Anatomical notes on four species of *Ochetostoma* Leuckart & Rüppell (Echiura) together with a list of the species of the genus

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(With 2 Text-figures)

I—INTRODUCTION

The material which forms the basis of this paper was obtained from the Zoological Survey of India, Calcutta. A part of this work was done in the laboratory of the ZSI during May and June, 1964. Spengel (1912) separated the genera *Thalassema* Lamarck, *Ochetostoma* Leuckart and Rüppell and *Listriolobus* Spengel, and the basis of the distinction of the genera was primarily the longitudinal muscle layer of the body wall. The latter is of uniform thickness in *Thalassema*, thickened into bundles interrupted by intervals in *Ochetostoma*, and the bundles not interrupted by intervals in *Listriolobus*. It is often hard to make this distinction between *Ochetostoma* and *Listriolobus* considering the work involved in the process as has been hinted by Wharton (1913) and stated clearly by Bock (1942, p. 13). There are further difficulties in making the distinction between young specimens of *Ochetostoma* and *Listriolobus*. Between *Ikedosoma* Bock and *Ochetostoma* the difference is long extensible proboscis as also numerous gonoducts arranged in pairs of groups in the former. The arrangement of the muscles of the body wall is identical in the two genera.

The number of muscle bands, and the number and the location of the gonoducts are important criteria for the determination of quite a few of the species of *Ochetostoma*. Notwithstanding, the dimension of the basis of the taxonomic consideration of the species of this genus has increased with the increase of knowledge of the group. Besides *O. erythrogrammon* (Leuckart and Rüppell) which has been described by many authors, morphological accounts of the species are generally brief. In the description of a few species, the interbasal muscle, the neurointestinal vessel, and the rectal coecum have been mentioned. A few species are remarkably characterised by the modification of the posterior extremity of the body (e.g. *atlantedei* Wesenburg-Lund, *mercator* Wesenburg-Lund, *arkati* (Prashad)). There is, however, special problem with the species *caudex* (Lampert), *stuhlmani* (Fischer), *leptodermon* (Fischer), and *kokotoniense* (Fischer), which together with *erythrogrammon* and *palense* (Ikeda), have been regarded by Sato (1939, p. 357) as conspecific. To us the species *palense* seems to be a distinct one from *erythrogrammon* on the basis of the absence of the rectal caecum. With the information at hand it is not possible to separate the rest of the species from *erythrogrammon*. Fisher (1946,

p. 241) has put in his key the species *griffini* along with these conspecific forms, to which we add *sorbillans*.

In this paper we have given anatomical notes on *O. erythrogrammon, O. kempi, O. australiense,* and *O. bombayensis,* which should facilitate recognising the species. Besides, an upto date list of the species of *Ochetostoma* together with a brief key has been incorporated.

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II—Systematic Account

Ochetostoma erythrogrammon (Leuckart and Rüppell)

(Text-fig. 1)

Ochetostoma erythrogrammon Leuckart and Rüppell, 1828 ; Spengel, 1912 ; Fischer, 1926 ; Sato, 1935, 1939 ; Stephen, 1952 ; Stephen and Robertson, 1952 ; Wesenburg-Lund, 1954, 1959.

Thalassema erythrogrammon Drasche, 1881 ; M. Muller, 1852 ; Greeff, 1879 ; Sluiter, 1883, 1890 ; Rietsch, 1886 ; Shipley, 1899, 1902.

Thalassema caudex Lamper, 1883 ; Rietsch, 1886 ; Shipley, 1898, 1899 ; Sluiter, 1902 ; Wharton, 1913 ; Prashad, 1935.

Thalassema kokotoniense Fischer, 1892, 1895, 1914 ; Shipley, 1899 ; Sluiter, 1902 ; Ikeda 1904.

Thalassema stuhlmani Fischer, 1892, 1895, 1914 ; Augener, 1903.

Thalassema leptodermon Fischer, 1892 ; Sluiter, 1902 ; Augener, 1903.

Thalassema griffini Wharton, 1913.

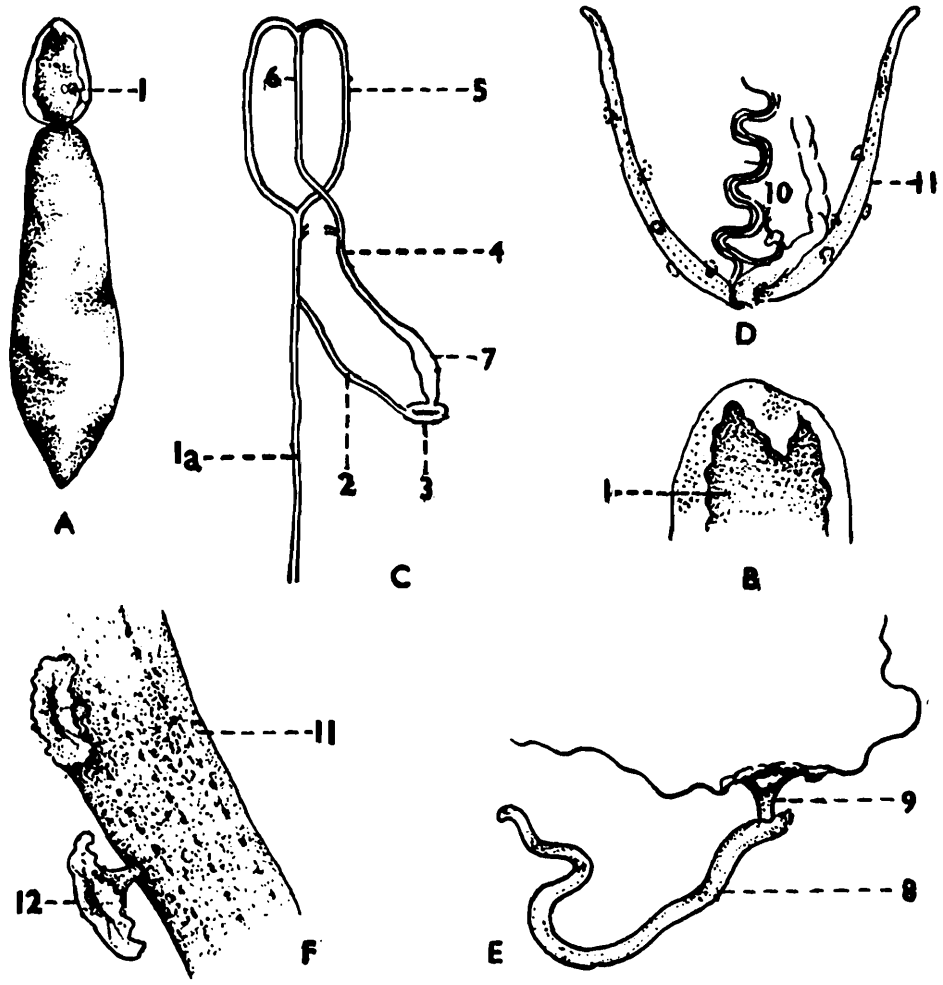
Thalassema sorbillans Lampert, 1883.

Altogether 3 specimens have been examined, a list of which has been presented below.

Material : (1) & (2) Coll. Dr. K. K. Tiwari of Zoological Survey of India, Calcutta : 2 exs., Port Blair (Andaman Island : Bay of Bengal), August, 1961 ; 52 mm. & 19 mm. body length, 14 mm. & 8 mm. proboscis length ; 16 & 14 muscle bands. (3) Coll. Marine Survey: 1 ex., West of Octaria Bay (Andaman Island), date unknown, 73 mm. body length, 29 mm. proboscis length, 14 muscle bands.

The preserved specimens were pinkish grey in colour. A sharp constriction marks the junction of the proboscis and the trunk. The proboscis is narrow anteriorly. Besides, the margin of the proboscis is thin and inflected ventrally leaving a central fleshy pad (Text-fig. 1, A and B-1). The body is covered with conspicuous papillae throughout. The papillae are round to oval in shape and are arranged transversely ; there are sharp grooves between the transverse rows.

The vascular system (Text-fig. 1, C) consists of a ventral vessel (C-1a), a neurointestinal (C-2) connecting the ventral with the ring sinus (C-3), and a dorsal (C-4). Posteriorly the ventral vessel terminates on the rectal caecum (Text-fig. 1, D-10). Near the junction of the proboscis and the trunk both the dorsal and the ventral vessels send off branches towards the pharynx. It could not be acertained whether these branches are connected with a system of 'nuchal ring' (Prashad, 1919*b*, as adopted from Spengel, 1880). The ventral vessel is bifurcated in the proboscis, the 2 limbs run as 2 lateral vessels (C-5) along the margin of the proboscis to unite with the median vessel (C-6) at the tip.



TEXT-FIG. 1. Diagrams of *Ochetostoma erythrogrammon* (Leuckart and Rüppell).

A. Entire view, showing the central fleshy pad of the proboscis ; B. Proboscis ; C. Vascular system ; D. Posterior end showing the disposition of ventral vessel, rectum and anal vesicle ; E. Gonoduct with nephrostome ; F. Anal vesicles with funnels.

1. Central fleshy pad ; 1a. Ventral vessel ; 2. Neurointestinal ; 3. Ring sinus ; 4. Dorsal vessel ; 5. Lateral vessel ; 6. Median vessel, 7. Heart ; 8. Gonoduct ; 9. Nephrostome ; 10. Rectal caecum ; 11. Anal vesicles ; 12. Funnels.

There are 3 pairs of large gonoducts, the first pair being in front of the setae. The second pair is the largest, and the largest gonoducts (left-61 mm. ; right-47 mm.) that we have seen in any echiurid. Each gonoduct is a tubular organ (Text-fig. 1, E-8) provided with a funnel like gonostome (E-9) near the gonopore ; the margin of the funnel is produced into a pair of filamentous lips. The anal

vesicles are 2 long tubular sacs (Text-fig. 1., D and F-11) with short stalked funnels (F-12) throughout the vesicle.

Distribution.—Tropical West Africa, South Africa, East Africa, Andaman and Nicobar Islands, Red Sea, East Indies, Japan, West Indies, North Caroline Islands, Tahiti.

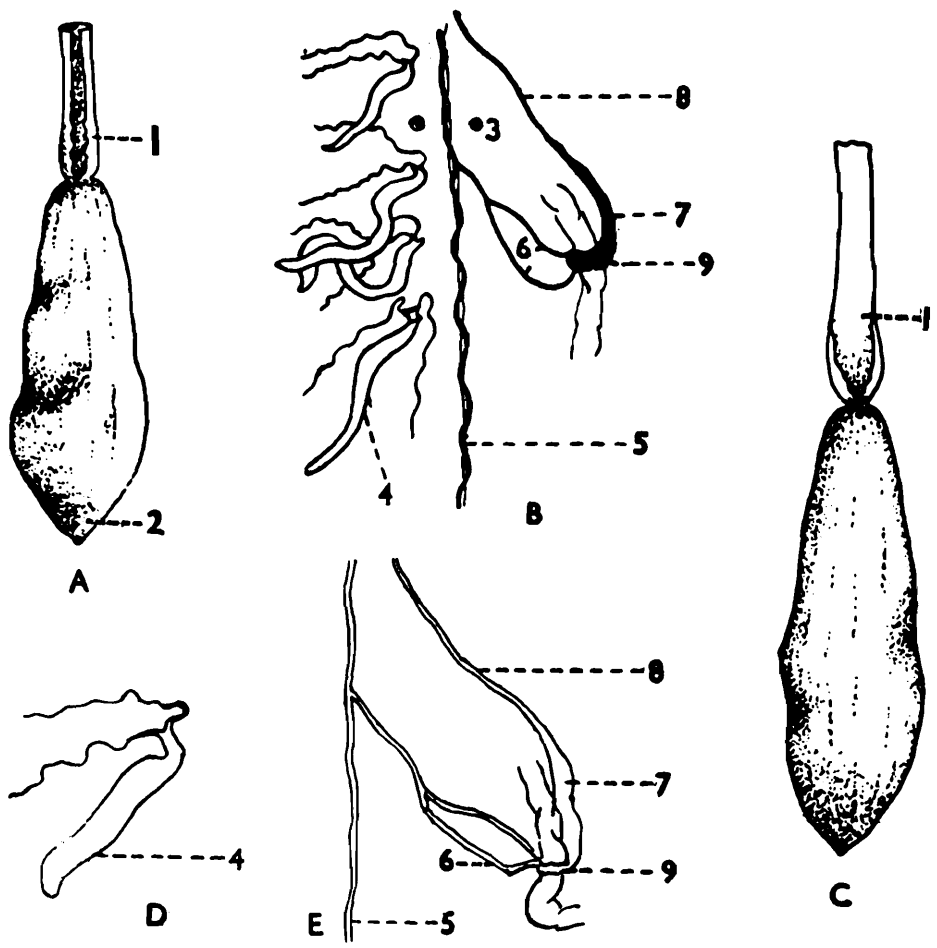
Ochetostoma kempi (Prashad)

(Text-fig. 2, A & B)

Thalassema kempi Prashad, 1919, 1935.

Ochetostoma kempi: Fisher, 1946.

Only one specimen has been examined, collected by Lt. Col. R. B. Sewell from the Mcpherson Strait (Andaman Island) on 29.i.24, and described by Dr. B. Prashad (1935, p. 41). The proboscis of the specimen is nearly tubular, whose lateral margins are slightly indented. The body is covered with rounded papillae, which are prominent towards the posterior end. The extreme posterior end of



TEXT-FIG. 2. A, B, and D *Ochetostoma kempi* (Prashad); C and E *Ochetostoma australiense* Edmonds.

1. Proboscis; 2. Entire body; 3. Ventral setae; 4. Nephridia; 5. Ventral vessel; 6. Neurointestinals; 7. Heart; 8. Dorsal vessel; 9.Ring sinus.

the body is devoid of papillae, and is made of concentric fleshy rings. In this respect this specimen does not conform with the type specimen of Prashad (1919*b*). There are 20 muscle bands which are inconspicuous at the posterior end. The 2 setae are golden yellow in colour, and are encased in a muscular sheath. An interbasal muscle is absent.

There are 4 pairs of gonoducts, the first pair being presetal. All the gonoducts are fairly large and their gonostomes are as in *O. erythrogrammon* (Text-fig. 2, B and D-4).

The vascular system (Text-fig. 2, B) consists of a ventral (B-5), 2 neurointestinals (B-6), a ring sinus, a heart, and a dorsal (B-9, 7, and 8 respectively). The 2 neurointestinals are separate throughout their length, which unite close to its opening in the ventral vessel at about the level of the ventral setae (B-3). A rectal caecum is absent, and the ventral vessel terminates on the rectal wall. The anal vesicles are long tubular sacs, studded with short stalked funnels.

Prashad (1919*b*, p. 337) named and described the species, characterised by 20 longitudinal muscle bands and 4 pairs of nephridia, all the nephridia being postsetal. He amended his description (1935, pp. 40-41) in his article on *Thalassema* in the Indian Museum, where he stated "In general appearence *Thalassema caudex* resembles *Thalassema kempi* Prashad, but the latter species, as I have confirmed by a re-examination of the type and the specimen recorded below, has four and not three pairs of segmental organs. My description of this species, however, needs correction in that the anterior two pairs of segmental organs are situated in front of the setae." The first note of correction is contrary to his description of the type in which he has mentioned 4 pairs of segmental organs (Prashad, 1919*b*, p. 336). The second note of correction, however, needs further amendment as there is only one pair of presetal gonoducts in the present specimen and not two pairs. The position of the gonoducts could not be compared with the type as the latter was not available. Fisher (1946, p. 241) in his key for the species of *Ochetostoma* has placed *kempi* under 4 pairs of 'nephridia' posterior to the setae. To our knowledge *O. kempi* has not been reported by any body after Prashad (1935). The position of the gonoducts is clear in this specimen, and we are inclined to regard this species as characterised by 4 pairs of gonoducts of which the first pair is presetal.

Distribution.—Ross Island (Andaman Islands).

Ochetostoma australiense Edmonds

(Text-fig. 2, C and E)

Ochetostoma australiense Edmonds, 1960.

Only one specimen has been studied, collected by the Marine Survey from the west of Octaria Bay, Andaman Islands. The exact date of collection could not be known. The specimen measures 109 mm in length of which the proboscis is 41 mm. The latter is nearly a flat structure with its margin slightly undulated (Text-fig. 2, C-1); its surface almost smooth with imperceptible marks of papillae. There are 14 longitudinal muscle bands. The first pair of the 3 pairs of gonoducts are situated in front of the setae. The vascular system (Text-fig. 2, E) consists of a ventral (E-5), 2 neurointestinals (E-6), a ring sinus (E-9), a heart (E-7) and a dorsal (E-8). The neurointestinals emerge as one from the ventral vessel and bifurcates into two, which open separately into the ring sinus. The anal vesicles are long (3/4 of the length of the body) and tubular, studded with short stalked funnels.

Edmonds (1960) has named and described the species *australiense* which is characterised by 11-14 muscle bands. To us the trenchent character appears to be the neurointestinals. Both *erythrogrammon* and *australiense* have 3 pairs of nephridia, the first pair being presetal, and variable number of muscle bands. The species *australiense* has 2 neurointestinals (Edmonds, 1960, pp. 94-95, Figure 4) while *erythrogrammon* has one.

Distribution.—Eastern coast of Australia, Andaman Islands.

Ochetostoma bombayensis (Prashad and Awati)

Thalassema bombayensis Prashad and Awati, 1929; Awati and Deshpande, 1936; Awati, 1936.

Only one complete specimen has been studied, collected by the Marine Survey from Port Blair (Andaman Islands). The exact date of collection could not be ascertained. The specimen is 32 mm. long of which the proboscis is 12 mm. The body is covered with conspicuous papillae which are prominent towards the posterior end. The proboscis is smooth and its margin is without any modification. There are 12 longitudinal muscle bands running from the anterior to the posterior end. The first pair of the 4 pairs of gonoducts are situated in front of the setae. The gonoducts are small in size.

In the species *bombayensis* the number of gonoducts varies from 4 to 5 pairs, and the longitudinal muscle bands from 10 to 11 (Prashad and Awati, 1929). The only point of difference from *bombayensis* is one additional muscle band in this specimen, which could be the result of splitting of one of the bands. It seems probable since variation in the number of muscle bands has already been observed in *bombayensis*, as in a few other species of this genus. Besides *O. bombayensis*, the 2 species which are nearer to this one are *O. decameron* and *O. kempi*, both of which have 4 pairs of gonoducts. In *O. kempi* the first pair of gonoducts are presetal, in which respect *O. kempi* is similar to the present specimen; but *O. kempi* has 20 longitudinal muscle bands. Besides, its extreme posterior end is modified, which make *kempi* distinct from the present specimen. In *O. decameron* 2 pairs of gonoducts lie in front of the setae and 2 behind (Lanchester, 1905, p. 35). The species *bombayensis*, therefore, seems to be characterised by 4 to 5 pairs of gonoducts, the first pair being in front of the setae, and 10-12 longitudinal muscle bands.

Distribution.—Coasts of Bombay and Andaman Islands.

The following species belong to the genus *Ochetostoma*.

1.	With 7 pairs of gonoducts ...	2	
	With 5 pairs of gonoducts or less ...	3	
2.	First pair of gonoducts presetal; 12 longitudinal muscle bands ...	*zanzibarense* Stephen and Robertson, 1952	
	All the gonoducts postsetal; 7 longitudinal muscle bands ...	*senegalense* Stephen, 1960	
3.	With presetal gonoducts ...	4	
	Without presetal gonoducts ...	10	
4.	Gonoducts 5 pairs ...	5	
	Gonoducts less than 5 pairs ...	6	

5.	3 pairs of gonoducts presetal; 10 longitudinal muscle bands ...	*hornelli* (Prashad), 1920
	1 pair of gonoducts presetal; 10-12 longitudinal muscle bands; gonoducts occasionally 4 pairs ...	*bombayensis* (Prashad and Awati), 1929
6.	Presetal gonoducts 1 pair ...	7
	Presetal gonoducts 2 pairs; 10 longitudinal muscle bands ...	*decameron* (Lanchester), 1905
7.	Gonoducts 4 pairs in all; 20 longitudinal muscle bands ...	*kempi* (Prashad), 1919
	Gonoducts 3 pairs in all ...	8
8.	Rectal caecum present ...	9
	Rectal caecum absent; 15 longitudinal muscle bands ...	*palense* (Ikeda), 1924
9.	Single neurointestinal vessel; longitudinal muscle bands vary from 14-19 ...	*erythrogrammon* (Leuckart and Rüppell), 1828 *caudex* (Lampert), 1883 *stuhlmani* (Fischer), 1892 *leptodermon* (Fischer), 1892 *kokotoniense* (Fischer), 1892 *sorbillans* (Lampert), 1883 *griffini* (Wharton), 1913
	2 neurointestinal vessels; 11-14 longitudinal muscle bands ...	*australiense* Edmonds, 1960
10.	Gonoducts 2 pairs; muscle bands less than 10 ...	11
	Gonoducts as above; muscle bands more than 10 ...	15
11.	Circumanal area not modified ...	12
	Circumanal area modified ...	14
12.	Interbasal muscle absent ...	13
	Interbasal muscle present; 7-8 longitudinal muscle bands ...	*capensis* Jones and Stephen, 1954
13.	Muscle bands 8 in number which fuse into a continuous sheath at the posterior end ...	*octomyotum* Fisher, 1946
	6-8 muscle bands separate throughout	*formosulum* (Lampert), 1883
14.	Smooth circumanal ring; 8 muscle bands ...	*arkati* (Prashad), 1935
	Annular frills around the circumanal ring; 7 muscle bands ...	*septemyotum* DattaGupta and Menon, 1963
15.	Anal disc with subulate papillae ...	16
	No such modification ...	17
16.	With oesophageal diverticulum; 13 muscle bands ...	*atlantidei* Wesenburg-Lund, 1959
	Without oesophageal diverticulum; muscle bands 13 ...	*mercator* Wesenburg-Lund, 1954
17.	Variable muscle bands ...	18
	Not so ...	20
18.	Anal vesicles characteristically modified; muscle bands 17-19 ...	*baronii* (Greeff), 1879
	Not as above ...	19
19.	Muscle bands 10-11 ...	*hupferi* (Fischer), 1892
	Muscle bands 16-17; interbasal muscle present ...	*edax* Fisher, 1946
20.	13 muscle bands ...	*pellucidum* (Fischer), 1895
	14 muscle bands ...	*manjuyodense* (Ikeda), 1905

III — Summary

Ochetostoma erythrogrammon and *O. australiense* are reported from the Andaman and Nicobar islands. Anatomical features of the species *erythrogrammon* conform with the earlier accounts except that the nephridia of the specimens collected from Port Blair are extremely large. *O. australiense* has 2 neurointestinals, otherwise the species is comparable with *erythrogrammon*. A re-examination of a duplicate of *O. kempi* reveals that the species is characterised by 20 longitudinal muscle bands, and 4 pairs of nephridia of which the first pair is presetal instead of the first two pairs. The longitudinal muscle bands in *O. bombayensis* have been known to vary from 10-11, although in the present case the number is 12. *O. bombayensis* thus has 4-5 gonoducts with 1 pair presetal, and 10-12 longitudinal muscle bands.

An upto date list of the species of *Ochetostoma* together with a brief key for the species has been incorporated.

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