsule, clypeus, labrum and mandibles pale golden yellow ; mandibular teeth darker ; anterior part of head,



TEXT-FIG. 10.—*Microcerotermes danieli* n. sp. Worker (paramorphotype), from the South Andamans.

(a) Head and thorax, in dorsal view. (b) Ditto, in lateral view. (c) Labrum, in dorsal view. (d) and (e) Left and right mandibles respectively, in dorsal view. (f) Right antenna. (g) Pronotum, in dorsal view.

acl., anteclypeus ; *ant.*, antenna ; *ap.t.*, apical tooth of mandible ; *lr.*, labrum ; *lt.*, left ; *md.*, mandible ; *m₁*, *m₂*, 1st and 2nd mandibular teeth respectively ; *mst.*, mesonotum ; *mtt.*, metanotum ; *pcl.*, postclypeus ; *prt.*, pronotum ; *rt.*, right.

antenna and pronotum pale yellow ; rest of thorax, legs and abdomen pale yellowish white. Head and body moderately pilose. Total length including mandibles (but excluding antennae) *ca.* 3·8—4·6 mm.

Head : Subsquamish, broader than long. *Fontanelle* : Indistinct. *Eyes and ocelli* : Absent. *Antennae* : With 13 segments ; segment 1 longest ; 2 longer than either 3 or 4 ; 3 shortest, 4-12 gradually increasing in size ; the apical (13) ovate, slightly longer than 12 and with a pointed tip. *Clypeus* : Anteclypeus an apilose narrow strip ; distal end projected medially. Postclypeus swollen, sparsely pilose ; divided into right and left halves by a median vertical suture. *Labrum* : Subsquamish, but swollen laterally in middle ; broader than long ; with a few long hairs on anterior part and on body. *Mandibles* : Subsquamish: Right mandible with an apical and 2 marginal teeth ; apical finger-like and pointed ; 1st marginal like apical but slightly smaller ; 2nd short and blunt and widely separated from 1st. Left mandible with an apical and 2 marginal teeth ; apical long and finger-like ; 1st marginal like apical ; 2nd small and blunt and close to 1st.

Thorax : Moderately pilose. *Pronotum* : Saddle-shaped ; much broader than long (length 0·23—0·26 ; width 0·53—0·58 mm.) ; anterior margin convex, without a median notch ; posterior margin weakly convex ; also without a median notch. *Mesonotum* : broader than pronotum ; sides rounded. *Metanotum* : broader than mesonotum ; sides somewhat projected and acutely rounded. *Legs* : long, fairly pilose ; apical tibial spur formula 3 : 2 : 2.

Abdomen : Oblong, fairly pilose. Cerci 2-jointed, *ca.* 0·08 mm. long. Styli 1-jointed, *ca.* 0·05 mm. long.

Body-measurements (in mm.) of workers of Microcerotermes danieli n. sp. (7 examples).

1. Total body-length including mandibles (but excluding antennae), <i>ca.</i>	3·8	—	4·6
2. Head-length to lateral base of mandibles	0·73	—	0·98
3. Maximum width of head	0·80	—	0·98
4. Maximum height of head	0·48	—	0·55
5. Maximum length of pronotum .. .	0·23	—	0·26
6. Maximum width of pronotum	0·53	—	0·58

(c) *Type specimens*.—*Holotype* : A soldier, in a vial, Z.S.I. Reg. No. 3563/H8, from Material, Lot (B) (ii), Fd. Coll. No. 9, Coll. Sta. No. 1, near streamlet near Phoenix Bay, Port Blair, South Andaman Is., coll. A. Daniel, 9.ii.1961, ex. "2ft. from ground-level, from a fallen palm tree" ; deposited in Z.S.I. *Morphotype* : A worker, in a vial, Z.S.I. Reg. No. 3564/H8, from holotype lot ; deposited in Z.S.I. *Paratypes* and

Paramorphotypes : (i) 3 paratype soldiers and 6 paramorphotype workers, in a vial. Z.S.I. Reg. No. 3565/H8 ; from holotype lot and with the same data ; deposited in Z.S.I. (ii) One paratype soldier and one paramorphotype worker, from holotype lot in F.R.I., Dehra Dun. (iii) 1 paratype soldier and 1 paramorphotype worker, from holotype lot, with Prof. A.E. Emerson, U.S.A.

(d) *Type-locality and Geographical distribution.*—*Type-locality.*—Coll. Sta. No. 1, streamlet near Phoenix Bay, Port Blair, South Andaman Is.

Geographical distribution.—*Andamans Only* : North Andamans (Interview Is.), South Andamans (Phoenix Bay, Port Blair, the type-locality) and Little Andamans (Tokoibuea and Kwateneabo).

(e) *Comparisons.*—The soldiers of *Microcerotermes danieli* n. sp. are close to *M. cameroni* Snyder and *M. celebensis* Kemner., but differ from them as follows :—

From M. cameroni : (i) Fontanelle distinct (vs. indistinct). (ii) Mandibles stouter and longer (length 0.95-1.03 vs. 0.90 mm.) (Head Mandible Index, i.e., Mandible-length/Head-length, 0.61-0.67 vs. 0.55). (iii) Anterior margin of pronotum with a very weak median notch (vs. with well developed notch). (iv) Pronotum narrower (width 0.58-0.63 vs. 0.65 mm.). (v) Antennae with segment 3 shorter than 4 (vs. subequal).

From M. celebensis : (i) Labrum rounded and a little broader than long (vs. pointed and as long as wide). (ii) Mandibles longer (0.95-1.03 vs. 0.73-0.83 mm.). (iii) Postmentum shorter (length 0.87-0.88 vs. 0.93 mm.). (iv) Antenna with segment 2 equal to 3 and 4 together (vs. shorter than 3 and 4).

(f) *Biological Remarks.*—The species was obtained from a fallen palm tree, the trunk of a cocoanut tree and the wooden pillar of a hut.

11. *Microcerotermes nicobarensis* n. sp.

(Tables 6 and 7 ; Text-figs. 11-13 ; and Pl. 13, Fig. 7)

(a) *Material.*— 2 vials in spirit, Im., Ny., S. and W., Andamans and Nicobars, coll. K. K. Tiwari, March, 1959, as follows :—(i) Fd. Coll. No. 622, Im. 1 Ny., 1. S. and sev. W., Ross Is., South Andamans, 14.iii.1959. (ii) Fd. Coll. No. 959, several Im., 2 S. and several W., Arong village, Car Nicobar Is., 31.iii.1959, ex. " mounds on cocoanut tree ".

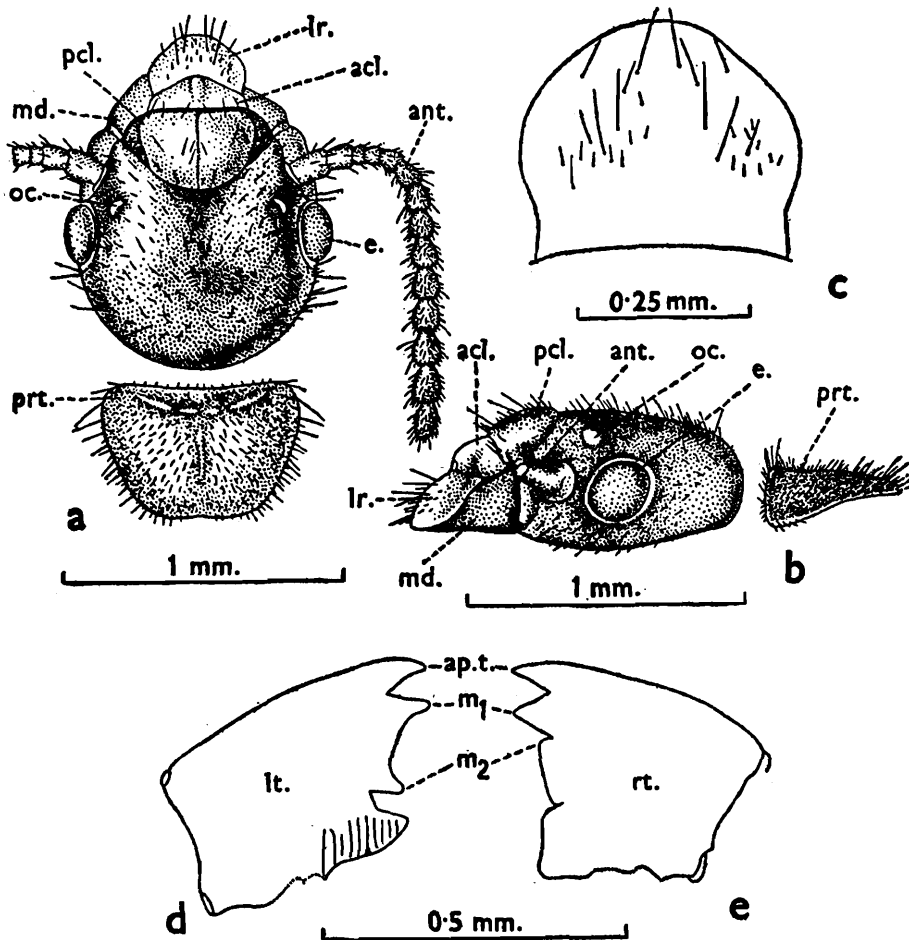
(b) *Description.*—

1a. IMAGO ♀ (Table 6 ; and Text-figs. 11 and 12.) :

General : Head-capsule deep yellowish brown ; postclypeus and pronotum pale brownish yellow ; antenna and rest of thorax paler ; mandibles yellowish brown, with dark brown teeth ; anteclypeus, legs and

abdomen pale yellowish ; wings pale yellowish brown, veins darker ; abdominal tergites pale brown. Head fairly, and body densely, pilose. Total length up to tip of labrum, without wings *ca.* 5.7-6.8 mm. ; with wings 9.1-10.6 mm.

Head : Subspherical, a little broader than long (maximum width with eyes, 0.90-0.97 mm. ; length to lateral base of mandibles 0.80-0.88 mm.) ; slightly converging in front ; rounded posteriorly ; frons weakly sloping in front. *Fontanelle* : Distinct, rounded, situated about the middle of head-dorsum. *Eyes* : Two, lateral, sub-spherical eyes, one on either side ; maximum diameter 0.25-0.26 mm. *Ocelli* : Two, lateral, prominent, translucent, subspherical ocelli, one on either side ; maximum diameter 0.06-0.09 mm. ; minimum diameter 0.05-0.07 mm. ; separated from eye by a distance subequal to its maximum diameter (eye-ocellus distance 0.08-0.10 mm.). *Antennae* : With 14 segments ; segment 1 longest, cylindrical ; 2 shorter than 1 ; 3 shortest, about half

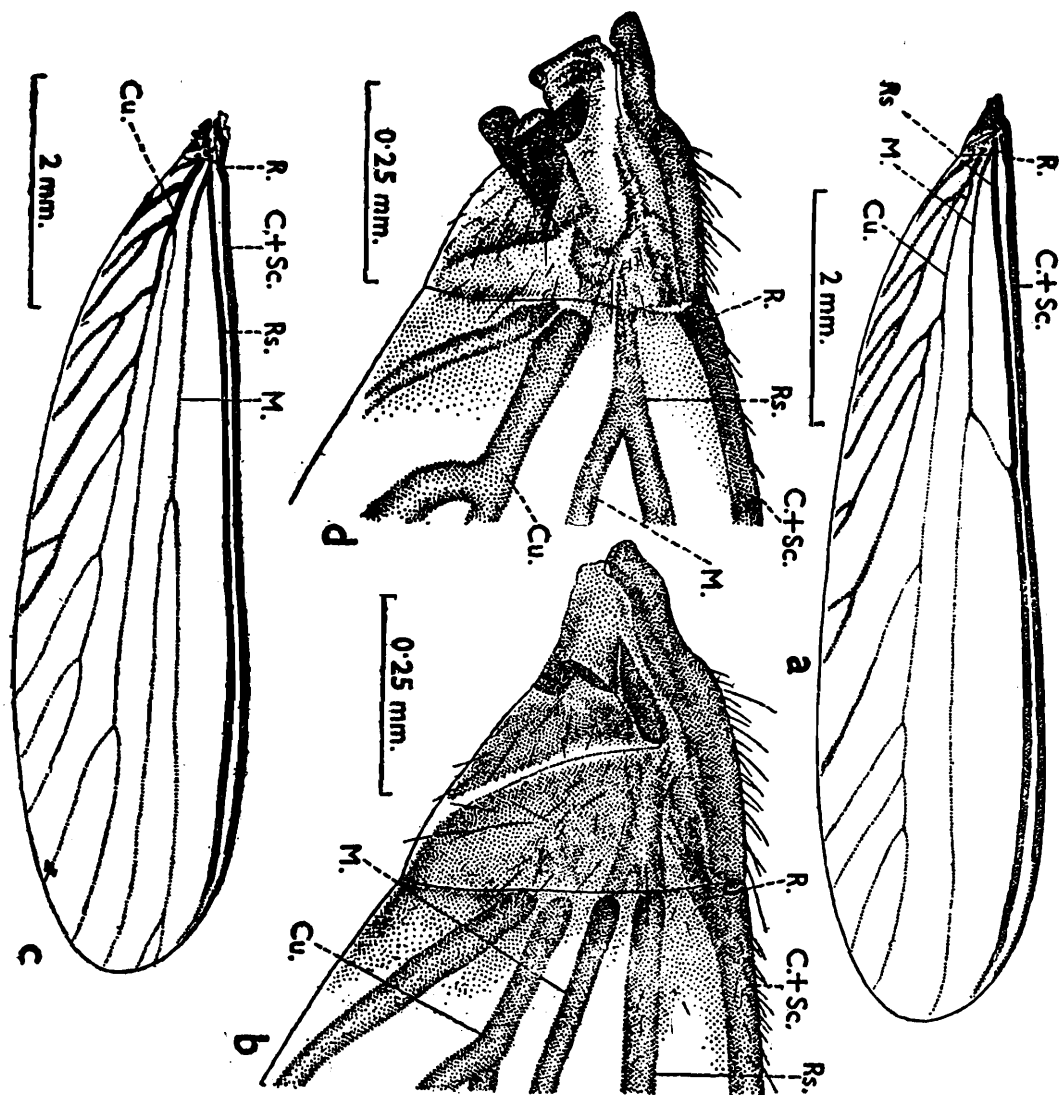


TEXT-FIG. 11.—*Microcerotermes nicobarensis* n. sp. Image (paramorphotype), from the South Andamans.

(a) Head and pronotum, in dorsal view. (b) Ditto, in lateral view. (c) Labrum, in dorsal view. (d) and (e) Left and right mandibles respectively, in dorsal view.

acl., anteclypeus ; *ant.*, antenna ; *ap.t.*, apical tooth of mandible ; *e.*, eye ; *lr.*, labrum ; *lt.*, left ; *m₁*, *m₂*, 1st and 2nd mandibular teeth respectively ; *md.*, mandible ; *oc.*, ocellus ; *pcl.*, postclypeus ; *prt.*, pronotum ; *rt.*, right.

of 2 ; 4 onward progressively increasing in length to the penultimate one; the last (14) ovate, club-shaped, subequal to and narrower than the penultimate one. *Clypeus*: Anteclypeus narrow, hyaline, apilose; medially projected to a broad tip. Postclypeus swollen, sparsely hairy, twice as broad as long; posterior margin greatly rounded and well demarcated from frons; divided into right and left halves by a median vertical suture. *Labrum*: Subsquamish, with broadly rounded tip; several long, bristle-like hairs as well as short hairs present on body. *Mandibles*: Of typically *Microcerotermes*-type. Right mandible with an apical and 2 marginal teeth; apical large, finger-like; 1st marginal triangular, subequal to apical; 2nd short, blunt and situated close to 1st. Left mandible also with an apical and 2 marginal teeth; apical and 1st marginal as in right mandible; 2nd marginal short, blunt and widely separated from 1st.



TEXT-FIG. 12.—*Microcerotermes nicobarensis* n. sp. Imago, from the South Andamans.

(a) Right forewing, in dorsal view. (b) Scale and part of right forewing, in dorsal view. (c) Right hindwing, in dorsal view. (d) Scale and part of right hindwing, in dorsal view.

C.+Sc., Costa-subcosta; Cu., Cubitus; M., Median; R., Radius; Rs., Radial sector.

TABLE 6.—*Body-measurements (in mm.), etc. of Microcerotermes nicobarensis n.sp. (Roonwal & Bose). Caste : Imago.*

Body-parts	Range (5 examples)
1. Total body-length with wings (and excluding antennae), <i>ca.</i> ..	9.1—10.6
2. Total body-length without wings (and excluding antennae), <i>ca.</i>	5.7 ¹ —6.8
3. Length of head to lateral base of mandibles.	0.80—0.88
4. Maximum width of head with eyes	0.90—0.97
5. Maximum height of head	0.48—0.49
6. Maximum length of postclypeus	0.23—0.27
7. Maximum width of postclypeus	0.50—0.53
8. Maximum length of labrum	0.18—0.23
9. Maximum width of labrum	0.33—0.40
10. Maximum diameter of eye with ocular sclerite	0.25—0.26
11. Minimum diameter of eye with ocular sclerite	0.22—0.23
12. Maximum diameter of lateral ocellus	0.06—0.09
13. Minimum diameter of lateral ocellus	0.05—0.07
14. Minimum eye-ocellus distance	0.08—0.10
15. Minimum eye-antennal distance	0.04—0.05
16. Minimum ocellus-antennal distance	0.09—0.10
17. Maximum length of pronotum	0.45—0.46
18. Maximum width of pronotum	0.60—0.68
19. Length of forewing with scale	7.30—7.70
20. Length of forewing scale	0.35—0.40
21. Length of hindwing with scale	6.80—7.00.
22. Length of hindwing scale	0.33—0.38
23. No. of antennal segments	14

Thorax: Pronotum : Very weakly saddle-shaped, subtrapezoidal, broader than long ; anterior margin substraight, without a median notch ; sides converging posteriorly ; posterior margin with a weak median notch. *Mesonotum* and *metanotum* : With deeply notched posterior margins. *Legs* : Thin, moderately long, fairly densely pilose ; apical tibial spur formula 3 : 2 : 2. *Wings* : Long, hairy, punctate. *Forewings* : Longer than hindwings ; scale also longer than that of hindwing. Costa-subcosta fused, thickened, chitinized, hairy and bordering the anterior margin. Radius rudimentary, visible upto just a little outside the scale where it joins the costa-subcosta. Radial sector almost as thick as costa-subcosta, running parallel to latter all along entire wing-length and meeting it at distal margin. Median relatively thin and less chitinized, arising jointly with radial sector and separating from the latter just before leaving the scale. Cubitus also poorly chitinized ; with 15-16 branches to posterior border of wing ; proximal branches heavily, and distal ones very poorly, chitinized. *Hindwing* : Costa-subcosta radius and radial sector as in forewing. Median arising from radial sector outside the scale and bifurcating near middle of wing. Cubitus with 14 branches to posterior margin of wing.

Abdomen : Elongate, fairly densely pilose. Cerci 2-jointed, *ca.* 0.1 mm. long. Styli absent.

1b. IMAGO ♂ : Similar to ♀.

2. SOLDIER (Table 7 ; Text-fig. 13 ; and Pl. 14, Fig. 7) :

General : Head-capsule and postclypeus light to deep golden brown, labrum, anteclypeus, antennae, thorax, and legs pale golden yellow ; mandibles dark reddish brown ; abdomen pale yellowish. Head and thorax lightly pilose ; abdomen and legs somewhat more pilose. Total length without antennae *ca.* 6.2-6.3 mm.

Head : Subrectangular, much longer than broad (length to base of mandibles 1.70-1.76 mm. ; width 0.98-1.08 mm.) ; anterior corners angular, posterior margin rounded. *Fontanelle* : Indistinct. *Eyes* : absent. *ocelli* : Absent. *Antennae* : With 13 segments ; segment 1 and 2 sparsely, and the remainder moderately, pilose ; segment 1 longest, cylindrical ; 2 shorter than 1, and longer than 3 ; 3 shortest ; 4 subequal to 2 ; 5 onward progressively increasing in size to the penultimate one ; last (13) thinner, ovate, and longer than 12. *Clypeus* : Anteclypeus narrow, apilose, with a broad median tip. Postclypeus separated from frons by a deep semicircular demarcation ; much broader than long ; with a few long and short hairs. *Labrum* : Subpentagonal, with a median tip in front and a few long hairs on body. *Mandibles* : Sabre-shaped thick and stout ; outer margin convex, inner margin finely serrated and with only one large denticle at the basal third. *Postmentum* : Vase-shaped, widest at about one-third of its length from anterior margin and with a waist in the posterior one-third ; anterior margin weakly convex ; posterior margin weakly concave and with a median bulge.

Thorax : Saddle-shaped ; with many long hairs on margins and a few shorter hairs on body ; broader than long ; anterior margin with a

TABLE 7.—*Body-measurements (in mm.), etc. of Microcerotermes nicobarensis n. sp. (Roonwal & Bose). Caste : Soldier.*

Body parts	Range (3 examples)	Holotype
1. Total body length (including mandibles), <i>ca.</i>	6.2 — 6.3	6.2
2. Length of head with mandibles	2.60—2.70	2.70
3. Length of head to lateral base of mandibles	1.70—1.76	1.75
4. Maximum width of head	0.98—1.08	1.05
5. Maximum height of head	0.85—0.88	0.88
6. Length of mandibles	0.90—0.95	0.95
7. Head Index I (Width/Length*)	0.58—0.61	0.60
8. Head Index II (Height/Width)	0.81—0.87	0.84
9. Head Index III (Height/Length*)	0.50	0.50
10. Maximum length of labrum	0.25—0.28	0.25
11. Maximum width of labrum	0.33—0.34	0.33
12. Median length of postmentum	1.00—1.08	1.08
13. Maximum width of postmentum	0.33—0.35	0.35
14. Width of postmentum at waist	0.20—0.23	0.20
15. Width of postmentum at anterior margin ..	0.23—0.25	0.23
16. Maximum width of pronotum	0.62—0.63	0.63
17. Maximum length of pronotum	0.38—0.40	0.40
18. Maximum width of mesonotum	0.60—0.68	0.60
19. Maximum width of metanotum	0.75	0.75
20. No. of antennal segments	13	13

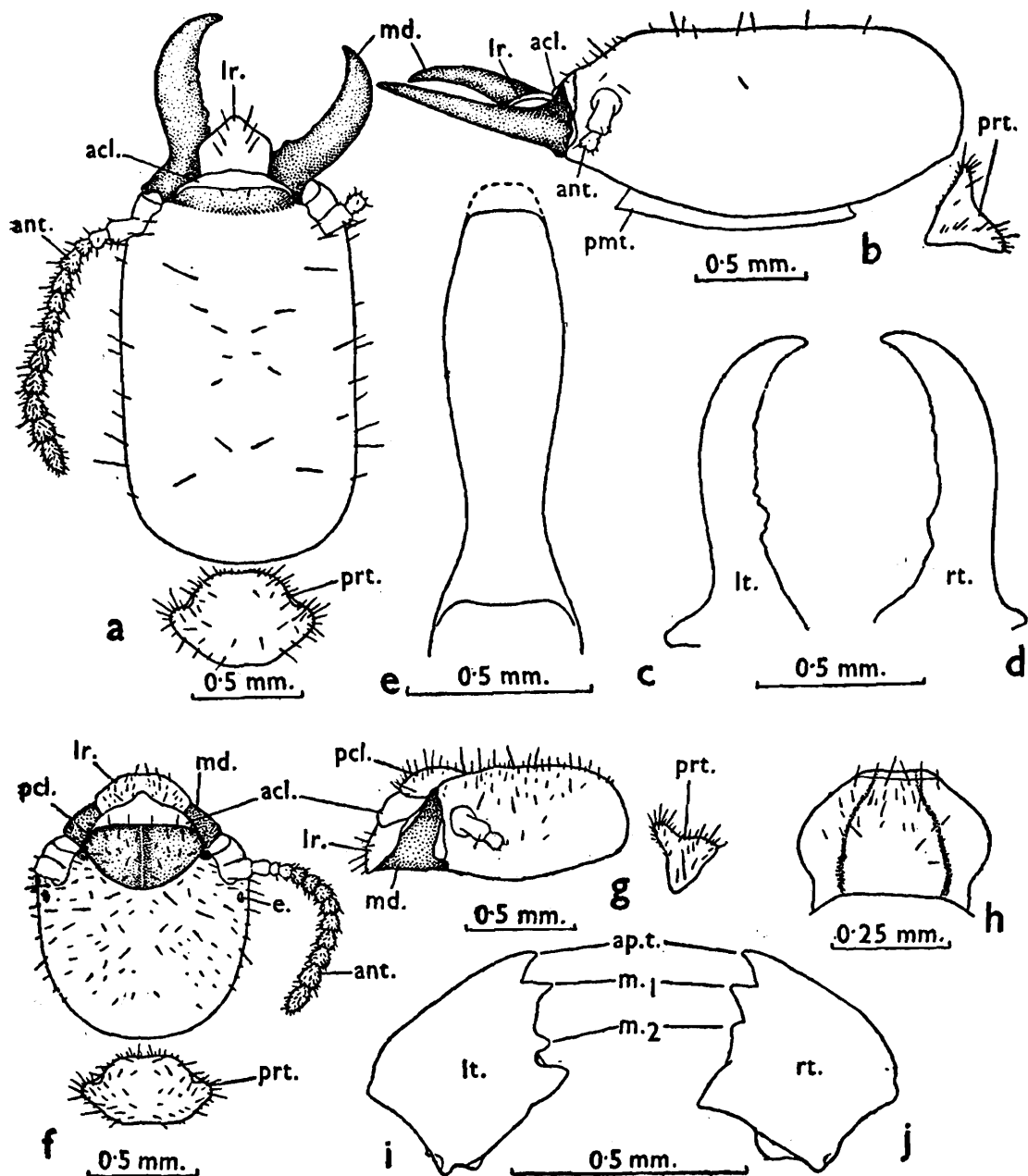
very weak or no median notch ; anterior angles broadly rounded ; sides strongly converging posteriorly ; posterior margin substraight, without a median notch. *Mesonotum* : Oval, broader than long, a little broader than pronotum. *Metanotum* : Much broader than long ; broader than mesonotum. *Legs* : Long and pilose ; apical tibial spur formula 3 : 2 : 2.

*Length to lateral base of mandibles.

Abdomen: Oval, elongate. Cerci 2-jointed, *ca.* 0.06 mm. long. Styli 1-jointed, *ca.* 0.02mm. long.

WORKER MAJOR (Text-fig. 13) :

General : Head capsule, postclypeus, labrum, antennae and mandibles yellowish ; mandibular teeth reddish brown ; thorax, legs and abdomen



TEXT-FIG. 13.—*Microcerotermes nicobarensis* n. sp. Soldier (holotype) (a-e) and Worker major (f-j), from the Car Nicobar Is.

(a) Head and pronotum, in dorsal view. (b) Head and pronotum, in lateral view. (c) and (d) Left and right mandibles respectively. (e) Postmentum. (f) Head and pronotum, in dorsal view. (g) Ditto, in lateral view. (h) Labrum, in dorsal view. (i) and (j) Left and right mandibles respectively.

acl., anteclypeus ; *ant.*, antenna ; *ap.t.*, apical tooth of mandible ; *e.*, eye-spot ; *lr.*, labrum ; *lt.*, left ; *m₁*, *m₂*, 1st and 2nd mandibular teeth respectively ; *md.*, mandible ; *pcl.*, postclypeus ; *prt.*, pronotum ; *rt.*, right.

pale yellow. Head and body moderately pilose. Total length without-antennae *ca.* 4.5-5.3 mm..

Head: Subsuarish, broadest anteriorly; sides converging posteriorly to a round posterior margin. *Fontanelle*: Indistinct. *Eyes*: Present as two small brown patches, one on either side, a little below the base of antennae. *Ocelli*: Absent. *Clypeus*: Anteclypeus hyaline, apilose; anterior margin projected into a median tip. Postclypeus swollen, pilose; separated from frons by a semicircular demarcation and divided into right and left halves by a median vertical line; width almost twice the length. *Labrum*: Broader than long, and bulged in middle; with a few long and short hairs on body. *Antennae*: With 13 segments; segment 1 longest, cylindrical; 2 smaller than 1, twice 3 and subequal to or somewhat longer than 4; 3 shortest; 5-12 progressively increasing in size; 13 club-shaped, ovate and slightly longer than 12. *Mandibles*: Of typically *Microcerotermes*-type. Teeth as in imago.

Thorax: *Pronotum*: Saddle-shaped; anterior margin weakly notched medially. *Mesonotum*: Subequal to or slightly broader than pronotum. *Metanotum*: Much broader than mesonotum. *Legs*: Long, thin, pilose; apical tibial spur formula 3 : 2 : 2.

Abdomen: Fairly elongate, pilose. *Cerci* 2-jointed, *ca.* 0.06 mm. long. *Styli* 1-jointed, *ca.* 0.05 mm. long.

5. WORKER MINOR.—Like the worker major but smaller.

Body-measurments (in mm.) of Worker Major and Minor of Microcerotermes nicobarensis n. sp. (4 examples each).

	Workers Major	Workers Minor
1. Total body-length excluding antennae, <i>ca.</i>	4.5—5.3	4.2—4.6
2. Length of head to lateral base of mandibles	0.90—0.98	0.73—0.78
3. Maximum width of head	0.93—0.95	0.80—0.83
4. Maximum height of head	0.48—0.50	0.43—0.45
5. Maximum length of pronotum	0.33—0.34	0.23—0.26
6. Maximum width of pronotum	0.60—0.63	0.45—0.50

(c) *Type specimens*.—*Holotype*: A soldier in a vial, Z.S.I. Reg. No. 3566/H8, from "Material (ii)" above. Field Coll. No. 959, Arong village, Car Nicobar Is., coll. K.K. Tiwari, 31. iii. 1959, ex. "mounds on coconut tree", deposited in Z.S.I. *Morphotype*: A ♀ imago and 2 workers (1 major, 1 minor), in a vial, Z.S.I. Reg. No. 3567/H8, from hojotype lot, deposited in Z.S.I. *Paratypes and paramorphotypes*: (i) A

paratype soldier, a paramorphotype imago ♂ and 2 paramorphotype workers (1 major, 1 minor), in a vial, Z.S.I. Reg. No. 3568/H8, from holotype lot, deposited in Z.S.I. (ii) A paratype soldier, a paramorphotype imago ♀ and 4 paramorphotype workers (2 major, 2 minor), in a vial, Z.S.I. Reg. No. 3569/H8, from "Material (i)" above. Field Coll. No. 622, Ross Is., South Andamans, coll. K. K. Tiwari, 14.iii.1959; deposited in Z.S.I. (iii) A paramorphotype imago ♀ and 2 paramorphotype workers (1 major, 1 minor) from holotype lot; deposited in F.R.I., Dehra Dun. (iv) A paramorphotype imago ♀ and 2 paramorphotype workers (1 major, 1 minor), from holotype lot; deposited with Prof. A.E. Emerson, U.S.A.

(d) *Type-locality and Geographical distribution.*—*Type-locality* : Arong village, Car Nicobar Is.

Geographical distribution : Andamans : South Andamans (Ross Is., Nicobars : Car Nicobar Is. (Arong village).

(e) *Comparisons.*—1. IMAGO.—The imago of *Microcerotermes nicobarensis* n. sp. is close to that of *M. heimi* Wasm. but differs from it as follows :—(i) Head-size a little larger (length without mandibles 0.80-0.88 mm. vs. 0.75-0.82 mm.; width 0.90-0.97 mm. vs. 0.85-0.92 mm.). (ii) Head-capsule deep yellowish brown to brown vs. light brown. (iii) Eyes larger (maximum diameter 0.25-0.26 vs. 0.19-0.21 mm.; minimum diameter 0.22-0.23 vs. 0.16-0.17 mm.). (iv) Eye-ocellus distance slightly greater than (vs. equal to) maximum diameter of ocellus (0.08-0.10 and 0.06-0.09 mm. vs. 0.08-0.10 and 0.07-0.10 mm. respectively).

2. SOLDIER.—The soldiers of *Microcerotermes nicobarensis* n. sp. are close to *M. fletcheri* Holmgren, *M. annandalei* Silvestri and *M. bugnioni* Holmgren, but differs from these as follows :—

(1) *From M. fletcheri* : (i) Mandibles longer, slightly more convex and slender (vs. shorter, more straight and stouter). (ii) Head wider (maximum width 1.05-1.10 vs. 0.95 mm.).

(2) *From M. annandalei* : (i) Smaller (head-length to lateral base of mandibles 1.70-1.76 vs. 1.83-1.90 mm.) (ii) Labrum pentagonal and pointed (vs. tongue-shaped). (iii) Mandibles more convex and uniformly broad to about its distal one-fourth (vs. more straight and broader towards base and thinner towards apex.).

(3) *From M. bugnioni* : Head larger (length with mandibles 2.60-2.70 vs. 2.25 mm., without mandibles 1.70-1.76 vs. 1.63 mm.; maximum width 1.05-1.10 vs. 0.92 mm.). (ii) Mandibles longer (0.90-0.95 vs. 0.62 mm.). (iii) Labrum wider than long (vs. as long as wide).

(f) *Biological Remarks.*—The collector's field labels say that the material was obtained from "mounds on cocoanut tree" Presumably he obtained it from the large subglobular carton nests at the base of cocoanut trees; these nests are characteristic of the genus *Microcerotermes* and, when covered by soil as they often look like "mounds".

Subfamily (ii) *Macrotermitinae*Genus (6) *Odontotermes* Holmgren12. *Odontotermes latigula* (Snyder)

(Pl. 12, Figs. 1-3 and 5 ; and Pl. 13, Fig. 8)

1934. *Termes (Cyclotermes) latigula* T. E. Snyder, *Indian For. Rec. (Ent.)* Delhi, 20 (11), pp. 9, 10. S. Type-locality : North Andaman Is.

(a) *Material*.—26 vials, S. and W., the Andamans and the Nicobars, as follows :—Lot (A) : 4 vials, South Andamans, coll. O. Paiva, March-April, 1911, as follows (all *det.* Silvestri as “*Odontotermes redemanni* Wasm.”): (i) 30.iii.1911, ex. “*Mangifera indica*”; no other details. (ii) Ross Is., 30.ix.1911, ex. “mango tree” (iii) Garacharama, 2.iv.1911. (iv) Garacharama, 3.iv.1911.

Lot (B) : 4 vials, South Andamans, coll. N. Annandale, November-December, 1923, as follows (all *det.* Silvestri as “*Odontotermes obesus* Ramb.”): (v) Coll. Sta. No. 1, base to summit of Mt. Harriet, 29.xi.1923 (10 to 11 a.m.), Z.S.I. Reg. No. 7379/H2, ex. “gallery on jungle path”. (vi) Coll. Sta. No. 31, summit of Mt. Harriet, 1190 ft., 30.xi.1923, Z.S.I. Reg. No. 7380/H2, ex. “earthen gallery” (vii) Mt. Harriet, 500 ft., xii. 1923, Z.S.I. Reg. No. 7342/H2, ex. “under stones and wood”. (viii) Coll. Sta. No. 51, thick jungle, north side of Mt. Harriet, 500-1000 ft., xii. 1923, Z.S.I. Reg. No. 7381/H2, ex. “dead log on floor of jungle”.

Lot (C) : (ix) 1 vial, Coll. Sta. No. B10, Hope Town, Ranighat, South Andamans, coll. R.B.S. Sewell, 27.viii.1928.

Lot (D) : 13 vials, Andamans and Nicobars, coll. K. K. Tiwari, January to April 1959, thus : (x) Fd. Coll. No. x, Coll. Sta. No. 1, Aberdeen Bay near Port Blair, South Andamans, 12.i.1959, ex. “rotten log of wood” (xi) Fd. Coll. No. 17, Coll. Sta. No. 3, Wright Myo, South Andamans, 13.i.1959, ex. “below stone”. (xii) Fd. Coll. No. 143, Coll. Sta. No. 6, Long Is. Middle Andamans, 23.i.1959, ex. “bark of a tree”. (xiii) Fd. Coll. No. 260, Coll. Sta. No. 11, Port Cornwallis, North Andamans, 31.i.1959, ex “log of wood”. (xiv) Fd. Coll. No. 286, Coll. Sta. No. 12, Diglipur, North Andamans, 2.ii.1959. (xv) Fd. Coll. No. 306, Coll. Sta. No. 13, Interview Is., North Andamans, 7.ii.1959. ex. “decaying log of wood” (xvi) Fd. Coll. No. 323, Coll. Sta. No. 13, Interview Is., North Andamans, 8.ii.1959, ex. “decaying timber” (xvii) Fd. Coll. No. 401, Coll. Sta. No. 15, Chouldhari, South Andamans, 26.ii.1959, ex. “decaying log of wood” (xviii) Fd. Coll. No. 553, Coll. Sta. No. 17, Port Blair, South Andamans, 8.iii.1959, ex. “loose mud under a thorny bush”. (xix) Fd. Coll. No. 649, Coll. Sta. No. 23, Collinpur, South Andamans, 15.iii.1959, ex. “rotting log of wood” (xx) Fd. Coll. No. 655, Coll. Sta. No. 24, Herbertabad, South Andamans, 15.iii.1959. (xxi) Fd. Coll. No. 733, Coll. Sta. No. 25, Malacca village, Car Nicobar (Nicobars), 23.iii.1959, ex. “rotten log of wood”. (xxii) Fd. Coll. No. 1045, Coll. Sta. No. 25, Malacca village, Car Nicobar (Nicobars), 8.iv.1959.

Lot (E) : 4 vials, Little Andamans, coll. A. Daniel, February-March, 1961, thus : (xxiii) Fd. Coll. No. 473, Coll. Sta. No. 5, Gaje, 25.ii.1961

ex. "pillar of Onge hut" (xxiv) Fd. Coll. No. 587, Coll. Sta. No. 6, Ongebera, Kwateneabo, 28.ii.1961, ex. "tree" (xxv) Fd. Coll. No. 615, Coll. Sta. No. 2, near Dugong Creek, Tokoibuea, 1.iii.1961, ex. "dead tree" (xxvi) Fd. Coll. No. 616, Coll. Sta. No. 2, near nullah (streamlet) at Tokoibuea, 1.iii.1961, ex. "trees"

(b) *Measurements (in mm.) of Soldiers (30 examples).*

1. Total body-length without antennae, ca.	..	..	..	..	4.8—5.6
2. Length of head with mandibles	..	.	..	..	2.23—2.40
3. Length of head to lateral base of mandibles	..	..	..	..	1.25—1.38
4. Maximum width of head	..	..	..	..	1.15—1.30
5. Maximum length of pronotum	..	..	..	..	0.55—0.58
6. Maximum width of pronotum	..	..	..	..	0.83—0.93
7. No. of antennal segments	..	..	..	..	17

(c) *Geographical Distribution.*—*Andamans* : North Andamans (Port Cornwallis and Interview Is.) and Middle Andamans (Long Is.) ; South Andamans (Aberdeen Bay, Port Blair, Mt. Harriet, Wright Myo, Collinpur, Herbertabad, Chouldhari, Hope Town, Garacharama and Ross Is.) ; and Little Andamans (Dugong Creek, Gaje, Kwateneabo and Tokoibuea). *Nicobars* : Car Nicobar (Malacca village). *Elsewhere* : Burma (South Shan States, *vide* Roonwal and Pant, 1953, p. 55).

(d) *Biological Remarks.*—This is a widely distributed species in the Andamans and the Nicobars, and so far this is the only species of *Odontotermes* recorded from there. It is differentiated from all other *Odontotermes* of the "obesus" group by its very wide and swollen postmentum. It seems to be the species whose mounds from the Andamans were described by Annandale (1924, p. 27) as a small (about 90 cm. high and 90 cm. in basal diameter) formless mass of earth, nearly solid and with only a few narrow passages. Annandale's specimens were identified by Silvestri as "*Odontotermes obesus* (Ramb.)." but this is an error, and we find the specimens to be *O. latigula* (*vide* Material above, Lot B). (In this connection, also see Roonwal, 1962.) The present collections have been obtained from various situations, e.g. "earthen galleries" in jungle path, on ground under stones and wood, in rotten logs, under bark of trees, and in the wooden pillar of a hut.

Subfamily (iii) *Nasutitermitinae*

Genus (7) *Nasutitermes* Banks*

13. *Nasutitermes krishna* n. sp.

(Table 8 ; and Text-figs. 14 and 15)

(a) *Material*.—5 vials, S. and W., Andaman Islands, as follows :—
Lot (A) : (i) Fd. Coll. No. 306, Coll. Sta. No. 13, Interview Is., North Andamans. coll. K. K. Tiwari, 7.ii.1959, ex. “decaying log of wood”.
Lot (B) : 4 vials, Little Andaman Is., coll. A. Daniel, thus: (ii) Fd. Coll. No. 163, Coll. Sta. No. 2, near Entizebera, 16 km. west of Tokoibuea, 15.ii.1961, ex. “dead tree” (iii) Fd. Coll. No. 272, Coll. Sta. No. 3, Kwate-tu-Kwage, 18.ii.1961, ex. “dead tree”. (iv) Fd. Coll. No. 438, Coll. Sta. No. 4, forest 1 km. north of Benyabobera, 16 km. west of Ingoie, 23.ii.1961, ex. “dead tree”. (v) Fd. Coll. No. 580, Coll. Sta. No. 6, Ingitekudda forest, north of Nachugea, 28.ii.1961, ex. “dead tree”

(b) *Description*.

1. IMAGO.—Unknown.

2. SOLDIER (Table 8 ; and Text-fig. 14).

General : Head-capsule and antennae brownish yellow ; rostrum reddish brown ; mandibles yellowish ; pronotum, mesonotum, metanotum, legs and abdominal tergites, pale brownish yellow. Head with several short and 2 pairs (one distal and one proximal) of long bristle-like hairs ; thorax with many short hairs ; abdomen with several short and a few long bristle-like hairs. Total length with rostrum (but without antennae) ca. 3.4-3.7 mm.

Head : Nearly pear-shaped, with anterior end prolonged into a rostrum ; posterior margin rounded ; maximum width subequal to, or a little more than, the length (head-length without rostrum 0.93-1.00 mm. maximum width 0.98-1.10 mm.) ; widest near middle of head-capsule. *Rostrum* : Subcylindrical and slender ; gradually narrowing distally and ending in a conical truncated apex with a cluster of short hairs on tip ; shorter than head (rostrum-length 0.55-0.68 mm. ; head-length 0.93-1.00 mm.). *Fontanelle* : Gland and tube distinct. *Eyes and ocelli* : Absent. *Antennae* : With 12 segments ; segments 1 and 2 sparsely, and the remainder fairly densely, pilose ; segment 1 long, cylindrical ; 2 shorter than 1 and longer than 3 ; 3 shortest ; 4 slightly longer than 3 ; 5-11 subequal and pyriform ; apical (12) ovate, club-shaped, subequal to 11. *Mandibles* : Vestigial and small ; each with a spine-like apical process in middle of outer margin ; inner or molar margin rounded. *Postmentum* : Pentagonal, short, much broader than long.

* *Nasutitermes* Banks 1920 replaces *Nasutitermes* Dudley 1890, *vide* discussion in Prasad & Sen-Sarma (1959, p. 2).

TABLE 8.—*Body-measurements (in-mm.) of Nasutitermes krishna n. sp. (Roonwal & Bose). Caste : Soldier.*

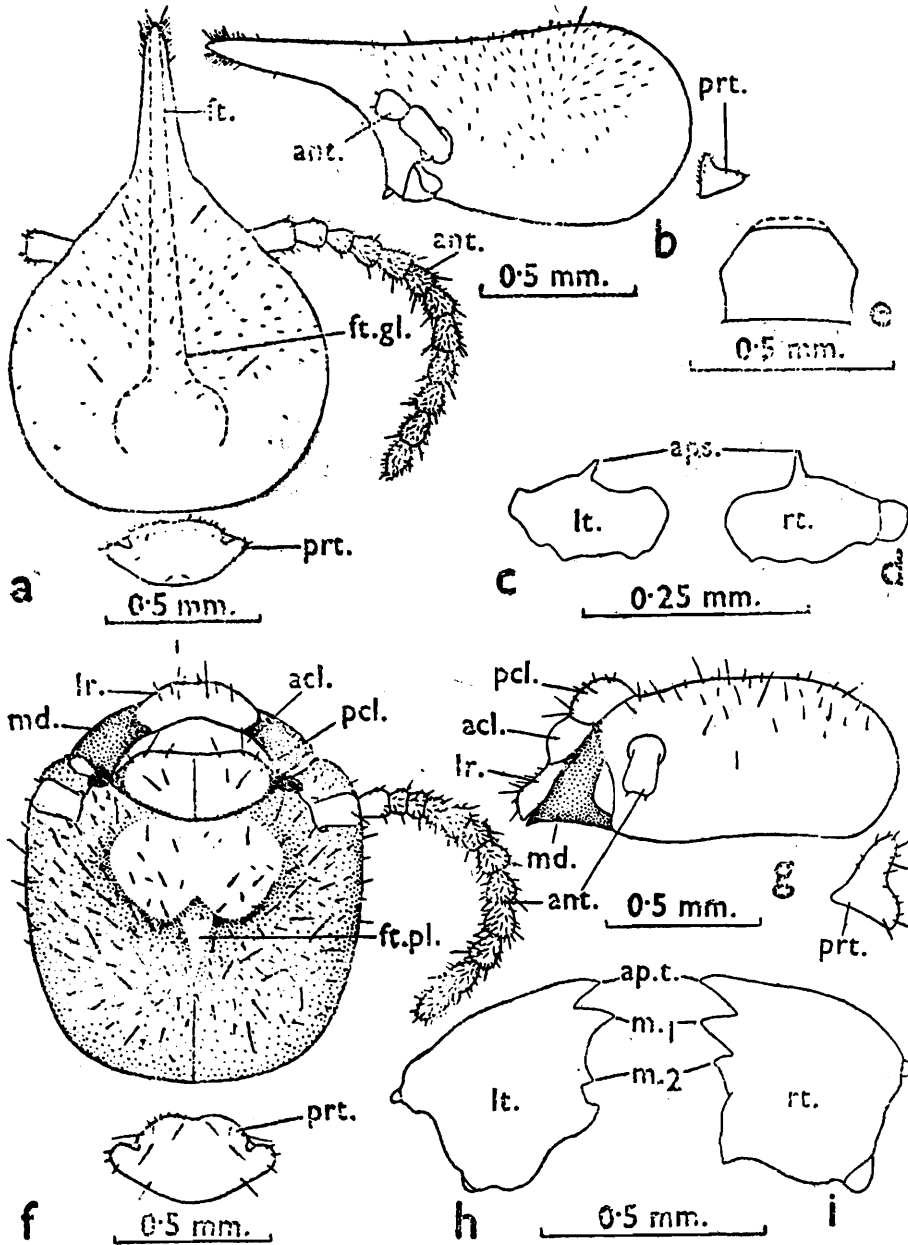
Body-parts	Range (10 examples)	Holotype
1. Total body-length without antennae, ca. ..	3.4 —3.7	3.46
2. Length of head with rostrum ..	1.55—1.60	1.60
3. Length of head upto base of rostrum ..	0.93—1.00	0.95
4. Length of rostrum	0.55—0.68	0.65
5. Maximum width of head	0.98—1.10	1.05
6. Maximum height of head ..	0.60—0.68	0.68
7. Head Index I (Width/Length to base of rostrum)	1.03—1.14	1.10
8. Head Index II (Height/Length to base of rostrum)	0.67—0.72	0.72
9. Head Index III (Height/Width)	0.58—0.65	0.64
10. Head-Rostrum Index (Length of rostrum/Length of head to base of rostrum) ..	0.60—0.76	0.68
11. Posterior bulge of head	0.26—0.30	0.28
12. Head production Index I (Head bulge/Length of head to base of rostrum) ..	0.25—0.30	0.29
13. Head production Index II (Head bulge/Width of head)	0.24—0.30	0.26
14. Median length of postmentum ..	0.25—0.30	0.25
15. Maximum width of postmentum	0.30—0.33	0.30
16. Minimum width of postmentum	0.25—0.28	0.25
17. Postmentum Index (Maximum width/Maximum length)	1.07—1.32	1.20
18. Maximum length of pronotum	0.16—0.18	0.18
19. Maximum width of pronotum ..	0.43—0.48	0.45
20. Pronotum-Head Index (Pronotum-width/Head-width)	0.43—0.47	0.43
21. Maximum width of mesonotum	0.33—0.38	0.33
22. Maximum width of metanotum ..	0.48—0.50	0.50
23. Length of hind-tibia	0.90—0.98	0.90

Thorax : Pronotum : Saddle-shaped, weakly hairy, with a few small hairs on body and on margins ; broader than long (width ca. $2\frac{1}{2}$ times the length ; index Length/Width 0.40-0.44) ; much narrower than head-capsule (index Pronotum-width/Head-width 0.43-0.47) ; anterior margin rounded, with a weak median notch ; sides converging posteriorly to a narrow subconvex posterior margin. *Mesonotum* : Oval ; broader than long ; narrower than pronotum ; with very minute hairs on margins and on body. *Metanotum* : Oval, much broader than long ; with very minute hairs on margins and on body. *Legs* : Thin and long ; pilose ; apical tibial spur formula 2 : 2 : 2.

Abdomen.—Elongate ; sparsely hairy with a pair of long hairs on lateral margins and another such pair towards middle line of each posterior tergite ; remaining segments fairly densely covered with minute hairs ; sternites also covered with many long and short hairs. *Cerci* 2-jointed ca. 0.08 mm. long. *Styli* absent.

3. WORKER MAJOR (Text-fig. 14) :

General : Head-capsule and labrum, yellow to reddish yellow ; postclypeus, thorax and antennae yellowish ; anteclypeus, legs and abdomen pale creamish yellow. Head and body moderately pilose. Total length excluding antennae *ca.* 3.8-4.9 mm.



TEXT-FIG. 14.—*Nasutitermes krishna* n. sp. from the Little Andamans. (a-e). Soldier (paratype). (f-i). Worker major (paramorphotype).

(a) Head and pronotum, in dorsal view. (b) Ditto, in lateral view. (c) and (d) Left and right mandibles respectively. (e) Postmentum. (f) Head and pronotum, in dorsal view. (g) Ditto, in side view. (h) and (i) Left and right mandibles, respectively.

acl., anteclypeus ; *ant.*, antenna ; *aps.*, apical spine of mandible ; *ap.t.*, apical tooth of mandible ; *ft.*, fontanelle tube ; *ft. gl.*, fontanelle gland ; *ft. pl.*, fontanelle plate ; *lr.*, labrum ; *lt.*, left ; *m₁*, *m₂*, 1st and 2nd mandibular teeth respectively ; *md.*, mandible ; *pcl.*, postclypeus ; *prt.*, pronotum ; *rt.*, right.

Head : Subrectangularly oval ; a little broader than long (length to lateral base of mandibles 0.90-0.93 mm. ; maximum width 1.00-1.08 mm.), widest anteriorly. **Fontanelle** : Fontanelle Plate triangular, long, whitish, translucent ; situated almost in middle of head-capsule. **Antennae** : With 13 segments ; segments 1 and 2 sparsely, and the remainder fairly densely, pilose ; segment 1 longest, cylindrical ; 2 shorter than 1 and $1\frac{1}{2}$ times 3 ; 3 shortest ; 4-12 gradually increasing in size ; apical (13) ovate, club-shaped, subequal to 12. **Clypeus** : Anteclypeus subtrapezoidal, narrow, hyaline and apilose ; anterior margin projecting in middle. Postclypeus swollen, sparsely pilose, anterior margin concave ; divided into right and left halves by a median vertical suture. **Labrum** : Broader than long ; broadest anteriorly ; anterior margin rounded. **Mandibles** : Of typically *Nasutitermes*-type. Right mandible with an apical and 2 marginal teeth ; apical finger-like ; 1st marginal subequal to apical ; 2nd short and blunt and lying close to 1st. Left mandible also with an apical and 2 marginal teeth ; apical finger-like ; 1st marginal similar and subequal to apical ; 2nd short and widely separated from 1st.

Thorax : Pilose, with many long and short hairs on margins and on body. **Pronotum** : Saddle-shaped, much narrower than head (maximum width 0.53-0.58 mm. vs. 1.00-1.10 mm.) ; broader than long (maximum length 0.23-0.28 mm. ; width 0.53-0.58 mm.) ; anterior margin strongly upturned and with a deep median notch ; posterior margin substraight and without a median notch. **Mesonotum** : Oval, broader than long, narrower than pronotum ; sparsely pilose. **Metanotum** : Oval, broader than pronotum, sparsely pilose. **Legs** : Thin and long ; pilose ; apical tibial spur formula 2 : 2 : 2.

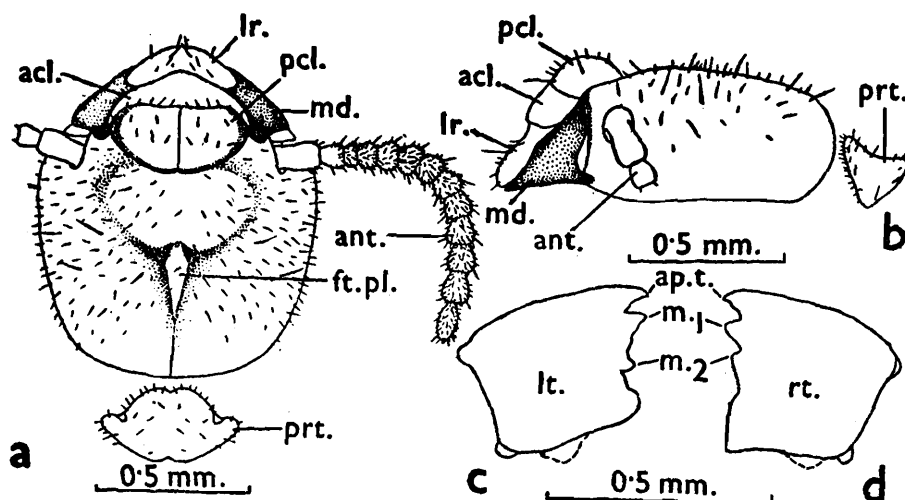
Abdomen : Elongate, hairy. Cerci 2-segmented, ca. 0.08 mm. long. Styli absent.

4. WORKER MINOR (Text-fig. 15).

Like worker major, but smaller.

Measurements (in mm.) of workers major and minor of Nasutitermes krishna n. sp. (7 examples each).

	Workers major	Workers minor
1. Total body-length without antennae, ca.	3.8-4.9	3.0-4.1
2. Length of head to lateral base of mandibles	0.90-0.93	0.70-0.83
3. Maximum width of head	1.00-1.10	0.80-0.93
4. Maximum height of head	0.50-0.60	0.40-0.48
5. Maximum length of pronotum	0.23-0.28	0.15-0.23
6. Maximum width of pronotum	0.53-0.58	0.40-0.48



TEXT-FIG. 15.—*Nasutitermes krishna* n. sp. Worker minor (paramorphotype), from the Little Andamans.

(a) Head and pronotum, in dorsal view. (b) Ditto, in lateral view. (c) and (d) Left and right mandibles respectively.

acl., anteclypeus ; *ant.*, antenna ; *ap.t.*, apical tooth of mandible ; *ft.pl.*, fontaneille plate ; *lr.*, labrum ; *lt.*, left ; *m₁*, *m₂*, 1st and 2nd mandibular teeth respectively ; *md.*, mandible ; *pcl.*, postclypeus ; *prt.*, pronotum ; *rt.*, right.

(c) *Type-specimens*.—*Holotype* : A soldier in a vial, Z.S.I. Reg. No. 3570/H8, Fd. Coll. No. 272, Kwate-tu-Kwage, Little Andamans, coll. A. Daniel, 18.ii.1961, deposited in Z.S.I. *Morphotypes* : 2 workers (1 major, 1 minor) in a vial, Z.S.I. Reg. No. 3571/H8, same data as for holotype ; deposited in Z.S.I. *Paratypes (soldiers) and paramorphotypes (workers)* : From the holotype lot ; deposited as follows : 10 S. and 15 W. (10 major, 5 minor) in Z.S.I., Z.S.I. Reg. No. 3572/H8. (ii) 2 S. and 2 W. (1 major, 1 minor) in F.R.I., Dehra Dun. (iii) 2 S. and 2 W. (1 major, 1 minor) in I.A.R.I., New Delhi. (iv) 2 S. and 2 W. (1 major, 1 minor) with Prof. A.E. Emerson, U.S.A.

(d) *Type-locality and Geographical Distribution*.—*Type-locality* : Little Andaman Is., Coll. Sta. No. 3, Kwate-tu-Kwage.

Geographical Distribution : Andamans : North Andamans (Interview Is.). Little Andamans (Kwate-tu-Kwage, the type-locality ; and Tokoibuea, Benyabobera and Ingitekudda).

(e) *Comparison*.—*Nasutitermes krishna* n. sp. appears to be close to *N. emersoni* Snyder but differs from it as follows : SOLIDER : (i) Head light yellow to orange (*vs.* brown to castaneous brown). (ii) Head in profile slightly concave (*vs.* slightly convex). (iii) Nasus conical but not with convexical sides (*vs.* with slightly convexical sides). (iv) Segment 3 of antenna smaller than 2 or 4 (*vs.* larger). (v) Anterior abdominal tergites with no long hairs (*vs.* a few such hairs).

(f) *Biological Remarks*.—The species appears to attack dead wood, and was obtained from “ dead trees ”

14. *Nasutitermes matangensis matangensiformis* (Holmgren)

(Pl. 13, Fig. 9)

1913. *Eutermes* (*E.*) *matangensiformis* N. Holmgren, *K. Sv. Vet. Akad.-Handl.*, Stockholm, 50(2), p. 185, *Im.*, *S.* and *W.* Type-localities : Sarawak (Borneo) and Nankauri Is. (Nicobars). Restricted to Sarawak by Prashad & Sen-Sarma (1959, p. 53).
1956. *Nasutitermes matangensis matangensiformis* (Holmg.), M. L. Roonwal and P. K. Sen-Sarma, *Indian J. agric. Sci.*, New Delhi, 26 (2), pp. 27-29.

(a) *Material*.—7 vials, one *Im.* several *S.* and *W.*, Andamans and Nicobars, as follows :—

Lot (A) : 2 vials, Car Nicobar Is. (Nicobars), coll. *K. K. Tiwari*, March-April, 1959, thus : (i) *Fd.* Coll. No. 768, Coll. Sta. No. 25, Tamalu village, 24.iii.1959, ex. "a rotten cocoanut tree" (ii) *Fd.* Coll. No. 1005, one *Im.*, one *S.* and several *W.*, Coll. Sta. No. 32, Sawi village, 5. iv. 1959.

Lot (B) : 5 vials, Little Andaman Is., coll. *A. Daniel*, February, 1961, thus : (iii) *Fd.* Coll. No. 162, Coll. Sta. No. 2, Entizebera, 16 km. west of Tokoibuea, 15.ii.1961, ex. "dead log" (iv) *Fd.* Coll. No. 215, Coll. Sta. No. 2, Bedeabdulu, 19. km. south of Tokoibuea, 16.ii.1961, ex. "dead log" (v) *Fd.* Coll. No. 313, Coll. Sta. No. 3, Tailanda, 24 km. north of Kwate-tu-Kwage, 19.ii.1961, ex. "dead log" (vi) *Fd.* Coll. No. 314, Coll. Sta. No. 3, Tailanda, 23 km. north of Kwate-tu-Kwage, 19.ii.1961. ex. "dead wood" (vii) *Fd.* Coll. No. 472, Coll. Sta. No. 5, Gaje, near Onge hut, 25.ii.1961, ex. "dead tree"

(b) *Measurements* (in mm.).—

Imago (1 example)

1. Total body length with wings (but without antennae), <i>ca.</i>	..	13.2
2. Body-length without wings and antennae	.. ..	8.2
3. Length of head to tip of labrum	..	1.55
4. Length of head to lateral base of mandibles	..	1.10
5. Maximum width of head	.. ..	1.40
6. Maximum diameter of eye	.. ..	0.50
7. Maximum diameter of ocellus	.. ..	0.18
8. Minimum eye-ocellus distance	.. ..	0.025
9. Maximum length of pronotum	..	0.75
10. Maximum width of pronotum	.. ..	0.18
11. No. of antennal segments	.. ..	15

Soldiers (11 examples)

1. Total body-length (without antennae), <i>ca.</i>	.. ..	3.4—4.0
2. Length of head with rostrum	.. ..	1.43—1.68
3. Length of head to base of rostrum	..	0.83—1.08
4. Maximum width of head	..	0.88—1.08
5. Maximum length of pronotum	.. ..	0.18—0.25
6. Maximum width of pronotum	.. ..	0.43—0.55
7. No. of antennal segments	.. ..	13

(c) *Geographical Distribution*.—*Andamans* : Little Andamans (Bede-abdulu, Entizebera, Gaje and Tailanda). *Nicobars* : Nankauri Is. (Holmgren, 1913), Camorta Is. (Roonwal & Sen-Sarma, 1956) and Car Nicobar Is. (Tamalu and Sawi, present record). *Elsewhere* : Malay Peninsula and Indonesia (Java, Sumatra and Borneo).

(d) *Biological Remarks*.—The species was obtained from “dead logs”.

IV—ZOOGEOGRAPHY OF THE ANDAMAN AND NICOBAR TERMITES* (Table 9)

1. *General remarks*

The following considerations have to be kept in mind while discussing the zoogeography of the termite fauna of the Andaman and Nicobar Islands :—(i) As discussed below, these islands first arose from the ocean bed in the Mesozoic period about 110 million years ago and have since then undergone several periods of *partial* submergence and elevation. (ii) They lie in the middle of the oriental region, having affinities with India, Burma and Indonesia. (iii) The Nicobar chain of islands has so far been scantily worked out from the point of view of termite fauna ; any conclusions arrived at for that area must, therefore, be tentative.

2. *Geological history of the Andamans and Nicobars*

The geology of the Andaman and Nicobar Islands has been studied by several workers, notably Oldham (1885), Tipper (1911), Gee (1926) and, in recent years, by Karunakaran (1962), the last named author having given a useful review on which, and on personal discussions with him, the following summary is based.

The arcuate chain of islands which comprise the Andamans and the Nicobars can be separated into two concentric areas—an outer (western) non-volcanic arc comprising the major islands of the Andamans and the Nicobars, and an inner (eastern) volcanic arc jutting above the sea as the conical volcanoes of the Narcondam and the Barren Islands. According to Karunakaran, rock formation on the Andamans and the Nicobars can be classified as follows :—

1. *Quaternary Era* : Recent and subrecent (0.01 million years ago) : Aluvium, raised beaches, reef limestone.

2. *Tertiary Era* : (a) Miocene-Pliocene (12-25 million years ago) : Clays of Nicobar group. Interview Island stage (limestone and sandstone). (b) Oligocene (40 million years ago). (c) Eocene (60 million years ago) : Archipelago series (clays ; Port Blair series, e.g., grits, sandstones, shales and conglomerates).

3. *Mesozoic Era* : Cretaceous (110 million years ago) : Ultrabasic rocks.

Ultrabasic and basic rocks are found over fairly large areas on the islands, and associated with them are the oldest sedimentary rocks, viz., some limestones or marble cherts (which contain minute Radiolaria) and quartzites. All the other rocks are marine sediments of the Tertiary and Recent ages.

* For a preliminary account, see Roonwal & Bose, 1965, *Bull. syst. Zool* Calcutta, 1 (1), pp. 3-4.

The deposition of the oldest sediments, which contain fossil Radiolaria, probably took place over 100 million years ago. This was followed, at the beginning of the Tertiary Era (about 60 million years ago), by upheavals when intense crumpling of these sedimentary basins accompanied by uplifts (up to about 5 km.) took place. The uplift was probably accompanied by volcanic activity. These compressions and upheavals, resulting in the formation of land-masses out of the ocean basin, were followed by a period of quiet during which erosion took place. A second period of mountain-building, folding and faulting now took place up to the Miocene time (about 25 million years ago), and was succeeded by a period of submergence so that shallow water deposits were formed over the older rocks. The quiet Miocene period (12-25 million years ago) was followed by one of folding and elevation of this island group again into a land-mass.

After this Miocene period, geological history has been one of periodic fluctuations in level-elevation followed by submergence. Thus, during the Pliocene and Pleistocene periods (1-10 million years ago) some shelly sands were deposited in the Ritchies Archipelago areas which were subsequently elevated and tilted. This was followed by minor upheavals and submergence. Finally, in the Recent period there has been further submergence, resulting in drowned valleys as indicated by the deeply indented coastline and the existence of island-studded bays.

Thus, these islands, which were first raised in the Mesozoic period (about 100 million years ago), have since then undergone several periods of submergence and elevation up to the Pleistocene (about one million years ago), and finally some submergence in the Recent period. These considerations are of importance in the study of the terrestrial fauna which is not likely to survive periods of total submergence. But the submergences in these islands appear to have been *partial*. Evidences of partial submergence in recent times are to be seen in the form of marine shell-beds at about six metres above the present sea-level. The total absence of shell-beds in the higher ridges of the islands suggests that such submergences were only partial and ranged only within a few metres. That submergences in the older geological periods were also partial is shown by the fact that the ultrabasic rocks near the peaks, such as Saddle Hill (North Andamans), *ca.* 600 metres, have no marine deposits. Such marine deposits are to be found at much lower elevations only, a few metres above the sea-level along the flanks of the higher ridges as well as in the outlying islands like those of the Ritchies Archipelago which have a low elevation.

3. Discussion on composition of termite fauna

The 17 termite species known from these islands are phylogenetically distributed as follows :—

Family Kalotermitidae	.. ..	3 (or 17.6 %)
Family Rhinotermitidae	.. ..	8 (or 47.1 %)
Family Termitidae	.. ..	6 (or 35.3 %)

Thus, the Rhinotermitidae is the best represented family and the Kalotermitidae the poorest. Among the Rhinotermitidae, only three genera namely, *Coptotermes*, *Prorhinotermes* and *Schedorhinotermes*, occur, and of these the last mentioned is the dominant one, with four species. Among the Kalotermitidae, which is the most primitive of the three families, the two species of *Cryptotermes* are widely distributed, mainly by introduction. Their "absence" from the Nicobars is almost certainly due to inadequate surveys. *Neotermes andamanensis* is a rare species. It is highly likely that with intensive surveys in the forests, and a careful examination of tree trunks, some more Kalotermitidae species will be found. Among the Termitidae, which is the most highly evolved family among termites, the occurrence of only a single species of the genus *Odontotermes* is noteworthy since this genus is highly successful in the humid tropics. The species, however, is perhaps the most commonly met with termite on these islands. The nasute termites (Nasutitermitinae) are represented by 2 genera and 3 species, namely *Nasutitermes krishna* n. sp., *N. matangensis matangensisformis* and *Hospitalitermes blairi*.

Of the 17 species found, 10 (or 58·8 per cent) are endemic to these islands and are not found elsewhere (Table 9). These are : *Neotermes andamanensis*, *Prorhinotermes shiva*, *Schedorhinotermes eleanoreae* n. sp., *S. longirostris*, *S. tiwarii*, *Microcerotermes danieli* n. sp., *M. nicobarensis* n. sp., *Odontotermes latigula*, *Nasutitermes krishna* n. sp. and *Hospitalitermes blairi*. One species (or 5·9 per cent), namely, *Prorhinotermes flavus* (Fam. Rhinotermitidae) is common with the Indian Region only. Six species (or 35·3 per cent) are common with the Oriental Region as a whole—these are : *Cryptotermes dudleyi*, *Crypt. havilandi* (Kalotermitidae), *Coptotermes heimi*, *Copt. travians*, *Schedorhinotermes medioobscurus* (Rhinotermitidae) and *Nasutitermes matangensis matangensisformis* (Termitidae). The two species of *Cryptotermes* are very widely distributed due to introductions.

Thus, there is a strong element (nearly 59 per cent) of endemic fauna in these islands, and in the remaining portion the oriental element is prominent. This is to be expected, judging from the geological history of these islands which first arose from the ocean bed in the Mesozoic era. Although in their subsequent history the islands underwent several periods of submergence and elevation, the submergences were only *partial* and, therefore, did not completely blot out the terrestrial fauna, including termites. Such fauna must have survived in the considerable areas left above the submergence level, and could easily invade the freshly elevated areas after each period of submergence. Since the islands are separated from the mainland by a vast stretch of the ocean, and contacts with the outside world by natural means, such as driftwood, etc., must have been of rare occurrence, the original termite fauna should be regarded as having survived without any appreciable dilution by introduced species, and any evolution which took place must have occurred on the islands themselves. This accounts for the high percentage of endemism. In the last few thousand years, however, with the coming in of man on the scene, the islands were no longer isolated, and a few widespread wood-inhabiting species, such as *Cryptotermes* spp., *Coptotermes* spp., and probably also *Schedorhinotermes* spp., are perhaps to be regarded as relatively recent introductions.

TABLE 9.—Geographical distribution of the termite species of the Andaman and Nicobar Islands in various regions of the world.

+ , present ; — , absent.

Species	Andamans	Nicobars	Other parts of "Indian Region"*	Other parts of Oriental Region	Africa (including Madagascar)	Europe	Australia and Oceania	Nearctic (N. and Middle America)	Neotropical (South America)
1	2	3	4	5	6	7	8	9	10
Fam. 1. KALOTERMITIDAE									
1. <i>Neotermes andamanensis</i> (Snyd.)	+	—	—	—	—	—	—	—	—
2. <i>Cryptotermes dudleyi</i> Bks.	+	—	+	+	+	—	+	+	+
3. <i>Cryptotermes havilandi</i> (Sjöst.)	+	—	+	+	+	—	—	—	+
Fam. 2. RHINOTERMITIDAE									
4. <i>Coptotermes heimi</i> (Wasm.)	+	—	+	+	—	—	—	—	—
5. <i>Coptotermes travians</i> (Hav.)	+	+	+	+	—	—	—	—	—
6. <i>Prorhinotermes flavus</i> (Bug. & Pop.)	+	—	+	—	—	—	—	—	—

7. <i>Prorhinotermes shiva</i> (Roon. & Th.)	+	-	-	-	-	-	-	-	-	
8. <i>Schedorhinotermes eleanorae</i> n. sp.	+	-	-	-	-	-	-	-	-	
9. <i>Schedorhinotermes longirostris</i> (Br.)	-	+	-	-	-	-	-	-	-	
10. <i>Schedorhinotermes medioobscurus</i> (Holmg.)	+	-	-	+	-	-	-	-	-	
11. <i>Schedorhinotermes tiwarii</i> (Roon. & Th.)	+	-	-	-	-	-	-	-	-	
Fam. 3. TERMITIDAE										
12. <i>Microcerotermes danieli</i> n. sp.	+	-	-	-	-	-	-	-	-	
13. <i>Microcerotermes nicobarensis</i> n. sp.	+	+	-	-	-	-	-	-	-	
14. <i>Odontotermes latigula</i> (Snyd.)	+	+	-	-	-	-	-	-	-	
15. <i>Nasutitermes krishna</i> n. sp.	+	-	-	-	-	-	-	-	-	
16. <i>Nasutitermes matangensis matangensis-formis</i> (Holmg.)	+	+	-	+	-	-	-	-	-	
17. <i>Hospitalitermes blairi</i> Roon. & Sen-Sarma.	+	-	-	-	-	-	-	-	-	

*India, E. and W. Pakistan, Burma and Ceylon.

V—SUMMARY

1. Until the present study was made, only 7 species of termites were known from the Andaman and Nicobar groups of islands. This study, which is based on the material from a number of collections, both recent and old, present in the Zoological Survey of India, Calcutta, raises the number of termites known from these islands to 17 of which 4 species are new to science and 5 are new distributional records from these islands. The major part of the collections are from the Andamans.

2. A list of the 17 species, the castes known and the geographical distribution are given.

3. A key for the identification of the genera and species is provided.

4. Fourteen species present in the collections studied are considered here, and their body-measurements, and in several cases, their illustrations, are given. The four new species described here are : *Schedorhino-termes eleanorae* n. sp., *Microcerotermes danieli* n. sp., *Microcerotermes nicobarensis* n. sp. and *Nasutitermes krishna* n. sp.

5. The zoogeography of the Andaman and Nicobar termites is discussed. Of the three families represented, the Rhinotermitidae is dominant (with 8 species or 47·1 per cent of the total), the representation of the other families being : Termitidae 6 species (or 35·3 per cent) and Kalotermitidae 3 species (or 17·6 per cent).

6. Ten (58·8 per cent) out of the 17 species present on these islands are endemic and have not been found elsewhere. Thus, the proportion of endemism is high. One species (or 5·9 per cent) is common with the Indian Region only and 6 (or 35·3 per cent) are common with the Oriental Region only. The distribution is also discussed in relation to the age of the islands and the introduction of widely-spread species by artificial agencies.

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PLATE 10

Maps of the Andaman Islands, showing the localities where termite collections were made.

FIG. 1.—The Andaman chain of islands.

FIG. 2.—The Little Andaman Island.

FIG. 3.—Map of India, showing the position of the Andaman and Nicobar groups of islands.

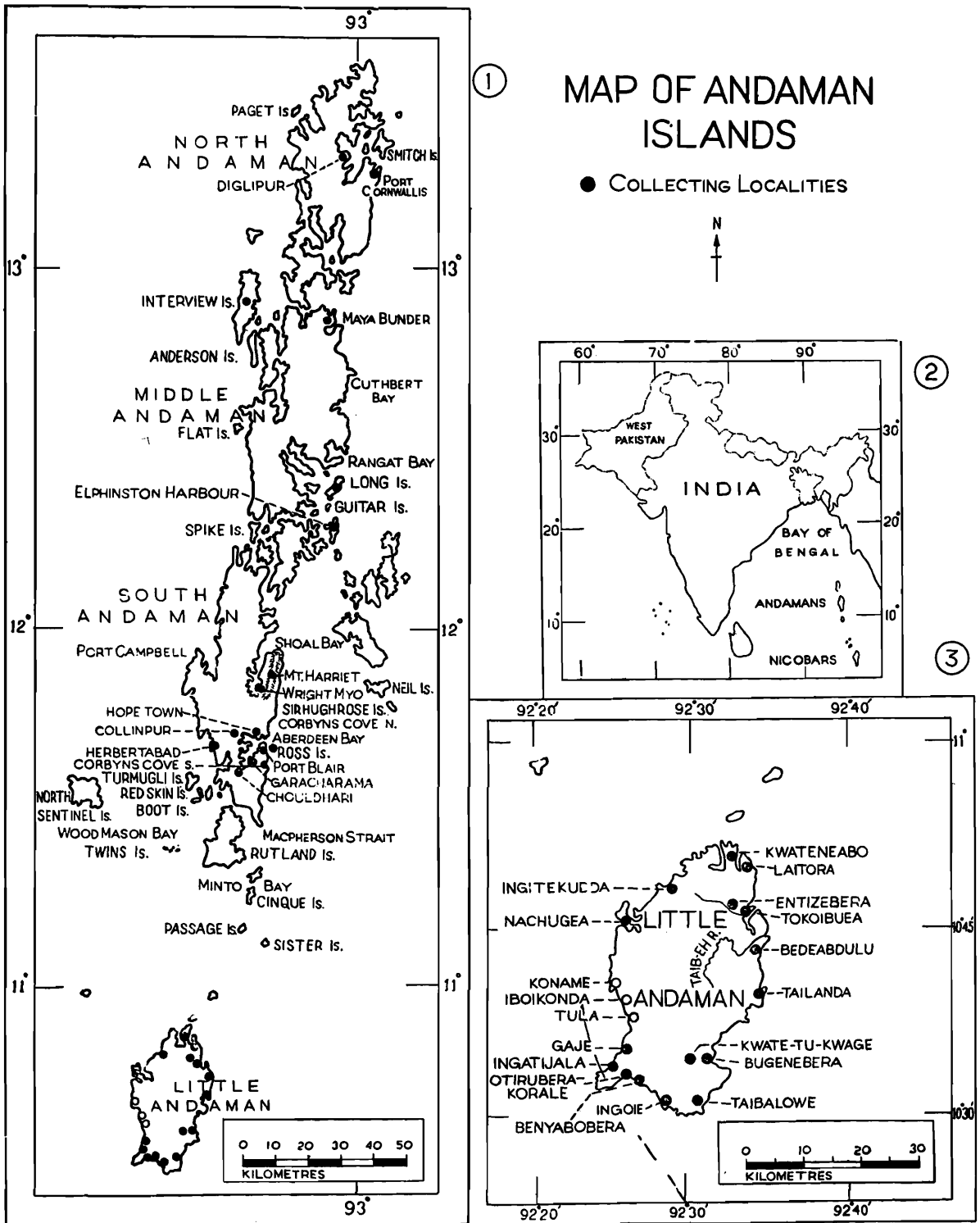


PLATE 11

Maps of the Nicobar Islands showing the localities where termite collections were made.

FIG. 1.—The Nicobar group.

FIG. 2.—The Car Nicobar Island.

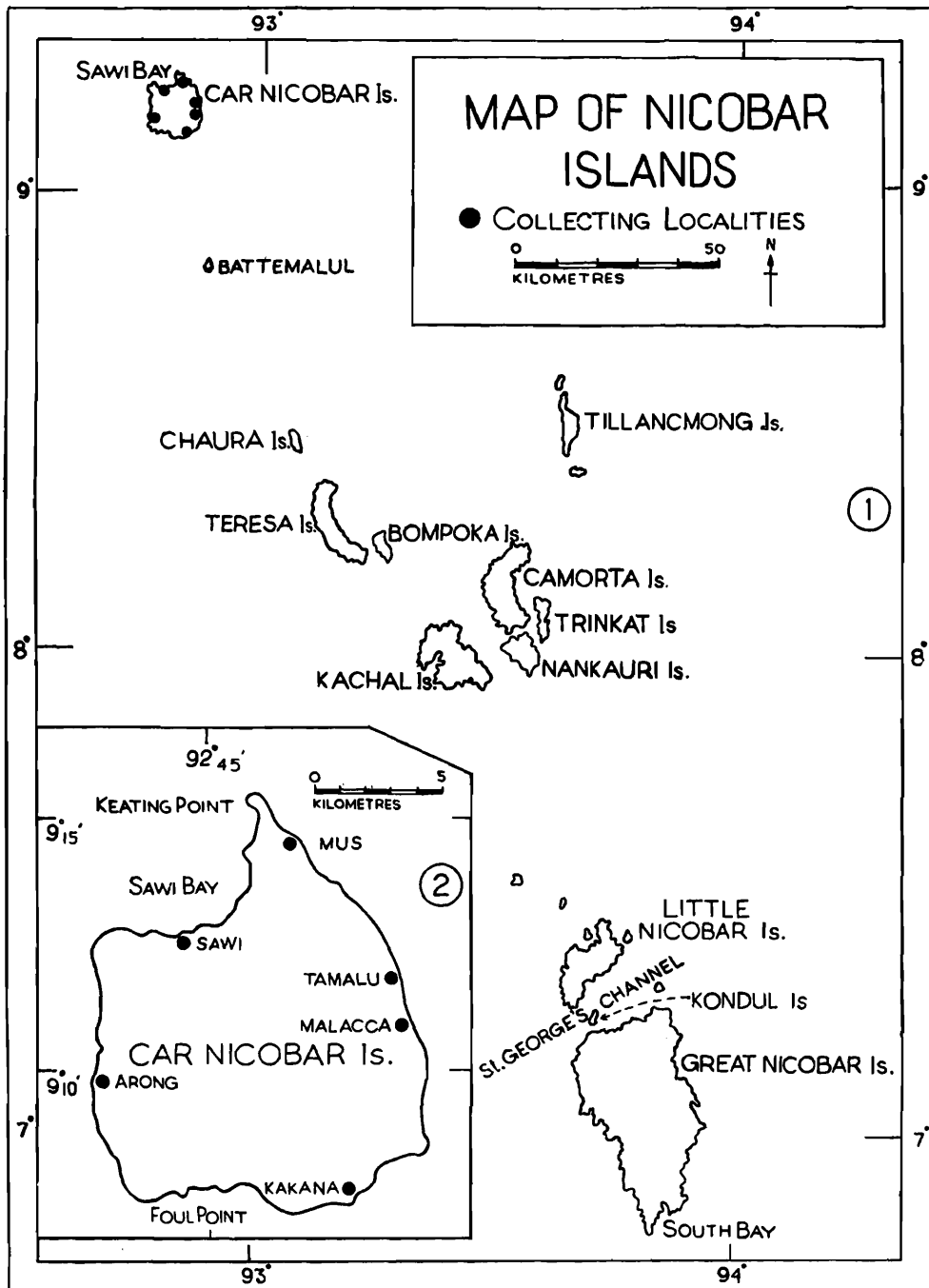


PLATE 12

Some ecological habitats in the Andaman Islands. (Photos K. K. Tiwari, January-April, 1959.)

- FIG. 1.—Diglipur, North Andamans (February, 1959). Habitat for *Odontotermes latigula*.
- FIG. 2.—A scene on Interview Island, North Andamans (February, 1959). Habitat for *Odontotermes latigula*.
- FIG. 3.—Another scene on Interview Island, North Andamans (February, 1959). Dense forest. Habitat for *Odontotermes latigula*.
- FIG. 4.—A scene near Elphinstone Harbour, Middle Andamans (January, 1959). Habitat for *Nasutitermes* sp.
- FIG. 5.—A scene near Port Blair, South Andamans (March, 1959). Habitat for *Odontotermes latigula* and *Hospitalitermes blairi*.



1



2



3



4



5

PLATE 13

Soldiers of some termite species from the Andamans and Nicobars.
Photographs, showing termites in dorsal view.

FIG. 1.—*Cryptotermes havilandi* (Sjöstedt).

FIG. 2.—*Coptotermes heimi* (Wasmann).

FIG. 3.—*Coptotermes travians* (Haviland).

FIG. 4.—*Prorhinotermes flavus* (Bugnion & Popoff).

FIG. 5.—*Prorhinotermes shiva* Roonwal & Thakur. Soldier major.
Holotype.

FIG. 6.—*Schedorhinotermes tiwarii* Roonwal & Thakur. Soldier major.
Paratype.

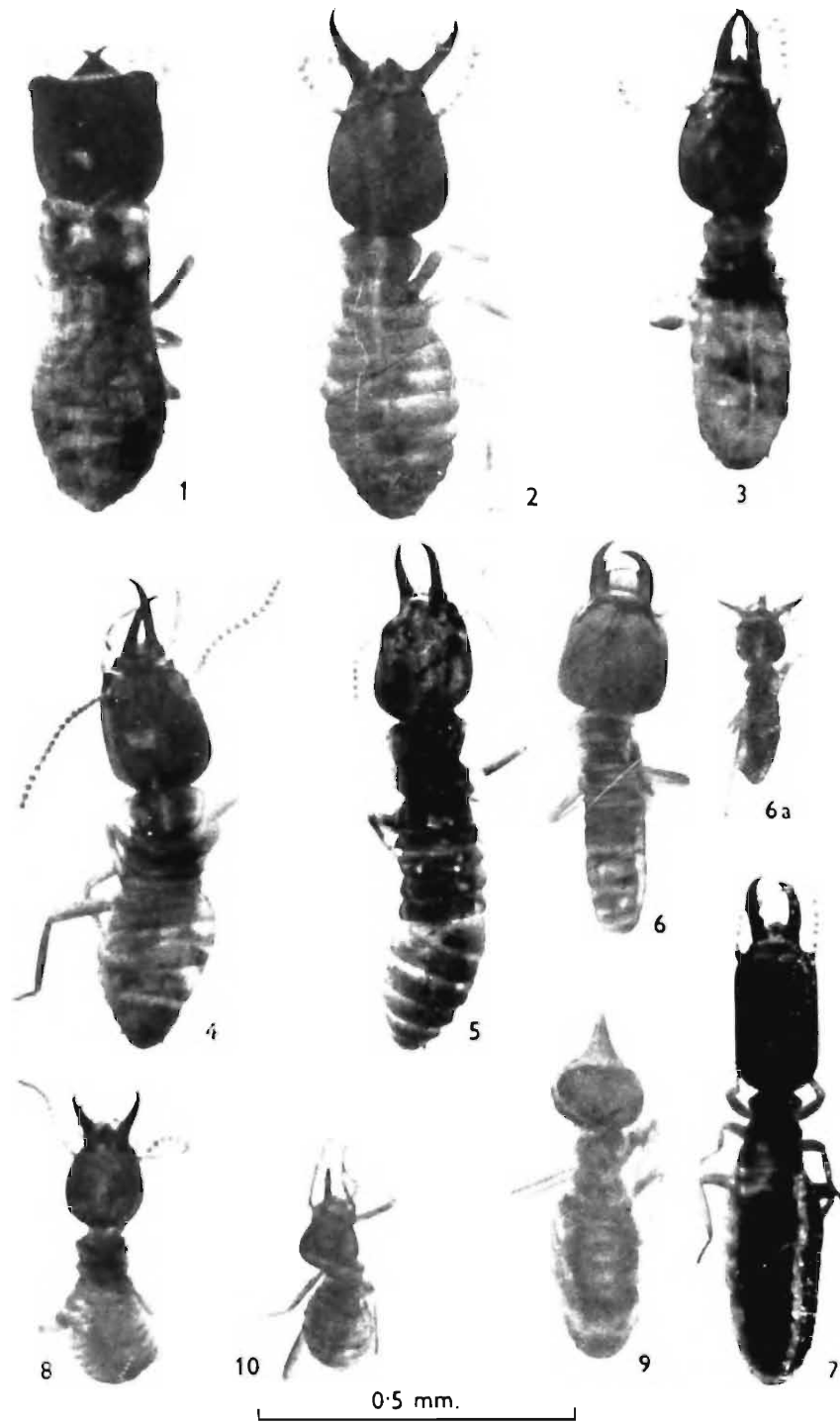
FIG. 6a.—*Schedorhinotermes tiwarii* Roonwal & Thakur. Soldier minor.
Morphotype.

FIG. 7.—*Microcerotermes nicobarensis* n. sp.

FIG. 8.—*Odontotermes latigula* (Synder).

FIG. 9.—*Nasutitermes matangensis matangensiformis* (Holmgren).

FIG. 10.—*Hospitalitermes blairi* Roonwal & Sen-Sarma.



FAUNA OF RAJASTHAN, INDIA

PART 8.—TREMATODA

By

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(With 2 Tables and 6 Text-figures)

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I—INTRODUCTION

(a) *General*

An examination of the literature on the helminth fauna of India shows that no major work on the trematodes of Rajasthan has so far been done. The present study is based mainly on the collection made by the author during September-November, 1962, from the western part of Rajasthan, in the districts of Barmer, Bikaner, Jaisalmer and Jodhpur. In addition, a small collection made by Dr. B. Biswas, of the Zoological Survey of India, from the Nagaur District during December, 1956, has also been studied. For an account of the topography, climate, vegetation, etc. of Rajasthan, see Part 1 (General Introduction) of this series of papers (Roonwal, 1968), *Rec. zool. Surv. India*, 61 (3 & 4), pp. 291-375.

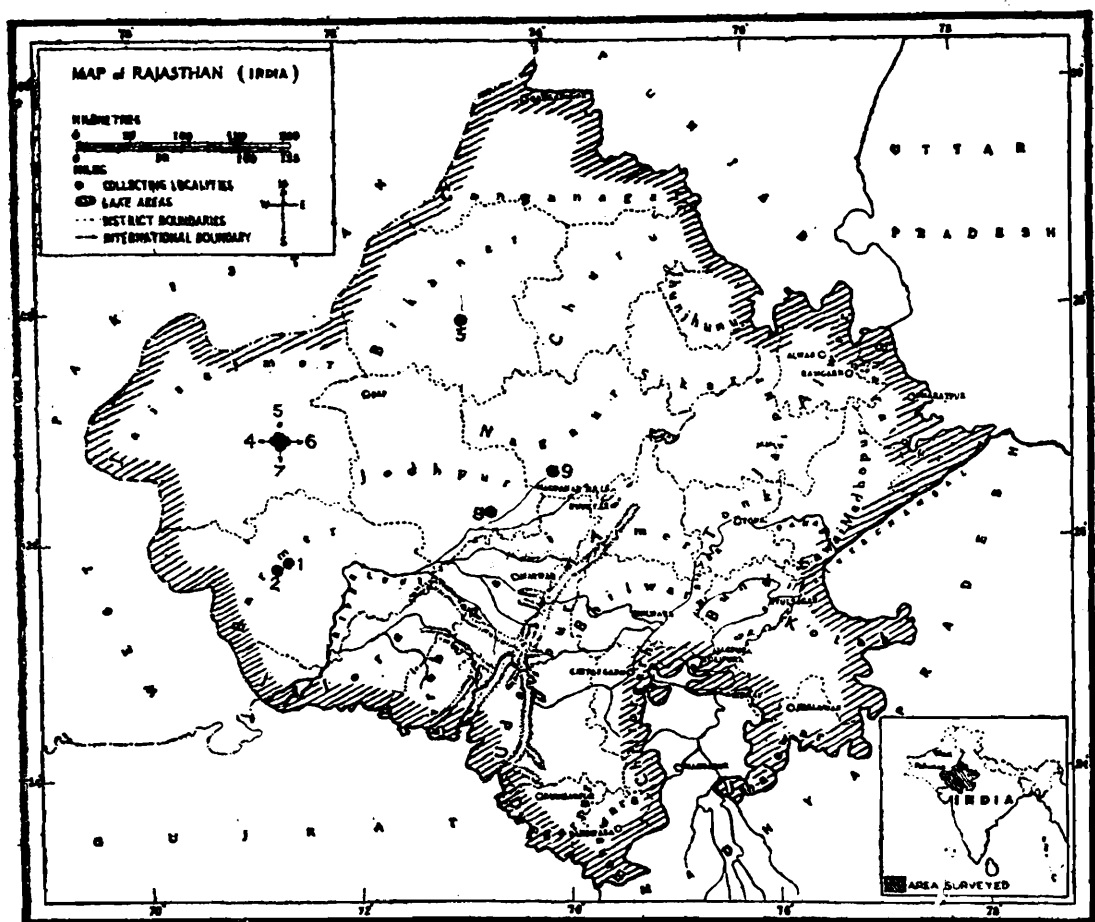
[171]

In the present account, 15 species belonging to 14 genera and 9 families are reported. All the species are new records for Rajasthan, while the genus *Ophthalmophagus* is first recorded here from India. Three species described herein are new to science. The type-specimens of the new species have been deposited in the National Zoological Collections at the Zoological Survey of India, Calcutta.

(b) Acknowledgements

It is a pleasure to gratefully acknowledge the help and the encouragement received from Dr. M. L. Roonwal, Director, Zoological Survey of India, Calcutta, during the collection and study of the material, and also for the valuable suggestions in preparing the manuscript. Thanks are due to other colleagues who have identified the hosts. I am indebted to the Government of Rajasthan, through its Chief Secretary and the Chief Conservator of Forests, for various facilities received during the collection of the material.

II—LIST OF COLLECTING STATIONS



TEXT-FIG. 1.—Map of Rajasthan, showing the Collecting Stations for Trematodes.

The present material was collected from Western Rajasthan in the districts of Barmer, Bikaner, Jaisalmer, Jodhpur and Nagaur. The list of the collecting Stations is given in Table 1 (also see Text-fig. 1).

TABLE 1.—*List of Collecting Stations for Rajasthan Trematodes (B. Biswas 1956; P. D. Gupta, 1962).*

Locality	District	Approx. Latitude and Longitude	
		Lat. N.	Long. E.
1. Bhap Talab	Barmer	25°51'	71°26'
2. Jalipa Tank	Barmer	25°50'	71°23'
3. Devikund	Bikaner	27°56'	73°18'
4. Golab Sagar	Jaisalmer	26°55'	70°57'
5. Station No .15 (1962)	Jaisalmer	26°55'	70°57'
6. Dak Bungalow area, Jaisalmer	Jaisalmer	26°55'	70°57'
7. Gareshwar Tank, Jaisalmer	Jaisalmer	26°55'	70°57'
8. Bilaspur	Jodhpur	26°18'	73°27'
9. Merta	Nagaur	26°35'	74°06'

III—LIST OF TREMATODES KNOWN FROM RAJASTHAN ; AND KEYS FOR IDENTIFICATION

(a) *List of Species*

The following is a list of trematodes known from Rajasthan, and discussed in this paper ; all of them are based on the present record.

Family I. CYCLOCOELIDAE

Genus (1) *Cyclocoelum* Brandes, 1892

1. *Cyclocoelum bikanerensis* n. sp.

Genus (2) *Haematotrephus* Stossich, 1902

2. *Haematotrephus lanceolatum* (Wedl.) Stossich

Genus (3) *Ophthalmophagus* Stossich, 1902

3. *Ophthalmophagus mertensis* n. sp.

Family II. DICROCOELIIDAE

Genus (4) *Anchitrema* Looss, 1899

4. *Anchitrema sanguineum* (Sonsino) Looss

Family III. DIPLOSTOMIDAE

Genus (5) *Neodiplostomum* Railliet, 1919

- 5.
- Neodiplostomum tityense*
- Patwardhan

Family IV ECHINOSTOMATIDAE

Genus (6) *Paryphostomum* Dietz, 1909

- 6.
- Paryphostomum indicum*
- (Bhalerao)

Family V HEMIURIDAE

Genus (7) *Halipegus* Looss, 1899 *emend.* Rankin, 1944

- 7.
- Halipegus mehransis*
- Srivastava

Family VI. LECITHODENDRIIDAE

Genus (8) *Ganeo* Klein, 1905

- 8.
- Ganeo kumaonensis*
- Pande
-
- 9.
- Ganeo tigrinum*
- Mehra & Negi

Genus (9) *Pleurogenes* Lühe, 1901

- 10.
- Pleurogenes gastroporus*
- Lühe

Genus (10) *Prosthodendrium* Dollfus, 1931

- 11.
- Prosthodendrium ovimagnosum*
- (Bhalerao)

Family VII. NOTOCOTYLIDAE

Genus (11) *Notocotylus* Diesing, 1839

- 12.
- Notocotylus barmerensis*
- n. sp.

Family VIII. PLAGIORCHIIDAE

Genus (12) *Astiotrema* Looss, 1900

- 13.
- Astiotrema*
- sp.

Genus (13) *Tremiorchis* Mehra & Negi, 1925, *emend.*
Verma, 1930

- 14.
- Tremiorehis ranarum*
- Mehra & Negi

Family IX. PSILOSTOMATIDAE

Genus (14) *Psilochasmus* Lühe, 1909

15. *Psilochasmus oxyurus* (Creplin) Lühe

(b) *Keys for Identification of Rajasthan Trematodes*

Keys for the identification of the families and genera of the trematods known from Rajasthan are given below.

1. *Key to families of Rajasthan Trematodes*

- 1(4). Ventral sucker absent.
- 2(3). Intestinal caecae united posteriorly . . . 1. Cyclocoelidae
- 3(2). Intestinal caecae not united posteriorly . . . 2. Notocotylidae
- 4(1). Ventral sucker present.
- 5(6). Body divided into two regions . . . 3. Diplostomidae
- 6(5). Body not divided into two regions.
- 7(8). Head collar present . . . 4. Echinostomatidae
- 8(7). Head collar absent.
- 9(10). Vitellaria compact . . . 5. Hemiuridae
- 10(9). Vitellaria follicular.
- 11(12). Gonads situated in acetabular zone . . . 6. Lecithodendriidae
- 12(11). Gonads situated behind acetabulum.
- 13(14). Ovary post-testicular ; testes situated in hind
body . . . 7. Dicrocoeliidae
- 14(13). Ovary pre-testicular.
- 15(16). Uterus pre-ovarian . . . 8. Psilostomatidae
- 16(15). Uterus extending backward and behind the
testes . . . 9. Plagiorchiidae

2. Key to Rajasthan genera of family Cyclocoelidae

- 1(2). Ovary post-testicular 1. *Ophthalmophagus*
- 2(1). Ovary pre-testicular.
- 3(4). Uterine coils intercaecal ; posteriorly not surrounding the testes 2. *Cyclocoelum*
- 4(3). Uterine coils inter- and extra-caecal ; posteriorly surrounding the testes 3. *Haematotrephus*

3. Key to Rajasthan genera of family Lecithodendriidae

- 1(2). Caeca short, not surpassing acetabulum ; vitellaria pre-bifurcal ; genital pore median and pre-acetabular 1. *Prosthodendrium*
- 2(1). Caeca long, surpassing acetabulum ; vitellaria lying along caeca ; genital pore marginal.
- 3(4). Testes situated asymmetrically one behind the other ; muscular cirrus sac absent 2. *Ganeo*
- 4(3). Testes situated symmetrically at the same level ; muscular cirrus sac present 3. *Pleurogenes*

4. Key to Rajasthan genera of family Plagiorchiidae

- 1(2). Caeca short, terminating in mid-region of body 1. *Tremiorchis*
- 2(1). Caeca long, terminating near posterior extremity of body 2. *Astiotrema*

IV—SYSTEMATIC ACCOUNT OF RAJASTHAN TREMATODES

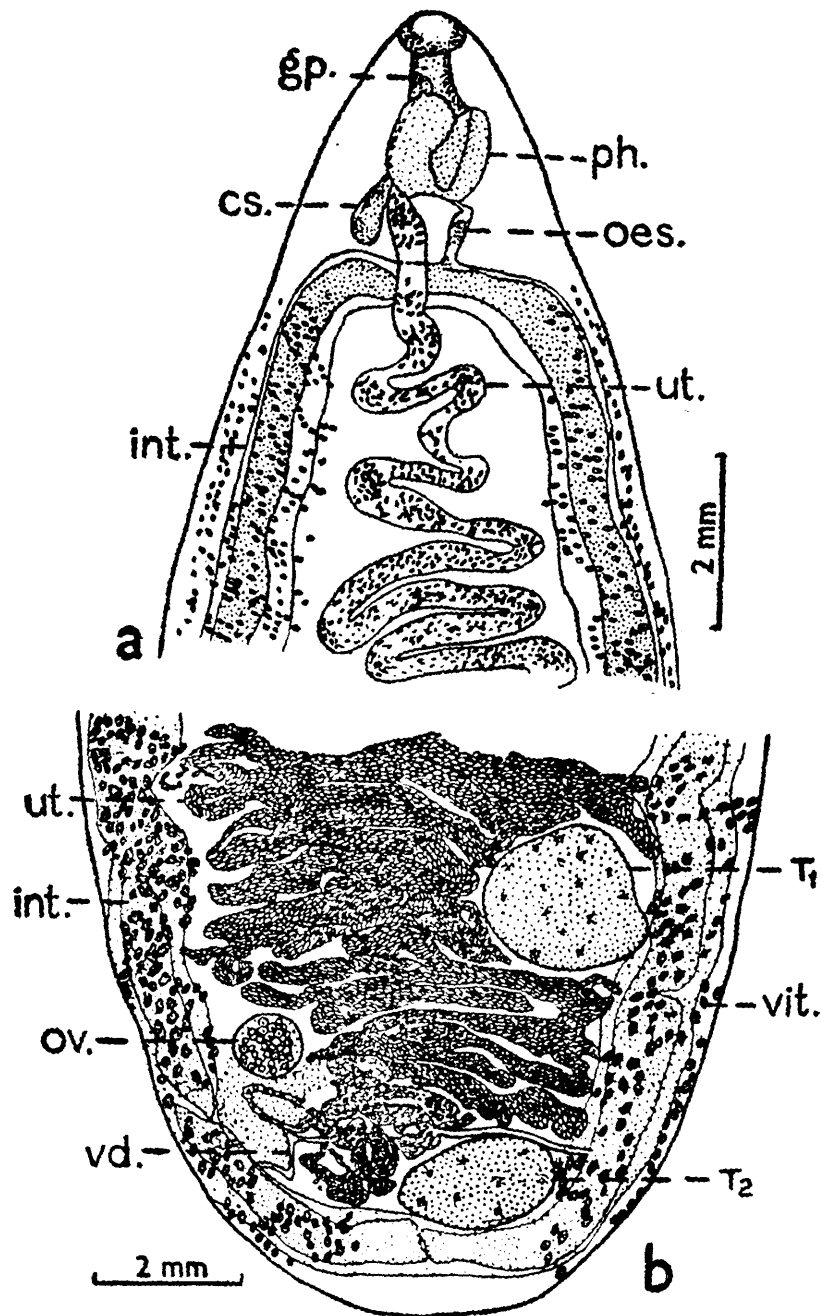
Family I. CYCLOCOELIDAE

1. *Cyclocoelum bikanerensis* n. sp.

(TEXT-FIG. 2 a, b.)

Material.—(i) 2 exs., from air sacs of the coot, *Fulica atra* L., Devikund, Bikaner Dist., coll. P. D. Gupta, 4.x.62. (ii) 14 exs., Calcutta W. Bengal), coll. J. K. Sen, from body-cavity of *Fulica atra* ♂, 4.xii.54.

Description.—Length (unpressed) 18-25 mm. Following description based on specimens pressed and mounted on slides :—Length 22-25 mm. ; width 8.5-9.5 mm. Body tapering gradually to a narrow anterior end ; broadly rounded at posterior end ; cuticle devoid of spines ; oral sucker very weak ; excretory sac transversely elongated



TEXT-FIG. 2.—*Cyclocoelum bikanerensis* n. sp.

(a) Anterior region. (b) Posterior region.

in space behind posterior intestinal arch. Terminal mouth leading to prepharynx (0.63-0.77 mm. long), the latter opening into a pharynx (0.86-1.35 × 0.93-0.97 mm.); oesophagus bent, 0.47-0.63 mm. long. Intestinal caeca wide, tubular and indented, running very close to body-wall and forming the intestinal arch at posterior end of body. Oesophagus and caeca filled with blackish sap from host-body.

Testes situated one behind the other on right side in the last quarter of body ; separated from each other by a few uterine coils ; generally transversely elongated, with entire margins (in some cases irregular, with one or two crenulations). Anterior testis 1.46-1.93 × 0.86-1.98 mm.; posterior one 1.56-1.62 × 0.97-1.36 mm. Cirrus sac 1.24-1.25 mm.; situated entirely in front of intestinal bifurcation ; its posterior portion, lying behind pharynx, saccular ; the anterior portion, situated in the pharyngeal region, very narrow. Genital pore situated in front of pharynx slightly to left of median line. Ovary 0.59-0.82 × 0.74-0.77 mm., almost spherical, lying between and at the opposite side of testes (in one specimen in level with middle of posterior testes). Mehlis' gland lies just behind ovary. Uterine coils occupying almost entire intercaecal space, rarely coming in contact with caeca. Ova 0.090-0.093 × 0.047-0.049 mm.

Vitelline follicles distributed from level of intestinal bifurcation to posterior margin of intestinal arch ; profusely developed, covering the caeca along their entire length and sometimes intruding into intercaecal field. Right vitelline duct traversing entire width of body to meet the left duct some distance behind ovary, and forming a common vitelline duct which joins the Mehlis' gland complex.

Discussion.—*Cyclocoelum bikanerensis* n. sp. resembles *C. mutabile* (Zeder) in the general topography of the organs but differs as follows :— (i) Body larger. (ii) Pharynx larger. (iii) Eggs and other organs smaller. So far, *C. mutabile* has been reported from the nearctic neotropical and palaeotropical regions.

Type-Specimens.—*Holotype* : One example on slide, ex air sacs of *Fulica atra*. Devikund. Reg. No. W-6652/1. *Paratypes* : Two examples as follows :—One on slide (Reg. No. W-6653/1) ; other details as for holotype. The second one on slide (Reg. No. W-6654/1), Calcutta, *vide* Material (ii) above.

Distribution.—RAJASTHAN : Bikaner Dist. *Elsewhere* : Calcutta (W Bengal).

2. *Haematotrephus lanceolatum* (Wedl, 1858) Stossich, 1902

1858. *Monostoma lanceolatum* Wedl, C., *S. B. Akad. Wiss. Wien. (math-naturwiss. Cl.)*, Vienna, 26, pp. 251-252.
 1902. *Haematotrephus lanceolatum*: Stossich, M., *Boll. Soc. Adriat. Sci. nat.*, Trieste, 21, pp. 2, 4, 5, 23.
 1958. *Cyclocaelum titiri* Chatterjee P. N., *J. Parasitol.*, Urbana, 44, p. 561.
 1959. *Cyclocoelum (Haematotrephus) lanceolatum*: Dubois, G., *Rev. suisse Zool.*, Geneva, 66 (1), pp. 75, 76, 78, 96.

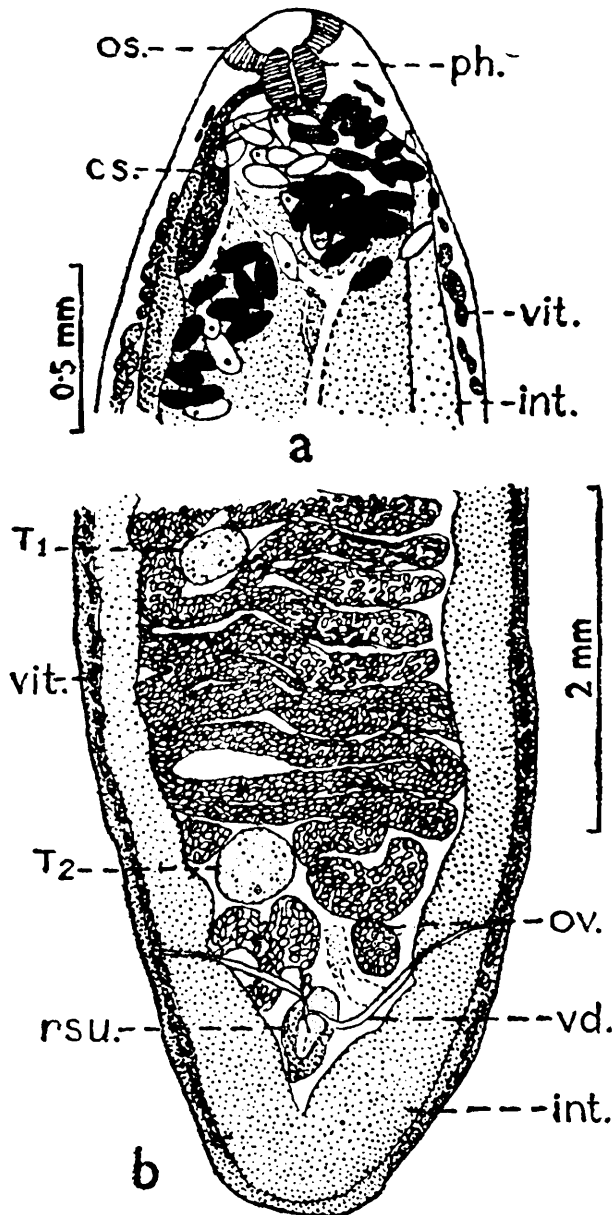
Material.—1 ex., from body-cavity of Black-winged Stilt, *Haemantopus haemantopus* (L.) ; Merta (Nagaur Dist.), coll. B. Biswas, 30.xii.1956.

Distribution.—RAJASTHAN (first record) : Merta (Nagaur Dist.). *Elsewhere* : India, China, Australia, Egypt, Russia, Japan, Switzerland and U.S.A.

Remarks.—*Cyclocoelum titiri* Chatterji, from the body-cavity of *Haplopterus* [sc *Haplopterus*] *ventralis*, is regarded by Dubois (1959) as a synonym of *Haematotrephus lanceolatum*, and I agree with this view.

3. *Ophthalmophagus mertensis* n. sp.

(TEXT-FIG. 3 a, b).



TEXT-FIG. 3.—*Ophthalmophagus mertensis* n. sp.
(a) Anterior region. (b) Posterior region.

Material.—1 ex. (slightly damaged) on slide, from body-cavity of Sandpiper, *Actitis hypoleucos* (L.), Merta (Nagaur Dist.), coll. B. Biswas, 30.xii.1956.

Description.—Length *c.* 15 mm.; width in middle *c.* 3 mm. Anteriorly tapering gradually to a cone; posteriorly rounded. Oral sucker poorly developed, 0.2 mm. in diameter. Ventral sucker absent. Pharynx 0.20 mm. in diameter. Oesophagus not discernible. Intestinal bifurcation lying immediately behind pharynx. Intestinal caeca reaching the posterior end of body; caeca wide, provided with crenulations along inner margin; posterior caecal arch wider than rest of caeca which run very close to body-wall, leaving very little space for development of vitellaria and almost completely obliterating the excretory sac.

Testes situated one behind the other on left side of posterior third of body and separated from each other by a number of uterine coils. Anterior testis oval (0.36×0.48 mm.), situated at beginning of posterior third of body. Posterior testis almost rounded (0.42×0.48 mm.); situated just in front of ovary. Cirrus sac elongated (0.50×0.11 mm.), extending behind intestinal bifurcation. Genital pore situated just behind pharynx slightly to left of median line. Ovary subspherical (0.34×0.30 mm.), situated behind posterior testis on right side of median line. Mehlis' gland situated behind ovary. Receptaculum seminis uterinum occupying almost whole space immediately in front of posterior intestinal arch. Uterine coils filling whole of intercaecal field anterior to ovary, never overlapping the intestinal caeca. Ova $0.11-0.14 \times 0.06-0.08$ mm.

Vitelline follicles arranged in a single row, being squeezed between intestinal caeca and body-wall; extending from intestinal bifurcation to slightly in front of posterior margin of posterior caecal arch. Vitelline follicles of two sides not anastomosing with each other.

Discussion.—*Ophthalmophagus mertensis* n. sp. differs from the allied species as follows :—

(a) From *O. singularis* Stossich : (i) Larger body-size. (ii) Genital pore post-pharyngeal (vs. peribuccal to midway between mouth and pharynx). (iii) Testes widely separated (vs. narrowly separated). (iv) Uterine coils restricted to intercaecal field only (vs. not so). (v) Oesophagus absent (vs. present). (vi) Ovary lies close to posterior testis (vs. separated from posterior testis).

(b) From *O. oculobius* (Cohn) : (i) Larger body-size. (ii) Testes situated in posterior third of body (vs. in anterior half of body). (iii) Uterine coils restricted to intercaecal field (vs. not so). (iv) Genital pore postpharyngeal (vs. in pharyngeal region). (v) Vitelline follicles of two sides not meeting posteriorly (vs. anastomosing posteriorly).

(c) From *O. skrjabinus* (Witenberg) : (i) Testes situated in posterior third of body-length and arranged one behind the other (vs. in middle length of body and arranged side by side). (ii) Uterine coils restricted to intercaecal field (vs. not so). (iii) Vitellaria not united posteriorly (vs. united posteriorly).

(d) From *O. variolaris* (Fuhrmann) : (i) Larger body-size. (ii) Testes situated in posterior third of body (vs. one equatorial or pre-equatorial and the other post-equatorial). (iii) Ventral sucker and pre-pharynx absent (vs. present).

(e) From *O. magalhaesi* Travassos : (i) Genital pore postpharyngeal (vs. between mouth and pharynx). (ii) Testes arranged directly one behind the other on same side (vs. obliquely arranged). (iii) Pharynx smaller.

Type-specimen.—*Holotype* : One specimen (slightly damaged) on slide, Reg. No. W-6651/1 ; details as given above.

Distribution.—RAJASTHAN : Merta (Nagaur Dist.). This is the first record of the genus *Ophthalmophagus* from India.

Family II. DICROCOELIIDAE

4. *Anchitrema sanguineum* (Sonsino, 1894) Looss, 1899

1894. *Distoma sanguineum* Sonsino, P., *P. V. Soc. tosc. Sci. nat.*, Pisa, 9, pp. 110-116.
 1899. *Anchitrema sanguineum* Looss, A., *Zool. Jb. (Syst.)*, Jena, 12, pp. 636-640.
 1935. *Anchitrema sanguineum*: Pande, B.P., *Bull. Acad. Sci. U.P.*, Allahabad, 4 (4), pp. 376-378.

Material.—1 ex., from intestine of the bat, *Taphozous kachensis kachensis* Dobson, Collecting Station No. 15 (Jaisalmer Dist.), coll. P. D. Gupta, 21.x.1962.

Distribution.—RAJASTHAN (first record) : Jaisalmer Dist. *Elsewhere* : India (Allahabad, U.P.) ; *Tunisia and Egypt.

Family III. DIPLOSTOMIDAE

5. *Neodiplostomum tityense* Patwardhan, 1935

1935. *Neodiplostomum tityense* Patwardhan, S. S., *Proc. Indian Acad. Sci.*, Bangalore, 2 (1), pp. 25-27.
 1936. *Neodiplostomum tityense*, Verma, S. C., *Allahabad Univ. Stud.*, Allahabad, 9, pp. 175-176.

Material.—10 exs., from intestine of White Scavenger Vulture, *Neophron percnopterus* L., Bhap Talab (Barmer Dist.), coll. P. D. Gupta, 3.xi.1962.

Distribution.—RAJASTHAN (first record) : Barmer Dist. *Elsewhere* : Nagpur (Maharashtra).

Family IV ECHINOSTOMATIDAE

6. *Paryphostomum indicum* (Bhalerao, 1927)

1927. *Testisacculus indicum* Bhalerao, G. D., *Proc. 14th Indian Sci. Congr.*, Calcutta, p. 191.
 1931. *Paryphostomum indicum* Bhalerao, G. D., *Parasitology*, Cambridge, 23, pp. 99-102.
 1941. *Reptiliotrema indicum*: Baschkirova, E. In Skrjabin, K.I. : *Trematodes of Animals and Man*, Moscow, 12, pp. 817-818.

Material.—8 exs., from intestine of Monitor Lizard, *Varanus monitor* (L.), Dak Bungalow area, Jaisalmer (Jaisalmer Dist.), coll. P. D. Gupta, 23.x.1962.

Distribution.—RAJASTHAN (first record) : Jaisalmer Dist. *Elsewhere* : Northern India.

Remarks.—So far, only one species of the genus, *P. indicum*, is known from a reptilian host, viz., *Uromastix hardwickii*, from North India ; *Varanus monitor* appear to be the second reptilian host.

Bhalerao (1927) created the genus *Testisacculus* and gave a brief description of *T. indicum* as the type-species, obtained from *Uromastix hardwickii*. Later (1931), he published a fuller account of apparently the same species designating it as *Paryphostomum indicum*. Although (his synonymy was not indicated by Bhalerao (1931), the descriptions of

Testisacculus indicum and *Paryphostomum indicum* appear to be based on the same material and the characters and host are also identical. The simultaneous appearance of the description of *Stunkandia dilymphosa* along with description of *Testisacculus indicum* and *Paryphostomum indicum* points to the fact that Bhalerao (1927 and 1931) was dealing with same material in two cases. Baschkirova (1941) considered *P. indicum* as belonging to a new genus *Reptiliotrema*. In my opinion the species should be retained in genus *Paryphostomum* and genus *Reptiliotrema* treated as a synonym of *Paryphostomum*.

Family V HEMIURIDAE

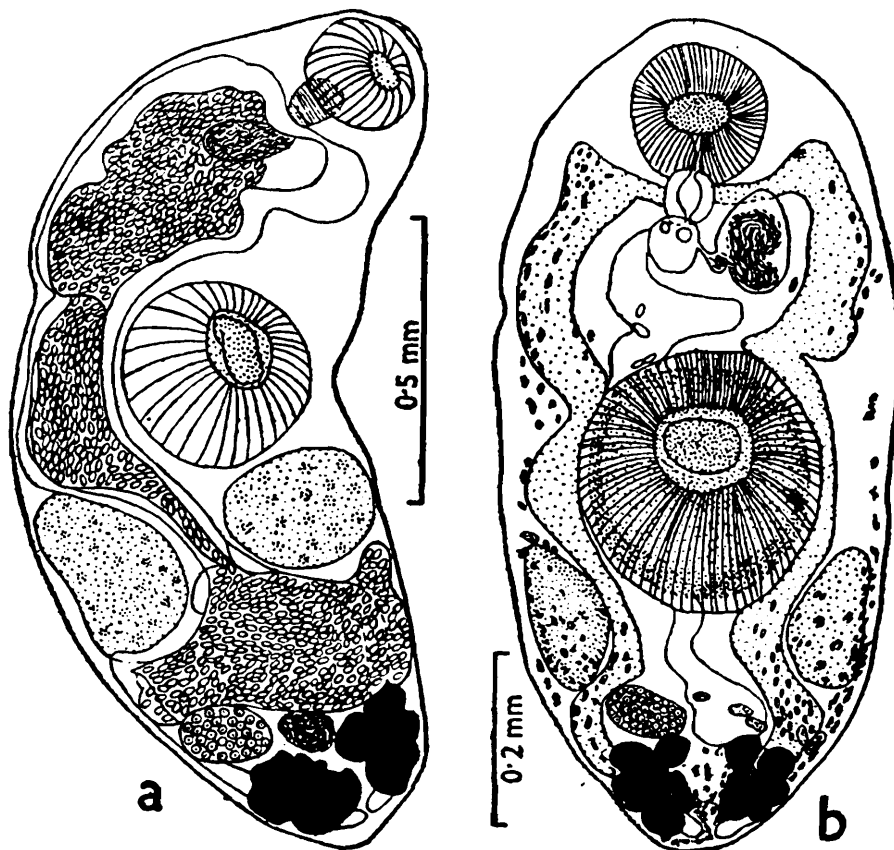
7. *Halipegus mehransis* Srivastava 1933

(TEXT-FIG. 4a, b)

1933. *Halipegus mehransis* Srivastava, H. D., *Bull. Acad. Sci., U.P.*, Allahabad, 3 (1), pp. 42-45.

1944. *Halipegus mehransis*: Rankin Jr., S. J., *Trans. Amer. micr. Soc.*, Menasha, 63 (2), p. 159.

Material.—All coll. P. D. Gupta, 1962, from intestine of the frog, *Rana cyanophlyctis* Schneider, as follows:—(i) 2 exs., Jalipa Tank (Barmer Dist.), 4.xi.62. (ii) 6 lots with 6, 3, 1, 1, 2 and 2 exs., Golab Sagar, Jaisalmer Dist., 25.x.62. (iii) One lot, 8 exs., Gareshwar Tank (Jaisalmer Dist.), 26.x.62.



TEXT-FIG. 4.—*Halipegus mehransis* Srivastava. (a) Dorsal view of mature specimen with symmetrically arranged testes. (b) Ventral view of immature specimen with symmetrically arranged testes.

Distribution.—RAJASTHAN (first record) : Barmer and Jaisalmer Dists. *Elsewhere* : India : Maharashtra (Nagpur) and Uttar Pradesh.

Remarks.—Srivastava (1933) gave the length as 3.1-5.1 mm. ; in the present material it is 2.2-2.6 mm. which is intermediate between that for *Halipegus mehransis* Srivastava and for *H. mehransis* var. *minutum* Srivastava. This fact lends support to the views expressed by Bhalerao (1936), Rankin (1944) and Chauhan (1953) that the variety *minutum* is untenable.

In one mature specimen (2.55 mm.) with uterus full of ova, the testes are comparatively much smaller and slender in shape instead of triangular; the right testis is 0.22×0.06 , the left 0.20×0.12 mm. The shape of the oral sucker is also variable—in some rounded (as described by Srivastava), and in a few transversely elongated. In certain cases the ratio of the size of the oral to the ventral sucker is more than 1 : 2.

Two specimens show peculiar arrangement of the testes : One (Text-fig. 4a), 1.5 mm., is fully mature with uterus full of ova. The other (Text-fig. 4b), 0.87 mm., is at an early stage of maturity with the uterus having a few ova. Both specimens have the testes symmetrically arranged, immediately behind acetabulum or extending to acetabular zone. The suckers are almost circular ; the oesophagus appear to be absent. The shape of the testes varies—almost rounded to antero-posteriorly elongated and somewhat triangular. The ovary is on the left side of the body. The vesicula seminalis lies behind the intestinal bifurcation. The genital pore is immediately behind the pharynx and behind the intestinal bifurcation.

Family VI. LECITHODENDRIIDAE

8. *Ganeo kumaonensis* Pande, 1937

1937. *Ganeo kumaonensis* Pande, B. P., *Proc. Indian Acad. Sci.*, Bangalore, B 6 (2), pp. 116-119.

1954. *Ganeo kumaonensis* ; Singh, K. S., *Trans. Amer. micr. Soc.*, Menasha, 73 (2), pp. 206-207.

Material.—15 exs., from intestine of the frog, *Rana cyanophlyctis* Schneider, Golab Sagar (Jaisalmer Dist.), coll. P. D. Gupta, 27.x.1962.

Distribution.—RAJASTHAN (first record) : Jaisalmer Dist. *Elsewhere* : India : Uttar Pradesh (Bhimtal, Dist. Almora ; and Lucknow) and Kashmir.

Remarks.—Fotedar (1959) considers this species as synonym of *G. tigrinum* Mehra & Negi, but I disagree.

9. *Ganeo tigrinum* Mehra & Negi, 1928

1928. *Ganeo tigrinum* Mehra, H. R. & Negi, P. S., *Allahabad, Univ. Stud.*, Allahabad, 4, pp. 66-80.

Material.—All coll. P. D. Gupta, 1962, from intestine of the frog. *Rana cyanophlyctis* Schneider, as follows :—(i) 5 lots, with 4, 2, 4, 3 and 2 exs., Golab Sagar (Jaisalmer Dist.), 25.x.62. (ii) 2 lots with 2 (immature) and 3 exs., Golab Sagar, as above, 27.x.62. (iii) 1 ex. Bisalpur Dam (Jodhpur Dist.), 12.x.62.

Distribution.—RAJASTHAN (first record) : Jodhpur and Jaisalmer. Dists. *Elsewhere* : India (Uttar Pradesh and Maharashtra) and China.

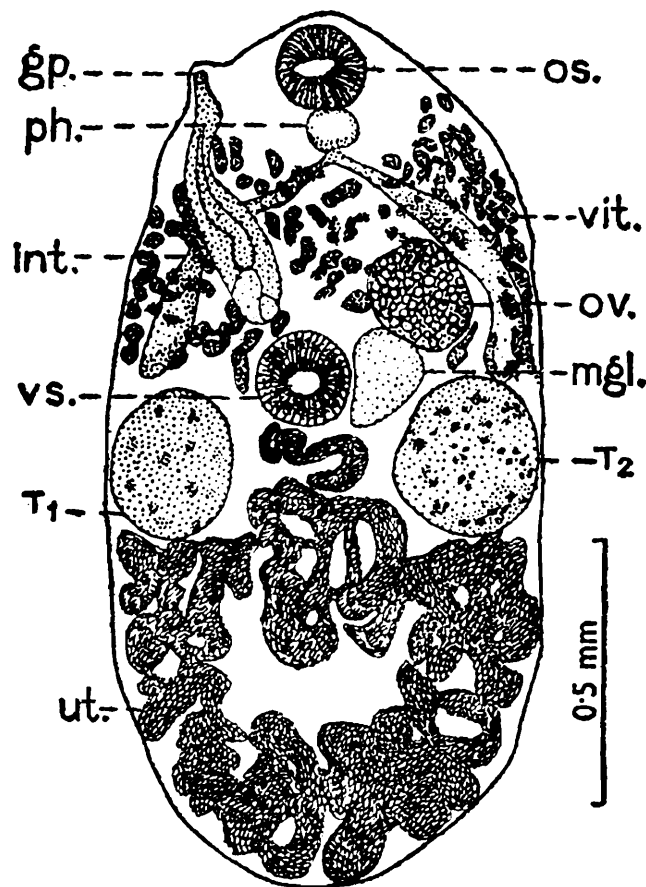
Remarks.—Some specimens show peculiar variations in the arrangement of gonads and the shape of excretory bladder. Thus, in some cases the gonads are opposed to each other. In one specimen the ovary is situated clearly behind the ventral sucker and the posterior testis. In some other specimens the ovary is located partly in level with the hind testis and the ventral sucker. The excretory vesicle has a variable shape U, V, or Y-shaped.

10. *Pleurogenes gastroporus* Lühe, 1901

(TEXT-FIG. 5)

1901. *Pleurogenes gastroporus* Lühe, M., *Ctbl. Bakt.*, Jena, 30, pp. 166-171.

1928. *Pleurogenes gastroporus* var. *equalis* Mehra, H. R., and Negi, P. S., *Allahabad Univ. Stud.*, Allahabad, 4, pp. 86-89.



TEXT-FIG. 5.—*Pleurogenes gastroporus* Lühe, in ventral view.

Material.—2 exs., from intestine of the frog, *Rana cyanophlyctis* Schneider, Gareshwar (Jaisalmer Dist.), coll. P. D. Gupta, 24.x.1962.

Distribution.—RAJASTHAN (first record) : Jaisalmer Dist. *Elsewhere* : India : Uttar Pradesh (Allahabad, Varanasi and Lucknow).

11. *Prosthodendrium ovimagnosum* (Bhalerao, 1926)

1926. *Lacithodendrium ovimagnosum* Bhalerao, G. D., *J. Burma Res. Soc.* Rangoon, 15 (3), pp. 188-190.

Material.—Four lots, with 1, 2, 4 and 3 exs., from intestine of the bat, *Taphozous kachensis kachensis* Dobson, Collecting Station No. 15, Jaisalmer Dist. coll. P. D. Gupta, 21.x.1962.

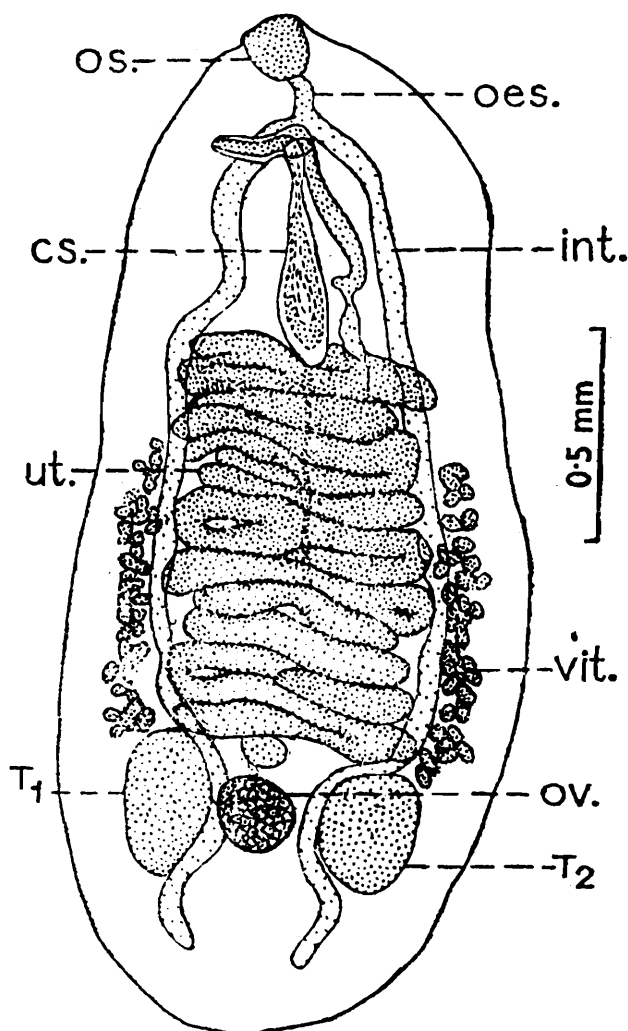
Distribution.—RAJASTHAN (first record): Jaisalmer Dist. *Elsewhere* : India : (Uttar Pradesh, Bengal and Punjab); Burma, the Philippines and Somaliland (Africa).

Remarks : In one specimen the ovary is confined to the left side of the body between the testis and the median line ; in others of the same lot it is slightly less extensive than that described by Bhalerao. The differences are merely individual variations.

Family VII. NOTOCOTYLIDAE

12. *Notocotylus barmerensis* n. sp.

(TEXT-FIG. 6)



TEXT-FIG. 6.—*Notocotylus barmerensis* n. sp., in ventral view.

Material.—2 exs., from intestine of the coot, *Fulica atra* L., Jalipa Tank (Barmer Dist.), coll. P. D. Gupta, 3. xi. 1962.

Description.—Length 2.42mm.; width (in middle) .115 mm. Oral sucker 0.18×0.18 mm., pharynx absent, oesophagus 0.14mm. long ; intestinal caeca terminating about 0.04mm. in front of posterior border of body. Testes two, elongated antero-posteriorly ; with entire margins ; situated in extracaecal field, occupying space created by inflection of intestinal caeca. Left testis 0.32×0.22 mm.; slightly larger than right

(0.30×0.22mm.). Cirrus sac 0.66×0.14mm., situated in first one-third of body ; cirrus eversible, 0.24 mm. long. Genital pore situated just behind intestinal bifurcation. Ovary with entire margin ; lying between the two caeca in testicular region, partly covering the left intestinal caecum ; slightly elongated in transverse plane ; size 0.18×0.23mm.; Mehlis' gland lying just in front of ovary. Uterine coils compactly coiled between testes and cirrus sac ; sometimes overlapping the intestinal caeca. Metraterm 0.40mm.; length c. 2/3rd of that of cirrus sac. Vitelline follicles commencing at about 0.25mm. behind cirrus sac and extending to anterior margin of testes.

Discussion.—Most of the known species of *Notocotylus* are reported as having lobed gonads, the exceptions being : *N. pacifer* (Noble, 1933) with entire ovary and lobed testes ; *N. parzonae* Harwood, 1939, with entire ovary and slightly lobed testes ; *N. skrjabini* Ablassov, 1953, with entire ovary and lobed testes ; and *N. gibbus* (Mehlis, 1846) Kossack, 1911, with entire ovary and reniform or crenated testes. *N. barmerensis* n. sp. differs from all these species in having both the testes and the ovary with entire margins.

N. barmerensis n. sp. is closely allied to *N. gibbus* (Mehlis) but differs as follows :—(i) Size larger. (ii) Testes rounded (vs. reniform ; lobed according to Stunkard and Dunihue, 1931).

Type-Specimens.—*Holotype* : One ex. on slide, Reg. No. W 6649/1 ; details as above. *Paratype* : One ex., in spirit, Reg. No. W 6650/1 ; from the holotype lot.

Distribution.—RAJASTHAN: Barmer Dist.

Family VIII. PLAGIORCHIIDAE

13. *Astiotrema* sp.

Material.—1 ex. (anterior portion damaged), from intestine of the turtle, *Lissemys punctata granosa* (Schoepff), Bisalpur (Jodhpur Dist.) coll. P. D. Gupta, 16.x.1962.

Distribution.—RAJASTHAN : Jodhpur Dist.

Remarks.—As the specimen is damaged, specific identification has not been possible.

14. *Tremiorchis ranarum* Mehra & Negi, 1925

1925. *Tremiorchis ranarum* Mehra, H. R. and Negi, P. S., *Proc. 12th Indian Sci. Congr.*, Calcutta, p. 147.

1926. *Tremiorchis ranarum* : Mehra, H. R. and Negi, P. S., *Parasitology*, Cambridge, 18 (2), pp. 168-181.

1926. *Centrovitus pentadelphi* Bhalerao, G. D., *Parasitology*, Cambridge, 18(2), pp. 154-159.

Material.—Coll. P. D. Gupta, 1962, Jaisalmer Dist., from intestine of the frog, *Rana cyanophlyctis* Schneider, as follows :—(i) 3 exs. ; Gareshwar Tank, Jaisalmer, 26.x.62. (ii) 15 exs., Golab Sagar, 27.x.62.

Distribution.—RAJASTHAN (first record): Jaisalmer Dist. *Elsewhere*: India : Uttar Pradesh (Allahabad, Lucknow) ; Punjab (Karnal) and Maharashtra (Nagpur).

Remarks.—Some interesting features are given below :—Length is 3.57—3.85 mm. In some the diameter of the ventral sucker is equal to, and in others larger than, the oral sucker, prepharynx present. Intestinal caeca extend to just behind anterior margin of anterior testis. Testes post-equatorial. Ovary pre-equatorial. Vitelline follicles distributed from hinder margin of ventral sucker to slightly in front of termini of intestinal caeca.

Singh (1954) presumed the prepharynx to be absent, while Mehra and Negi 1926 reported it to be present. According to Verma (1930) and Singh (1954) the intestinal caeca reach behind the posterior testis, while according to Mehra and Negi they extend to just behind the front margin of the anterior testis. Regarding the position of the testes, my specimens agree with the description of Bhalerao who reported them to be post-equatorial. Mehra and Negi, and Singh have described the ventral sucker as larger than the oral sucker, and Verma gave the reverse condition.

Family IX. PSILOSTOMATIDAE

15. *Psilochasmus oxyurus* (Creplin, 1825) Lühe, 1909 *emend.* Gupta, 1957

1825. *Distoma oxyurum* Creplin, F. C., *Observations de entozois*, Griefswald, pp. 48-49.

¹1909. *Psilochasmus oxyurus* : Lühe, M., *Süsswasserfauna Deutschlands*, Jena, Heft 17, pp. 59-60.

1913. *Psilochasmus longicirratu*s Skrjabin, K. I., *Zool. Jb. (Syst.)*, Jena, Abt. I, 35, pp. 365-368, pl. 13, pp. 4-6.

1921. *Psilochasmus agilis* Travassos, L. *Brazil medico*, Rio de Janeiro, 35 (1), p. 179, fig. 1.

1935. *Psilochasmus japonicus* Ishii, N., *Jap. exp. Med.*, Tokyo, 13 (5), pp. 276-278, fig. 1.

1957: *Psilochasmus oxyurus* : Gupta, P. D., *Parasitology*, Cambridge, 47 (3-4), p. 455.

Material.—1 ex., from intestine of the common teal, *Anas crecca* (L.), Gareshwar Tank (Jaisalmer Dist.), coll. P. D. Gupta, 19. x. 1962.

Distribution.—RAJASTHAN (first record) : Jaisalmer Dist. *Elsewhere* : India (U. P. and Mysore) ; the Phillipines, Japan, China, Formosa, Germany, W. Siberia, Egypt, Brazil, Canada and U. S. A.

V—HOST-PARASITE LIST OF RAJASTHAN TREMATODES

(Table 2)

The host-parasite list of the Rajasthan trematodes discussed in this paper is given in Table 2.

TABLE 2.—Host-parasite list of Rajasthan Trematodes.

HOST		TREMATODE PARASITE
Scientific name (and position)	Common name	
(A) AMPHIBIA		
1. <i>Rana cyanophlyctis</i> Schneider	Frog	1. <i>Halipegus mehransis</i> Srivastava 2. <i>Ganeo kumaonensis</i> Pande 3. <i>G. tigrinum</i> Mehra & Negi 4. <i>Pleurogenes gastroporus</i> Lühe 5. <i>Tremiorchis ranarum</i> Mehra & Negi
(B) REPTILIA		
2. <i>Varanus monitor</i> (L.)	Monitor Lizard	1. <i>Paryphostomum indicum</i> (Bhalerao)
3. <i>Lissemys punctata granosa</i> (Schoepff)	Turtle	2. <i>Astiotrema</i> sp.
(C) AVES		
4. <i>Fulica atra</i> L.	Coot	1. <i>Cyclocoelum bikanerensis</i> n. sp. 2. <i>Notocotylus barmerensis</i> n. sp.
5. <i>Haemantopus haemantopus</i> (L.)	Black-winged Stilt	1. <i>Haematotrephus lanceolatum</i> (Wedl.) Stossich
6. <i>Actitis hypoleucos</i> (L.)	Common Sandpiper	1. <i>Ophthalmophagus mertensis</i> n. sp.
7. <i>Neophron percnopterus</i> (L.)	White Scavenger Vulture	1. <i>Neodiplostomum tityense</i> Patwardhan
8. <i>Anas crecca</i> (L.)	Common Teal	1. <i>Psilochasmus oxyurus</i> (Creplin) Lühe
(D) MAMMALIA		
9. <i>Taphozous kachensis kachenvis</i> Dobson	Bat	1. <i>Anchitrema sanguineum</i> (Sonsino) Looss 2. <i>Prosthodendrium ovimagnosum</i> (Bhalerao)

VI—SUMMARY

1. This is believed to be the first major account of trematodes (Platyhelminthes) from Rajasthan. Fifteen species belonging to 14 genera and 9 families are reported here.
2. All the species are first records from Rajasthan. The genus *Ophthalmophagus* Stossich is recorded for the first time from India.
3. Three new species, namely, *Cyclocoelum bikanerensis* n. sp., *Notocotylus barmerensis* n. sp., and *Ophthalmophagus mertensis* n. sp., are described.
4. Keys for the identification of the families and genera of Rajasthan trematodes are given.
5. A host-parasite list of Rajasthan trematodes is also included.

VII—REFERENCES

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VII—LETTERING USED IN TEXT-FIGURES

c.s., cirrus sac ; *gp.*, genital pore ; *int.*, intestine ; *mgl.*, Mehlis' gland ; *oes.*, oesophagus ; *os.*, oral sucker ; *ov.*, ovary ; *ph.*, pharynx ; *rsu.*, receptaculum seminis uterinum ; *T₁*, *T₂*, testes ; *ut.*, uterus ; *vd.*, vitelline duct ; *vs.*, ventral sucker ; *vit.*, vitellaria.

FAUNA OF RAJASTHAN, INDIA

PART 9.—CESTODA

By

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Zoological Survey of India, Calcutta

(With 9 Text-figures)

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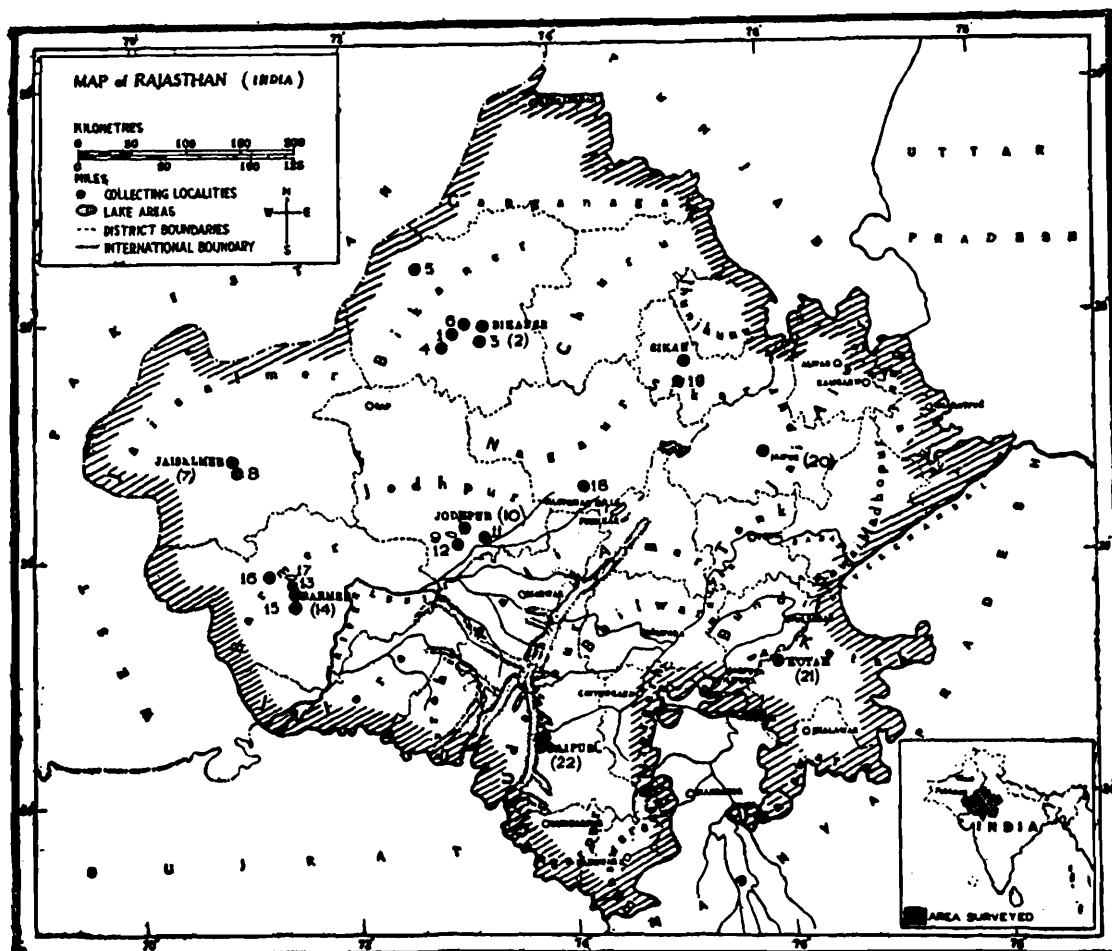
I—INTRODUCTION

A study of the literature reveals that only a few cestodes have been reported from Rajasthan. This paper deals with the cestode parasite collected in recent years from various hosts by Dr. P. D. Gupta and other parties of the Zoological Survey of India from different parts of Rajasthan. The author is of the opinion that further studies of these parasites from Rajasthan may bring to light some more new forms or new records. It is hoped that this paper may be of some help to the future workers. Unless otherwise mentioned all the specimens which form the basis of this paper were collected by Dr. P. D. Gupta.

A total of 26 species belonging to 16 genera are recorded here. Of these all but one (*Vampirolepis nana*) are new records from Rajasthan ; and 8 species are new to science.

Acknowledgement.—The author feels grateful to Dr. M. L. Roonwal, Director, Zoological Survey of India, Calcutta, for his encouragement, necessary help, for providing facilities throughout the work, for placing the specimens at the disposal of the author and for going through the manuscript.

II—LIST OF COLLECTING STATIONS FOR RAJASTHAN CESTODE



TEXT-FIG. 1.—Map of Rajasthan, showing the collecting localities for cestodes, (The number given refers to the serial number of locality in the list of collecting stations in the text).

A total of 22 Collecting Stations in 9 districts of Rajasthan from which the cestodes were obtained are listed below. A few places marked with an asterisk (*) refer to those taken from the published literature. The serial numbers given below will also be found in the map (Text-fig. 1). The approximate longitudes and latitudes are also given.

1. Bikaner District

Place	Long. E.	Lat. N.
1. Sobasar village	73°10'	28°05'
2. Bikaner	73°22'	28°01'
3. Devikund	73°18'	27°56'
4. Kolayat	72°58'	27°50'
5. Pungal	72°48'	28°30'
6. Gajner road (3 km. W. of Bikaner) . . . . .	..	..

2. Jaisalmer District

1. Jaisalmer	70°57'	26°55'
2. Goreshwar (3 km. S. E. of Jaisalmer)	70°57'	26°55'

3. Jodhpur District

9. Kailana tank	72°58'	26°19'
10. Jodhpur	73°04'	26°18'
11. Bilaspur Dam	73°27'	26°18'
12. Umedsagar	72°55'	26°15'

4. Barmer District

13. Nehru-Nagar (1 km. N. of Barmer)	71°23'	25°45'
14. Barmer	71°25'	25°45'
15. Sujer Hills	71°23'	25°45'
16. Kapurdi	71°20'	25°50'
17. Bhap talao	71°26'	25°51'

5. Nagaur District

18. Merta	74°06'	26°35'
---------------------	--------	--------

6. Sikar District

19. Choka-Ka-Bas (16 km. S. of Sikar)	75°08'	27°29'
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7. Jaipur District

*20. Jaipur	75°52'	26°55'
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8. Kotah District

*21. Kotah	75°52'	25°10'
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9. Udaipur District

*22. Udaipur	73°42'	24°35'
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III—LISTS OF CESTODES KNOWN FROM RAJASTHAN

Note.—All the species except one (No. 20, marked *) are new records from Rajasthan; 8 species are new.

Class I. CESTODA

Subclass (a) *EUCESTODA* SouthwellOrder (1) *PSEUDOPHYLLIDEA* CarusFamily (i) *DIPHYLLOBOTHRIDAE* LüheGenus 1. *Duthiersia* Perrier1. *Duthiersia fimbriata* (Diesing)Order (2) *PROTEOCEPHALIDEA* MolaFamily (i) *PROTEOCEPHALIDAE* La RueGenus. 1. *Proteocephalus* Weinland2. *Proteocephalus woodlandi* MogheOrder (3) *CYCLOPHYLLIDEA* Ben in BraunFamily (i) *ANOPLOCEPHALIDAE* CholodkovskyGenus 1. *Oochoristica* Lühe3. *Oochoristica tuberculata* (Rudolphi)Family (ii) *DAVAINEIDAE* FuhrmannSubfamily (i) *Davaineinae* BraunGenus 1. *Raillietina* FuhrmannSubgenus (1) *Raillietina* Stiles and Orleman4. *Raillietina (Raillietina) polychalix* (Kotlan)5. *Raillietina (Raillietina) torquata* (Meggitt)6. *Raillietina (Raillietina) quxdritesticulata* Moghe7. *Raillietina (Raillietina) nagpurensis* MogheSubgenus (2) *Paroniella* Fuhrmann8. *Raillietina (Paroniella) barmerensis* n. sp.Genus 2. *Davainea* Blanchard9. *Davainea himantopodis* JohnstonGenus 3. *Cotugnia* Diamare10. *Cotugnia cuneata* Meggitt11. *Cotugnia bikanerensis* sp. n.Family (iii) *DILEPIDIDAE* Railliet and HenrySubfamily (i) *Dilepidinae* FuhrmannGenus 1. *Laterorchites* Fuhrmann

12. *Laterorchites rajasthanensis* n. sp.
Genus 2. *Paricterotaenia* Fuhrmann
13. *Paricterotaenia coronata* (Creplin)
14. *Paricterotaenia sujerensis* n. sp.
Subfamily (ii) *Dipylidiinae* Stiles
Genus 1. *Choanotaenia* Railliet
15. *Choanotaenia kapurdiensis* n. sp.
16. *Choanotaenia croaxum* n. sp.
Family (iv) HYMENOLEPIDIDAE Railliet and Henry
Subfamily (i) *Hymenolepidinae* Perrier
Genus 1. *Sobolevicanthus* Spassky & Spasskaja
17. *Sobolevicanthus gracilis* (Zeder)
18. *Sobolevicanthus serratus birmanicus* (Meggitt)
Genus 2. *Hymenolepis* Weinland
19. *Hymenolepis diminuta* (Rudolphi)
Genus 3. *Vampirolepis* Spassky
20. *Vampirolepis nana* (Siebold)
Genus 4. *Myotolepis* Spassky
21. *Myotolepis jaisalmerensis* n. sp.
Genus 5. *Diorchis* Clerc
22. *Diorchis magnicirrosa* Moghe and Inamdar
23. *Diorchis gigantocirrosa* Singh
24. *Diorchis jodhpurensis* n. sp.
Family (v) ACOLEIDAE Fuhrmann
Genus 1. *Acoelus* Fuhrmann
25. *Acoelus vaginatus* (Rudolphi)
Family (vi) TAENIDAE Ludwig
Genus 1. *Taenia* Linnaeus
26. *Taenia taeniaeformis* (Batsch)

IV—KEY FOR RAJASTHAN CESTODES

- (3). Scolex compressed laterally ; bothria present.
2. Genital pore ventral. . . *Duthiersia fimbriata*
- 3(1). Scolex not compressed ; bothria absent.
- 4(5). Fifth sucker or apical organ present ; cuticle of scolex in anterior part covered with spines. *Proteocephalus woodlanai*
- 5(4). Fifth sucker or apical organ absent ; spines absent from cuticle of scolex in anterior part.

- 6(7). Rostellum absent ; testes in 3-4 rows across posterior region of ovary or in horse-shoe shape. .. *Oochoristica tuberculata*
- 7(6). Rostellum present ; testes may or may not be arranged in 3-4 rows but not in horse-shoe shape.
- 8(10). Few segments ; small worms.
9. Genital pores regularly alternate. .. *Davainea himantopodia*
- 10(8). Numerous segments ; large worms.
- 11(20). Suckers armed ; genitalia single.
- 12(13). Testes 75-90 ; each egg-capsule with single egg. .. 5. *Raillietina (Paroniella) barmerensis* n. sp.
- 13(12). Testes not more than 22 ; each egg-capsule with several eggs.
- 14(17). Rostellum with 220-250 hooks ; testes 10-22.
- 15(16). Rostellum with 220 hooks ; suckers with single row of hooks ; testes 19-22. .. *Raillietina (Raillietina) nagpurensis*
- 16(15). Rostellum with 240-250 hooks ; suckers with 4-5 rows of minute hooks ; testes 10. .. *Raillietina (Raillietina) polychalix*
- 17(14). Rostellum with 150-180 hooks ; testes 4-10.
- 18(19). Rostellum with 150 hooks ; barrel-shaped collar with thickly studded deciduous hooks present at posterior part of rostellum ; testes 8-10. .. *Raillietina (Raillietina) torquata*
- 19(18). Rostellum with 180 hooks ; barrel-shaped collar with hooks at posterior part of rostellum absent ; testes 4. .. *Raillietina (Raillietina) quadritesticulata*
- 20(11). Suckers unarmed ; genitalia double.
- 21(22). Rostellum with double circle of hooks ; a circular cushion present behind rostellum ; testes may extend laterally to longitudinal excretory canal. .. *Cotugnia cuneata*
- 22(21). Rostellum with single crown of hooks ; circular cushion absent ; testes not extending beyond excretory canals. .. *Cotugnia bikanerensis* n. sp.
- 23(30). Uterus sac-like, containing several eggs.
- 24(26). Proglottids broader than long ; rostellar hooks 24.
- 25(27). Testes in two groups one on each side of female gland. .. *Laterorchites rajasthanensis* n. sp.
- 26(24). Proglottids usually longer than broad ; rostellar hooks 10-22.
- 27(25). Testes in one group present posterior to female gland.
- 28(29). Rostellum with 10 hooks ; testes 20-27. .. *Paricterotaenia coronata*
- 29(28). Rostellum with 22 hooks ; testes 30-58. .. *Paricterotaenia sujerensis* n. sp.
- 30(23). Uterus represented by egg-capsules, containing one to several eggs.
- 31(32). Rostellum with 12-14 hooks ; testes 20-30. .. *Choanotaenia croaxus* n. sp.
- 32(31). Rostellum with 16 hooks ; testes 46-61. .. *Choanotaenia kapurdiensis* n. sp.
- 33(43). Testes 3 in number.
- 34(37). Rostellum present well developed and armed.
- 35(36). Cirrus extends almost to the aporal margin of proglottid ; testes usually in straight lines across the proglottid. .. *Sobolevicanthus serratus birmanicus*
- 36(35). Cirrus extends nearly to aporal longitudinal excretory canal ; 2 testes aporal. .. *Sobolevicanthus gracilis*
- 37(34). Rostellum absent or rudimentary and unarmed.

38. Testes one poral and two antiporal to vitelline gland.
Hymenolepis diminuta
- 39(41). Testes forming triangle.
- 40(42). Medium sized worm.
Myotolepis jaisalmerensis n. sp.
- 41(39). Testes not forming triangle.
- 42(40). Dwarf tapeworm.
Vampirolepis nana
- 43(33). Testes 2 in number.
- 44(45). Suckers armed ; cirrus sac extending beyond aporal longitudinal excretory ducts ; testes lie side by side.
Diorchis gigantocirrosa
- 45(44). Suckers unarmed ; cirrus sac extends upto middle to beyond the middle of proglottid ; testes quite apart or lie on either side close to ovary.
- 46(47). Cirrus sac extends upto middle of proglottid ; testes present one on either side close to ovary.
Diorchis jodhpurensis n. sp.
- 47(46). Cirrus sac reaches beyond centre of proglottid ; testes lie quite apart to each other.
Diorchis magnicirrosa
- 48(49). Scolex unarmed ; genital pores alternating regularly ; cirrus large and armed.
Acoleus vaginatus
- 49(48). Scolex armed ; genital pores alternating irregularly ; cirrus not so large and unarmed.
Taenia taeniaeformis

V—SYSTEMATIC ACCOUNT

1. *Duthiersia fimbriata* (Diesing)

1850. *Solenophorous fimbriatus* Diesing, K. M., *Syst. helm.*, Vienna, 1, p. 679.

1930. *Duthiersia fimbriata* : Southwell, T., *Fauna Brit. India, Cestoda*, London, 1, pp. 60-62, figs. 9 and 10.

Material.—8 exs., near kailana tank (Jodhpur Dist.), 10.x.62, *ex. rectum* of a monitor lizard *Varanus monitor* (Linnaeus).

Distribution.—RAJASTHAN : Kailana tank (Jodhpur Dist.). *Elsewhere* : India (Bengal and Punjab) ; Ceylon ; Africa.

2. *Proteocephalus woodlandi* Moghe

1926. *Proteocephalus woodlandi* Moghe, M.A., *Rec. Indian Mus.*, Calcutta, 28, pp. 55-60, figs. 4-10.

Material.—20 exs., Sobasar village (Bikaner Dist.), 5.x.62 ; near Kailana tank (Jodhpur Dist.), 10.x.62; *ex* (i) *rectum* of a uromastix *Uromastix hardwickii* Gray (4 exs.); (ii) *intestine* of 3 monitor lizards *Varanus monitor* (Linnaeus) (16 exs.).

Distribution.—RAJASTHAN : Sobasar village, Kailana tank (Bikaner; Jodhpur Dists.). *Elsewhere* : India (Nagpur).

3. *Oochoristica tuberculata* (Rudolphi)

1819. *Taenia tuberculata* Rudolphi, C. A., *Eutozoorum synopsis cui accedunt mahtissa duplex et indices locupletissimi*, Berolini, 10, p. 811.

1930. *Oochoristica tuberculata* : Southwell, T., *Fauna Brit. India, Cestoda*, London, 2, pp. 61-62, fig. 247.

Material.—17 exs., Sobasar village (Bikaner Dist.), 5.x.62 (12 exs.), Jaisalmer (5 exs.); 23.x.62; ex intestine of a monitor lizard *Varanus monitor* (Linnaeus).

Distribution.—RAJASTHAN : Sobasar (Bikaner) and Jaisalmer Dists. *Elsewhere* : Europe ; N. Africa (Morocco).

Remarks.—Out of 17 specimens, one is provided with a fifth sucker. Probably this is a variation.

4. *Raillietina (Raillietina) polychalix* (Kotlan)

1921. *Davainea polychalix* Kotlan, A., *Ann. Hist. Nat. Mus. Nat. Hungarici*, Budapest, 18, pp. 17-20, figs. 10-12.

1930. *Raillietina (Raillietina) polychalix* : Southwell, T., *Fauna Brit. India, Cestoda*, London, 2, pp. 80-81, fig. 259.

Material.—3 exs., Bikaner city, 2.x.62. ex intestine of a pigeon, *Columba livia* Gmelin.

Distribution.—RAJASTHAN : Bikaner city. *Elsewhere* : India (Calcutta ; Lucknow) ; New Guinea.

5. *Raillietina (Raillietina) torquata* (Meggitt)

1924. *Houttuynia torquata* Meggitt, F. J., *Parasitol.*, Cambridge, 16, pp. 307-309, text-figs. 3 and 4.

Material.—8 exs., Jaisalmer, 22.x.62, ex intestine of a pigeon, *Columba livia* Gmelin.

Distribution.—RAJASTHAN : Jaisalmer. *Elsewhere* : India ; Rangoon ; Nepal.

6. *Raillietina (Raillietina) quadritesticulata* Moghe

1925. *Raillietina (Raillietina) quadritesticulata* Moghe, M.A., *Rec. Indian Mus.*, Calcutta, 27, pp. 433-437, figs. 5-7.

Material.—21 exs., Jaisalmer, 19.x.62, 20.x.62, ex intestine of 4 brown doves, *Streptopelia senegalensis* (L.).

Distribution.—RAJASTHAN : Jaisalmer city. *Elsewhere* : India (Nagpur).

7. *Raillietina (Raillietina) nagpurensis* Moghe

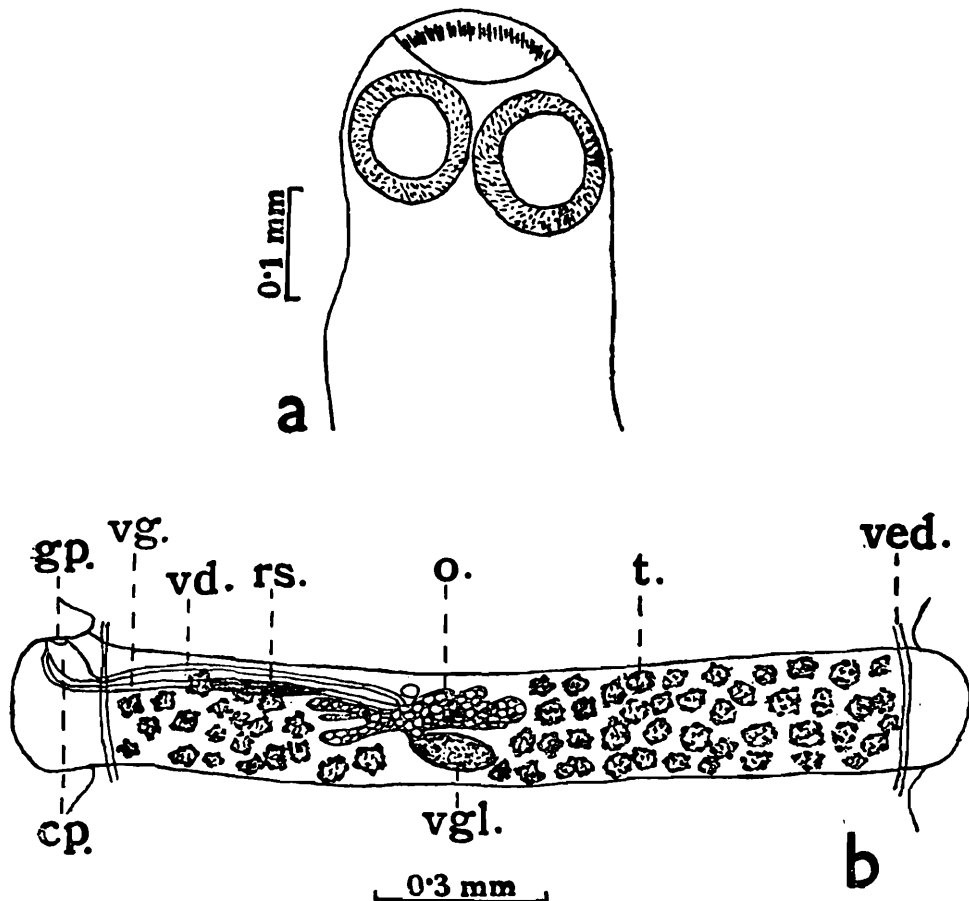
1925. *Raillietina (Raillietina) nagpurensis* Moghe, M.A., *Rec. Indian Mus.*, Calcutta, 27, pp. 431-437, figs. 1-4.

Material.—27 exs., Jaisalmer, 22.x.62, ex intestine of 3 pigeons, *Columba livia* Gmelin.

Distribution.—RAJASTHAN : Jaisalmer. *Elsewhere* : India (Nagpur); Nepal ; Australia.

8. *Raillietina (Paroniella) barmerensis* n. sp.
(Text-fig. 2)

Material.—3 exs., Nehru Nagar (Barmer Dist.), 1.XI.62, ex intestine of a house crow, *Corvus splendens* Vieillot.



TEXT-FIG. 2.—*Raillietina (Paroniella) barmerensis* n. sp.
(a) Scolex. (b) Mature proglottid.

Description.—Length 31-37 mm. ; maximum breadth 1.2-1.7 mm. Proglottids broader than long. Scolex small almost rounded ; length 0.25-0.42 mm. ; width 0.23-0.35 mm. Rostellum length 0.06-0.07 mm. ; width 0.08-0.09 mm. Rostellum with double crown of 120 hooks ; length of hooks 0.01-0.02 mm. Suckers muscular ; diameter 0.08-0.12 mm. ; with 4-5 rows of hooks. Testes small, in two groups on each side of ovary ; 75-90 in numbers, 20-25 poral and 55-65 aporal ; testes in between longitudinal excretory ducts. Cirrus pouch not extending upto longitudinal excretory ducts ; length of cirrus 0.10-0.11 mm., width 0.04-0.06 mm. Vas deferens less coiled. Genital pore anterior of lateral margin of segment. Ovary asymmetrically bilobed, each lobe again lobed. Vitelline gland slightly lobed ; posterior to ovary ; length 0.15-0.17 mm. ; width 0.04-0.05 mm. Vagina narrow canal ; opening posterior to cirrus pouch ; provided posterior end with receptaculum seminis.

Comparison.—The present species comes close to *R. (P.) corvina* (Fuhrmann), *R. (P.) compacta* (Clerc), *R. (P.) reynoldsae* Meggitt and *R. (P.) coronea* Tubanguai and Masilungan but differs as follows :—

From *R. (P.) corvina* : (i) Body-length 31-37 mm. (vs. 120). (ii) Genital opening lies anterior (vs. middle of lateral margin of segment). (iii) Rostellar hooks 120 (vs. 80). (iv) Number of testes 75-90 (vs. 26). (v) Vas deferens almost straight (vs. much coiled).

From *R. (P.) compacta*.—(i) Rostellar hooks 120 (vs. 400). (ii) Length of rostellar hooks 0.01-0.02 mm. (vs. 0.013-0.015). (iii) Number of testes 75-90 (vs. 20-25). (iv) Length of cirrus pouch 0.12 mm. (vs. 0.15).

From *R. (P.) reynoldsae*.—(i) Body-length 31-37 mm. (vs. 250) ; width 1.2-1.7 mm. (vs. 3). (ii) Rostellar hooks 120 (vs. 250). (iii) Spiny collar absent (vs. present). (iv) Testes 75-90 (vs. 33-39). (v) Vas deferens almost straight (vs. much coiled). (vi) Length of cirrus pouch 0.10-0.11 mm. (vs. 0.13-0.21). (vii) Ovary asymmetrically bilobed (vs. not bilobed).

From *R. (P.) coronea*.—(i) Body-length 31-37 mm. (vs. 250) ; width 1.2-1.7 mm. (vs. 3.3). (ii) Rostellar hooks 120 (vs. 200). (iii) Testes 75-90 (vs. 44-46). (iv) Vas deferens almost straight (vs. much coiled). (v) Length of cirrus pouch 0.10-0.11 mm. (vs. 0.13-0.14). (vi) Ovary asymmetrically bilobed (vs. not bilobed). (vii) Vitelline gland almost straight (vs. much coiled).

Type-Specimens.—*Holotype* : On a slide, Z.S.I. Reg. No. W6608/1 ; Nehru Nagar (Barmer Dist.), ex intestine of the house crow, *Corvus splendens* Vieillot, P. D. Gupta, coll., 1.XI.62. *Paratype* : (i) 1, on a slide, Z.S.I. Reg. No. W6609/1. Other details as above. (ii) 1, in tube, Z.S.I. Reg. No. W6610/1 ; other details as above.

Distribution.—RAJASTHAN : Barmer Dist. Nehru Nagar near Barmer, (the Type-locality). Known only from there.

9. *Davainea himantopodis* Johnston

1911. *Davainea himantopodis* Johnston, T., *Proc. Linn. Soc. N.S.W.*, Sydney, 36, pp. 75-79, figs. 1-5.

1952. *Davainea himantopodis* : Singh, K. S., *Indian J. Helm.*, Lucknow, 4, pp. 7-8, figs. 3-5.

Material.—15 exs., Chokhaka (Sikar Dist.), 14.ix.60. *Desert and Gangetic Plain Regional Station*, Z.S.I. Coll.; ex intestine of a black winged stilt, *Himantopus himantopus* (Linnaeus).

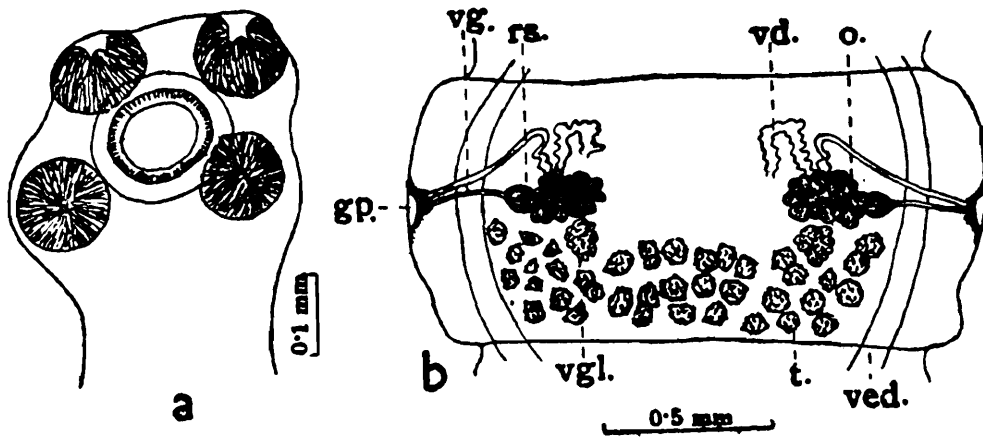
Distribution.—RAJASTHAN : Chokhaka (Sikar Dist.). *Elsewhere* : India (Lucknow) ; China ; Australia.

10. *Cotugnia cuneata* Meggitt

1924. *Cotugnia cuneata* Meggitt, F. J., *Parasitol.*, Cambridge, 16, pp. 304-307, text-figs. 1 and 2.

Material.—3 exs., Devikund (Bikaner Dist.), 2.X.62, ex intestine of a ring dove, *Streptopelia decaocto* (Frisvaldszky).

Distribution.—RAJASTHAN: Devikund (Bikaner Dist.). *Elsewhere*: India (Kasauli ; Nagpur ; Lucknow) ; Burma (Rangoon) ; Egypt ; Eastern Europe.

11. *Cotugnia bikanerensis* n. sp.

TEXT-FIG. 3.—*Cotugnia bikanerensis* n. sp.
(a) Scolex. (b) Mature proglottid.

Material.—2 exs., Bikaner, 5.x.62, ex intestine of a sand grouse *Pterocles exustus* Temminck.

Description.—Length 56.1-60.3 mm.; maximum width 2.1-2.3 mm. Proglottids broader than long. Scolex rounded 0.35-0.37 mm. in diameter. Rostellum 0.15-0.17 mm. in diameter; provided with a single crown of more than 200 hooks. Hooks 0.01 mm. in length. Unarmed muscular suckers 0.13 mm. in diameter. Testes 35-41, arranged in one group, posterior to ovaries, between two longitudinal excretory ducts. Testes 0.05-0.06 mm. in diameter. Cirrus pouch long reaches and even crosses in certain proglottids longitudinal excretory ducts, 0.38 mm. in length, 0.02 mm. in breadth. Cirrus unarmed. Small vas deferens less coiled. Genital pores anterior to middle of lateral margins. Each proglottid with two sets of female genitalia, one on each side. Ovary much lobed, 0.12-0.16 mm. long, 0.22-0.25 mm. broad. Vitelline gland posterior to ovary, 0.08-0.12 mm. in length, 0.11-0.13 mm. in breadth. Vagina wide tube opens posterior to male genital opening, near ovary vagina enlarges to form a large receptaculum seminis. Uterus occupying almost whole of proglottid, contains numerous egg-capsules. Each egg-capsule with a single egg. Eggs rounded, 0.02-0.04 mm. in diameter.

Comparison.—The present species comes close to *C. digonopora* (Pasuqale), *C. inaequalis* Fuhrmann and *C. seni* Meggitt, but differs as follows :—

From *C. digonopora*.—(i) Body-length 56.1-60.3 mm. (vs. 80); breadth 2.1-2.3 mm. (vs. 8). (ii) Testes 35-41, in between two longitudinal excretory canal (vs. 100, crosses two longitudinal canal). (iii) Ovary large, much lobed (vs. small less lobed). (iv) Sucker 0.13 mm. (vs. 0.45). (v) Vas deferens less coiled (vs. much coiled).

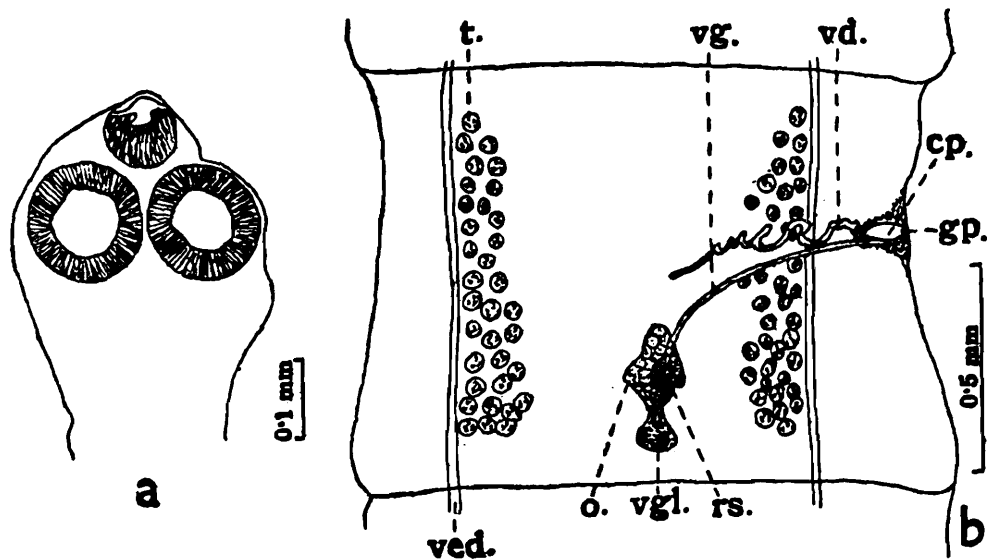
From *C. inaequalis*.—(i) Testes 30-41 in single group (vs. 50, in two groups). (ii) Cirrus pouch long, reaches or crosses longitudinal excretory ducts (vs. short, not reaching longitudinal excretory ducts). (iii) Receptaculum seminis close to ovary (vs. away from ovary). (iv) Vas deferens less coiled (vs. much coiled).

From *C. seni*.—(i) Body-length 56.1-60.3 mm. (vs. 10), breadth 2.1-2.3 mm. (vs. 1). (ii) Size of rostellum 0.15-0.17 mm. (vs. 0.21-0.27). (iii) Cirrus pouch 0.38 mm. (vs. 0.19). (iv) Vas deferens less coiled (vs. much coiled). (v) Receptaculum seminis small (vs. large).

Type-Specimens.—*Holotype* : On a slide, Z.S.I. Reg. No. W6611/1; Bikaner, *ex intestine* of sand grouse *Pterocles exustus* Temminck ; *P. D. Gupta*, coll., 5.x.62. *Paratype* : 1, in a tube, Z.S.I. Reg. No. W6612/1; other details as above.

Distribution.—RAJASTHAN : Bikaner.

12. *Laterorchites rajasthanensis* n. sp.



TEXT-FIG. 4.—*Laterorchites rajasthanensis* n. sp.
(a) Scolex. (b) Mature proglottid.

Material.—7 exs., Barmer city, 31.x.62, *ex intestine* of two falcons, *Falco jugger* Gray, J. E.; *P. D. Gupta* coll.

Description.—Length 39.5-44.7 mm. ; maximum width 1.93-1.99 mm. Proglottids broader than long. Scolex rounded, 0.21-0.31 mm. in diameter. Rostellum small, 0.06-0.07 mm. (mean 0.07 mm.) long; 0.08-0.09 mm. broad; armed with a single crown of 24 hooks. Hooks 0.01-0.02 mm. in length. Sucker 0.12-0.17 mm. in diameter. Testes 55-87, arranged in two group on each side of female glands and lateral to proglottid ; lying between two longitudinal excretory ducts ; 0.03-0.04 mm. in diameter. Cirrus pouch small ; 0.10-0.14 mm. long 0.05-0.07 mm. broad ; not extending up to longitudinal excretory ducts. Cirrus not spiny; 0.08-0.10 mm. long. Vas deferens long but less coiled. Genital pores irregularly alternate ; open a little anterior to middle of segment. Ovary longer than broad ; situated at posterior region of proglottid. Vitelline gland situated posterior to ovary ; 0.10-0.14 mm. in breadth. Vagina a narrow canal, opening posterior to cirrus pouch opening ; portion near the ovary provided with a small receptaculum seminis.

Comparison.—It differs from the only other known species of the genus, *L. bilateralis* (Fuhrmann) (from Central America) as follows: (i) Number of hooks 24 (*vs.* 10). (ii) Genital pore opens a little anterior to middle of segment (*vs.* much anterior, near anterior margin to middle of segment). (iii) Cirrus spines absent (*vs.* present). (iv) Testes more on lateral field and not arranged in horse-shoe-shape (*vs.* less so, and arranged in horse-shoe-shape near ovary). (v) Ovary triangular (*vs.* oblong). (vi) Vitelline gland large (*vs.* small).

Type-Specimens.—*Holotype* : On a slide, Z.S.I. Reg. No. W6613/1; Barmer, *ex intestine* of falcon, *Falco jugger* J. E. Gray ; *P. D. Gupta*;

coll., 31.X.62. *Paratypes* (details as above) : 6, as follows : (i) 1, on a slide, Z.S.I. No. W6614/1 ; (ii) 1, on a slide, Z.S.I. Reg. No. W6615/1 ; (iii) 3, in a tube, Z.S.I. Reg. No. W6616/1 ; (iv) 1, in a tube, Z.S.I. Reg. No. W6617/1.

Distribution.—RAJASTHAN: Barmer Dist.

13. *Paricterotaenia coronata* (Creplin)

1829. *Taenia coronata* Creplin, F.C.H., *Novae observationes de Entosois*, Berolini, p. 134.

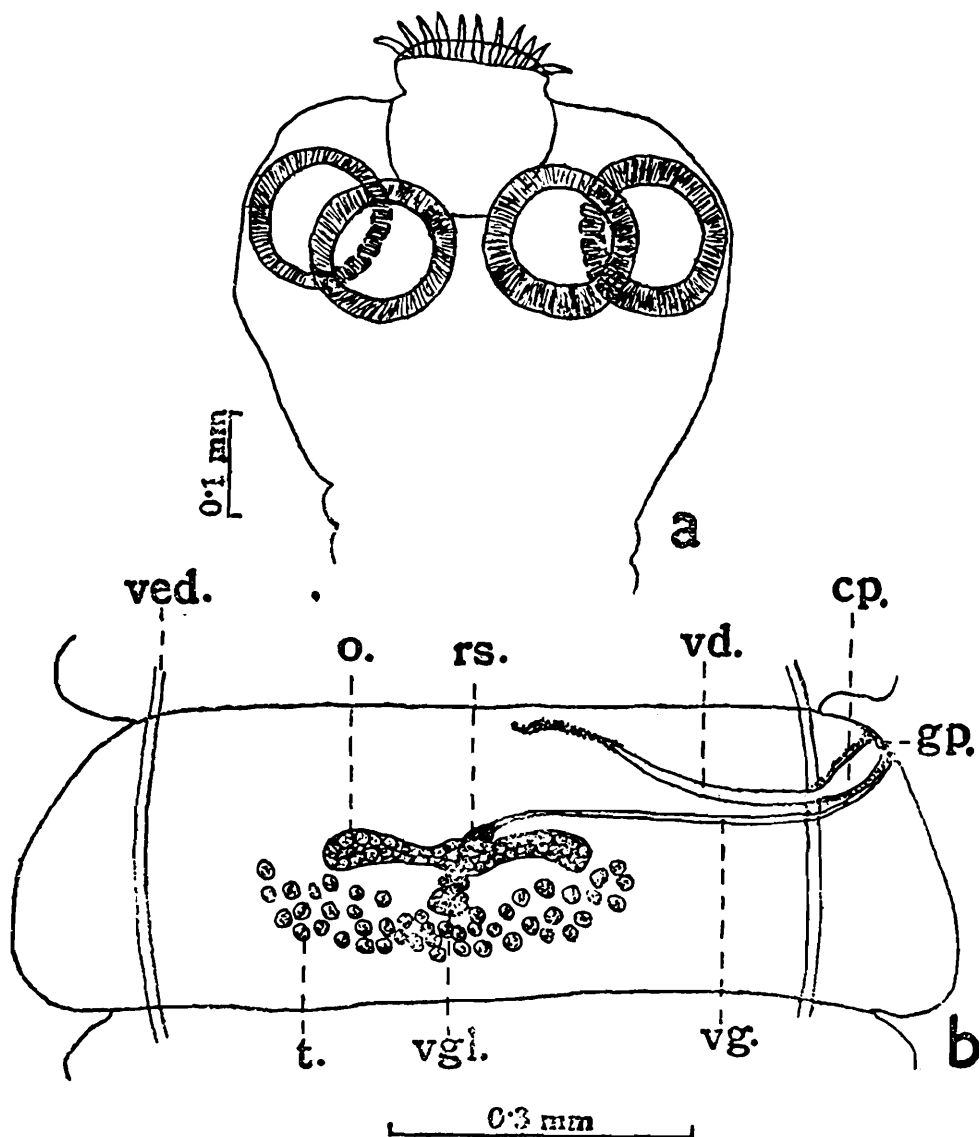
1940. *Paricterotaenia coronata* : Burt, D.R.R., *Spol. Zeyl.*, Colombo, 22, pp. 13-16, figs. 9 and 10.

Material.—5 exs., Jaisalmer, 23.X.62, ex intestine of a stone curlew, *Burhinus oedicnemus* (Linnaeus).

Distribution.—RAJASTHAN : Jaisalmer City. *Elsewhere* : India (U. P.), Ceylon ; Africa ; Europe.

14. *Paricterotaenia sujerensis* n. sp.

Material.—4 exs., Sujer Hills (Barmer Dist.), 30.X.62, ex intestine of a desert chat, *Oenanthe deserti* (Temminck).



TEXT-FIG. 5.—*Paricterotaenia sujerensis* n. sp.
(a) Scolex. (b) Mature proglottid.

Description.—Size small ; length 13.5-16.6 mm. ; maximum breadth 1.29-1.35 mm. Scolex rounded ; 0.42-0.50 mm. in diameter. Conical muscular rostellum ; 0.18-0.21 mm. in length ; 0.16-0.17 mm. in breadth. Rostellum with single crown of 22 hooks. Hooks 0.05 mm. long. Muscular sucker 0.12-0.15 mm. in diameter. Testes 30-35 present behind ovary ; between two longitudinal excretory canals ; 0.01-0.02 mm. in diameter. Cirrus pouch long, slightly bent tube, crosses excretory duct ; 0.15-0.17 mm. in length ; 0.03-0.07 mm. in breadth. Vas deferens small, less coiled. Genital pores irregularly alternate ; open much anterior to middle of lateral margin of proglottid. Ovary almost symmetrically bilobed ; in middle of segment. Vitelline gland small, compact, located posterior to ovary ; 0.01-0.02 mm. in diameter. Vagina narrow canal ; opens posterior to male genital opening ; posteriorly near ovary it dilates to form a small receptaculum seminis. Egg 0.01-0.02 mm. in diameter.

Comparison.—Present species comes close to *P. parina* (Dujardin), *P. parvirostris* (Krabbe) and *P. barbara* (Meggitt) but differs as follows :

From *P. parina* : (i) Hooks 22 (vs. 17-20) ; length 0.05 mm. (vs. 0.01-0.02). (ii) Testes 30-35 (vs. 20).

From *P. parvirostris* : (i) Body-length 13.5-16.6 mm. (vs. 30). (ii) Diameter of scolex 0.42-0.50 (vs. 0.20). (iii) Length of hooks 0.05 mm. (vs. 0.01). (iv) Testes 30-35 (vs. 18-20).

From *P. barbara* : (i) Body-length 13.5-16.6 mm. (vs. 20-30). (ii) Diameter of scolex 0.42-0.50 mm. (vs. 0.02). (iii) Length of hooks 0.05 mm. (vs. 0.01-0.02). (iv) Testes 30-35 (vs. 24-26). (v) Ovary not deeply lobed (vs. deeply lobed).

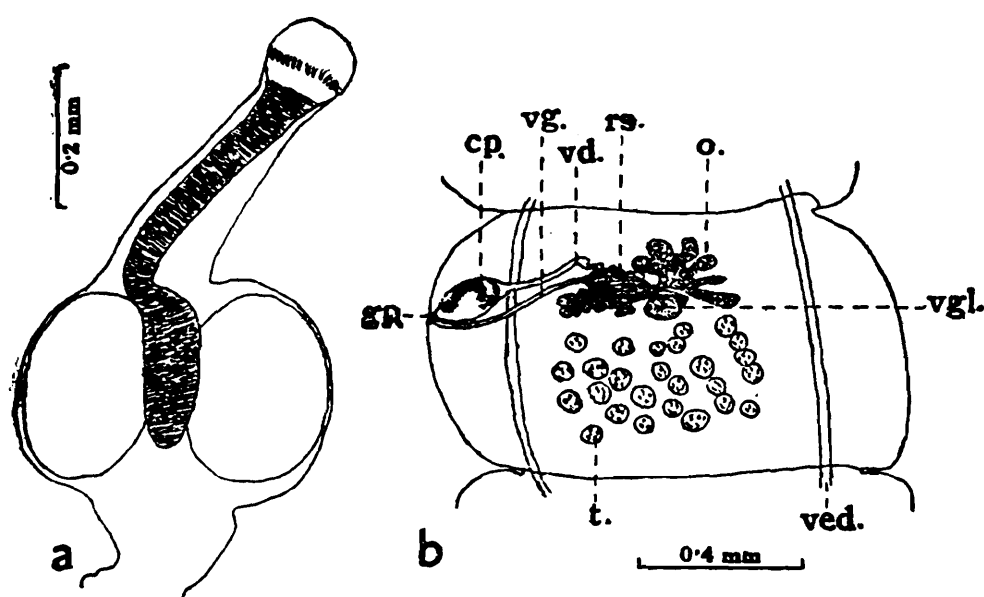
Type-Specimens.—*Holotype* : On a slide, Z.S.I. Reg. No. W6618/1; Sujer Hills (Barmer Dist.), ex intestine of desert chat *Oenanthe deserti* (Temminck), *P. D. Gupta*, coll. 30.x.62. *Paratypes* : (Details as above) : (i) 1, on a slide, Z.S.I. Reg. No. W6619/1. (ii) 1, on a slide, Z.S.I. Reg. No. W6620/1. (iii) 1, in tube, Z.S.I. Reg. No. W6621/1.

Distribution.—RAJASTHAN : Sujer Hills, Barmer Dist.

15. *Choanotaenia kapurdiensis* n. sp.

Material.—33 exs., Jaisalmer ; Nehru Nagar 21.x.62, and Kapurdi (Barmer Dist.), 1.x.62, ex intestine of 7 exs. of cream coloured courser, *Cursorius cursor* (Latham).

Description.—Body-length 54.06-57.24 mm. ; maximum breadth 1.48-1.85 mm. Proglottids broader than long. Scolex almost rounded ; 0.26-0.35 mm. in length ; 0.32-0.48 mm. in breadth. Rostellum 0.26-0.46 mm. in length ; 0.11-0.18 mm. in breadth ; armed with a single row of 12-14 hooks. Hooks 0.02-0.03 mm. in length. Suckers 0.32 mm. long ; 0.21 mm. broad. Testes 20-30, located posterior to ovary, in between two longitudinal excretory canals. Cirrus pouch extending upto longitudinal excretory duct, 0.11-0.12 mm. long ; 0.06 mm. broad. Vas deferens small, less coiled. Genital pores irregularly alternate, present anterior to middle of proglottid. Ovary asymmetrically bilobed, each lobe again lobed. Vitelline gland lies posterior to ovary, 0.03-0.05



TEXT-FIG. 6.—*Choanotaenia kapurdiensis* n. sp.
(a) Scolex. (b) Mature proglottid.

mm. long ; 0.05-0.08 mm. broad. Vagina a narrow canal, opens posterior to cirrus pouch opening ; at posterior end near ovary provided with receptaculum seminis. Uterus in form of egg capsules. Egg. 0.02-0.03 mm. in diameter.

Comparison.—The new species comes very close to *C. joyeuxi* (Tseng Shen), *C. lobipluviae* Burt and *C. aurantia* Singh, but differs from them as follows :—

From *C. joyeuxi* : (i) Body-length 54.06-57.24 mm. (vs. 45) ; width 1.48-1.85 mm. (vs. 0.65). (ii) Number of hooks 12-14 (vs. 10). (iii) Length of hook 0.02-0.03 mm. (vs. 0.23-0.25). (iv) Size of cirrus pouch 0.11-0.12 × 0.06 mm. (vs. 0.10-0.19 × 0.03). (v) Testes 20-30 (vs. 14-18). (vi) Diameter of egg 0.02-0.03 mm. (vs. 0.01-0.02).

From *C. lobipluviae* : (i) Body-breadth 1.48-1.85 mm. (vs. 2.35-2.6). (ii) Length of scolex 0.29 × 0.37 mm. (vs. 0.62-0.73). (iii) Number of hooks 12-14 (vs. 18). (iv) Length of hooks 0.02-0.03 mm. (vs. 0.15-0.16). (v) Number of testes 20-30 (vs. 110-120). (vi) Length of cirrus pouch 0.11-0.12 × 0.06 mm. (vs. 0.26-0.28 × 0.07-0.08).

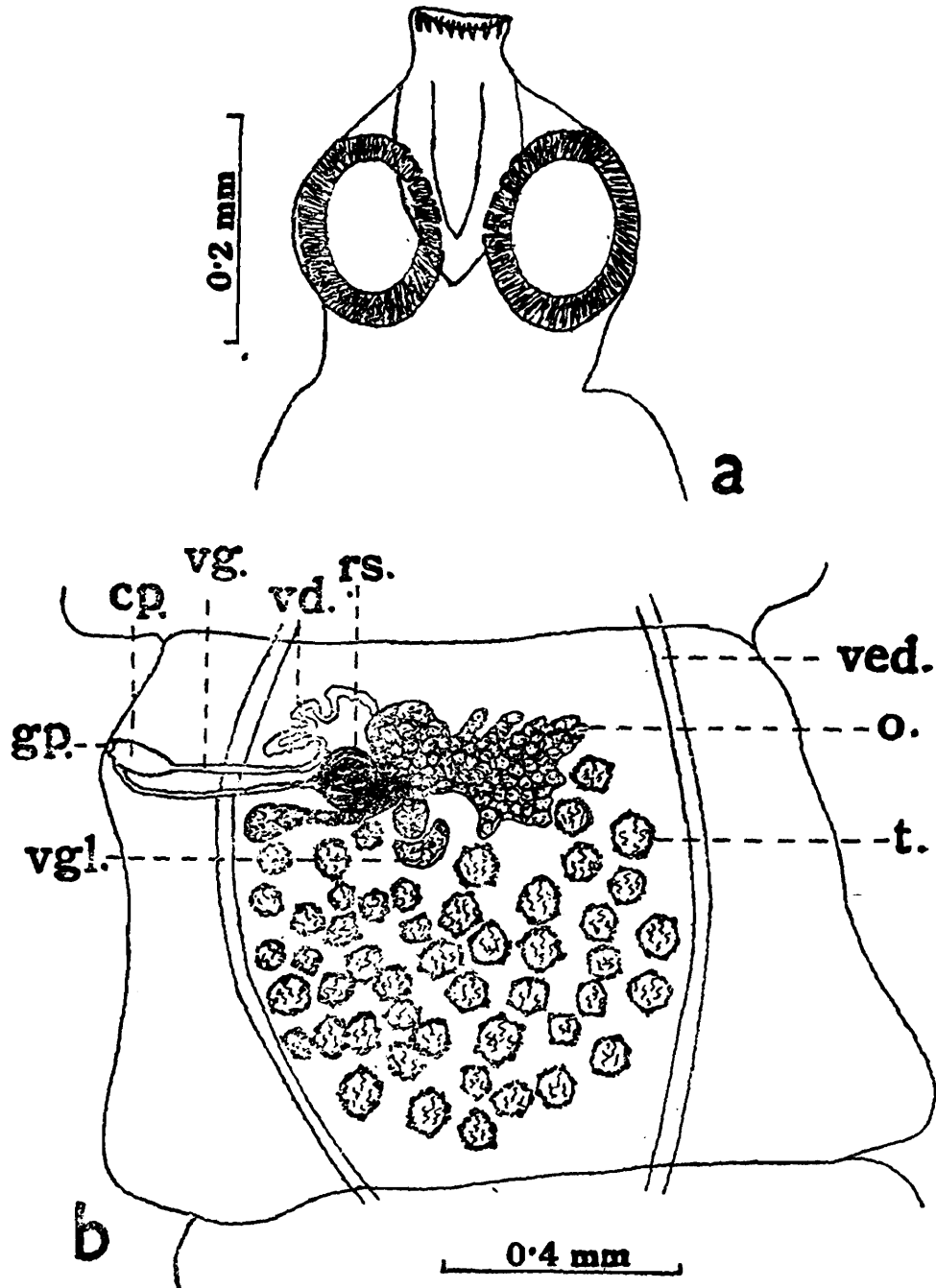
From *C. aurantia* : (i) Body-length 54.06-57.24 mm. (vs. 10-37) ; width 1.48-1.85 mm. (vs. 0.31-0.48). (ii) Sucker 0.32 × 0.21 mm. (vs. 0.12 × 0.17). (iii) Number of hooks 12-14 (vs. 14-18). (iv) Length of hooks 0.02-0.03 mm. (vs. 0.01-0.02). (v) Rostellum 0.26-0.48 × 0.11-0.18 mm. (vs. 0.06-0.11). (vi) Number of testes 20-30 (vs. 16-20). (vii) Size of cirrus pouch 0.11-0.12 × 0.06 mm. (vs. 0.03-0.05 × 0.01). (viii) Vitelline gland not lobed ; size 0.03-0.05 × 0.05-0.08 mm. (vs. lobed : size 0.04-0.08).

Type-Specimens.—*Holotype* : On a slide, Z.S.I. Reg. No. W6635/1 ; Kapurdi (Barmer Dist.), ex intestine of cream coloured courser, *Cursorius cursor* (Latham), P. D. Gupta, coll. 21.x.62. *Paratypes* : (Other details as above) : (i) 2, on a slide, Z.S.I. Reg. No. W6636/1. (ii) 2, on a slide, Z.S.I. Reg. No. W6637/1. (iii) 3, on a slide, Z.S.I. Reg. No. W6638/1. (iv) 4, on a slide, Z.S.I. Reg. No. W6639/1.

Distribution.—RAJASTHAN : Jaisalmer and Barmer Dists.

16. *Choanotaenia croaxum* n. sp.

Material.—6 exs., Nehru Nagar (Barmer Dist.), 1.xi.62. ex intestine of two house crows *Corvus splendens* Vieillot.



TEXT-FIG. 7.—*Choanotaenia croaxum* n. sp.
(a) Scolex. (b) Mature proglottid.

Description.—Length 66.77-69.68 mm. ; maximum breadth 1.35-1.66 mm. Proglottids slightly broader than long. Scolex 0.28-0.37 mm. long; 0.33-0.39 mm. broad. Muscular rostellum 0.22-0.26 mm. long ; 0.11-0.15 mm. broad ; with a single row of 16 hooks. Hook 0.01-0.02 mm. long. Muscular sucker 0.16-0.20 mm. in diameter. Testes 46-61, posterior to ovary; between two longitudinal excretory canals ; 0.07-0.09 mm. in diameter. Cirrus pouch 0.14-0.18 mm. long ; 0.04-0.05 mm. in maximum breadth ; extending upto or near to longitudinal excretory duct. Vas deferens small ; less coiled. Genital pores irregularly

alternate, lie much anterior to middle of proglottid. Ovary asymmetrically bilobed : poral lobe much smaller than aporal : both lobes again lobed. Compact vitelline gland lies posterior to ovary : 0.05-0.07 mm. long ; 0.16-0.17 mm. broad. Vagina narrow canal, opens posterior to male genital opening ; near ovary vagina dilates to form receptaculum seminis. Uterus with egg capsules. Egg 0.04-0.05 mm. in diameter.

Comparison.—The present species comes close to *C. microsoma* Southwell ; *C. iola* Lincicome and *C. orioli* Joyeux and Baer, but differs as follows :

From *C. microsoma* : (i) Length of hooks 0.01-0.02 mm. (*vs.* 0.03). (ii) Number of testes 46-61 (*vs.* 16-20). (iii) Ovary asymmetrically bilobed (*vs.* symmetrically bilobed). (iv) Vas deferens not dilates (*vs.* dilating close to median extremity).

From *C. iola* : (i) Number of hooks 16 (*vs.* 17-20) ; length of hook 0.01-0.02 mm. (*vs.* 0.03). (ii) Number of testes 46-61 (*vs.* 13-17).

From *C. orioli* : (i) Number of testes 46-61 (*vs.* 19-22). (ii) Diameter of cirrus pouch 0.14-0.18 × 0.04-0.05 mm. (*vs.* 0.12-0.13 × 0.02-0.03).

Type-Specimens.—*Holotype* : On a slide, Z.S.I. Reg. No. W6622/1 ; Nehru Nagar (Barmer Dist.), *ex* intestine of house crow *Corvus splendens* Vieillot. *P. D. Gupta*, coll. 1.xi.62. *Paratypes* (Details as above) : (i) 1, on a slide, Z.S.I. Reg. No. W6623/1. (ii) 1, on a slide, Z.S.I. Reg. No. W6624/1. (iii) 2, in a tube, Z.S.I. Reg. No. W6625/1, (iv) 1, in a tube, Z.S.I. Reg. No. W6626/1.

Distribution.—RAJASTHAN : Nehru Nagar (Barmer Dist.).

17. *Sobolevicanthus serratus birmanicus* (Meggitt)

1924. *Hymenolepis rugosa Birmanica* Meggitt, F.J., *Parasitol.*, Cambridge, 16, pp. 309-310, text-fig. 5.

Material.—4 exs., Bikaner, 2.x.62, *ex* intestine of a pigeon *Columba livia* Gmelin.

Distribution.—RAJASTHAN : Bikaner, *Elsewhere* : India (Lucknow) ; Burma (Rangoon) ; Europe.

18. *Sobolevicanthus gracilis* (Zeder)

1803. *Taenia gracilis* Zeder, J.G.H., *Anleitung Naturges. Eingeweide-würmer*, Bamberg, 16, p. 432.

1930. *Hymenolepis gracilis* : Southwell, T., *Fauna Brit, India, Cestoda*, London, 2, pp. 130-131, fig. 297.

Material.—7 exs., Goreshwar Tank (Jaisalmer Dist.), 19.x.62. Bhop Taloa (Barmer Dist.), 24.x.62, 3.xi.62 ; *ex* intestine of 4 European pochard, *Aythya ferina* (Linnæus).

Distribution.—RAJASTHAN : Barmer and Jaisalmer Dists. *Elsewhere* : India (Orissa ; Manipur ; Assam ; Calcutta) ; Burma (Rangoon) ; Formosa ; Japan ; Egypt ; W Siberia ; U. S. A.

19. *Hymenolepis diminuta* (Rudolphi)

1819. *Cysticercus hymenolepis-diminutae* Rudolphi, C.A., *Entozoorum synopsis cui accedunt mantissa duplex et indices locupletissimi*, Berlin 10, p. 811.
1930. *Hymenolepis diminuta*, Southwell, T., *Fauna Brit. India, Cestoda*, London, 2, pp. 119-121, figs. 287 and 288.

Material.—7 exs., as follows : (i) 3 exs. Kolayat and Pungal (Bikaner Dist.), B. Biswas coll., 11.ix.60; 14.ix.60; 20.ix.60; 21.ix.60; ex intestine of 6 gerbils, *Gerbillus gleadowi* Murray, (ii) 4 exs, Bikaner 1.x.62; and Jaisalmer Dists.; P. D. Gupta coll. 19.x.62; 21.x.62; ex intestine of 4 rats, *Rattus rattus rufescens*.

Distribution.—RAJASTHAN : Bikaner; Jaisalmer Dists. *Elsewhere* : Cosmopolitan.

20. *Vampirolepis nana* (Siebold)

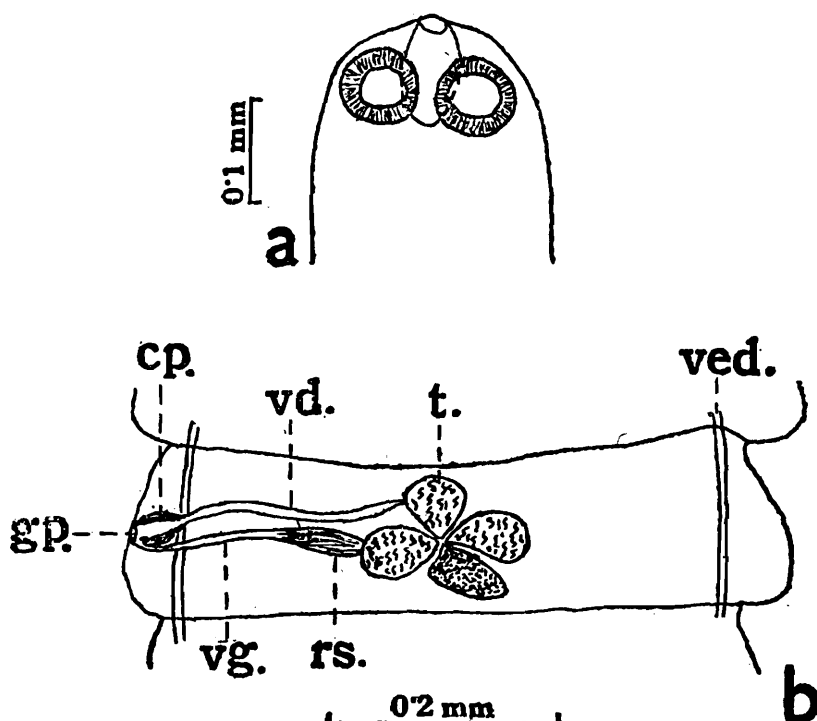
1852. *Taenia nana* Siebold, C. T., *Z. Wiss. Zool.*, Leipzig, 4, pp. 53-76.
1929. *Hymenolepis nana* : Faust, E. C., *Human Helminthol.*, Philadelphia, pp. 207-273, figs. 151 and 152.

Material.—None. (Reported by Chandler from man ex intestine).

Distribution.—RAJASTHAN : Jodhpur; Bikaner; Jaipur; Kotah; Udaipur Dists. (Chandler, 1927). *Elsewhere*; Cosmopolitan.

21. *Myotolepis jaisalmerensis* n. sp.

Material.—11 exs., Jaisalmer, 21.x.62, ex intestine of 3 bats *Tapozous kachhensis kachhensis* Dobson.



TEXT-FIG. 8.—*Myotolepis Jaisalmerensis* n. sp.
(a) Scolex. (b) Mature preglottid.

Description.—Size small; length 10.61-11.44 mm.; width 0.32-0.62 mm.; proglottids broader than long. Scolex small 0.21-0.24 mm. across suckers. Small unarmed rudimentary rostellum, 0.07-0.08 mm. in length, 0.04-0.05 mm. in width. Muscular unarmed sucker 0.05-0.06 mm. in diameter. Testes three, close together, arranged in triangle in median field of segment, 0.05-0.06 mm. in diameter. Cirrus pouch 0.37-0.42 mm. in length; 0.11-0.13 mm. in breadth; crosses longitudinal excretory canal. Genital pores unilateral, opens almost to middle of lateral margin of proglottid. Vesicula seminalis elongated, present at base of cirrus pouch. Ovary and vitelline gland compact, unlobed, rounded structure, like testes 0.05 mm. in diameter. Compact ovary and vitelline gland present almost in centre of triangle formed by three testes. Vagina a narrow tube, opening posterior to male genital opening. Receptaculum seminis elongated. Eggs 0.02-0.03 mm. in diameter.

Comparison.—It differs from the only other known species of the genus, *M. crimensis* (Skarbilovilsch) as follows :—(i) Ovary and vitelline gland almost rounded (*vs.* oblong). (ii) Cirrus pouch comparatively large reaching longitudinal excretory canals (*vs.* small not reaching longitudinal excretory canals).

Type-Specimens.—*Holotype* : On a slide, Z.S.I. Reg. No. W6627/1, Jaisalmer city, *ex* intestine of bat, *Taphozous kachhensis kachhensis* Dobson, *P. D. Gupta*, coll., 21.x.62. *Paratypes* : (i) 1, on a slide, Z.S.I. Reg. No. W6628/1. (ii) 1, on a slide, Z.S.I. Reg. No. W6629/1. (iii) 3, in a tube, Z.S.I. Reg. No. W6630/1. (iv) 2, in a tube, Z.S.I. Reg. No. W6631/1. (v) 3, in a tube, Z.S.I. Reg. No. W6632/1.

Distribution.—RAJASTHAN : Jaisalmer City.

22. *Diorchis magnicirrosa* Moghe & Inamdar

1934. *Diorchis magnicirrosa* Moghe, M.A. and Inamdar, N.B., *Rec. Indian Mus.*, Calcutta, 36, pp. 11-12, figs. 9-12.

Material.—12 *exs.*, Gajner Road (Bikaner Dist.), 3.x.62, 5.x.62 and near Bisalpur Dam (Jodhpur Dist.), 14.x.62, *ex* intestine of five ring doves, *Streptopelia decaocto* (Frisvaldszky).

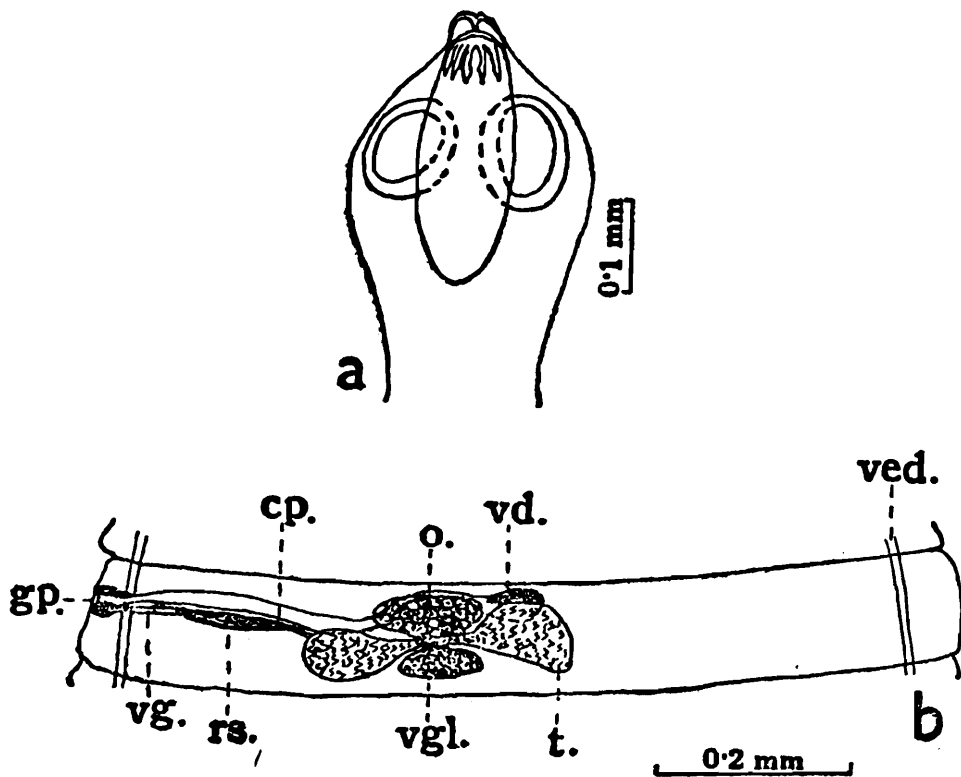
Distribution.—RAJASTHAN : Bikaner ; Jodhpur Dists. *Elsewhere* : India (U. P.).

23. *Diorchis gigantocirrosa* Singh

1959. *Diorchis gigantocirrosa* Singh, K.P., *Indian J. Helm.*, Lucknow, 11, pp. 58-62, figs. 17-22.

Material.—5 *exs.*, Devikund (Bikaner Dist.), 4.x.62 and Bhap Taloa (Barmer Dist.), 3.xi.62; *ex* intestine of coot, *Fulica atra* Linnaeus.

Distribution.—RAJASTHAN : Bikaner and Barmer Dists. *Elsewhere* : India (Barabanki, U. P.).

24. *Diorchis jodhpurensis* n. sp.

TEXT-FIG. 9.—*Diorchis jodhpurensis* n. sp.
(a) Scolex. (b) Mature proglottid.

Material.—2 exs., Umedsagar (Jodhpur Dist.), 9.x.62, ex intestine of a ringed plover *Charadrius dubius* Scopoli.

Description.—Length 29.95-33.28 mm.; maximum breadth 1.19-1.25 mm. Proglottid broader than long. Small scolex 0.34-0.38 mm. in length; 0.28-0.30 mm. in width. Rostellum muscular 0.30-0.32 mm. long; 0.09-0.13 mm. broad; rostellar pouch extends beyond base of suckers; rostellum with 10 hooks. Hooks 0.04 mm. in length, handle of hook slightly longer than blade. Suckers longer than broad; unarmed 0.18-0.19 mm. long; 0.11-0.15 mm. broad. Two fairly large testes, one on either side of ovary. Testes 0.13-0.16 mm. long; 0.17-0.21 mm. broad. Cirrus pouch 0.48-0.50 mm. long; 0.03-0.05 mm. broad; extends upto middle of proglottid. Cirrus small with 4-5 spines at base; 0.04-0.05 mm. in length. Genital pores unilateral present at middle or a little anterior to middle of proglottid. Ovary large; situated between the two testes; 0.09-0.11 mm. long; 0.11-0.22 mm. broad; slightly lobed. Vitelline gland compact located posterior to ovary 0.07-0.09 mm. long; 0.12-0.14 mm. broad. Vagina closely applied to cirrus pouch. Receptaculum seminis elongated broad structure present near posterior end of vagina. Sac like uterus full of rounded eggs. Eggs 0.01 mm. in diameter.

Comparison.—The present species comes close to *D. lintoni* (Linton), *D. spinata* Mayhew and *D. anomala* Schmelz, but differs from them as follows :

From *D. lintoni* : (i) Length of rostellar hooks 0.04 mm. (vs. 0.05). (ii) Cirrus pouch extending to middle of proglottid (vs. not reaching middle of proglottid). (iii) Cirrus with spines at base (vs. no spines at base).

From *D. spinata*: (i) Body-length 29.95-33.28 mm. (vs. 80-122). (ii) Cirrus pouch extending to middle of proglottid (vs. $\frac{1}{2}$ - $\frac{3}{4}$, often to aporal excretory vessel.). (iii) Testes broader than long (vs. almost rounded). (iv) Cirrus 0.04-0.05 mm. long (vs. 0.15). (v) Cirrus with 4-5 spines at base (vs. basal half of cirrus sparsely set with large spines). (vi) Eggs rounded (vs. cylindrical).

From *D. anomala*: (i) Body-length 29.95-33.28 mm., (vs. 80-100). (ii) Diameter of scolex 0.34-0.38 × 0.28-0.30 mm. (vs. 0.26). (iii) Length of hook 0.04 mm. (vs. 0.05). (iv) Length of cirrus pouch 0.04-0.05 mm. (vs. 0.20-0.22). (v) Cirrus armed (vs. unarmed). (vi) Ovary not deeply lobed (vs. ovary deeply lobed with three lobes).

Type-Specimens.—*Holotype* : On a slide, Z.S.I. Reg. No. W6633/1, Umedsagar (Jodhpur Dist.), ex intestine of ringed plover *Charadrius dubius* Scopoli, P. D. Gupta, coll., 9.x.62. *Paratype*: 1, on a slide, Z.S.I. Reg. No. W6634/1, other details as above.

Distribution.—RAJASTHAN : Umedsagar (Jodhpur Dist.).

25. *Acoelus vaginatus* (Rudolphi)

1819. *Taenia vaginatus* Rudolphi, C. A., *Eutozoorum synopsis accedunt mantissa duplex et indices locuplelissimi*, Berolini, 10, p. 811.

1952. *Acoelus vaginatus* : Singh, K. S., *Indian J. Helm.*, Lucknow, pp. 64-65, fig. 91.

Material.—2 exs., Merta (Nagaur Dist.) ; Chokhaka (Sikar Dist). B. Biswas ; coll., 30.xii.56; and *Desert and Gangetic Plain Regional Station*, Z.S.I. coll., 14.xi.60. ex intestine of two black winged stilts *Himantopus himantopus* (Linnaeus).

Distribution.—RAJASTHAN: Nagpur and Sikar Dists. *Elsewhere* : Widespread. India (Lucknow, U. P.) ; Asia ; Africa ; Europe ; U.S.A.

26. *Taenia taeniaeformis* (Batsch)

1786. *Hydatigena taeniaeformis* Batsch, A.J.G., *Naturgeschichte der Bandwurmgarthung veberhaupt und ihrer Arten insbesondere, nach den neuern Beobachtungen in einem systematischen Auszuge*, Halle, pp. 298.

1808. *Cysticercus fasciolaris* Rudolphi, C.A., *Entozoorum sive vermium intestinalium aistorta naturalis*, Amstelaedami, 26, p. 457.

1930. *Taenia taeniaeformis* : Southwell, T., *Fauna Brit. India, Cestoda* London, 2, pp. 18-19.

Material.—6 exs., Kolayat (Bikaner Dist.), B. Biswas coll., 15.ix.60, ex intestine of a gerbil, *Gerbillus gleadowi* Murray.

Distribution.—RAJASTHAN : Bikaner Dist. *Elsewhere* : Cosmopolitan.

VI—PARASITE-HOST LIST OF RAJASTHAN CESTODES

CESTODE PARASITES	HOST	
	Scientific Name	Common Name
(1)	(2)	(3)
1. <i>Duthiersia fimbriata</i> (Diesing)	<i>Varanus monitor</i> (L.)	Monitor lizard
2. <i>Proteocephalus woodlandi</i> Moghe	<i>Varanus monitor</i> (L.) & <i>Uromastix hardwickii</i> Gray	Monitor lizard & Uromastix
3. <i>Oochoristica tuberculata</i> (Rudolphi)	<i>Varanus monitor</i> (L.)	Monitor lizard
4. <i>Raillietina (Raillietina) polychalix</i> (Kotlan)	<i>Columba livia</i> Gmelin	Pigeon
5. <i>Raillietina (Raillietina) torquata</i> (Meggitt)	<i>Columba livia</i> Gmelin	Pigeon
6. <i>Raillietina (Raillietina) quadritesticulata</i> Moghe	<i>Streptopelia senegalensis</i> (L.)	Brown dove
7. <i>Raillietina (Raillietina) nagpurensis</i> Moghe	<i>Columba livia</i> Gmelin	Pigeon
8. <i>Raillietina (Paroniella) barmerensis</i> n. sp.	<i>Corvus splendens</i> (Vieillot)	House crow
9. <i>Davainea himantopodis</i> Johnston	<i>Himantopus himantopus</i> (L.)	Black-winged stilt
10. <i>Cotugnia cuneata</i> Meggitt	<i>Streptopelia decaocto</i> (Frivalszky)	Ring dove
11. <i>Cotugnia bikanerensis</i> n. sp.	<i>Pterocles exustus</i> Temm. & Laug.	Sand grouse
12. <i>Laterorchites rajasthanensis</i> n. sp.	<i>Falco jugger</i> Gray	Laggar falcon
13. <i>Paricterotaenia coronata</i> (Creplin)	<i>Burhinus oedicnemus</i> (L.)	Stone-curlew
14. <i>Paricterotaenia sujerensis</i> n. sp.	<i>Oenanthe deserti</i> (Temminck)	Desert chat
15. <i>Choanotaenia kapurdiensis</i> n. sp.	<i>Cursorius cursor</i> (Latham)	Cream coloured courser
16. <i>Choanotaenia croaxum</i> n. sp.	<i>Corvus splendens</i> Vieillot	House crow
17. <i>Sobolevicanthus serratus birmanicus</i> (Meggitt)	<i>Columba livia</i> Gmelin	Pigeon
18. <i>Sobolevicanthus gracilis</i> (Zeder)	<i>Aythya ferina</i> (L.)	European pochard

VI—PARASITE-HOST LIST OF RAJASTHAN CESTODES—*contd.*

CESTODE PARASITES (1)	HOST	
	Scientific Name (2)	Common Name (3)
19. <i>Hymenolepis diminuta</i> (Rudolphi)	<i>Rattus rattus rufescens</i> (Gray) & <i>Gerbillus gleadowi</i> Murray	Rat & Gerbil
20. <i>Vampirolepis nana</i> (Siebold)	—	Man
21. <i>Myotolepis jaisalmerensis</i> sp. n.	<i>Taphozous kachhensis kachhensis</i> Dobson	Bat
22. <i>Diorchis magnicirrosa</i> Moghe & Inamder	<i>Streptopelia decaocto</i> (Frigalszky)	Ring dove
23. <i>Diorchis gigantocirrosa</i> Singh	<i>Fulica atra</i> L.	Coot
24. <i>Diorchis jodhpurensis</i> n. sp.	<i>Charadrius dubius</i> Scopoli	Ringed plover
25. <i>Acoleus vaginatus</i> (Rudolphi).	<i>Himantopus himantopus</i> (L.)	Black-winged stilt
26. <i>Taenia taeniaeformis</i> (Bath)	<i>Gerbillus gleadowi</i> Murray	Gerbil

VII—SUMMARY

1. This paper deals with the cestodes collected in recent years from various parts of Rajasthan by parties of the Zoological Survey of India.

2. Twenty-six species belonging to 16 genera are described. Of them, the following 8 species are new to science.

- (i) *Railletina (Paroniella) barmerensis* n. sp.
- (ii) *Cotugnia bikanerensis* n. sp.
- (iii) *Laterorchites rajasthanensis* n. sp.
- (iv) *Paricterotaenia sujerensis* n. sp.
- (v) *Choanotaenia kapurdiensis* n. sp.
- (vi) *Choanotaenia croaxum* n. sp.
- (vii) *Myotolepis jaisalmerensis* n. sp.
- (viii) *Diorchis jodhpurensis* n. sp.

3. All the species except one (*Vampirolepis nana*, reported by Chandler, 1927) are new records from Rajasthan.

4. A systematic list of the cestodes known from Rajasthan, a field key, a systematic account of the species and a parasite-host list are also included.

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IX.—LETTERING USED IN TEXT-FIGURES

c., cirrus.

cp., cirrus pouch.

dc., dorsal excretory duct.

gp., genital pore.

o., ovary.

rs., receptaculum seminis.

t., testis.

ted., transverse excretory duct.

vg., vagina.

vd., vas deferens.

ved., ventral excretory duct.

vgl., vitelline gland.

THREE SPECIES OF AEOLOTHRIPS (INSECTA : THYSANOPTERA : AEOLOTHRIPIDAE), INCLUDING A NEW ONE, FROM WEST PAKISTAN AND WESTERN INDIA

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(With 2 Text-figures)

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I—INTRODUCTION

In this article a remarkable new thrips of the genus *Aeolothrips* has been described from West Pakistan. While the majority of species in this genus possess distinct cross bands on the forewings and the body is at least in part dark brown, the new species is completely yellow. Its nearest relation seems to be the recently described *A. intactus* Pelikan from Samarkand (U. S. S. R., Central Asia), which is also completely yellow. The material was labelled previously as "*Aeolothrips fasciatus* Linn." Two other species *A. collaris* PRICs. and *A. intermedius* Bagn. are reported from E. Punjab (India).

I am grateful to the Director, Zoological Survey of India, for enabling me to study the material.

II—SYSTEMATIC ACCOUNT

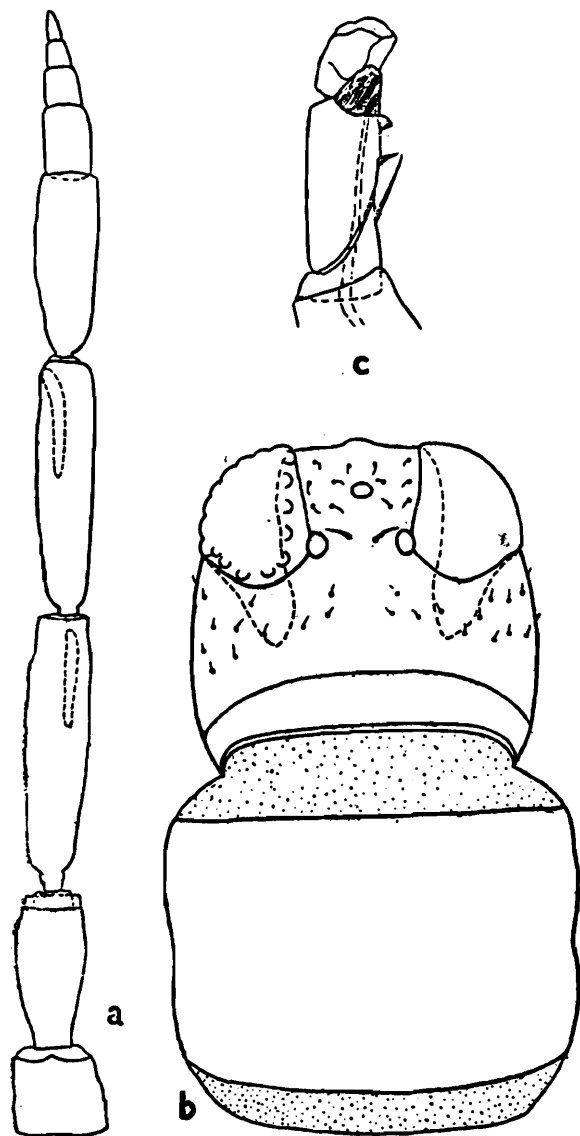
Genus *Aeolothrips* Haliday

1. *Aeolothrips novus* n.sp.

Material.—3 ♀♀, Uchhali, Salt Range (c. 2800 ft.), W. Punjab (W. Pakistan), 16-18. iv. 1931, coll. H. S. Pruthi, Z. S. I. Reg. Nos. 1102/H8 (2 exs.) and 1103/H8 (1 ex.), labelled "*Aeolothrips fasciatus* (L.)" These were preserved in alcohol and only recently (12-16. xii. 1963) mounted on slides in Canada balsam. Two of the specimens were mildly treated in NaOH, and the third mounted without that treatment.

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Description.—FEMALE (macropterous) : Total body-length 1.8-2.1 mm. *Colour* : General body more or less uniformly yellow, apex of abdomen not deeper in shade. Antecostal ridges on abdominal sterna 3-7 brownish. Eyes with opaque black pigment inside. Ocelli might have had reddish (?) crescents, but all colour completely faded due to long preservation in alcohol (over 32 years). Postoccipital rim yellowish-brown, very conspicuous in untreated specimens. Anterior ridge of probasisternum (between the two apophysial pits) somewhat shaded, otherwise sternum yellow. Mesosternum



TEXT-FIG. 1.—*Aeolothrips novus* n. sp. Female.

(a) Right antenna of holotype, dorsal view. (b) Head and pronotum (partly diagrammatic). Setae of pronotum omitted. (c) Fore-tarsus of paratype, showing armature.

anteriorly with a brownish edge medially. Antennae very light pale yellow, segment 3 completely whitish. Legs pale yellow, much lighter than body; tarsi still lighter, unguitactor plate in each tarsus very faintly brown (probably faded). Wings hyaline, but in the forewings of one paratype (No. 1103/H8) only faintly visible, almost imperceptible are two shaded areas in about the position as in *intermedius*, but shorter in length. All body state hyaline; apical abdominal setae yellowish.

Head: With extremely minute setae (5-8 μ long), these are not visible under the ordinary research microscope in specimens treated with NaOH, as also small setae on other body regions. Length 174-179 μ ; width at eyes 186-195 μ , at cheeks 200-205 μ . Interocellar setae (lying between posterior ocelli) 14-15 μ long. 'Premarginal collar' (occipital suture?) distinct. Maxillary palpi 3-segmented, their shape typical of the genus. Mouth cone neither very broad nor pointed, rather triangular; length of face (upto transclypeal suture) 128 μ , of mouth cone (from thence onward) 202 μ . **Antennae:** Total length 447 μ , about 2.51-2.56 as long as head, about 1.17 times as long as the combined length of head and pronotum (382 μ). Setae on antennal segments normal, as in *intermedius*, but in specimens treated with NaOH not visible under the ordinary microscope. Sensoria on antennal segments 3 and 4 not proximally reaching beyond the middle of each segment, only slightly bent towards apex on segment 4. Length of sensory area on segment 3, 38-53 μ long (3.5 μ wide); on 4, 47-51 μ (4-7 μ wide).

TABLE 1.—*Measurements of antennal segments (in μ) of Aeolothrips novus n. sp.*

Segment	i	ii	iii	iv	v	vi	vii	viii	ix
Length	33	60-63	109-125	101-107	72	25-27	18-19	11.6	11-11.6
Greatest width	33-38	28-33	23	23-25	23	18	14	9	6
Width at base/pedicel	33-38	16	9	8	7	—	—	—	—

Thorax: Pronotum smooth, without sculpture apparently. Disc setae extremely minute, 4-8 μ long. Length of pronotum 192 μ , width 235 μ . Width of prosternellum 114 μ . Length of pterothorax dorsally 341 μ , ventrally 372 μ , width at mesothorax 337 μ , at metathorax 305 μ . Length of mesosternum (including mesospinasternum) 219 μ , of metasternum 153 μ . Width of mesospinasternum 156 μ , width between mesosternal angles 291 μ . Length of spinula on mesosternum 123 μ , on metasternum 131 μ . **Legs:** Armature of foretarsus as in text-fig. 1c. Tarsi 2-segmented. Strong spines at apex of hind tibia 35-38 μ long, c. 1.3 μ thick. **Wings:** Setae on veins very small, 14-16 μ long, hyaline, and difficult to see. Veins rather clear, normal. Forewing 1064 μ long; c. 6.6. times as long as wide: about uniformly wide, width taken beyond middle c. 161 μ .

TABLE 2.—Measurements of legs (in μ) of *Aeolothrips novus* sp. n.

	Femur		Tibia		Tarsus	
	Length	Width	Length	Width	Length	Width
Fore-leg . . .	219-237	100	223-242	56	79-81	25
Middle-leg . .	216	65-67	216-219	49	73	23
Hind-leg . . .	296-298	74-77	338-340	47	93	23

Abdomen: Normal, somewhat vespiform. Length 1179-1345 μ , width at segment 5 (untreated paratype) 431 μ . Setae on proximal abdominal segments not clear—in untreated specimen due to fat in the body and in the treated ones due to transparency. Only in the untreated paratype the major setae on segments 9 and 10 can be seen: on 9, s.1, 84-91 μ , others broken; on 10, s.1, 70 μ , s.2, ? (broken). Ovipositor 427-430 μ long.

MALE: Unknown.

Type-specimens.—All specimens in the collection of the Zoological Survey of India, Calcutta. *Holotype*: ♀, Uchhali, Salt Range, West Punjab, West Pakistan, 16-18.iv.1931, coll. H. S. Pruthi (Z.S.I. Reg. No. 1102/H8). Treated with NaOH before mounting. *Paratypes*: (i) 1 ♀ (data as for holotype); antennae missing. (ii) 1 ♀ (same data as above; Z.S.I. Reg. No. 1103/H8), untreated; segments 5-9 in both antennae, and middle and hind-legs missing.

Comparison.—*Aeolothrips novus* can be compared only with the Central Asian species *A. intactus* Pelikan, since that is the only other completely yellow species in the genus. Both species have the body uniformly yellow with the apex of abdomen not darkened and both lack dark shadings on wings, but *A. novus* can be readily separated as follows:—(i) Antennae uniformly yellow (segments 3 and 4 at apex, and 5-9 completely light gray in *intactus*). (ii) Longer antennae (447 μ vs. 352-354 μ). (iii) Antennal segments 3 and 4 longer (109-125 and 101-107 μ vs. 90 and 75 μ). (iv) Segment 3 much more slender (4.7-5.4 as long as wide vs. 4.0). (v) Ovipositor 427-430 μ long (vs. 365 μ). In general the measurements of *novus* are greater than those in *intactus*.

2. *Aeolothrips collaris* Priesner

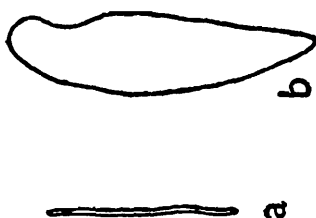
1919. *Aeolothrips fasciatus* var. *collaris* H. Priesner, *Sitz. Ber. Akad. Wiss. Wien*, 128, p. 119.

Material.—1 ♀, India, East Punjab, Manali to Kote (Stn. II), on broad leaves of plant in the stream, 24.v.1955, coll. A. P. Kapur; with a label "*Aeolothrips fasciatus* Linn, syn. *fulvicollis* Bagn.", Z.S.I. Reg. No. 1775/H8. (The alcohol material was mounted on slide in Canada balsam recently, 12.xii.1963.)

Remarks.—As stated elsewhere (Bhatti, in press), *fulvicollis* is a synonym of *collaris*, not of *fasciatus*. Antennal segments 3-5 measure as follows: Length/width of iii, 104/23; iv, 93-101/23; v, 70/22 μ . Sensory area on segment 3, 35 μ long; on 4, 41-49 μ ; in width varying from 4 μ proximally to 7 μ distally. I believe it to be a typical example of *collaris*.

3. *Aeolothrips intermedius* Bagnall

1934. *Aeolothrips intermedius* R. S. Bagnall, *Ent. Mon. Mag.*, London, 70, p. 123.



TEXT-FIG. 2.—*Aeolothrips intermedius* Bagn. Female. Manali to Kote, E. Punjab
(a) Abnormal sensory area on antennal segment 3. (b) Abnormal sensory area on segment 4.

Material.—1 ♀, India, Punjab, Manali to Kote (Stn. II), on broad leaves of plant in the stream, 24.v.1955, coll. A. P. Kapur; with a label "*Aeolothrips fasciatus* Linn. syn. *fulvicollis* Bagn.", Z.S.I. Reg. No. 1775/H8. (The alcohol material was mounted on slide in Canada balsam recently, 16.xii.1963, after treatment with NaOH.)

Remarks.—Length/width of antennal segments 3-5: iii, 104/28; iv, 102/28; v, 73/25 μ . Segments 6-9 together measure 70 μ in length. Sensoria on antennal segments 3 and 4 abnormal (Text-figs, 2a, b); on segment 3 an exceptionally thin area, 40 μ long, 1 μ wide; on 4 an exceptionally broad area, 58 μ long, 16 μ wide. One antenna broken.

III—SUMMARY

1. A new species, *Aeolothrips novus*, is described from W Punjab (W. Pakistan).
2. Two species of *Aeolothrips*, *A. collaris* Priesner and *A. intermedius* Bagnall, are recorded from East Punjab, India.

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Acata Soc. ent. Bohem, Praha, 60 (1-2), pp. 99-113.

SOME ABNORMAL ANTLERS AND HORNS OF DEER AND ANTELOPES IN THE COLLECTIONS OF ZOOLOGICAL SURVEY OF INDIA

By

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Zoological Survey of India, Calcutta

(With 2 plates)

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I—INTRODUCTION

I have come across a few abnormal antlers of deer and antelopes (Artiodactyla) in the collections of the Zoological Survey of India. While not being uncommon, these abnormalities differ in detail from the earlier records which, though not many, are scattered in the Zoological literature. The length has been measured along the outer curvature and the circumference immediately above the burr. The collection numbers given below are Z.S.I. Registered Numbers.

I am thankful to Dr. M. L. Roonwal, Director, Zoological Survey of India, for going through the paper and for many helpful suggestions, and to Dr. B. Biswas and Sri B. Nath for advice and criticism during this work and to Shri G. Saha for taking the photographs.

II—OBSERVATIONS

1. Axis axis Erxleben

(Pl. 14, Figs. 1 & 2)

Material.—No. 15306 ; left antler ; no history.

Description.—Has the normal single brow-tine and single trez-tine ; the deformity is in beam proper. Has developed on its back side a massive outgrowth throughout the length ; this structure arises from the burr and terminates abruptly at level of tip of trez-tine. Is well developed throughout, but is maximum about the middle ; is wavy and continuous, with a few well marked depressions ; has a longitudinal furrow on each side horizontally between the beam proper and the outgrowth. Length of antler 74.6 ; circumference 17.2 cm.

Apparently it looks like deposition of foreign matter on the beam, but on closer examination it appears to originate from the beam itself.

2. *Cervus unicolor* Kerr

(Pl. 14, Figs. 3-6)

Specimen 1. (Fig. 4) :

Material.—No. 15307 ; frontal bone with 2 antlers ; no history.

Description.—Both antlers abnormal. Are short, stumpy and heavy ; the left antler is stouter ; right somewhat flattened. Brow-tines arise normally, but right one longer than left ; the latter possesses a small flattened branch at base ; at the points of origin of brow-tines are a number of tubercles on main beam. Trez-tine of right antler arising near tip as a small protuberance. Left trez-tine has a small branch at its tip. Left main beam, after forming the trez-tine, dividing and giving an additional branch lying parallel to trez-tine. Left antler : length 61.5 ; circumference 20.4 cm. Right antler : length 51.75 ; circumference 16.75 cm.

Specimen 2. (Fig. 5) :

Material.—No. 10338 ; skull with 2 antlers ; *donor*. Maharaja of Dungarpur ; no other history.

Description.—Left antler normal, bearing one brow and one trez-tine. Right antler abnormal, thus : Massive ; somewhat flattened ; with normal brow-tine. Beam, instead of giving rise to a single trez-tine, branches into 6 abnormal tines—the inner or lowermost branch is probably the normal trez-tine ; other 5 tines appear to be abnormal branches of beam proper. Of these 5 branches, the outer 2 fused throughout ; at sites of origin of each of the 5 branches, a cup-like depression present on the beam. On the beam is a furrow which continues from base of brow-tine to the abnormal tines. Left antler : length 78.75 ; circumference 15.5 ; length of the trez-tine 33.75 cm. Right antler : length 74.5 ; circumference 16.25 ; length of the individual abnormal tines (from below upwards) 16.2 ; 19.2 ; 23.0 ; 17.2 ; 14.5 ; 9.0 cm.

Specimen 3. (Fig. 6) :

Material.—No. 153322 ; skull with 2 antlers ; no history.

Description.—Specimen massive, left antler normal, having one brow and one trez-tine ; Right antler abnormal : Brow-tine normal ; abnormality occurs at point of origin of trez-tine. Right beam gives rise to 3 branches, instead of a single trez-tine, diverging in different directions, making it difficult to determine the actual trez-tine and the prolongation of the beam proper. Left antler : Length 76.8 ; circumference 19.0 ; length of the brow-tine 40.2 ; length of the trez-tine 24.6 cm. Right antler : length 71.2 ; circumference 19.2 ; length of the brow-tine 38.8 ; length of the abnormal tines (from below upwards) 22.1 ; 23.1 ; 26.8 cm.

3. *Antelope cervicapra* Linnaeus

(Pl. 15, Figs. 1 and 2)

Specimen 1. (Fig. 2) :*Material.*—No. 194 ; skull with 2 horns ; no history.*Description.*—Left horn normal. Right one abnormal, thus : Is devoid of spiralling and bends backwards and downwards in a bold sweep, tending to go to the left side over the shoulder with the tip everted. Measurement of the spiralled one along the course of spiralization is about the same as that of the non-spiralled one along curve ; thus the relative length is the same in both cases. Left horn, length 48.0 ; right, length 68.5 cm.*Specimen 2.* (Fig. 3) :*Material.*—No. 197 ; skull with 2 horns ; no history.*Description.*—Left horn normal. Right horn abnormal thus : Curves round in a circular sweep, the tip ending bluntly near base ; as well as outer covering are pressed severely at tip. Left horn, length 50.0 ; right, length 22.0 cm.4. *Gazella gazella arabica* Lichtenstein

(Pl. 15, Fig. 4)

Material.—No. 3308 ; skull with 2 horns ; *don.* Zool. Garden, Calcutta.*Description.*—Normal horns are simple, straight, slightly directed backward, and possess bony core, with outer annulated horny covering. Present specimen is abnormal thus : Right horn : Other covering lost, but its bony core shows a normal appearance. Left horn : After coming straight upward three-fourths of its course, bends downwards posteriorly at a right angle ; at the bend the bony core damaged. Left horn, length 7.2 ; right, length 10.0 cm.

III—DISCUSSION

The causes of deformities of horns and antlers have been discussed by a number of authors. Sterndale (1886), Morris (1891), Rörig (1901), Clarke (1916), Moore (1931), Darling (1937) and Wislocki (1952) are of the opinion that injuries in any part of the body may create the deformities of horns and antlers. Dixon (1934), however, recognises no connection between a malformed antler and a body injury and this view is also supported by Robinette and Jones (1959). These last named authors are of the opinion that in some cases antler deformation probably results from a direct injury during early growth.

The effect of unilateral castration on the development of antler was marked by Penrose (1924) ; but by similar experiment Jaczewski (1952) found that the symmetry of the antler in subsequent seasons was not influenced. Deraniyagala (1953) accepts the popular view that the deer nibble the tender sprouting antler that is in velvet until; excited by the

saline taste, they suddenly bite off the tip, but it is difficult to accept this view, for otherwise most deer would have abnormal antlers. Whatever may be the exact cause, the extant views mentioned above may be summed up as injury-reflex.

IV—SUMMARY

Some abnormal horns and antlers of *Axis axis* Erxl. *Curvus unicolor* Kerr, *Antelope cervicapra* L., and *Gazella gazella arabica* Licht. are described.

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PLATE 14

FIG. 1.—Normal antler of *Axis axis*.

FIG. 2.—Abnormal antler (Left side) of *Axis axis*.

FIG. 3.—Normal antler of *Cervus unicolor*.

FIGS. 4, 5 and 6.—Abnormal antlers of *Cervus unicolor*.

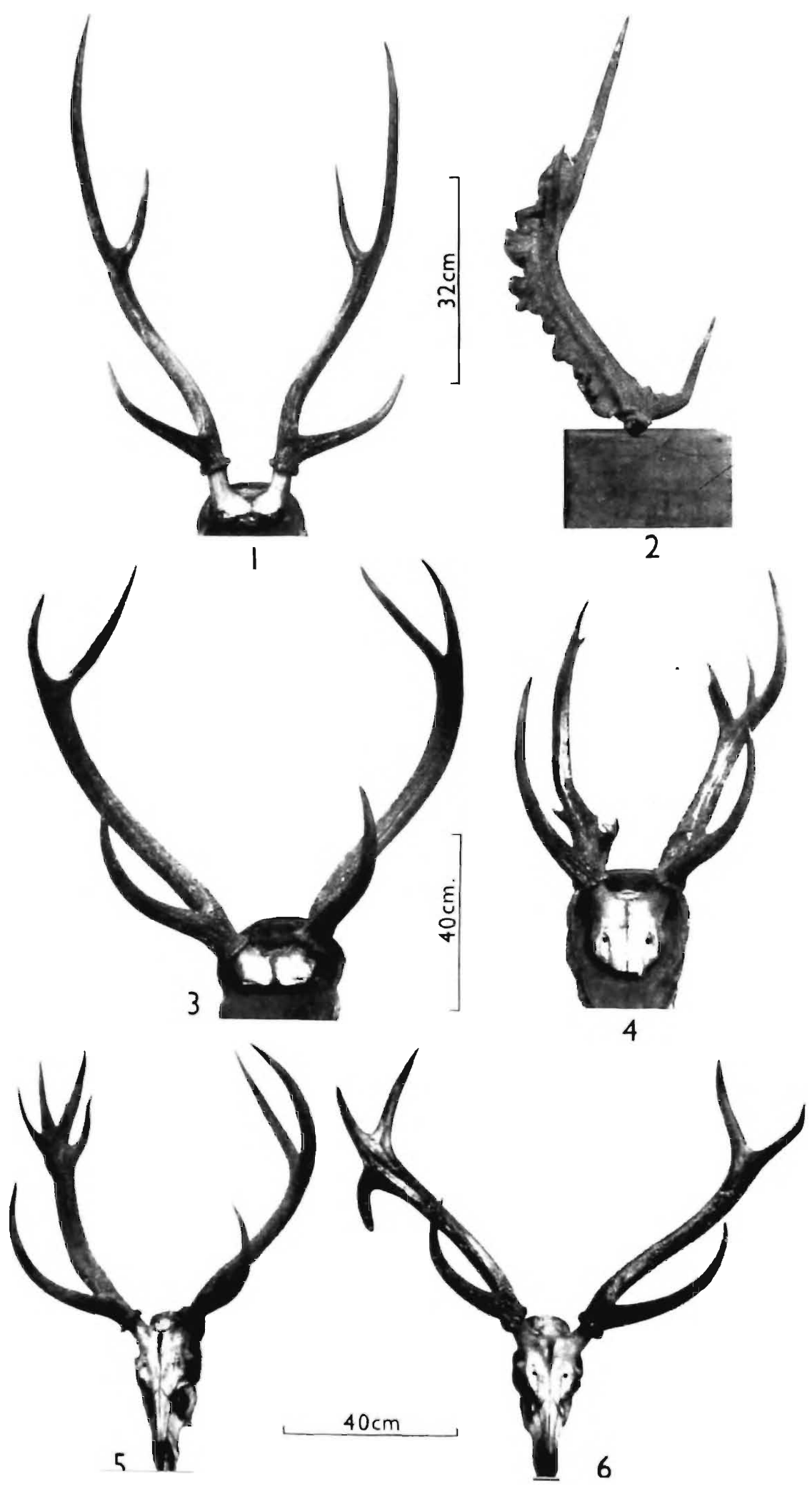
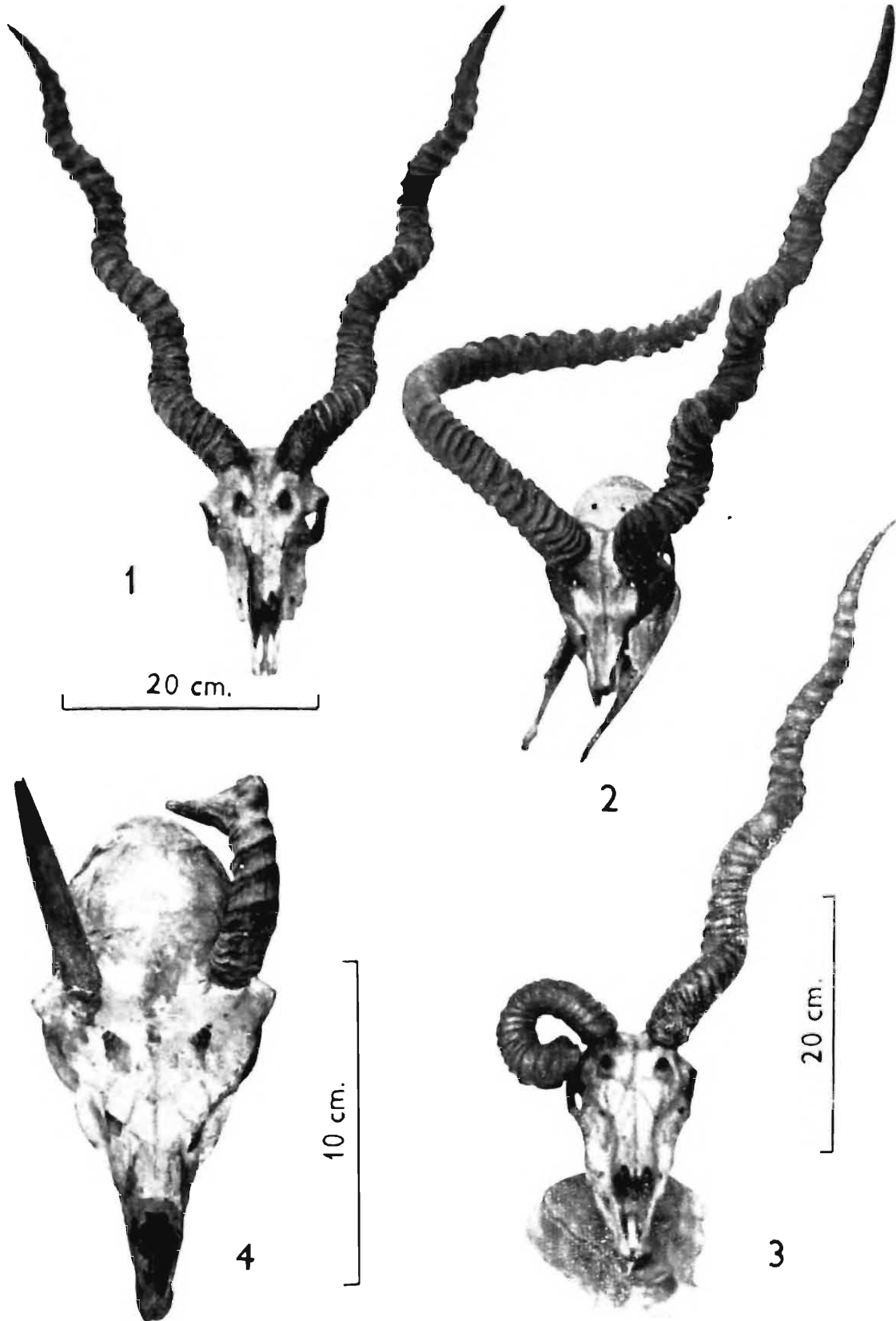


PLATE 15

FIG. 1.—Normal horns of *Antelope cervicapra*.

FIGS. 2 and 3.—Abnormal horns of *Antelope cervicapra*.

FIG. 4.—Abnormal horn of *Gazella gazella arabica*.



**A POPULATION CENSUS OF CHITAL OR SPOTTED DEER
AXIS AXIS, AND SOME OTHER WILD ANIMALS IN DEHRA
 DUN FOREST DIVISION, UTTAR PRADESH, INDIA**

By

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(With 4 Tables, 1 Text-figure and 2 Plates)

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I—INTRODUCTION

1. *General*

In view of the rapidly vanishing wild life of India, the Central Advisory Board of Biology recommended sometime ago the undertaking of a census of certain important species of the Indian wild fauna. The Board further recommended that, in the first instance, the census of the Spotted Deer (Chital), *Axis axis* Erxleben may be undertaken in the Dehra Dun Forest Division.

The present census was taken in March, 1962, jointly by the Zoological Survey of India and the Wild Life Preservation Organisation (Forest Department) of Uttar Pradesh. The local expenditure for such operations as the organising of beats, and the enumeration of animals, etc. was met with by the latter department.

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2. Acknowledgements

We are indebted to Dr. M. L. Roonwal, Director, Zoological Survey of India, for his encouragement and valuable criticism and also for personally supervising a few "drives" in the Dehra Dun Forest Division. We are obliged to Shri R.C. Soni, Chief Conservator of Forests, Uttar Pradesh for the facilities provided for this work. For his helpful suggestions and the keen interest, we are grateful to Shri N. D. Backheti, then Divisional Forest Officer, Dehra Dun. Thanks are due to Shri A. S. Bist, Wild Life Warden, U. P., for his assistance in organising the field work. To Shri T. D. Soota, Officer-in-Charge of the Northern Regional Station of the Zoological Survey of India, Dehra Dun, and to Sarvashri Mamman Koshy, M. L. De and S. L. Verma of the same department and Amar Singh, Assistant Wild Life Warden, U. P., we are thankful for varied help in connection with this work. We also thank Shri S. Guha-Roy, Senior Statistical Assistant, Zoological Survey of India, for the statistical analysis of the data.

3. Previous work

The only existing records of the census of Indian wild animals are that of the lion in the Gir Forest, Saurashtra, and the rhinoceros in the Kaziranga Sanctuary, Assam. No census ever appears to have been undertaken of a fairly abundant animal like the chital. Periodic estimations over a period of years is essential for understanding the trend of growth of population.

4. Expenditure

The expenditure incurred in connection with the census, excluding the travelling expenditure of the staff, is given below :

	Rs. p.
1. Cost of cartridges, stationery, etc.	212-65
2. Labour hire charges for beaters, etc.	4,469-00
3. Petrol and lubrication for motor vehicles	175-82
4. Cutting and clearing of 10-foot lines	1,888-61
5. Charges of motor truck hired for transport of labour to site	581-24
Total	<hr style="width: 100%; border: 0.5px solid black;"/> 7,327-32

II—METHODS

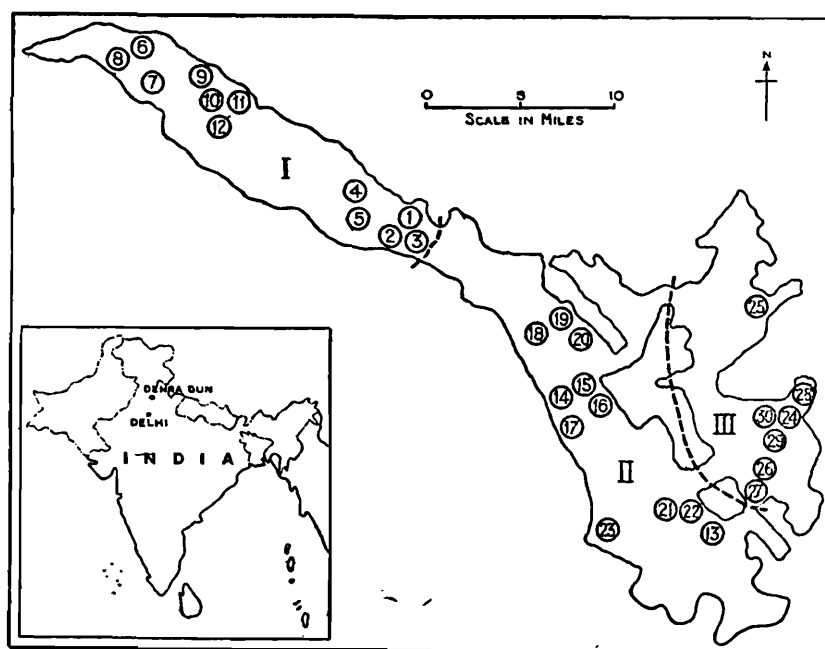
1. General

There are three usual methods of taking an animal census : (i) By direct enumeration of the whole population or samples therefrom. (ii) By ratios based on trapping, banding and recapture of samples. (iii) By indirect observations of population density by the use of suitable indices.

From what we know about the habits of chital, the direct count is by far the best technique and the only practicable one (*vide* Dharmakumarsinhji, 1959, 1960). As the area involved in the present work was very large, only representative sample areas could be censused and the total population was calculated from these samples. Direct enumeration of the total number of heads in the entire Division is impracticable in execution and prohibitive in cost.

2. Procedure and design

The census was confined to the reserved forest areas of the Dehra Dun Forest Division, Uttar Pradesh. The Division is divided into a



TEXT-FIG. 1.—Map of the Dehra Dun Forest Division (Uttar Pradesh, India), showing the three strata (I, II & III) and the Sample Compartments (1—30). (See Appendix for details.)

number of unequal Forest Blocks which are subdivided into Forest Compartments. In view of the diversity of the geographical and vegetational features, the Division was arbitrarily divided into three Strata* for accuracy in sampling, *viz*, Stratum I (Western Siwaliks, *i.e.*, west of Dehra Dun-Saharanpur main road); II (Eastern Siwaliks, *i.e.*, east of Dehra Dun-Saharanpur main road and bounded in the north-east by the Song river); and III (Thano-Barkot forests, *i.e.*, the plains blocks of Thano forest Range and the entire Barkot forest Range, except the Thapoban and Birbhaddar blocks). The sampling design was a stratified two-stage sampling of Blocks and Compartments. Twelve first-stage units of Blocks were selected by simple random sampling without replacement with due consideration of the proportion of the number of units in the strata. Thirty second-stage units of Compartments were selected based on the same method, but later on three Compartments were combined to yield a total of twenty seven sampling units. These sample Compartments constituted an area of 12,144 acres. The proportion of the sample area to the total area is 7.7 per cent. The sample Compartments were found to vary from 166 to 872 acres in extent. The stratum-wise distribution of the sample Compartments with other

*Stratum I consisted of 13 Blocks; and stratum II and III of 14 Blocks each.

details are given in the Appendix. Some forest Blocks, known by long experience to be more or less devoid of game, were excluded. These were :

- | | |
|---------------|------------------|
| 1. Dumet | 10. Sansarukhala |
| 2. Langha | 11. Maidan |
| 3. Chandpur | 12. Suridhar |
| 4. Bainkhala | 13. Birbhaddar |
| 5. Jajra | 14. Tapoban |
| 6. Paled | 15. Saura |
| 7. Talai | 16. Kachar |
| 8. Patharkahn | 17. Rampur Mandi |
| 9. Ladwajoj | |

3. Enumeration

The number of chital and other animals in the individual sample Compartments was determined by conducting "drive counts" which were organised in the following manner :—

The required number of "beaters" were posted in one of the four boundaries of the Compartment roughly at 30-40 feet intervals. On the two side-boundaries, "stops" were posted also at regular intervals. Enumerators were stationed on the fourth boundary which was chosen to fall, as far as possible, either on a motorable road or on the 100 feet line. Beaters and stops were usually unskilled labourers recruited for the purpose from local villages but enumerators were trained departmental personnel. All the three categories of persons, *viz.*, beaters, stops and enumerators, were given preliminary training in experimental beat operations. Beaters and stops were posted along the two side-boundaries of the Compartment under study with the least possible disturbance and the Compartment encircled. The signal to commence the beat was given by firing a gun. The beaters then advanced in one line, raising a hullabaloo. Some departmental hands, interspersed in the line of beaters, helped in controlling and co-ordinating their progress in one file to keep the "leakage" of animals to the minimum. However, in the hilly and otherwise difficult Compartments, this procedure was not adequate, and the beaters were instructed to unfailingly report the number of animals that were seen retreating. The stops remained clapping and shouting at their posts to prevent the animals from escaping on either side. Here also a few animals, especially of the deer family, did break through the side-boundaries and records of these were also maintained. For each operation, the number of beaters and stops together varied from 93-180, and the enumerators from 5-30, depending upon the length of the Compartment and visibility on the boundary. They stood facing the Compartment in such a manner that each was visible to the man on his left.

The number and sex of the driven animals were recorded by the enumerators in blank schedules provided by us. Each enumerator recorded the game that emerged on his right hand side only. In instances where the Compartments were adjacent or lay very near each other,

the possibility of the same set of animals being counted twice in the data was eliminated in the following manner: If manageable, the adjacent Compartments were combined and treated as single units for the purpose of enumeration. When the Compartments were near enough to one another, beats were directed away from each other. In a few instances the near compartments were beaten out on different days, giving sufficient time to the animals to return to their normal haunts.

Two beats a day was the rule, but when the Compartments were small and the approach not difficult, three beats were held. In some difficult Compartments one beat alone occupied the whole day. All thirty, Compartments of the sample were covered by twenty seven beats in a period of fourteen days from three camps. The time taken for the actual beat depended on the size of the Compartment and generally varied from 30 minutes to one hour, though the combined Compartments took as much as an hour-and-a-half.

III—RESULTS

(Pls. 16 and 17 ; and Tables 1-4)

The sample areas comprised of four distinct vegetational types, *viz.*, (i) *sal* (*Shorea robusta* Gaerten.) forests ; (ii) miscellaneous forests ; (iii) grasslands and river beds ; and (iv) mixed forests on hilly terrain. The *sal* forests were composed mostly of *sal* trees of various ages with usually dense undergrowth. In the miscellaneous forests, the trees consisted of miscellaneous, deciduous species, and the undergrowth resembled that in the *sal* forests. The third type consisted of unproductive grasslands or open forests or dried up river beds. The last type comprised areas under protection on mountainous terrain, often steep to precipitous, the vegetation being a variable mixture of species. The distribution of these four types of areas in the total sample was as follows :

	Per cent
<i>Sal</i> forest	71.4
Miscellaneous forests	10.3
Grasslands, etc.	6.9
Mixed forests	11.4

Although intended primarily to collect data for the chital population, the other wild fauna which emerged in the beats was also enumerated. The enumeration thus included the following animals :—

MAMMALS

- Axis axis* Erxleben. (Chital or Spotted deer)
- Muntiacus muntjak* Zimmerman. (Kakar or Barking deer)
- Cervus unicolor niger* Blainville. (Sambar)
- Sus scrofa cristatus* Wagner. (Wild boar)
- Panthera pardus* Linnaeus. (Panther)
- Panthera tigris* Linnaeus. (Tiger)
- Melursus ursinus* Shaw. (Sloth bear)
- Canis aureus* Linnaeus. (Jackal)

BIRDS

Gallus gallus Linnaeus. (Jungle fowl)

Pavo cristatus Linnaeus. (Peafowl)

In addition, the wild cat, the hare, the porcupine, the hog deer and monkeys were also spotted occasionally, but records of these were not maintained as their estimate, based on the present drive-count technique, was not likely to be comprehensive. Much reliance could also not be placed on the present estimation of the Carnivora.

Table 1 gives the observed number of the different animals, their unbiased estimated population, the density and the proportion of animals in the forest territory under consideration. The size of the chital population of the Dehra Dun Forest Division in 1962 is estimated at $13,010 \pm 1928$ head. The chital thus constitutes nearly 41 per cent of the total "fauna" recorded, and the territory averages twelve acres per chital head (Table 4). Among the deer family, the chital constitutes 80.3 per cent, kakar 13.3 per cent and sambar 6.4 per cent (Table 2). The estimated sex-ratios (male : female) for the chital, kakar and sambar respectively are : 38 : 62 ; 50 : 50 ; and 41 : 59 (Table 3.) The sex-ratio for the chital was observed to vary considerably in the three Strata, the proportion of males being lowest in Stratum III and highest in Stratum I. A point of note is that the sex-ratios for the chital and the sambar are much alike in comparison with that of the kakar. The ratio of the number of young over adult is : chital 15, kakar 3 and sambar 8.

Sal occupies 71.4 per cent of the sample area. The value of the correlation coefficient between the characters *viz.*, the percentage of *sal* and the recorded number of chital therefrom is 0.46 with a standard error of 0.23. The correlation, paying due regard to its standard error, is statistically significant, which means that in the *sal* forests chital are more abundant. This fact, however, is subject to corroboration from future work.

The relative abundance of each species is given below being measured by the percentage of the compartments in which a given species is present :—

Chital	..	..	..	..	..	..	..	92.6
Wild boar	..	..	.					77.8
Kakar	..	..	..	..	.		..	74.1
Sambar	..	..	..	..	..	..	.	63.0
Jackal	..	..	..	..	..	..		51.9
Panther		.	.		.	.		40.7
Tiger	..	..	..	..	..	..	..	18.5
Bear	.		.	.	..	..	.	7.4

Thus, the chital is the most abundant mammal and is also most widely distributed ; and the bear, the least abundant. There is not even a single Compartment in the sample where at least one of the species of the deer family was not represented.

IV—SUMMARY

A census of the chital or spotted deer, *Axis axis* Erxleben, and other wild game was carried out in the Dehra Dun Forest Division, Uttar Pradesh, in March 1962, by the "drive-count" technique in forest compartments selected at random. The chital was observed to be the most abundant mammal and its population was estimated at about $13,010 \pm 1928$ head.

V—REFERENCES

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TABLE 1.—*Estimated population of some wild animals of the Dehra Dun Forest Division, U.P. (March, 1962).*

Animals	Number of sampled individuals	Estimated population (No. of head)	Per cent of total "Wild life"	Average area per animal (acres)
1. Chital	893	13,010	41.3	12
2. Kakar	171	2,159	6.9	73
3. Sambar	68	1,043	3.3	151
(Deer family)(Sub-total : 1-3)	(1,132)	(16,212)	(51.5)	(10)
4. Wild Boar	180	2,469	7.8	64
5. Jackal	30	371	1.2	426
6. Tiger	7	98	0.3	1,611
7. Panther	14	214	0.7	738
8. Bear	5	79	0.2	1,999
9. Jungle fool	870	11,240	35.6	14
10. Pea fowl	80	846	2.7	187
TOTAL	—	31,529	100	—

TABLE 2.—*Distribution of relative estimated population for each species of the deer family (chital, kakar and sambar) in the Dehra Dun Forest Division (March, 1962).*

Members of deer family	Male		Female		Sex unknown		Young		Total	
	Estimated population (No. of head)	Per cent of total	Estimated population (No. of head)	Per cent of total	Estimated population (No. of head)	Per cent of total	Estimated population (No. of head)	Per cent of total	Estimated population (No. of head)	Per cent of total
1. Chital	4,121	76	6,805	82.3	370	56	1,714	91.9	13,010	80.3
2. Kakar	921	17	922	11.2	244	36.9	72	3.9	2,159	13.3
3. Sambar	377	7	540	6.5	47	7.1	79	4.2	1,043	6.4
TOTAL	5,419	100	8,267	100	661	100	1,865	100	16,212	100

TABLE 3.—*Age-wise and overall estimated population and sex-ratio in the deer family (chital, kakar and sambar) in the Dehra Dun Forest Division (March, 1962).*

Members of deer family	Estimated population					Overall estimated population	95 per cent confidence limits for overall estimated population	Sex-ratio (Male : Female)	Age-ratio (Young Adult)
	Adult				Young				
	Male	Female	Sex unknown	Total					
									Per cent
1. Chital	4,121	6,805	370	11,296	1,714	13,010	9,230—16,790	38 : 62	15
2. Kakar	921	922	244	2,087	72	2,159	1,305—3,013	50 : 50	3
3. Sambar	377	540	47	964	79	1,043	576—1,510	41 : 59	8
TOTAL	5,419	8,267	661	14,347	1,865	16,212	11,973—20,451	—	—

TABLE 4.—*Stratum-wise distribution of estimated population of the deer family and their density and relative abundance in the Dehra Dun Forest Division (March, 1962).*

Stratum	Area (acres)	Chital			Kakar			Sambar		
		Estimated popula- tion (No. of head)	Density (average area in acres per animal)	Relative abundance (percentage of occur- rence in compart- ments)	Estimated popula- tion (No. of head)	Density (average area in acres per animal)	Relative abundance (percentage of occur- rence in compart- ments)	Estimated popula- tion (No. of head)	Density (average area in acres per animal)	Relative abundance (percentage of occur- rence in compart- ments)
				Per cent			Per cent			Per cent
I	50,110	2,683	19	100	920	54	80	86	583	60
II	76,128	6,197	12	90	881	86	70	787	97	70
III	31,677	4,130	8	85.7	358	88	71.4	170	186	57.1

APPENDIX

Details of Sample Compartments in the Dehra Dun Forest Division, U.P., for wild life census (March, 1962).

SERIAL NO. OF COMPARTMENT	RANGE	BLOCK	COMPARTMENT NO.	AREA (acres)
STRATUM I				
1.	Asarori	Laldhang	2	305
2.	„	„	4	207
3.	„	„	7	215
4.	„	Malhan	1	175
5.	„	„	2	435
6.	Timli	Dararit	1	577
7.	„	„	4	397
8.	„	„	11	607
9.	„	Dharmawala	2	304
10.	„	„	6	453
11.	„	„	8	221
12.	„	„	11	517
STRATUM II				
13.	Motichur	Jamankhata	3	430
14.	Lachiwala	Amsot	1	459
15.	„	„	4	293
16.	„	„	8	276
17.	„	„	12	610
18.	„	Phandowala	2	166
19.	„	„	6	390
20.	„	„	9	333
21.	Motichur	Koelpura	2	434
22.	„	„	3	437
23.	„	„	7	872

APPENDIX—*concl'd.*

STRATUM III

SERIAL NO. OF COMPARTMENT	RANGE	BLOCK	COMPARTMENT NO.	AREA (acres)
24.	Barkot	Chandna Rao	2	781
25.	Jajra	Bidhalna	3	360
26.	Barkot	Golatappar	2	344
27.	„	„	7	504
28.	„	Sainkot	2	467
29.	„	„	6	287
30.	„	„	8	288

PLATE 16

Views of the Dehra Dun forest (Uttar Pradesh, India) where the population census of chital was undertaken in March, 1962.

FIG. 1.—The dense undergrowth in a mixed forest.

FIG. 2.—A part of the *sal* forest with “beaters”.



1



2

PLATE 17

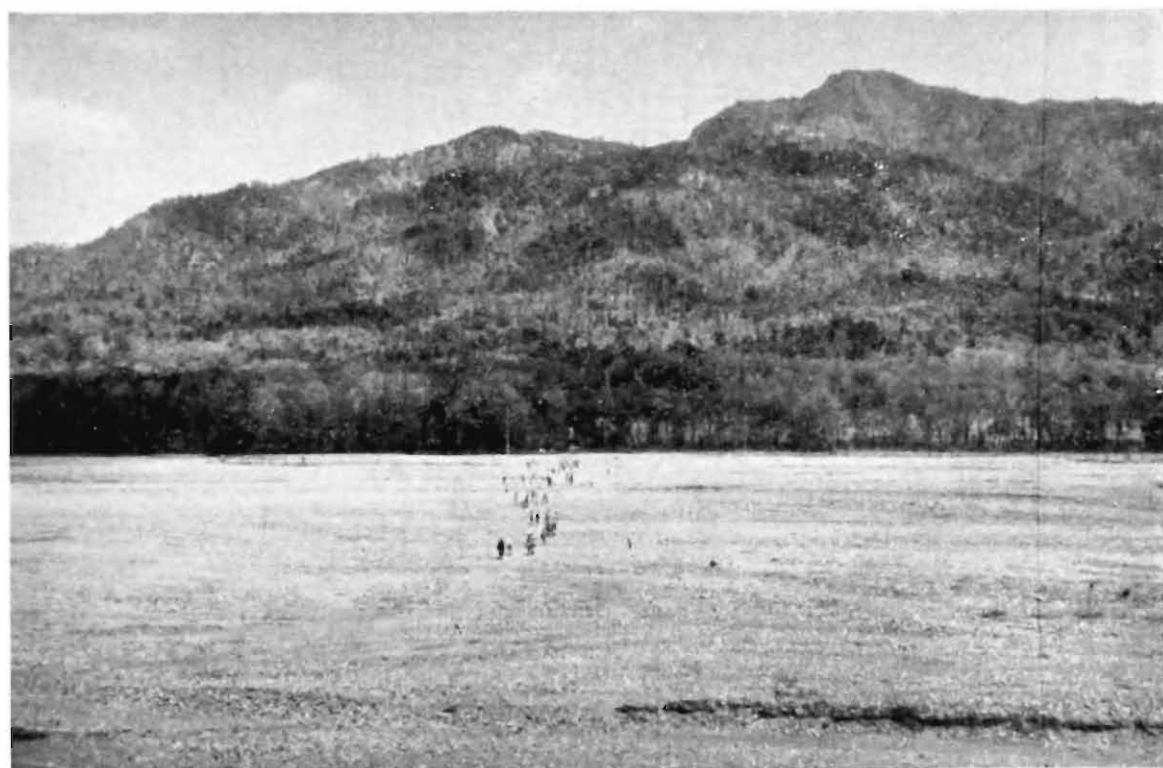
Views of the Dehra Dun forest (Uttar Pradesh, India) where the population census of chital was undertaken in March, 1962.

FIG. 1.—Posting of “beaters” along the boundary (motorable road) of a forest compartment.

FIG. 2.—A distant view, across a dried up river, of the hilly forest areas.



1



2

A NEW LIZARD, *EUMECES POONAENSIS* (SCINCIDAE) FROM INDIA

By

R. C. SHARMA

Zoological Survey of India, Calcutta

(With 2 Text-figures)

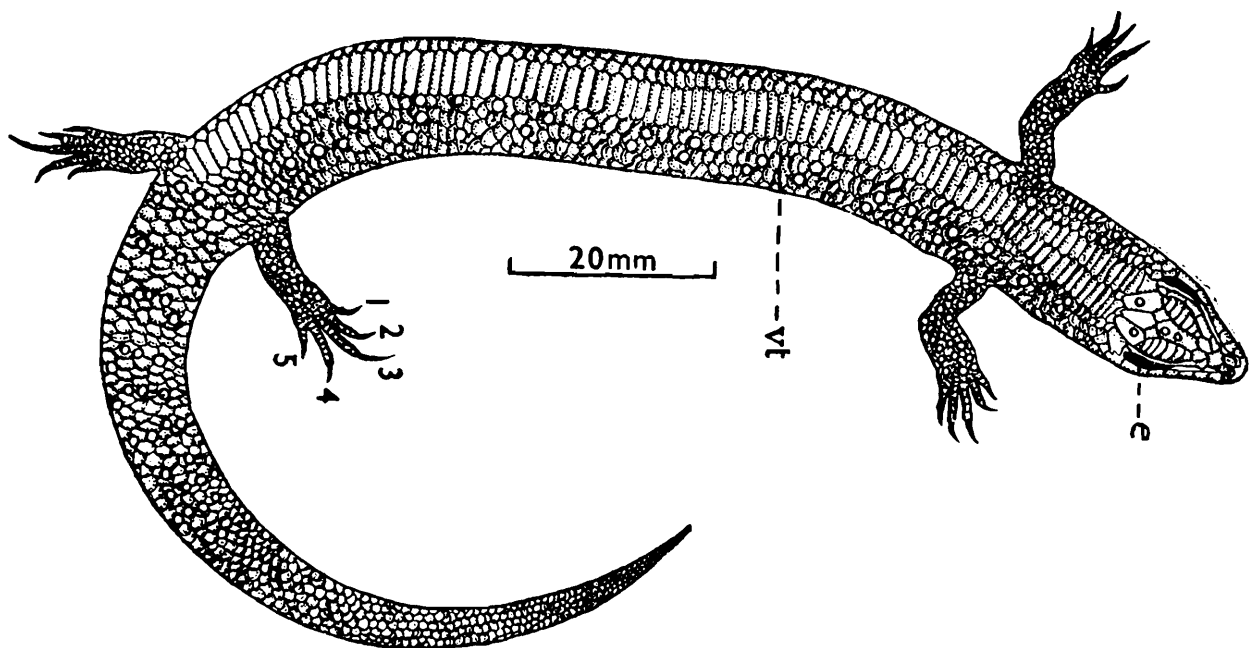
While studying a collection of reptiles made by the Western Regional Station of the Zoological Survey of India, I came across a new scink (Reptilia : Sauria : Scincidae) which is described below.

Genus *Eumeces* Weigmann, 1834

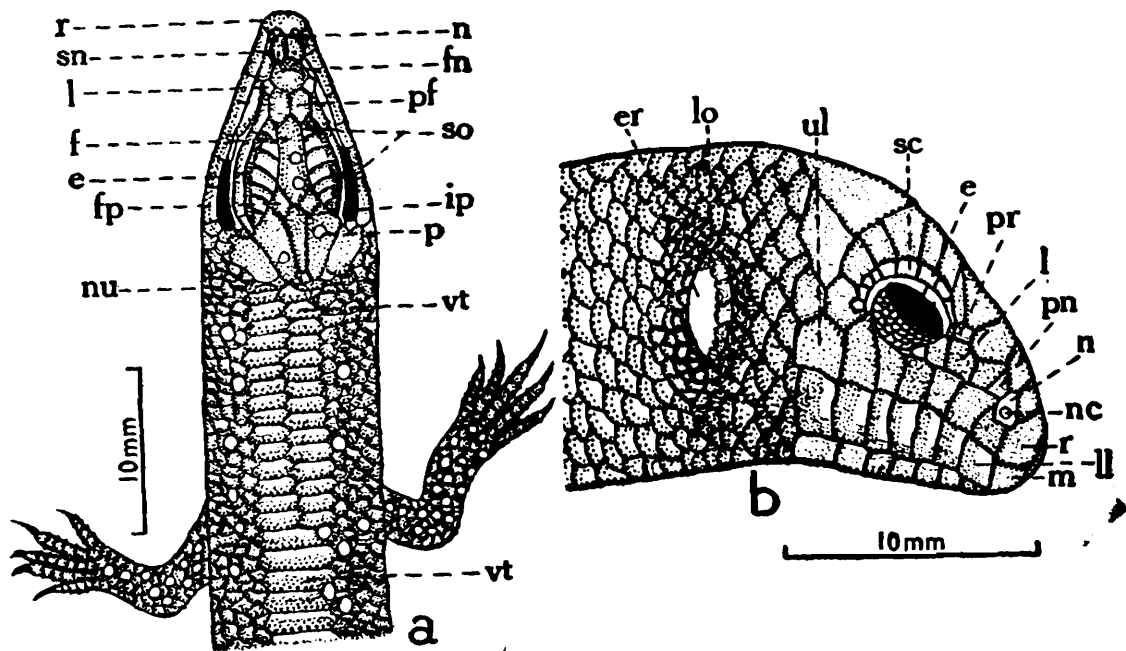
Eumeces poonaensis n. sp.

Material.—One female, in spirit, Katrajghat c. 27 km. south of Poona (Maharashtra, India), alt. c. 564 m., coll. B. K. Tikadar (No. 157/28. 7. 1961).

Description.—Dorsum and limbs dark brown to deep bronze, with a lateral series of round white spots arranged regularly and extending from head to half the tail ; sides from snout to half the tail with deep brown stripes ending vertically downwards to a point ; stripes more prominent on labials and neck ; ventrum yellowish white with numerous brown spots on ventral scales of tail.



TEXT-FIG. 1. *Eumeces poonaensis* n. sp., Entire specimen (dorsal view).
e., eye ; vt., vertebral scales.

TEXT-FIG. 2.—*Eumeces poonaensis* n. sp.

(a) Dorsal view of anterior portion of body. (b) Lateral view of head.

e., eye ; *er.*, ear ; *f.*, frontal ; *fn.*, frontonasal ; *fp.*, frontoparietal ; *ip.*, interparietal ; *l.*, loreal ; *ll.*, lower labials ; *lo.*, lobules of ear ; *m.*, mental ; *n.*, nasal ; *nc.*, nasal cavity ; *nu.*, nuchal ; *p.*, parietal ; *pf.*, prefrontal ; *pn.*, postnasal ; *pr.*, preocular ; *r.*, rostral ; *sc.*, supraciliaries ; *sn.*, supranasal ; *so.*, supraocular ; *ul.*, upper labials ; *vt.*, vertebral scale.

Head very small in comparison to body and tapering anteriorly ; body long and slender. Scales : First supraocular slightly smaller than second ; fronto-parietals small (smaller than interparietal) ; interparietal entirely separating the parietals ; 5 pairs of nuchal shields present ; nasal shield moderate-sized and semipentagonal ; a small postnasal present ; two pentagonal supranasals in close contact ; anterior loreal slightly broader than long and smaller than posterior loreal ; supralabials 7 in number, the first not higher than second and touching almost half of the border of postnasal ; rostral shield subtriangular and almost 3 times the size of first supralabial ; infralabials 7 in number ; mental shield subtriangular, almost 3 times the size of first infralabial ; 2 post-mental shields present, the anterior one smaller than the posterior. Ear opening oval and with 6 spur-like projecting lobules on anterior margin. Eyelids well developed ; lower eyelid scaly. With 23 scales round middle of body, of which the vertebral on back being in form of shields and about twice the size of other dorsal scales ; vertebral scales in series, $4\frac{1}{2}$ times as broad as long and formed by fusion of two median rows of dorsal scales, the fusion occurring at the 17th vertebral scale. With 85 dorsal scales (including nuchal scales) in longitudinal series of which 16 anterior scales in two rows ; scales on nape and near base of tail not fused. Limbs moderate-sized, pentadactyle, *third toe longest (and also longer than the fourth)* ; with 9 transverse lamellae under fourth and 10 under third toe.

Internal organs : Ovary white ; 9 mm. long, 3 mm. wide. Peritoneum yellow.

Measurements

1. Total length (snout to tip of tail)	203 mm.
2. Standard length (snout to vent)	118 mm.
3. Length of tail (vent to tip of tail)	85 mm.
4. Interorbital length	7 mm.
5. Girth of body	47 mm.

Type-specimen.—*Holotype* : female, deposited in the National Zoological Collection at the Zoological Survey of India, Calcutta (Z.S.I. Reg. No. 21159). *Type-locality* : Katrajhat, near Poona. Known only from the type-locality.

Comparisons.—*Eumeces poonaensis* n. sp. closely resembles *E. taniolatus* Blyth from West Pakistan, but is separable as follows :—(i) Third toe longer than fourth (*vs.* shorter). (ii) Dorsal scales in longitudinal series over 80 (*vs.* under 80, usually 72-80). (iii) Tail scales rough (*vs.* smooth). (iv) Tail shorter than body (*vs.* longer).

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