

# A TAXO-ECOLOGICAL STUDY OF THE EARTH-WORM FAUNA OF DOON VALLEY

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## CONTENTS

	PAGE
I—INTRODUCTION ... ..	173
II—SURVEY AND COLLECTION ... ..	173
III—LOCALITIES ... ..	174
IV—MATERIAL ... ..	175
V—SUMMARY ... ..	181
VI—ACKNOWLEDGEMENTS ... ..	182
VII—REFERENCES ... ..	182
VIII—SOIL ANALYSIS ... ..	183

### I—INTRODUCTION

The most recent reference on the taxonomy of the earthworms of Doon Valley is Gate's "Studies on the Earthworm Fauna of Saharanpur, Dehra Dun and Mussoorie" (1951). But as regards the ecology of these worms, not only from the above area but even from the whole of India, very little attention has been paid in this country. However Prashad (1916) dealt with the seasonal distribution and other ecological factors of earthworms of Lahore; Shrikhande and Pathak (1948) included data on the relationship between earthworms and soil-fertility in Kanpur; and Roy (1957) contributed certain observations on the cast formation and light-sensitivity of earthworms of Baranagore (West Bengal) and Giridih (Bihar).

In order to concentrate exclusively on the taxo-ecological aspects of these earthworms, the author undertook the present studies during 1963-65. The present paper includes only the general taxonomic aspects of the group.

### II—SURVEY AND COLLECTION

During the above period weekly visits were made to Rajaji Sanctuary and neighbouring areas of the Doon Valley to collect specimens and ecological data. About 3,000 examples, both juveniles and adults, were obtained and a large collection of ecological data recorded.

It may be stated here that the collection of specimens was made both by the usual digging process as well as by the "wet method" recommended by Evans & Guild (1947), namely, uniformly spraying an area approximately measuring 8 sq. ft. with a solution of 1/4-1/2 oz. of potassium permanganate dissolved in one gallon of water.

In the monsoon (July to September) when the soil was damp and the worms generally occurred near the surface layers, the "wet method" yielded very quick results, in that within two to five minutes after the

spraying the specimens appeared above the surface, enabling their collection within the brief period of half an hour or so. An interesting observation is that after the spraying, when the soil dried up before the worms were collected, the latter tended to become desiccated and ultimately a little later to be attacked by ants.

### III—LOCALITIES

The following are the collecting stations. (N.R.S. denotes Northern Regional Station of the Zoological Survey of India).

<i>Station numbers</i>	<i>Particulars</i>
1.	N.R.S. premises and neighbouring areas.
2.	Along the section of Rajpur Road between 5-10 Kms. N of N.R.S.
3.	Along the section of Mussoorie Road between 10-20 Kms. N of N.R.S.
4.	Along the section of Sahastradhara Road between 6-10 Kms. NE of N.R.S.
5.	Nearby areas and banks of the Sahastradhara stream close to Sulphur Spring, about 16 Kms. NE of N.R.S.
6.	Plots near the water storage tank, Raipur, about 12 Kms. E of N.R.S.
7.	A grassy plot by the side of a canal, Nehrugram, about 15 Kms. SE of N.R.S.
8.	A tract, between hills and leading to Robber's Cave from Guchhupani, a terminus area at the end of a metalled road, about 8 Kms. NW of N.R.S.
9.	Premises of Forest Research Institute, about 8 Kms. NW of N.R.S.
10.	A paddy field, Poeliyon Village, Nathuwala, about 10 Kms. NW of N.R.S.
11.	Along the section of Chakrata Road between 10-20 Kms. NW of N.R.S.
12.	A paddy field, Bahmanpur Village, about 45 Kms. NW of N.R.S.
13.	A grassy plot near Asoka Rock on the bank of a stream, Kalsi, about 50 Kms. NW. of N.R.S.
14.	Banks of Assan river, Herbetpur, about 40 Kms. SW of N.R.S.
15.	Premises and surrounding areas of Timli Forest Rest House, about 45 Kms. SW of N.R.S.
16.	Sides of Bijapur Dam, "Ghattikhola", about 8 Kms. W of N.R.S.
17.	A plot near a burning ghat on the banks of a stream, Chandarmani, about 9 Kms. NW of N.R.S.
18.	A pasture plot and the banks of a seasonal stream both on the eastern side of Saharanpur Road near P.W.D. Bridge no. 141/8, about 13.8 Kms. S of N.R.S.
19.	Grassy plots on the eastern bank of a seasonal stream near Asarori Forest Rest House on Saharanpur Road, about 13.9 Kms. S of N.R.S.
20.	Grassy plots near Mohund Tunnel on Saharanpur Road, about 14 Kms. S of N.R.S.
21.	A grassy plot between P.W.D. Bridges no. 139/6 and 139/7 along Saharanpur Road, about 18.1 Kms. S of N.R.S.
22.	The stony and bushy banks of a stream below "Lalpul", a P.W.D. Bridge no. 135/21 along Saharanpur Road, about 24.2 Kms. S of N.R.S.

23. Grassy plots between P.W.D. Bridges no. 134/17 and 135/1 along Saharanpur Road, about 25.6 Kms. S of N.R.S.  
 24. A cultivated plot in Ganeshpur Village along Saharanpur Road, about 35 Kms. S of N.R.S.  
 25. Along the section of Hardwar Road between 20-25 Kms. S of N.R.S.  
 26. Along the section of Hardwar Road between 30-50 Kms S of N.R.S.

## IV—MATERIAL

## Class CHAETOPODA

## Order OLIGOCHAETA

## Family 1. MEGASCOLECIDAE

***Perionyx excavatus* E. Perrier**

1872. *Perionyx excavatus* E. Perr., *N. Arch. Mus. Paris*, **8**, p. 126, pl. iv, figs. 73, 74.  
 1895. *Perionyx excavatus* + *P. intermedius* + *P. gruenewaldi*: Beddard, *Monog.*, pp. 436, 437.  
 1900. *Perionyx excavatus* + *P. intermedius*: Michaelsen, *Tierreich*, **10**, pp. 208, 209.  
 1916. *Perionyx fulvus*: Stephenson, *Rec. Indian Mus.*, **12**, p. 322, pl. xxi, fig. 16.  
 1923. *Perionyx excavatus* + *P. fulvus*, Stephenson, *Oligochaeta, Fauna Brit. India*, pp. 329, 333.  
 1933. *Perionyx excavatus*: Gates, *Rec. Indian Mus.*, **35**, p. 549.

*Main characteristic features.*—Dorsal pores from 4/5. Clitellum xiii-xvii. Male pores very close together in a slight depression. Spermathecal pores 2 pairs, close together in 7/8 and 8/9. Calciferous glands in xiii. Last heart in xiii. Penial setae almost straight, tips slightly curved, distal end ornamented with about twelve rings of rather long fine spines.

*Remarks.*—This was a perennially occurring species of the Doon Valley and its neighbourhood and was found in the damp soil round about pools, puddles and rivulets as well as in smaller water pockets.

*Distribution.*—The species has so far been recorded from the following localities in India—Dibrugarh & Sadiya (Assam); Abor Country (NEFA); Calcutta & Darjeeling (West Bengal); Dehra Dun, Kumaun hills & Pilibhit (Uttar Pradesh); Simla (Himachal Pradesh); & Little Andaman (Andaman Islands).

***Pheretima anomala* Michaelsen**

1907. *Pheretima anomala* Michaelsen, *Mitt. Mus. Hamb.*, **24**, p. 167.  
 1923. *Pheretima anomala*: Stephenson, *Oligochaeta, Fauna Brit. India* p. 294.  
 1937. *Pheretima anomala*: Gates, *Rec. Indian Mus.*, **39**, p. 193.

*Main characteristic features.*—Male pores on large conical papillae on xx. Spermathecal pores 3 pairs in 5/6-7/8. Genital markings paired in xviii, xix, xxi, and xxii.

*Remarks.*—This species was not very common.

*Distribution.*—The species has so far been recorded from the following localities in India—Calcutta & Darjeeling (West Bengal); and Dehra Dun (Uttar Pradesh).

**Pheretima birmanica** (Rosa)

1888. *Perichaeta birmanica* Rosa, *Ann. Mus. Genova*, (2) 6, p. 164.  
 1898. *Perichaeta birmanica* : Beddard, *Monog.* p. 405.  
 1900. *Amyntas birmanicus* : Beddard, *P.Z.S.*, p. 637.  
 1900. *Pheretima birmanica* : Michaelsen, *Tierreich*, 10, p. 255.  
 1945. *Pheretima birmanica* : Gates, *Sci. & Cult.*, 10(9), p. 403.

*Main characteristic features.*—Male pores on slightly swollen areas. Spermathecal pores 3 pairs in 5/6-7/8. No genital markings. Spermathecal ampulla oval, duct short, diverticulum in the form of a stalked oval sac in which lies a much convoluted tube.

*Remarks.*—This species was rather uncommon.

*Distribution.*—The species has so far been recorded in India only from Dehra Dun (Uttar Pradesh).

**Pheretima houletti** E. Perrier

1872. *Perichaeta houletti* E. Perrier, *N. Arch. Mus. Paris*, 8, p. 99.  
 1889. *Megascolex houletti* : Vaillant, *Hist. Nat. Annel.*, 3(1), p. 75.  
 1898. *Perichaeta crescentica* Fedarb, *Proc. zool. Soc. Lond.*, 1898, p. 447.  
 1898. *Perichaeta travancorensis* Fedarb, *J. Bombay nat. Hist. Soc.*, 11, p. 435.  
 1916. *Pheretima trivandran*a Stephenson, *Rec. Indian Mus.*, 12, p. 335.  
 1923. *Pheretima houletti* (part, excl. *campanulata* and the distribution of *guillelmi* and *meridiana*) + *P. travancorensis* + *P. trivandran*a : Stephenson, *Oligochaeta, Fauna Brit. India*, pp. 304, 313 and 314.  
 1934. *Pheretima houletti* : Gates, *Rec. Indian Mus.*, 36, p. 259.  
 1937. *Pheretima houletti* : Gates, *Rec. Indian Mus.*, 39, p. 203.

*Main characteristic features.*—Male pores on papillae about 1/3 of circumference apart in line with *h*. Spermathecal pores 3 pairs in 6/7-8/9. No genital markings. Spermathecal ampulla irregularly-shaped or pear-shaped, duct as long as ampulla, diverticulum long, tubular, with its ental portion much convoluted.

*Remarks.*—This species was fairly common.

*Distribution.*—The species has so far been recorded from the following localities in India.—Cherrapunji (Assam); Calcutta & Rani-ganj (West Bengal); Allahabad, Bhim Tal & Dehra Dun (Uttar Pradesh); Bandra, Bombay, Buldana & Matheran (Maharashtra); Bangalore, Mangalore, Mercara & Shimoga (Mysore); Trichur & Trivandrum (Kerala); Salem (Madras); and Andaman Islands.

**Pheretima morrisoni** Beddard

1892. *Perichaeta morrisoni* Beddard, *Proc. zool. Soc. Lond.*, 1892, p. 166.  
 1898. *Perichaeta cupulifera* Fedarb, *Proc. zool. Soc. Lond.*, 1898, p. 445.  
 1900. *Pheretima barbadensis* (part, excluding sixthcal forms) + *P. morrisoni*, Michaelsen, *Tierreich*, 10, pp. 254 & 287.  
 1900. *Amyntas hawayanus* (part), Beddard, *Proc. zool. Soc. Lond.*, 1900, p. 645 (excluding sixthcal forms).  
 1923. *Pheretima hawayana* (part, excl. sixthcal forms): Stephenson, *Oligochaeta, Fauna Brit. India* p. 300.  
 1937. *Pheretima morrisoni* : Gates, *Rec. Indian Mus.*, 39, p. 205.

*Main characteristic features.*—Male pores superficial. Spermathecal pores 2 pairs in 5/6-6/7. Genital markings near the male pores. Spermathecal ampulla oval-shaped, duct narrow, diverticulum narrow, tubular, somewhat coiled, nearly equal in length to main pouch with small terminal pear-shaped dilation.

*Remarks.*—This species was quite uncommon.

*Distribution.*—The species has so far been recorded from the following localities in India.—Imphal (Manipur); Kalimpong (West Bengal); Dehra Dun (Uttar Pradesh); Udaipur (Rajasthan) and Bombay (Maharashtra).

### *Pheretima posthuma* (L. Vaillant)

1868. *Perichaeta posthuma* L. Vaillant, *Ann. Sci. Nat.* (5), 10, p. 228.  
 1883. *Megascolex affinis* Beddard, *Ann. Mag. nat. Hist.* (5), 12, p. 214.  
 1889. *Megascolex posthuma*: L. Vaillant, *Hist. Nat. Annel.*, 3(1), p. 72.  
 1900. *Pheretima posthuma*: Michaelsen, *Tierreich*, 10, p. 295.  
 1923. *Pheretima posthuma*: Stephenson, *Oligochaeta, Fauna Brit. India*, p. 309.  
 1937. *Pheretima posthuma*: Gates, *Rec. Indian Mus.*, 39, p. 207.

*Main characteristic features.*—Male pores in setal zones. Spermathecal pores 4 pairs, segmental, in 5/6-8/9. Genital markings 2 pairs in setal circles on xvii and xix. Spermathecal ampulla ovoid, diverticulum of variable length.

*Remarks.*—This species was quite uncommon.

*Distribution.*—The species has so far been recorded from the following localities in India.—Calcutta & Raniganj (West Bengal); Bhagalpur, Purneah & Pusa (Bihar); Agra, Allahabad, Dehra Dun, Lucknow & Saharanpur (Uttar Pradesh); Ferozepore, Hoshiarpur, Jullundur, Ludhiana & Phagwara (Punjab); Kalka (Himachal Pradesh); Ajmer & Udaipur (Rajasthan); Gwalior (Madhya Pradesh); Baroda (Gujarat); Bombay (Maharashtra) and Andaman Islands.

### *Pheretima diffringens* (Baird)

1869. *Megascolex diffringens* Baird, *Proc. zool. Soc. Lond.*, 1869, p. 40.  
 1887. *Perichaeta mirabilis* Bourne, *Proc. zool. Soc. Lond.*, 1886, p. 668.  
 1900. *Amyntas heterochaetes* (part), Beddard, *Proc. zool. Soc. Lond.*, 1900, p. 622.  
 1909. *Pheretima heterochaeta*: Michaelsen, *Mem. Indian Mus.*, 1, pp. 110 and 189.  
 1923. *Pheretima heterochaeta* (part, excl. Synonymy and distribution of forms with copulatory chambers), Stephenson, *Oligochaeta, Fauna Brit. India*, p. 302.  
 1934. *Pheretima mirabilis*: Gates, *Rec. Indian Mus.*, 36, p. 260.  
 1937. *Pheretima diffringens*: Gates, *Rec. Indian Mus.*, 39, p. 198.

*Main characteristic features.*—Clitellum xiv-xvi. Male pores on elevated papillae about 2/5 of circumference apart. Spermathecal pores 4 pairs in 5/6-8/9. Genital papillae paired anteriorly on vii and viii and sometimes on ix also. Spermathecal ampulla pear-shaped, duct almost equal in length to ampulla, diverticulum long, tubular, dilated at its ental end to a knob-like seminal chamber.

*Remarks.*—This species was not so common.

*Distribution.*—The species has so far been recorded from the following localities in India.—Cherrapunji, Kobo, Sadiya & Shillong (Assam); Imphal (Manipur); Darjeeling, Kalimpong, Kurseong & Siliguri (West Bengal); Nainital (Uttar Pradesh); Dharmsala, Kangra, Palampur & Simla (Himachal Pradesh); Bababudan Hills (Mysore); and Coonoor & Kodaikanal (Madras). The species thus forms the first record from the Doon Valley.

**Pheretima alexandri** (Beddard)

1900. *Amyntas alexandri* Beddard, *Proc. zool. Soc. Lond.*, 1900, p. 998.  
 1909. *Pheretima alexandri*: Michaelsen, *Mem. Indian Mus.*, 1, p. 109.  
 1914. *Pheretima lignicola* Stephenson, *Rec. Indian Mus.*, 8, p. 399.  
 1922. *Pheretima suctoria* Stephenson, *Rec. Indian Mus.*, 24, p. 434.  
 1923. *Pheretima alexandri* + *P. lignicola* + *P. suctoria* (part, excl. Andaman Island forms): Stephenson, *Oligochaeta, Fauna Brit. India*, pp. 291, 305 and 311.  
 1925. *Pheretima suctoria* var. *mullani*, Stephenson, *Proc. zool. Soc. Lond.*, 1925, p. 893.  
 1931. *Pheretima alexandri*: Stephenson, *Rec. Indian Mus.*, 33, p. 182.  
 1937. *Pheretima alexandri*: Gates, *Rec. Indian Mus.*, 39, p. 192.

*Main characteristic features.*—Clitellum xiv-xvi. Male pores inconspicuous, in front and behind the pores are slightly curved grooves. Spermathecal pores 4 pairs in 5/6-8/9. No genital papillae. Spermathecal ampulla pear-shaped, duct longer than ampulla, diverticulum longer than main pouch and consisting of a duct and a moniliform chamber.

*Remarks.*—This species was met with rarely.

*Distribution.*—The species has so far been recorded from the following localities in India.—Dibrugarh (Assam); Calcutta (West Bengal); Bombay (Maharashtra); and Andaman Islands. The species thus forms the first record from the Doon Valley.

## Family 2 OCTOCHAETIDAE

**Octochaetoides beatrix** (Beddard)

1902. *Octochaetus beatrix* Beddard, *Ann. Mag. nat. Hist.* (7), 9, p. 456.  
 1914. *Octochaetus dasi* Stephenson, *Rec. Indian Mus.*, 10, p. 346.  
 1922. *Octochaetus beatrix*: Stephenson, *Rec. Indian Mus.*, 24, p. 436.  
 1923. *Octochaetus (Octochaetoides) beatrix*: Stephenson, *Oligochaeta, Fauna Brit. India*, p. 376.  
 1951. *Octochaetoides beatrix*: Gates, *Proc. natn. Acad. Sci. India* (B), 21, p. 18.

*Main characteristic features.*—Clitellum xiii-xvii. Spermathecal pores on viii and ix. Prostatic pores medial from *a*. Seminal grooves bowed outwards. No genital markings. Calciferous glands in xv, large and much lobed. Last heart in xiii. Spermathecae small, ampulla pear-shaped, duct short, diverticulum pear-shaped, half as long as ampulla. Penial setae nearly straight, slightly bent at the distal end with a few teeth lying flat against the shaft.

*Remarks.*—This species was quite uncommon.

*Distribution.*—The species has so far been recorded from the following localities in India.—Calcutta (West Bengal); Dehra Dun (Uttar Pradesh); Baroda (Gujarat); and Bombay (Maharashtra).

**Eutyphoeus incommodus** (Beddard)

1901. *Typhoeus incommodus* Beddard, *Proc. zool. Soc. Lond.*, pp. 200 and 206.  
 1903. *Eutyphoeus incommodus*: Michaelsen, *Geogr. Verbr.*, p. 109.  
 1914. *Eutyphoeus incommodus* + *E. mohammedi*, Stephenson, *Rec. Indian Mus.*, 10, pp. 349 and 350.  
 1916. *Eutyphoeus incommodus* + *E. annandalei* var. *fulgidus*, Stephenson, *Rec. Indian Mus.*, 12, p. 342.  
 1923. *Eutyphoeus incommodus* + *E. mohammedi*, Stephenson, *Oligochaeta, Fauna Brit. India*, pp. 438 and 443.  
 1938. *Eutyphoeus incommodus*: Gates, *Rec. Indian Mus.*, 40, p. 83.

*Main characteristic features.*—Avestibulate and apenile. Male pores within slight transversely placed grooves, the centres on/or close to *b*. Genital markings paired, post-setal in *ab* on xiii-xvi. Female pores paired. Spermathecal pores in the median half of *bc*. Supra-intestinal glands in lxii-lxxii. Dorsal blood vessel continued into iii. Holandric. Seminal chambers forming a circle around the spermathecal duct.

*Remarks.*—The species was quite uncommon.

*Distribution.*—The species has so far been recorded from the following localities in India.—Calcutta (West Bengal); Pusa & Rajmahal (Bihar); Agra, Allahabad, Anwargunj and Dehra Dun (Uttar Pradesh); Hoshiarpur (Punjab); Ambala (Haryana); Kasauli (Himachal Pradesh) and Bharatpur (Rajasthan).

### *Eutyphoeus waltoni* (Michaelson)

1907. *Eutyphoeus waltoni* (part, excluding specimens of *nicholsoni* from Faizabad) + *E. bengalensis*, Michaelson, *Mitt. Mus. Hamb.*, 24, pp. 179 and 183.  
 1909. *Eutyphoeus bengalensis* + *E. waltoni* (part, as above), Michaelson, *Mem. Indian Mus.*, 1, pp. 111, 112, 218, 219, 229 & 235.  
 1914. *Eutyphoeus waltoni* + *E. ibrahimi*, Stephenson, *Rec. Indian Mus.*, 10, pp. 352 & 357.  
 1923. *Eutyphoeus ibrahimi* + *E. waltoni*, Stephenson, *Oligochaeta, Fauna Brit. India*, pp. 438 & 455.  
 1938. *Eutyphoeus waltoni*: Gates, *Rec. Indian Mus.*, 40, p. 112.

*Main characteristic features.*—Bivestibulate and penile, penes long. Genital markings paired in *ab*, intersegmental, on 14/15-15/16, 18/19. Spermathecal pores with centres on *c*. Supra-intestinal glands in lxxviii-lxxxii. Dorsal blood vessel ends with hearts of vii. Metandric. Spermathecal diverticula paired, median and lateral.

*Remarks.*—This species was quite uncommon.

*Distribution.*—This species has so far been recorded from the following localities in India.—Manipur; Calcutta (West Bengal); Pusa & Rajmahal (Bihar); Agra, Dehra Dun, Faizabad, Kanpur & Lucknow (Uttar Pradesh); Delhi; Hoshiarpur & Kapurthala (Punjab) and Baroda (Gujarat).

### *Eutyphoeus orientalis* (Beddard)

1883. *Typhoeus orientalis* Beddard, *Ann. Mag. nat. Hist.* (5), 12, p. 219.  
 1900. *Eutyphoeus orientalis* + *E. masoni*: Michaelson, *Tierreich*, 10 pp. 322 and 323.  
 1923. *Eutyphoeus bishambari* + *E. masoni* + *E. orientalis* + *E. paivai* + *E. waltoni* (part, including only specimens with genital markings on xvi), Stephenson *Oligochaeta, Fauna Brit. India*, pp. 431, 442, 448, 449 and 455.  
 1938. *Eutyphoeus orientalis*: Gates, *Rec. Indian Mus.*, 40, p. 98.

*Main characteristic features.*—Bivestibulate and penile, penes short and annular. Genital markings paired in *ab* on xv and usually on xvi also. Spermathecal apertures in *bc*. Dorsal blood vessel terminates with hearts of vii. Metandric. Spermathecal diverticula paired, median and lateral.

*Remarks.*—This species, which is robust and large-sized, is mound-forming in habits and was always observed to retain its anterior end deep inside the mound, a posture possibly aiding it in readily escaping into the soil when disturbed. Though the species was quite common throughout the Valley occurring in quite a variety of habitats, generally

fully matured forms were met with only during the months of August and September when the monsoons were in full swing. In the month of October, however, with the cessation of rains, the worms generally began dwindling in population as well as in body size, so that by November, with the onset of winter, hardly a few individuals were available and these were generally weak and inactive and buried about a foot deep below the soil; and subsequently from December to May the members of the species were not at all available, thereafter only juveniles appearing during June-July.

*Distribution.*—The species has so far been recorded from the following localities in India.—Calcutta (West Bengal); Pusa (Bihar); and Dehra Dun (Uttar Pradesh).

### ***Eutyphoeus nicholsoni* (Beddard)**

1901. *Typhoeus nicholsoni* Beddard, *Proc. zool. Soc. Lond.*, pp. 195 and 206.  
 1909. *Eutyphoeus khani* + *E. nicholsoni* + *E. provincialis (lapsus)* + *E. waltoni* (part only, one specimen from Fyzabad), Michaelsen, *Mem. Indian Mus.*, 1, pp. 111, 112, 218, 219, 229, 233.  
 1923. *Eutyphoeus nicholsoni*: Stephenson, *Oligochaeta, Fauna Brit. India*, p. 446.  
 1938. *Eutyphoeus nicholsoni*: Gates, *Rec. Indian Mus.*, 40, p. 94.

*Main characteristic features.*—Bivestibulate and penile, apertures transversely slit-like about in *ab*, penes long. Genital markings paired on 15/16 with margins united at the mid-ventral line reaching laterally into *bc*. Spermathecal pores in 7/8 just lateral to *a*. Metandric. Seminal chambers in one or two clusters or a semi-circular row on the posterior face of the spermathecal duct.

*Remarks.*—This species, which is also fairly large and robust, and mound-forming in habits, occurs quite commonly during the monsoon periods all over the Saharanpur district as well as extending into the adjoining southern portion of Dehra Dun Forest Division where it was sometimes found in association with *E. orientalis* (Beddard); and though its stages of maturity and the time of its appearance coincided practically with the said species, it was always numerically greater and more robust in the overlapping ranges.

*Distribution.*—The species has so far been recorded from the following localities in India.—Calcutta (West Bengal); Rajmahal (Bihar), and Faizabad, Kanpur, Lucknow and Saharanpur (Uttar Pradesh). Now it is being recorded for the first time from Dehra Dun Forest Division, though its occurrence in the area is rather marginal.

### Family 3. DIPLOCARDIDAE

#### ***Dichogaster bolau* (Michaelson)**

1891. *Benhamia bolau* Michaelsen, *Jb. hamb wiss. Anst.*, 8, p. 9.  
 1895. *Benhamia bolau*: Beddard, *Monogr. Oligochaeta*, p. 565.  
 1900. *Dichogaster bolau*: Michaelsen, *Tierreich*, 10, p. 340.  
 1916. *Dichogaster bolau* subsp. *palmicola* Stephenson, *Rec. Indian Mus.*, 12, p. 348.  
 1917. *Dichogaster bolau*: Stephenson, *Rec. Indian Mus.*, 13, p. 413.  
 1918. *Dischogaster bolau*: Stephenson, *Mem. Indian Mus.*, 7, p. 257.  
 1923. *Dichogaster bolau*: Stephenson, *Oligochaeta, Fauna Brit. India*, p. 472.

*Main characteristic features.*—Clitellum saddle-shaped on xiv-xviii. Prostatic pores on xvii and xix. Seminal grooves straight. Spermathecal pores 2 pairs. Calciferous glands 3 pairs in xv-xvii. Prostates



almost straight. Spermathecal ampulla sac-like, duct thick, diverticulum small and club-shaped. Penial setae of two forms-1/ with about eight sharp, short teeth on the concave side of the distal end, tip slightly hooked. 2/ with slightly thickened distal end which is broadened in the form of a spatula and hollowed.

*Remarks.*—This species seems to be quite rare.

*Distribution.*—The species has so far been recorded from the following localities in India—Calcutta (West Bengal); Bayana (Rajasthan); Baroda and Junagadh (Gujarat); Bassein & Bombay (Maharashtra); and Ernakulum and Trivandrum (Kerala).

#### Family 4. LUMBRICIDAE

##### *Bimastos parvus* (Eisen)

1874. *Allolobophora parva* : Eisen, *Ofv. Vet. Ak. Forh.*, **31**, p. 36.  
 1894. *Allolobophora beddardi* Michaelsen, *Zool. Jb. Syst.*, **8**, p. 182.  
 1900. *Allolobophora (Bimastos) parva* + *A. (B.) beddardi*, *Helodrilus (B.) parva* + *H. (B.) beddardi*, Michaelsen, *Abh. naturw. Ver. Hamburg*, **16**, pp. 14-31, *H. (B.) parvus*, Michaelsen, *Tierreich*, **10**, p. 502.  
 1917. *Helodrilus (Bimastos) parvus* + *H. (B.) beddardi*, Smith, *Proc. U.S. natn. Mus.*, **52**, p. 173.  
 1923. *Allolobophora (Bimastos) parva*, Stephenson, *Oligochaeta, Fauna Brit. India*, p. 506.  
 1940. *Bimastos parvus* + *B. beddardi*, Kobayashi, *Sci. Rep., Tohoku Univ.*, **15**, pp. 297, 298.  
 1947. *Bimastos beddardi* : Cernosvitov & Evans, *Linn. Soc. London, Synopses British Fauna*, **6**, p. 80.  
 1956. *Bimastos parvus* : Gates, *Bull. Mus. comp. Zool. Harv.*, **115** (1), p. 6.  
 1958. *Bimastos parvus* : Gates, *Breviora*, **91**, p. 4.

*Main characteristic features.*—Seta *ab* greater than *cd*. Dorsal pores from 5/6. Spermathecae absent. Clitellum 24-30 segments (7 segments).

*Remarks.*—This species was met with very rarely.

*Distribution.*—This species has so far been recorded from the following localities in India.—Darjeeling (West Bengal); Patna (Bihar); Allahabad, Nainital & Saharanpur (Uttar Pradesh); Ferozepore (Punjab); Kasauli (Himachal Pradesh); Srinagar (Kashmir); and Partabgarh (Rajasthan). The species as well as its genus thus form the first record from the Doon Valley.

#### V—SUMMARY

The paper deals with the taxo-ecological aspects of earthworms from the Doon Valley. Out of the total recorded number of fourteen species, only eleven were collected. Four species including one genus, have been recorded for the first time from this area. Data on the seasonal distribution of the worms and other ecological observations, as well as the analyses of the habitat-soils, for some of the species, have also been included.

Survey trips for the above purposes were made mainly from 26 selected stations within a radius of 40 Kms., though there were also a few beyond this formally imposed limit; and the surveys were conducted for a period of about two years by the author during 1963-65.

## VI—ACKNOWLEDGMENTS

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## VII—REFERENCES

- BEDDARD, F. E. 1895. A monograph of the order of Oligochaeta. Oxford at the Clarendon press. pp. i-xii, 1-769, plates 5, text-figs. 52.
- EVANS, A. C. AND GUILD, W. J. MCL. 1947. Studies on the relationships between the earthworms and soil fertility. 1/ Biological Studies in the field.—*Ann. Appl. Biol.*, Cambridge, **34** (3), pp. 307-330.
- GATES, G. E. 1937. Indian Earthworms. I. The genus *Pheretima*.—*Rec. Indian Mus.*, Calcutta, **39**, pp. 175-212.
- GATES, G. E. 1938. Indian Earthworms. III. The genus *Eutyphoeus*.—*Rec. Indian Mus.*, Calcutta, **40**, pp. 39-119.
- GATES, G. E. 1951. Studies on the earthworm fauna of Saharanpur, Dehra Dun and Mussoorie.—*Proc. natn. Acad. Sci. India* (B), Allahabad, **21**, pp. 16-22.
- GATES, G. E. 1958. Contribution to a revision of the earthworm family Lumbricidae. II. Indian Species.—*Breviora*, Cambridge, Mass., **91**, pp. 1-16.
- MICHAELSEN, W. 1900. Oligochaeta. *Tierreich*, Berlin, **10**, pp. i-xxix, 1-575.
- PRASHAD, B. 1916. The earthworms of Lahore.—*J. Bombay nat. Hist. Soc.*, Bombay, **24**, pp. 494-506.
- ROY, S. K. 1957. Studies on the activities of earthworms.—*Proc. zool. Soc.*, Calcutta, **10**, pp. 81-98.
- SHRIKHANDE, J. G. AND PATHAK, A. N. 1948. Earthworms and insects in relation to soil fertility.—*Curr. Sci.*, Bangalore, **17** (11), pp. 327-328.
- STEPHENSON, J. 1923. *Fauna Brit. India, Ceylon and Burma*. Oligochaeta, London, pp. i-xxiv, 1-518, figs. 262.

### VIII—SOIL ANALYSIS

Sl. No.		<i>Eutyphoeus orientalis</i> (Beddard)		<i>Eutyphoeus nicholsoni</i> (Beddard)		
		Surface soil (up to 3")	Mound	Surface soil (up to 3")	Mound	
		Sta. Sta. 18	Sta. 18	Sta. 23/Site 1	Sta. 23/Site2	Sta. 23/Site1
1.	Fractions of soil %	11.48	00.47	35.00	35.00	01.86
		88.52	99.53	65.00	65.00	98.14
2.	Mechanical composition					
	Conser. sand %	28.85	28.20	25.80	32.70	21.30
	Fine sand %	30.75	38.75	51.50	43.20	39.75
	Silt %	25.00	25.00	10.00	17.50	17.50
	Clay %	12.50	07.50	07.50	05.00	17.50
3.	Air over dry moisture %	01.20	01.60	00.67	00.84	01.86
4.	Water holding capacity %	40.92	46.29	41.80	33.77	50.92
5.	Moisture equivalent %	27.07	29.85	29.89	24.66	33.73
6.	Organic carbon %	01.30	01.22	01.08	01.06	01.42
7.	Nitrogen %	0.114	0.139	0.111	0.088	0.142
8.	C/N ratio %	11.40	08.78	09.73	12.05	10.00
9.	Organic matter %	02.06	02.62	1.862	1.827	2.448
10.	Loss on ignition %	5.5	6.4	3.5	3.0	6.1

(Contd.)

## V--SOIL ANALYSIS (Contd.)

Sl. No.		<i>Eutyphoeus orientalis</i> (Beddard)		<i>Eutyphoeus nicholsoni</i> (Beddard)			
		Surface soil (up to 3")	Mound	Surface soil (up to 3")			
		Sta. Sta. 18	Sta. 18	Sta. 23/Site 1	Sta. 23/Site2	Sta.23/Site1	
11.	HCL insolubles %	87.1	86.2	86.0	89.2	83.9	
12.	R203 %	8.38	8.40	7.26	7.04	9.02	
	Fe203 %	2.5546	2.0758	2.8742	2.5548	3.1936	
	Al203 %	5.8252	6.1242	4.3858	4.7852	5.9264	
	Cao %	0.196	0.224	1.764	0.532	1.568	
	Mgo %	0.1411	0.1815	0.3225	0.4838	0.4838	
	K20 %	0.4603	0.4748	0.1778	0.2351	0.4831	
	P205 %	0.1668	0.1514	0.0433	0.0371	0.0803	
13.	PH	6	6.4	8	7.5	8	
14.	Available nutrients	K20 %	0.0312	0.028	0.039	0.023	0.0255
		P205 %	0.0036	0.0005	0.0029	0.004	0.0025
15.	Calcareousness	0	0	+++	+	++	
		+++ = High	++ = Less high	+ = Slight	0 = Nil		