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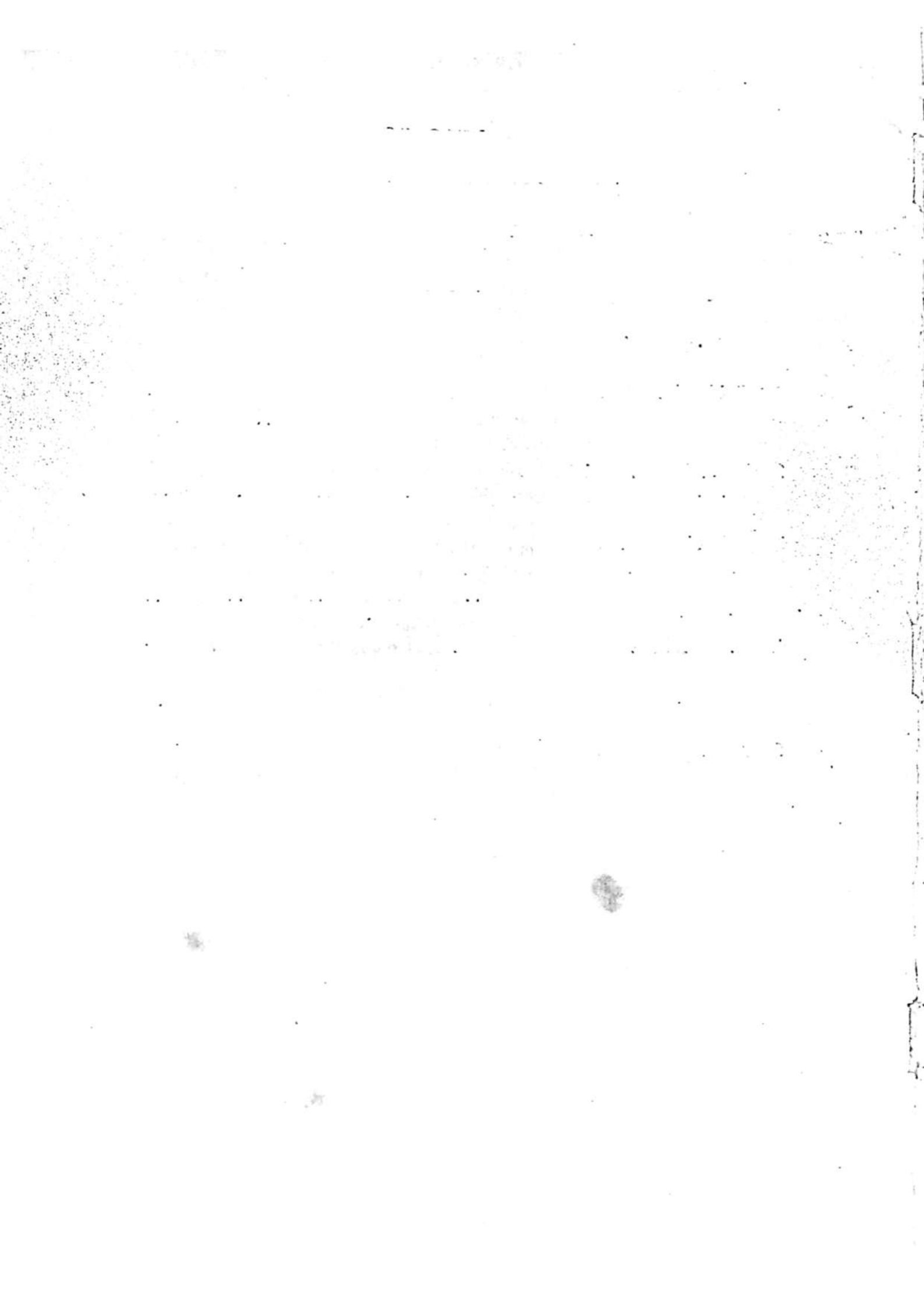
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NOTES ON A COLLECTION OF SOME SHREWS FROM WEST
PAKISTAN AND KASHMIR.

BY

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While preparing a checklist of the mamma's of Pakistan with particular reference to the mamma'ian collection in the British Museum (Natural History); some specimens of the genera *Suncus* and *Crocidars* were found to have been either not worked out or misidentified.

1. Genus *Suncus* Ehrenberg.

Lindsay (1929) recognised two species, the larger *caeruleus* and the smaller *subfulvus*. *S. caeruleus* was further divided, on the basis of differences in size and for colour, into two subspecies, *tyleri* Blyth ("averaging Head and Body 113 mm., Hind foot 19 mm., fur colour all shades from fawn to ashy-brown, and habitat: Western Himalayas, the Siwaliks and the plains"), and *sindensis* Anderson ("averaging Head and Body 116 mm., Hind foot 18 mm., ; fur colour neutral grey with a flush of umber, very pale in some cases; habitat; Kathiawar and Sind desert areas"). *S. subfulvus* Anderson is of markedly smaller size ("with Head and Body 70 mm., Hind foot 10.5 mm., fur colour pale fawn and ranging from Kathiawar to the Sind Plains.")

Ellerman and Morrison-Scott (1951) while replacing the specific name *caeruleus* Kerr by *murinus* Linn. and listing *subfulvus* as a subspecies of *S. stoliczkanus* Anderson, still recognised all three forms mentioned above. The range of *S. m tyleri* was stated to be Kumaon, Punjab and Kashmir, but there are specimens in the British Museum Collection also from Western Nepal.

Eighteen specimens of the genus *Suncus* in the British Museum Collection were found to be unnamed. They appeared to be intermediate in colour between *sindensis* and *tyleri*. Seven of these specimens from Kohat (North West Frontier Province), Sialkot and Ambala (Punjab) with the Head and Body 100-150 mm. and hind foot 18-21 mm., have the fur neutral grey with a little darker sheen (agreeing with *sindensis*) and the remaining eleven specimens from Pandritton, Garhi and the Jhelum River (Kashmir) and Dagshai (Punjab) with the Head and Body 95-144 mm. and Hind foot 18-21 mm., vary between slightly dark neutral grey to dark ashy brown (agreeing with *tyleri*).

The existence of these specimens, apparently intermediate between *S. m. tyleri* and *S. m. sindensis* occurring within the ranges of both, raised doubts regarding the existence of two distinct races. Accordingly, the skins and skulls

of all specimens of the genus *Suncus* in the British Museum Collection from West Pakistan, Kashmir and the adjoining areas of India were studied and the relevant observations are recorded in Table I.

From Table I it is evident that the body, hindfoot and cranial measurements of *S. m. tytleri* and *S. m. sindensis* fall within the same range. In addition the fur colour shows a gradual darkening from the pallid specimens of the desert and dry areas of Sind and Kathiawar to the darker specimens from the wet plains and mountains in the Punjab, the United Provinces, Nepal and Kashmir. Lindsay observed that the fur colour is darker in the specimens from higher altitudes than in those of the lower elevations.

The adaptive features of *Suncus murinus* to arid and semiarid zones and their response to the surrounding ecological conditions in their usual habitat have resulted in a change in the general colouration of fur and hairs. This view is substantiated by an examination of a large number of specimens collected from the provinces of the Punjab and Sind. The two species of musk shrew namely *S. murinus tytleri* Blyth 1859 and *S. m. sindensis* Anderson 1877, reported earlier from this region have much in common and support an idea of a single species. Both species are house dwellers, hiding themselves during day time in dark places, generally coming out at dusk for foraging over animal matters; and decaying rubbish. The breeding season in both the species are fall and spring, somewhat earlier in Sind and later in the Punjab and continue till September. The breeding of *S. tytleri* has been reported as fall (postmonsoon) and spring in the Lyallpur by Taber et al 1966. They remain active more or less throughout the year, but less in excessive cold. The size variation in *S. murinus* has been reported by Louch, Ghosh and Pal 1966. The specimens of *Suncus murinus* from Malaya, Ganm and Calcutta were all different in size and weight. The present observation on the two earlier described species have shown a little variation in their size and cranial structure and measurement. The measurement of different parts in either cases fall within a range common to both. The head and body length in case of *S. tytleri* fall within a range of 95-144; and in case of *S. sindensis* 100-150 mm. The hind foot in both varies from 18-21 mm. The average mean length of head and body of *S. tytleri* is 118, and that of *S. sindensis* 124 mm. The hind foot in case of former is 19 and in the later 18 mm. But the variation in individual is as such that its entity as a separate species seem to be untenable. Hence the mere colour variation due to adaptability cannot be accounted for a new species.

Hence it must be concluded that throughout West Pakistan and Kashmir there are two species of *Suncus* each of which is represented only by a single race. The two species are easily separated because of their great disparity in size *S. murinus tytleri* Blyth being almost twice as large as *S. stoliczkanus subfulvus* Anderson.

TABLE I.—Principal measurements (in mm.) of *Suncus* spp. from West Pakistan,

Name, British Museum, Number, Sex, Locality.	Length Head & Body.	Tail	Hind Foot	Condylol-basal () length ()	Lachrymal breadth
1	2	3	4	5	6
<i>S. murinus tytleri.</i>					
8·7·6·11, Female, Jhelum River, Kashmir.	126·5	65·5	19·3	..	6·4
8·7·6·12, Female, Pandritton, Kashmir	126	78	20	30·9	7·3
8·7·6·13, (?), Kashmir .. ..	..	..	..	29·1	7·0
11·9·3·5, Male, Dagshai, Simla ..	111	66	21	..	..
11·9·3·7, Male, Dagshai, Simla ..	128	68	19	29·6	7·0
11·9·3·8, Female, Dagshai, Simla ..	124	68	20	..	6·7
11·9·3·9, Female, Dagshai, Simla ..	95	63	18	26·0	6·7
11·9·3·10, Female, Dagshai, Simla ..	115	68	18	27·3	6·9
11·9·3·11, (?) Dagshai, Simla ..	..	..	..	26·7	6·8
28·8·1·10, Male, Rohilkhand, U.P. ..	124	80	20	..	..
28·9·3·11, Male, Simla	119	71	20	..	..
30·2·11·74, Male, Kumaon, U.P. ..	133	79	20	31·0	6·8
30·2·11·75, Male, Kumaon, U.P. ..	120	75	20	..	..
30·2·11·76, Male, Kumaon, U.P. ..	144	75	20	32·2	7·2
30·2·11·78, Female, Kumaon, U.P. ..	115	76	19	29·8	6·9
30·2·11·79, Male, Kumaon, U.P. ..	116	68	20	30·9	6·9
30·2·11·80, Male, Nepal	110	66	20	29·7	6·8
30·2·11·81, Female, Nepal	102	75	20	29·2	6·6
30·2·11·82, Male, Nepal	112	67	20	..	..
30·2·11·83, Female, Nepal	115	76	21	..	..
30·2·11·84, Male, Salt Range ..	112	84	20	30·3	6·9
30·2·11·85, Male, Salt Range ..	132	93	21	31·9	6·9
30·2·11·86, Male, Salt Range ..	126	75	20	..	..
30·2·11·87, Male, Murree	97	78	18	..	6·8
30·2·11·88, Male, Murree	103	77	18	27·6	6·6
30·2·11·90, Male, Kangra Distt. ..	122	90	20	31·2	7·1
30·2·11·91, Male, Kangra Distt. ..	123	82	18	..	..

Kashmir & India.

Breadth brain- case	Depth brain- case	Mandible	Maxillary tooth row	Mandi- bular tooth row	Fur colour.	
7	8	9	10	11	12	
..	..	15.7	13.0	12.1	Dorsal fur from slightly dark neutral grey to dark ashy brown, ventral fur lighter and with silvery sheen in the specimens with lighter shades.	
13.4	6.9	17.5	14.0	13.0		
12.7	6.5	16.6	13.4	12.4		
..	..	..	13.1	12.2
12.9	6.6	16.6	13.3	12.2		
..	..	15.9	13.0	11.9		
11.2	5.7	15.1	12.1	11.3		
11.2	6.1	15.6	12.8	11.6		
11.5	6.3	15.3	12.4	11.3		
..		
..		
13.3	6.9	17.0	13.6	12.2		
..		Dorsal fur from slightly dark neutral grey to dark ashy brown, ventral fur lighter and with silvery sheen in the specimens with lighter shades.
..	..	..	13.8	..
12.4	6.8	17.3	14.1	13.1		
13.2	6.3	17.4	14.0	12.9		
12.8	6.4	17.0	14.0	12.9		
12.3	6.3	16.7	13.6	12.5		
..		
..		
13.0	6.7	16.2	13.2	11.7		
13.2	6.6	16.9	14.1	12.7		
..		
..	..	15.0	13.0	11.9		
11.8	6.3	15.0	12.6	11.5		
12.6	6.5	16.9	14.1	12.8		
..		

Name, British Museum, Number, Sex, Locality.	Length Head & Body.	Tail	Hind Foot	Condylo- basal () length ()	Lachrymal breadth
1	2	3	4	5	6
30·2·11·92, Female, Kangra Distt. ..	103	74	18	28·5	6·7
30·2·11·93, Male, Kangra Valley ..	124	75	19	30·0	6·9
30·2·11·94, Female, Chamba State ..	108	78	19	..	..
30·2·11·95, Female, Chamba State ..	107	72	19	..	..
36·2·18·47, Female, Pandritton (Kashmir).	116	80	19	..	..
36·2·18·48, Female, Garhi Kashmir	127	61	19	..	..
90·1·1·36, (?), Murree .. ..	..	..	..	23·1	6·9
Average ..	117·3	74·7	19·4	29·4	6·8
<i>S. murinus sindensis.</i>					
7·10·4·1, Male, Sialkot (Punjab) ..	120	67	20·5	30·5	7·1
7·10·4·2, Female, Sialkot (Punjab) ..	120	66	18	27·4	6·9
9·4·6·6, Female, Ambala (Punjab) ..	100	?	19	..	..
9·4·6·7, Female, Ambala (Punjab) ..	133	83	21	..	..
9·4·6·8, Female, Ambala (Punjab) ..	177	67	20	29·0	6·7
9·4·6·9, Female, Ambala (Punjab) ..	118	68	19	31·1	7·1
28·8·1·5, Male, Kathiawar ..	115	65	18	..	..
30·2·11·96, Male, Gujrat (India) ..	124	76	18	29·0	6·0
30·2·11·97, Male, Gujrat (India) ..	122	77	20	..	..
30·2·11·98, Male, Gujrat (India) ..	111	65	18	..	..
30·2·11·99, Male, Kathiawar	110	67	18	..	6·4
30·2·11·100, Male, Kathiawar ..	121	77	19	..	..
30·2·11·101, Male, Kathiawar ..	120	73	18	..	..
30·2·11·102, Male, Kathiawar ..	128	65	20	..	..
30·2·11·103, Male, Kathiawar ..	139	73	21	..	..
30·2·11·104, Male, Cutch	128	76	19	..	..
30·2·11·105, Female, Cutch ..	105	67	17·5	28·5	6·6
30·2·11·132, Male, Gujrat (India) ..	120	67	18	..	..
80·12·15·14, Female, Karachi ..	..	..	..	30·2	6·9
90·1·1·39, (?), Ajmer .. ..	..	..	..	26·5	6·0
Zoological Survey Deptt., Female, Karachi.	150	92	19	..	..
Average ..	100-150	71·8	19·0	29·0	6·4

Breadth brain- case	Depth brain- case	Mandible	Maxillary tooth row	Mandi- bular tooth row	Fur colour.	
7	8	9	10	11	12	
12.2	6.6	16.4	13.5	12.5	Dorsal fur from slightly dark neutral grey to dark ashy brown, ventral fur lighter and with silvery sheen in the specimens with lighter shades.	
13.0	6.5	16.8	13.7	12.6		
..		
..		
..		
..		
12.2	6.5	15.6	13.2	11.9		
12.4	6.4	16.3	13.3	12.2		
13.3	6.9	16.7	13.8	12.8		Dorsal fur from neutral grey to sandy grey (neutral grey with a little darker sheen), ventral fur lighter and with silvery sheen.
11.7	6.2	15.7	12.9	11.9		
..	..	16.6	13.0	12.2		
..		
12.6	6.0	15.8	13.1	12.0		
13.7	6.9	17.7	14.1	13.0		
12.3	6.5	15.5	12.3	11.3		
..		
..		
..	..	15.6	12.5	11.4		
..		
..		
..		
..		
..		
12.1	6.2	15.1	12.1	11.1		
..		
12.6	6.3	15.9	13.4	12.6		
11.3	6.0	15.0	12.2	11.0		
..		
12.4	6.4	15.9	12.9	11.9		

Name, British Museum, Number, Sex, Locality.	Length Head & Body.	Tail	Hind Foot	Condylo- basal () length ()	Lachrymal breadth
1	2	3	4	5	6
<i>S. stoliczkanus subfulvus</i>					
28·8·1·20, Female, Sukkur (Sind) ..	74	48	11·0	..	..
28·8·1·21, Male, Kathiawar ..	70	46	10·5	..	..
30·2·11·138, Male, Kathiawar ..	71	36	10·5	..	..
30·2·11·139, Male, Kathiawar ..	72	44	11·0	..	..
30·2·11·140, Female, Sukkur (Sind)	50	34	10·0	..	..
Average ..	67·4	41·6	10·6	..	..

N. B, '—' denotes 'not available'.

Breadth brain- case	Depth brain- case	Mandible	Maxillary tooth row	Mandi- bular tooth row.	Fur colour.
7	8	9	10	11	12
..	Dorsal fur fawn colour and ventral paler.
..	
..	
..	
..	
..	
()	()	()	()	()	

2. Genus *Crocidura* Wagler:

Of nineteen specimens of the genus *Crocidura* from West Pakistan and Kashmir in B. M. (N. H.) Collection, thirteen specimens were found to have been allocated to *C. fuliginosa* Blyth and six undecided.

Blyth (1855) described *Crocidura fuliginosa* from Schwegeyin, near Pegu, Burma. Ellerman and Morrison-Scott (1951) indicated that, according to Chasen, this species occurred in the Malay Peninsula and that he was uncertain of its exact status. Anderson (1877) described *Crocidura kingiana* from Sikkim and Ellerman and Morrison-Scott (1951) examined specimens of this species in the B. M. Collection from Kumaon and Punjab. Miller (1911) described *Crocidura pullata* from Kotihar, Kashmir and also (Miller, 1913) *Crocidura pergrisea* from Shigar (Baltistan), Kashmir.

The principal dimensions of the Type specimens of these four species are given in Table II and those of the collections of *C. fuliginosa* and *C. kingiana* are given in Table III.

The remaining specimens previously allocated to *C. fuliginosa* and six unidentified specimens have been allocated as shown in Table IV.

TABLE II.—Principal dimensions (as recorded by their authors) of the Type specimens of *Crocidura* species, collected from West Pakistan and Kashmir.

Name of the Type	Length H. & B.	Tail	Hind Foot	Percentage of tail with H. & B.	Condylo- basal length	upper teeth	Remarks
<i>Crocidura fuliginosa</i> Blyth	.. 3 1/4"	2 1/4"	5/8"	70%—	1"	7/16"	In inches. Soles bare to the heel.
	=82.6	57.2	15.9	..	25.4	11.1	In mm.
<i>Crocidura kingiana</i> Anderson	.. 3.20"	2.42"	0.60"	70%+	0.73"	0.36"	In inches. Feet with dark coloured pads.
	=81.3	61.5	15.2		18.5	9.1	In mm.
<i>Crocidura pullata</i> Miller	.. 82.90 (86.1)	40.47 (42.6)	15 (14)	70%—	19.8	8.8	In mm.
<i>Crocidura pergrisea</i> Miller	.. 72.75	73.74	12.6	70%+	19.0, 19.4	8.6	In mm Tail with a dusky area on the dorsal surface at its tip.

TABLE III.—Principal dimensions of *C. fuliginosa* and *C. kingiana* (in mm.) in the

Specimens examined British Museum Number	Sex	Locality	Length Head & Body	Tail	Hind Foot	% tail with H. & B.
<i>Crocidura fuliginosa</i> Blyth :						
6·10·4·14	Female	Pahang	.. ..	.. ..	.. ..	.. ..
90·1·1·50	?	Darje- eling.	.. ..	.. ..	.. ..	.. ..
90·1·1·51 .. ..	?	„	.. ..	.. ..	.. ..	.. ..
90·1·1·52	Male	„	.. ..	.. ..	.. ..	.. ..
90·1·1·53	Female	„	.. ..	.. ..	.. ..	.. ..
<i>Crocidura kingiana</i> Anderson:						
15·9·1·46	Male	Sikkim.	73	70	15·5	70%+
15·9·1·47	Female	„	73	58	14	70%+
26·9·2·10	Male	Kangra.	77	57	15	70%+

British Museum (Natural History) Collections.

Condylo- basal length	Lachry- mal Bre- adth	Breadth of Brain- case	Depth of Brain- case (median)	Mandible	Maxil- lary tooth row(entire)	Mandibu- lar tooth row(entire)
.20-1	.. 5.4 ..	9.0 ..	5.2	11.5	.. 9.4	.. 8.4
.19.0	.. 5.1 ..	..	..	10.7	.. 9.0	.. 8.1
.20.2	.. 5.4 ..	9.4 ..	5.0	10.8	.. 9.1	.. 8.0
.20.6	.. 5.2 ..	9.5 ..	5.2	..	.. 9.2	..
.19.8	.. 5.3 ..	8.9 ..	5.0	11.0	.. 9.4	.. 8.5
20.9	.. 5.5 ..	9.5 ..	5.3	11.8	.. 9.0	.. 8.5
19.4	.. 5.0 ..	8.7 ..	4.7	10.9	.. 8.9	.. 8.2
23.2	.. 5.3 ..	10.0 ..	5.3	13.2	.. 10.5	.. 9.8

TABLE IV.—*Identification of nineteen specimens of the genus Crocidura from*

B. M. No.	Sex	Locality	Length Head & Body	Tail	Hind Foot	Percen- tage of tail with H. & B.	Condyl- basal length
<i>Crocidura pergrisea pergrisea</i> Blyth:							
7·8·1·1*	.. Female	Thandiani (Hazara)	60	43·5	12	70%+	17·1
7·11·21·6*	.. Female	Gharial (Punjab)	78	46	12	70%—	19·0
7·11·21·7*	.. Female	„	71	43	12	70%—	18·2
7·11·21·8*	.. Female	„	75	45	11	70%—	..
7·11·21·9*	.. ?	} Kaghan Val ley	62	40	11	70%—	..
8·10·3·3	.. Female	„	76	43	11	70%—	17·4
20·6·27·1	.. ?	Thandiani.	61	46	12	70%+	..
<i>Crocidura russula pullata</i> Miller :							
8·7·6·14*	.. Male	Pahlgam	73	40	12	70%—	..
8·7·6·15*	.. ?	Kashmir	69	43	12	70%—	..
8·7·6·16	.. Female	Dangram (Kashmir.)	76	48	13	70%—	19·9
36·2·18·43	..	Dachgam (Kashmir.)	73	45	12	70%—	..
<i>Crocidura attenuata kingiana</i> Anderson :							
8·10·4·1*	.. Male	Murree (Punjab.)	67	50	13	70%+	18·7
10·1·18·20*	Male	„	66	43	13	70%—	..
10·1·18·21*	Male	„	72	44	14	70%—	..
10·1·18·22*	Male	„	73	46	13	70%—	..
10·1·18·23*	Male	„	73	48	14	70%—	..
10·1·18·27*	Female	„	75	43	12	70%—	..
23·11·4·9	.. Male	„	72	51	13	70%+	..
23·11·4·10	.. Male	„	75	51	13	70%—	..

*Previously labelled *Crocidura fuliginosa* Blyth.

West Pakistan and Kashmir in the British Museum (Natural History) Collection.

Lachrymal Breadth	Breadth of brain case	Depth of Brain-case (Median)	Mandible.	Maxillary tooth row (entire)	Mandibular tooth row (entire)	Remarks
4.8	9.9	8.1	7.3	Feet and tail whitish; a prominent dusky area on the dorsal surface at the tip of the tail.
5.1	9.0	4.6	10.5	8.1	7.4	
5.1	9.0	4.4	10.0	8.0	7.3	
..	..	..	..	8.4	7.5
5.1	..	..	10.0	8.3	..
4.8	8.4	4.4	10.2	8.1	7.6	
..	10.2	8.3	7.5	Feet without dark coloured pads colour division between underparts & back less abrupt.
..	..	..	11.0	8.8	8.2
..	..	..	11.1	8.8	8.2
5.2	9.4	4.6	11.0	8.8	8.2	
5.2	..	..	11.1	8.9	8.2
..	9.2	4.8	10.8	8.4	7.9	Feet with distinct dark coloured pads.
..	
..	10.7	8.3	7.7	
5.1	11.0	8.7	8.0	
5.1	10.9	8.3	7.8	
..	10.4	8.2	7.5	
..	
..	

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ON THE MOLLUSCA : GASTROPOD-FAUNA OF PAKISTAN

BY

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INTRODUCTION

In this paper an attempt has been made to give a systematic account of the Gastropod Fauna of Pakistan, comprising marine, fresh water and the land forms inhabiting the coastal areas, particularly the littoral zone, and fresh water habitats, like ponds, lakes, rivers, streams, canals and to a certain limit the vegetation, of both wings of the country. The richness of the fauna, the multitudinousness of varieties, the peculiarity of their adaptations has till now remained fully un-explored, and as such a comprehensive description as to their distribution, their relation to ecological conditions is still scanty and scattered, though a considerable and illustrative work has been carried out on this group by large number of workers in India, a list of which is not added here.

The present study has been aimed to fill up the short-comings created by the unpaid attention of the earlier workers.

This work may not be a complete list of the members of this group but ways have been paved for the future workers to complete this list of animal.

AREAS SURVEYED

The marine forms described here are from both wings of the country, *i.e.*, from Arabian Sea and Bay of Bengal. St. Martin Island, Kutubdia Island, Cox's Bazar, Moheshkhali, Teknaf, Swan Deep, Badar Mukam (Distt. Chittagong), are the various localities in the Bay of Bengal. In West Pakistan, it was collected from Keti Bunder, Pitiani Creek, Korangi Creek, Clifton, Oyster Island, Native Jetty, Keamari, West Wharf, Fish Harbour, Manora Island, Bhit Island, Baba Island, Sands-pit, Hawks Bay, Bulleji, Paradise Point, G. M. Hut, Charna Light House, Gadani, Sonmiani Beach, Karachi Coast (Sind). Ormara, Astola Island, Pasni, Guwadar, Jiwani, Makran Coast (Baluchistan).

In East Pakistan the fresh water and land forms were surveyed and collected in the localities Tejgaon, Dacca (Distt. Dacca), Chapai, Nawabganj, Biani Beel, Madhupur (District Rajshahi), (District Sylhet), Teknaf. Sylhet Karanaphuli Lake, Purnavaba River, Rohanpur, Barkal, Dohazari, Kaptai Lake, (District Chittagong), Kaunsher River, Mohanganj (District Mymensingh), Lak-sum (District Comilla), Dinajpur. Jessore (Distt. Jessore), Khulna (District Khulna), Faridpur (Distt. Faridpur), Rangpur (District Rangpur).

In West Pakistan, Karachi, Tori Village, Sema Dara (District Jacobabad) Miani Dhand (District Hyderabad), Mirpur Sakro, Chack Sadeka, Kalri Lake (District Thatta), Mancher Lake (District Dadu), Sakrand (District Nawab shah) Larkana (District Larkana), Sind, Turbat, Makran, Mastung, Harnai, Khuzdar, Kalat State, Hanna, Quetta (Baluchistan), Murree, Abbottabad, Rawalpindi, Shahdara, Ravi River, Lahore (Punjab) and Azad Kashmir.

The material was collected both in alive and dead conditions. The alive forms were narcotized with 20% mg. So₄ and preserved in 5% formaline or 70% alcohol. Shell as well as living specimens were considered for the identification.

SYSTEMATICS ACCOUNT

Class GASTROPODA

Subclass : PROSOBRANCHIA Order : ARCHAEOGASTROPODA

Superfamily PLEUROTOMARIACEA

Family FISSURELLIDAE

Subfamily DIODORINAE

Genus *Diodora* Gray 1821

Synonymy. :

Sipho, Brown; not Klein. Rimula, Loven; not DeFrance.
Puncturella, Lowe. Cermorla, Leach.

Diodora funiculata Reeve

The Corded Fissurella.
Pl. I Sp. No. 1a, 1b.

The shell is ovate, and more or less attenuated anteriorly. The elevated conical top is inclined in front and the surface is closely gammatately cancellated throughout and provided with obtuse radiating and concentric lines. The orifice is nearly rounded, whitish, and rayed with olive rust colour. The cord is impregnated at intervals with olive brown colour. The exquisite sculpturing with finely curved lines, its colouration and the articulation of the cord makes it remarkable species.

Localities :

Karachi Coast (West Pakistan). Sonadia Island, District Chittagong, (East Pakistan).

Habitat :

The members of this species are mostly confined to the rocky shores. They live below low-tide mark.

Diodora tecaonica Reeve

The ticao Fissurella
Pl. I, Sp. No. 2.

This species like the previous one is ovate. The gibbosity is much elevated and larger and inclining anteriorly with somewhat hook-like structure. The surface is thickly flattened throughout with strong narrow radiating ridges and rayed concentric striae. The orifice is rather elongately oblong and the sides around are excavated. The general colouration is greenish-white intermixed with dots and blotches of olive green or bluish colour mostly round the orifice.

Localities :

Manora Island, Bulleji, Karachi Coast; Pasni, Makran Coast; (West Pakistan).

Habitat :

Similar to *D. funiculata*.

Superfamily PATELLICAE

Family PATELLIDAE

Genus *Cellana* H. Adams

Cellana radiata Born

The common Pakistani limpet
Pl. I, Sp. No. 3.

The shell is much conical having generally an out-growth of algae over the surface. The inner surface possesses a pearly lustre. The numerous concentric striae and superficial ridges are whitish and coarse, with promiscuously blood red streaks. Most specimens possess rough surfaces with reddish-brown spots.

Localities :

West Wharf, East of Manora Island, Bulleji, G.M. Hut, Paradise Point, Karachi Coast (West Pakistan) and St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

Low-tide mark along the coast on rocks.

Superfamily TROCHACEA

Family TROCHIDAE

Genus *Monodonta* Lamrack, 1801

Synonymy :

Labio, Oken, not Gray. Monodontes, Montf. Odontis, Sowerby. Trochidon, Swainson. Monodon, Schwsig. Unideus, Schinz.

Monodonta canalifera Lamarck

The common-top shell
Pl. II, Sp. No. 4.

A moderate size species with trochiform shell and inflated body whorl. The spiral ribs are minute. Aperture is ovate. Umbilicus is absent. There is usually a single, strong tooth at the fore part of the columella and the outer lip is much thickened. The operculum is orbicular and many whorled. The shell is purple with white spots, alternating with a regular brown spots, seemingly more or less with a continuous line.

Localities :

Bulleji, Karachi Coast; (West Pakistan). St. Martin Island, District Chittagong (East Pakistan).

Habitat

Very common among the rocks along low-tide mark. It was also found in littoral and sub-littoral habitats. Its littoral distribution was usually restricted to crevices or rock pools, especially those of the lower shore.

Monodonta labio Linné

The labio Monodont.
Pl. II, Sp. No. 5.

A medium size species with conoidal shell. Spiral ribs are minute. The whorls are composed of granules. The outer belt is procellanous, the middle perlacous, the inner with an elevated procellanous border. The aperture is oval. Columella toothed, and with a concave pit.

Localities :

St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

Attached to rocks near low-tide mark.

Genus *Clanculus* Montfort, 1810

Synonymy :

Clangulus, Blainv. *Fragella*, Swainson. *Otaria*, Risso, not Gray.

Clanculus microdon A. Adams

The Microdon top shell
Pl. II, Sp. No. 6a, 6b.

The shell is conical with rounded whorls. The surface sculpture consists of beaded spiral ridges. Umbilicus is present, rounded, large and toothed inside. The shell surface is dark gray to blackish, with dirty white spots.

Localities :

Manora Island, Bulleji, G. M. Hut, Charna Light House; Karachi Coast (West Pakistan).

Habitat :

Commonly found attached to rocks.

Genus *Euchelus* Philippi, 1847

Synonymy :

Eucheles, Philippi. *Arzadasia*, Gray.

Euchelus asper Gmelin.

The asper top shell.
Pl. II, Sp. No. 7.

The shell is turbinately conoidal with somewhat inflated body whorl. The whorls are rounded with transverse, granular ribs. Columella is acute. The lip is extremely thick, obtuse rounded and internally crenate. There is a single tooth on columella, and the operculum is ovate in shape and of comparatively few whorls. These are usually umbilicated. The shell is reddish-brown in colour.

Localities :

Manora Island, Bulleji, G. M. Hut, Charna Light House; Karachi Coast (West Pakistan).

Habitat :

Most common on rocky shore.

Genus *Trochus* Linne, 1758

Trochus niloticus Linné.

The water flowing top shell.
Pl. III, Sp. No. 8.

The shell is pyramidally conical and exceedingly large. Body whorl angularly flattened at the base. Aperture is oblique. The twisted columella at the hind part gives the appearance of false umbilicus and usually forms a sort of canal. The whorls are with an oblique flat sloping, sparingly grained, and white under the radiating flames of rose colour.

Localities :

St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

Both littoral and deep sea form. The eggs are laid on rocks or glued to sea-weed in masses.

Trochus maculatus Linné.

The spotted top shell.

Pl. III. Sp. No. 9.

The shell is excavately umbilicated, broadly conical and attenuated at the apex. The ground colour is reddish-olive, spotted near the apex with purple-red. Whorls are strongly crispy grained. Grains are comparatively larger near the suture. Base with a circular and a closely arranged granulated ridge.

Localities :

Astola Island, Pasni, Makran Coast (West Pakistan) and St. Martin Island, District Chittagong (East Pakistan).

Habitat :

These are found in considerable numbers on the rocks at low-tide.

Trochus virgatus Gmelin.

The striped top-shell.

Pl. III, Sp. No. 10.

The shell is imperforate and elevated in form. The outer surface of the shell is striped with large purple blotches. Whorls are slopingly convex; with strong spirally grained-ridge over the surface. Base is flatly concave with spirally arranged grains. Deep rose streaks are present all over the shell.

Localities :

St. Martin Island, Distt. Chittagong (East Pakistan) and Makran Coast (West Pakistan).

Habitat :

The individuals of the species are found on rocky shores or attached to hard object.

Trochus radiatus Gmelin.

The rayed top-shell

Pl. III, Sp. No. 11.

The shell like the previous species is excavately umbilicated with shorter longitudinal axis; whitish in colour and obliquely rayed with purple-red. Whorls are convex, encircled with three rows of nodules granules. Margin is encircled with two rows of smaller grains. The lower part of the whorl is angular with rather flattened base, and red-dotted.

Localities :

St. Martin Island, District Chittagong (East Pakistan) and Pasni, Makran Coast (West Pakistan).

Habitat :

These are commonly found attached to rocks at low-tide. They are chiefly vegetable feeders living on algae.

Genus *Umbonium* Link, 1807**Synonymy :**

Gilobulus, Schun; not J. Sowerby. *Helicina*, Gray, not Lamarck, Rote 112. Lamarck. *Pitonnillus*, Montf. *Ptychomphalus*, Agass.

Umbonium vestiarium Linné.

The vestiarium Button.
Pl. III, Sp. No. 12.

The shell is very small. The spire is depressed and the body whorl is inflated with an angular base. The aperture is somewhat D-shaped. Inner lip ending in a simple point, outer lip acute. Eoperculum is horny. The umbilicus is absent, and this place is represented by a large prominent callosity. There is a wide range of colour variation within the species. The shells are highly polished and brightly coloured.

Localities :

West Wharf, Manora Island, Karachi Coast (West Pakistan). St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

Members of this species are abundant on sandy beaches and found in dead condition along the sandy shore.

Family TURBINIDAE**Genus *Turbo* Linne, 1758****Synonymy :**

Fornax, Klein; not Laporte. *Olearia*, Klein, *Saccus*, Klein. *Lunaria*, Fabr. *Lunaris*, Link. *Cidaris*, chem; not Bolt.

Turbo marmoratus Linné.

The Marbled Turban shell
Pl. IV, Sp. No. 13.

This giant shell looks more or less like a turban. The spires are somewhat depressed, whorls are few square shouldered and knobbed. The body whorl is rounded. The columellar region is excavated considerably and the umbilicus is absent, the surface colour green marked with white and red-brown. The inner side is pearly. The operculum is thick and calcareous or stony.

Localities :

Martin Island, District Chittagong (East Pakistan).

Habitat :

They are well represented on rocky shore of East Pakistan. These are vegetable feeders.

Turbo intercostalis Menke.

The intercostalis Turbo.
Pl. IV, Sp. No. 14a, 14b.

The shell is of moderate size. The outer surface is granulated. The spire is elevated. The last whorl is rounded and ventricose. Aperture is sub-circular. Outer lip thick and simple. Operculum is convex in out line, calcareous and solid. Inner side is pearly.

Localities :

Manora Island, Bulleji, Karachi Coast (West Pakistan) and St. Martin Island, District Chittagong (East Pakistan).

Habitat :

The species of turbo are principally inhabitant of rocky areas of East and West Pakistan.

Turbo coronatus Gmelin.

The coronatus turbo.
Pl. V, Sp. No. 15a, 15b.

The shell is of moderate size nearly circular. The body-whorl more or less rounded. The spire somewhat depressed with nodules. The aperture is also circular. The operculum is thick and calcareous. Inner surface is of pearly lustre.

Localities :

Manora Island, Bulleji, G.M. Hut, Karachi Coast (West Pakistan).

Habitat :

They are found along the rocky coast.

Genus *Astraea* Röding, 1798

Synonymy :

Stella, Klein. Cyclocantha, Swainson. Calcar, Montf. Sol, Klein. Stellaria, Schmidt.

Astraea semicosta Kiener.

The common star-shell.
Pl. V, Sp. No. 16.

A small size specimen $1\frac{1}{2}$ inches in width. Shell is low, almost flat on its lower side. Periphery of whorls with strong, flattened, triangular spines. Umbilicus is absent. Aperture is silvery inside. General colour white.

Localities :

Manora Island, Bulleji, Sonmiani, Karachi Coast, Astola Island, Makran Coast (West Pakistan). St. Martin Island, District Chittagong (East Pakistan).

Habitat :

Fairly common near low-tide mark. Alive specimens were found on the underside of rocks at a depth of 30 meters. Shells were also collected on sand.

Superfamily NERITACEA**Family NERITIDAE****Genus *Nerita* Linné, 1758****Synonymy :**

Odontostoma, Klein; not D/orb. Neritarius, Dun.

Nerita plexa chemnitz.

The platted Nerite.

Pl. VI, Sp. No. 17a, 17b.

The shells generally measuring 3/4 to 1 inch in length. The ground surface is dirty white with irregular spots of black colour arranged in spiral rows. It is ovately globose, flatly compressed at the spire. The whorls are spirally ribbed. The ribs are broad and narrow. The Columella is flatly excavated. Columellar area tinged with yellow and consisting of 2 to 3 strong teeth. The Outer lip is white with black spots on margin. A D-shaped opercular opening is present. The Operculum is black in colour, finely papillose.

Localities :

West Wharf, Manora Island, Charna Light House, Karachi Coast. Astola Island, Makran Coast (West Pakistan) and St. Martin Island, District Chittagong, (East Pakistan).

Habitat :

Very abundant along the rocky shores facing the open ocean.

Nerita albicilla Linné.

The ex-plate Nerite.

Pl. VI Sp, No.18a.18b.

The shell is triangular, ovate, very depressed. The Outer surface in with white & black longitudinal bands. The spire is obtuse and flattened. The whorls are narrow and gradually expanded towards the aperture. The ribs are in a spiral and close-set, more or less obtuse. The outer lip is effused broadly, much thickened in-wardly, scarcely crenulated. Parietal area is granulated throughout, white to yellowish and with 2 to 3 teeth but minute in size. Umbilicus is absent.

Localities :

Manora Island, Paradise point, Charna Light House, Karachi Coast. Pasni Makran coast ; (West Pakistan) and St. Martin Island, District Chittagong, (East Pakistan).

Habitat :

Commonly congregate in large numbers on rocks near low-tide.

Nerita costata Gmelin*The ribbed Nerite*

Pl. VI Sp. No. 19a, 19b.

The shell is globose and solid with blackish and yellowish red striation. The spire is obtuse and flattened, surface spirally ribbed. Ribs are regular rounded and jet black. The parietal area convex, stained with yellow, upper margin wrinkled strongly toothed, 8 in number. The aperture is thick and strongly serrated.

Localities :

Manora Island, Charna Light House ; Karachi Coast and Makran coast (West Pakistan).

Habitat :

It is uncommon.

Nerita polita Linné*The polished Nerite.*

Pl. VII Sp. No. 20.

The shell is obliquely ovate and broadly convex, The spire is very minute, obtusely flattened. The whorls are narrowly rounded and latterally compressed towards the spire. Outer lip is thick, white and polished. The parietal area finely toothed at the edge. Teeth are variable in number. Bright in colour.

Localities :

Manora Island, Charna Light House, Karachi coast ; Astola Island ; Makran coast (West Pakistan) and St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

They are littoral in their habits living on rocks and stones and are said to be most active during the night, when they roam about, feeding on the algae. Their eggs are ovate, covered with a horny skin, and attached to other shells.

Nerita rumphii Recluz*The Rumphius Nerite.*

Pl. VII Sp. No. 21.

The shell is oblong, globose and shining. The spire is obtusely compressed. The whorls are concentrically striated and narrow, rather convex. The outer lip is very thickened. The parietal portion is concavely flattened. The teeth are present but minute in size and the colour of the shells are variable.

Localities :

Astola Island, Pasni, Makran coast ; (West Pakistan) and St. Martin island, Distt. Chittagong, (East Pakistan).

Habitat :

They are principally littoral in habits living on the rocks.

Nerita lineata Chemnitz

The lineated Nerite
Pl. VII Sp. No. 22a, 22b.

The shell is oblong, ovate and sub globose. Apex is present in lateral position but little exerted. The whorls are rounded but narrow. The aperture is slightly thickened and serrated. Columella is flat stained with yellow colour. with rudely toothed at their edge. Spire-ridge is pink-purple to black in colour.

Localities :

Charna Light House ; Karachi coast (West Pakistan).

Habitat :

It is inhabitant of low-tide. Living on rocks.

Genus : *Neritina* Lamarck, 1816

Synonymy :

Clypeolum, Recluz. Nercina, Crist, and Jan. Lamprostoma, Rafin ; not Swainson Chernites, Gistel.

Neritina neglecta

The Neglect Neritina.
Pl. VII Sp. No. 23a, 23b.

A small species, 1/2, inch in length. The shell surface is smooth, glossy, colour pattern and shades yellowish-black with white, crooked lines, dots and mottling. Zebra-like stripes and sometimes spirally banded, marking near and below the spire, are present. Columella is smooth, convex, white in colour and with a variable number of small, irregular teeth. The operculum usually black.

Localities :

Patiani creek, Kety Bunder in the delta of Indus River, (West Pakistan).

Habitat :

A very common, inhabitant of intertidal and brackish-water flats. They usually lay eggs in the month of July and August on the shells of same species. The peculiar characteristic of the species is in the fact that among the hatching eggs, the one which emerges earlier endeavours the others.

Order Mesogastropoda
Super Family Architaenioglossa
Family Cyclophoridae
Sub-Family Cyclophorinae
Genus Cyclophorus Montfort, 1810.
Subgenus *Annularia* Schumacher, 1817.

Synonymy :

Turbo, Chemnitz, *Annularia*, Schumacher.
Cyclostoma, Pfeiffer. *Helix*, Müller.

Cyclophorus (Annularia) *aurantiacus* Schum

The round Mouth snail
Pl. VIII Sp. No. 2

The shell is of larger size, fulvous white in colour with zig-zag deep brown marks, thick and solid. The spire is turbinated more depressed and are relative broad. The body-whorl is broad, smooth and fine, whorls of spire are convex transpiral bands are present. The aperture is circular and has a thickened peristome which is reflected out. Apertural lip is bright orange and inner portion is white.

Localities :

Rangamatti, Distt. Chittagong (East Pakistan); they are usually inhabitant in West Pakistan.

Habitat :

Humid parts of Forests and also in damp places among loose stones. They are also found concealed near the trees or inhabiting the branches and the foliage when humidity is high.

Family Viviparidae

Sub-Family Viviparinae.

Genus *Viviparus* Monfort, 1810.

Synonymy :

Vivipara, Lamarck. *Paludina*,

Viviparus bengalensis Lamarck

The Banded Pond-snail.
Pl. VIII Sp. No. 25a, 25b.

A moderately large size species 2 to 3 inches in length. The shell is ovate, sharply acuminate and with a relatively large semi-circular or almost rhomboidal mouth, which is never oblique. There are 5-1/2 to 6-1/2 whorls, the suture is narrowly impressed. The spire is relatively large. The aperture is mango shaped, i.e., angularly pointed above and rounded below. The sculpture consists of close set five transpiral bands and minute punctures. The coloration varies a great deal and is always shaded with olive-green, with alternating broad and narrow dark-brown spiral bands. The narrow bands are lighter in colour than broad ones. The former alone are present in basal region of the body whorl. Some-times longitudinal varices are present on the body-whorl.

The umbilicus is narrowly perforate or completely closed, rarely more open. The columella is strong. Operculum is moderately thin, annular, composed of concentric elements around a central nucleus and of deep brownish in colour.

Localities :

Kalri Lake, Distt. Thatta, Larkana, Mancher Lake, Distt. Dadu, Tori-Dhand, Distt. Jacobabad, Sind (West Pakistan).
Dohazari, Distt. Chittagong, Rajshahi, (East Pakistan).

Habitat :

This vivipera inhabits lakes and rivers. The females are ova-viviparus, and the young fry are not forsaken by their parent until the end of the second month of their existence.

Viviparus crassa Hutton

The thick vivipara.

Pl. VIII Sp. No. 26a, 26b.

The shell is ovately turbinate and is rather solid. Whorls are rounded and constricted at the sutures. The surface of the shell is obliquely plicately striated. Its spire is very feebly wave-striated and sometimes punctured on body whorl. The aperture is circular in outline and the edge of aperture is olive-black in colour. The colour of the shell is yellowish-olive.

Localities :

Purnavaba River, Rohanpur, Distt. Rajshahi (East Pakistan).

Habitat :

These animals are fluviatile, inhabitants of fresh-water. They are found on the banks of the lakes and rivers.

Viviparus naticoids Theobald

The Naticoid Vivipara.

Pl. VIII Sp. No. 27a, 27b.

The shell is obtusely ovate rather stout and with a feebly compressed umbilicus. The ground colour fulvous-olive, encircled with three purple-red bands. The whorls are not broad, but is convex, with closely plicately striation. The aperture is somewhat pyriformly ovate. The shell is covered with brownish-black periostracum.

Localities:

Teknaf, Distt. Chittagong (East Pakistan).

Habitat :

The members of this species are fluviatile, inhabiting lakes and streams.

Viviparus remossii Phillippi

The Remes's Vivipara.

Pl. IX Sp. No. 28a, 28b.

A medium size specimen 1 to 2 inches in length. It is thin, ovately conical and turbinated. The umbilicus is narrowly compressed. The whorls are rounded and smooth. The peristome is thin and continuous rather simple anteriorly. The shell is with a broad purple-red band encircling only the upper half of body whorl.

Localities :

Chapai, Nawabganj, Distt. Rajshahi (East Pakistan).

Habitat :

They are found chiefly in lakes, streams and rivers.

Family AMPULLARIIDAE

Genus *Pila* (Bolten) Röding, 1798

Synonymy :

Ampullarius, Montf. Pomacea, Perry. Pachystoma, Guild., not Blum
Pachylabra, Swainson. Ampullaria, Lamarck.,

Pila globosa Swainson

The Globose Apple snail
Pl. IX Sp. No. 29.

The shell is globose and the surface very smooth and glossy. The spire is depressed but the whorls are inflated. The aperture is oblong oval in out line. The margin is slightly thickened, fulvous and grooved. The umbilicus is very small. The peristome is slightly reflected. The transpiral striae runs all along the body-whorl and are thicker near the aperture. The interior of the shell is shiny with yellowish-tinge and transverse reddish bands. The shell is brownish-olive in colour.

Localities :

Biani Bheel, Madhopur, Distt. Rajshahi, Dohazari, Distt. Chittagong
(East Pakistan).

Habitat :

A fresh-water species which *abseusly* dig itself in mud during the dry seasons. The eggs are laid in small capsules, which adhere in a round mass to the stems of aquatic plants. When fresh, they are beautifully coloured, like crimson, pink or blue green.

Pila virens Lamarck

The Virens Apple snail
Pl. IX Sp. No. 30

The shell is globose in shape. The spire is much more depressed but the whorls are less inflated and convex. Hence the spire more conical in structure. The outer surface of the shell contains roughly transpiral striae. The aperture is ovate in shape but is narrowed at the upper end and rounded at the lower. The most important distinguishing feature is the conspicuous and very wide umbilicus. The inner side of the aperture is whitish but on the outer side yellowish, with reddish brown bands. The lips are narrow, reflected and columellar lip does not occlude the umbilicus.

Localities :

Biani Bheel, Madhopur, Distt. Rajshahi and Dohazari, Distt. Chittagong,
(East Pakistan).

Habitat :

The species has been collected along with *P. Globosa* in the same habitat.

Super Family LITTORINACEA

Family LITTORINIDAE

Genus *Littorina* Férussac, 1821

Synonymy :

Trochys, Adams, not Linné. Turbo, Swainson; not Linné. Bacalia, Gray.

Littorina angulifera Lamarck.

The Angulate Periwinkle.

Pl. X, Sp. No. 31a, 31b.

A small size species 1 inch in length, the shell is spirally turbinated. The First two or three whorls are smooth, remainder with five spiral grooves. The Granulations occur all over the surface. The Colour is variable, whitish, orange to red brown some-times black, with darker wavy vertical, oblique strips. The Columella is whitish in colour.

Localities :

Manora Island, Bulleji, G.M. Hut; Karachi Coast (West Pakistan). Sonadia Island, District, Chittagong, (East Pakistan).

Habitat :

Living on rocks between low-tide marks. The eggs are hatched with in or out side the body. They lay eggs in masses on sea weeds or rocks. The males are smaller than the females.

Littorina angulifera lineata Gmelin.

The Anguli-lineated Periwinkle.

Pl. X, Sp. No. 32.

The shell is thin strong and turbinated with sharply pointed conical apex. The spire is well developed. The apertural lip is simple. The Zig-Zag stripes of reddish-brown colour runs from the apex to the body-whorl.

Localities :

Lyari River Off: Lawrence Road, Karachi, (West Pakistan.)

Habitat :

This species survives in Blackish water. The Periwinkle is a vegetarian in habit.

Super Family CERITHIACEA

Family TURRITELLIDAE

Genus *Turritella* Lamarck, 1799

Synonymy :

Monoceros, Meusch; not Bloch or Lamarck. Xyolhelix, Chemnitz. Terebellum, Brown; not Klein. Turris, Hump; not Bolt. Aculea, Perry. Turritellus, Montf.

Turritella terebra Linné.

The Augur Turritella.
Pl. X, Sp. No. 33.

This species has the most elegantly turned spire, tapering into a needle point. Whorls are about twenty-five in number, and each swollen in the middle, with a very sharp six-keeled spire. The sutures are smooth. The pale surface is stained with orange, or clouded all over with chestnut-brown. The operculum is horny, circular in outline, multispiral.

Localities :

St. Martin Island, Distt., Chittagong, (East Pakistan).

Habitat :

This species inhabits from low-water mark to a depth of 100 fathoms. The dead specimens of this species are abundant at St. Martin Island.

Turritella duplicata Linné.

The duplicate Turritella.
Pl. X, Sp. No. 34.

The shell is thick and turbinated. The whorls are sixteen in number. The first few are many keeled, and the remaining with two to three which are very conspicuously elevated. The small keels disappear quickly, while larger keels are less raised. The aperture is considerably sinuated. The colour of the shell is fulvous-cream. The apex and 3 spires of the shell are rather darker in colour.

Habitat :

Common near low-tide marks. Specimens were collected from open sand, at depth of 8—20 meter. Frequently empty shells were found to be inhabited by hermit Crabs.

Family ARCHITECTONICIDAE

Genus *Torinia* Gray, 1842

Synonymy :

Heliacus, D'orb.

Torinia variegata Gmelin.

The variegated sundial.
Pl. XI, Sp. No. 35

The shell is orbicular and elevated in out line, with short axis. The last whorl is rounded at the periphery. The umbilicus is quite wide and deep. Apertural position is rhomboid. The Outer lip is very thin and simple. In operculum is horny, and circular, elevated. The colour of the shell is black with white spots along the spire. The Base is rounded and with cords bearing beads.

Localities :

G.M. Hut, Karachi coast; (West Pakistan).

Habitat :

It is uncommon at low-tide mark.

Genus *Architectonica* Röding, 1798

Synonymy :

Solarium, Lamarck; not Spix. *Physeter*, Humph; not Linné.

Architectonica *perspectivum* Linné.

The Oriental Sun-dial.
Pl. XI, Sp. No. 36a, 36b.

The shell is depressed with very short axis and flat base, having an angular margin. The Whorls possess spiral depression below the sutures, and on the basal coils. The Umbilicus is broad and deep. There occur narrow ridges on each side of the depression and are marked with brown spots. The ground colour is yellowish-brown.

Localities :

Bulleji, Manora Island, Baba Island, West Wharf, Karachi Coast, (West Pakistan) and Sonadia Island, Distt., Chittagong, (East Pakistan).

Habitat :

Fairly common in sand below low-water line.

Architectonica *granulata* Lamarck.

The Granulated sundial.
Pl. XI, Sp. No. 37a, 37b.

The shell is 1 to 2 inches in diameter, the whorls are creamy white with reddish-brown spots. The flat base enlarges into a nodules when it closes into the narrow umbilicus. The surface is with fine, radiating ridges, giving it a raised granules like structure all over its upper surface. The brown dots are in single row.

Localities :

Bhit Island, Baba Island, Karachi Coast, (West Pakistan).

Habitat :

Sundial shells are fairly common on sandy beaches.

Family MELANIIDAE

Genus MELANIA LAMARCK, 1799

Subgenus *Striatella* Brot, 1871

Synonymy :

Nerita, Müller. Tiara, Preston.

Melania (*Striatella*) *tuberculata* Müller.

The tuberculata snail.
Pl. XII, Sp. No. 38, 38.

The shell is elongate. The whorls are rounded slightly convex, and gradual increasing in size downwards. The aperture is rather small and ovate in form. The sculpture of the shell is with raised spiral striae and reddish marking just like a flame. The columellar margin is covered with thin calus. The operculum is ovate in outline and with spiral lines. It is transparent and brown in colour.

Localities :

Kalri Lake, Distt., Thatta, Sind, (West Pkaistan).

Habitat :

They are found on the bank of Lakes, Ponds, and are omnivorous in habit.

Subgenus *Plotia* (Bolten) Röding, 1798

Synonymy :

Buccinum, Müller. Helix, Chemnitz. Bulimus, Brug. Tiara, Preston.

Melania (*Plotia*) *scabra* Müller

The small scabra snail
Pl. XII, Sp. No. 39a, 39b.

The shell is ovate and very small. The surface of the shell is spirally ridged. Each whorl bears a strong transverse ridge and is prominent on the back of the body whorl. The aperture is ovate and narrow. The colour of the shell is pal brownish-olive, spotted and streaked.

Localities :

Turbat, Makran; Baluchistan, (West Pakistan).

Habitat :

They are found in Lakes, Ponds and stagnant water.

Melania (*Plotia*) *scabra* Var. *elegans* Hutton

The Pricky Black snail
Pl. XII, Sp. No. 40a, 40b.

The shell is turreted and consists of about 7 to 8 whorls. Each whorl is strong by an angular shoulder. The surface of the shell contains tubercles. There are transpiral ribs which are tuberculated. The aperture is smooth, ovate in shape. The columellar margin is polished. The colour of the shell is brownish-black.

Localities :

Barkal, Harbang, Teknaf, Distt. Chittagong (East Pakistan).

Habitat :

They are found in rivers, Lakes, Ponds of East Pakistan.

Family POTAMIDIDAE

Genus *Cerithidea* Swainson, 1840.

Cerithidea ohtusa Lamarck *The Blunt cerithidea*
Pl. XII, Sp. No. 41.

The shell is turreted, and spirally grooved. The whorls are longitudinally ribbed. The ribs are of noduliferous type. The last whorl is angular and has striated base. The aperture is rounded but slightly emarginate anteriorly. The outer lip is produced out of the canal.

Localities :

Dubla Island, Sunderban, Distt. Khulna, (East Pakistan).

Habitat :

This species is amphibious and crawling over mud. They are found at the mouth of the rivers. In dry season they close the aperture with operculum and hang suspended by glutinous threads to small branches and roots of mangrove.

Cerithidea fluviatilis Potiez and Mitchaud *The River mouth cerithidea*,
Pl. XIII, Sp. No. 42a, 42b.

The shell is 1 inch in length, dark grey in colour. The shell is narrow and elongated. There occurs 11 to 12 rounded whorls. The surface is ornamented with small tubercles which are arranged in regular transpiral rows. The aperture is ovate and thin. The outer lip is expanded to form the anterior canal.

Localities :

Bhit Island, Karachi Coast, (West Pakistan) and Badar Mukham Distt. Chittagong (East Pakistan).

Habitat :

A common shallow-water, mud-loving species.

Genus *Telescopium* Linné, 1758

Synonymy :

Cerithidea, Swainson. *Potamides*, Born.

Telescopium telescopium Linné,

The Telescope shell
Pl. XIII, Sp. No. 43.

The shell is 3 to 4 inches in length, pyramidal or turreted. Its whorls are spirally ribbed. The ribs are alternately dark brown and light brown in colour. The aperture is subquadrate in shape. The outer lip is thin and has got a wide flattened angular base.

Localities :

West Wharf, Native Jetty, Karachi coast, Kéty Bunder Pataiani creek, Sind coast (West Pakistan).

Habitat :

They are inhabitants of the salt marshes and are found in abundance at the mouth of Indus river.

Genus *Terebralia* Swainson; 1840

Synonymy :

Pyrazus, Montfort. Potamides, Bron. Cerithidea, Swainson.

Terebralia palustris Bruguiere

Pl. XIII, Sp. No. 44a, 44b.

The shell is turreted. It has many whorls and is transversely sulcate and is granular. Aperture bears a short canal in front, Columella with an oblique, spiral callosity in the middle. The outer lip is dilated and thickened united in the fore part with the inner lip. The colour of the shell is dark brown.

Localities :

Patiani creek, Sind Coast (West Pakistan).

Habitat :

They occur in great abundance in the salt marshes.

Family CERITHIIDAE

Genus *Cerithium* Bruguiere, 1789

Synonymy :

Anas, Klein, not Linné. Clava, Humph. Cerites, Delameth. Camillus, Montf.

Cerithium morus Lamarck

The Mulbersy cerithium
Pl. XIV, Sp. No. 45.

The shell is ovate rounded, black in colour, with striations. The whorls are encircled with three rows of tubercles which are rounded in shape and is rather very smooth. The aperture is very small, oval The canal is short. The outer lip is thick with stripped inner margin.

Localities :

Manora Island, Bulleji, G. M. Hut, Karachi Coast, Pasni, Astola Island, Makran Coast (West Pakistan) and St. Martin Island Distt. Chittagong, (East Pakistan).

Habitat :

Very common species in shallow water.

Cerithium sinensis Gmelin,

The Chines' cerithium

Pl. XIV, Sp. No. 46a, 4 6b

The shell is pyramidal and rounded exteriorly. The whorls are rather straight gradually increasing in size. The last whorl is rounded. The colour of the shell is Pale-fulvous, tending to become grey with varices. The regular rows of blackish small tubercles are present all over the shell. The aperture is rounded with a short canal. The outer lip is rounded, expanded, and crenulated.

Localities :

Manora Island, Bulleji, G. M. Hut; Karachi Coast (West Pakistan) and St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

Very common on rocks in shallow-water.

Cerithium citrinum Sowerby,

The citron cerithium,

Pl. XIV, Sp. No. 47.

The shell is pyramidal and more or less solid. It is spirally striated. The whorls are longitudinally plaited. In the middle of the shell is a ventricose and above the plaits at a greater distant, which are large and rounded. The body-whorl have a single varice. The aperture is large, elongated into a canal with produced, recurved, anterior culiferous tube. The outer lip is expanded. Columella is with a callosity at the hinder part, Citron in colour.

Localities :

Sonadia Island, District Chittagong, (East Pakistan) and Manora Island, Bulleji, Karachi Coast, (West Pakistan).

Habitat :

They are common in shallow-water. They are collected in dead condition.

Super Family—EPITONIACEA

Family EPITONIIDAE

Genus Epitonium Röding, 1798

Synonymy :

Scalarus, Montf. Scalaria, Lamarck. Acione, Leach. Acionea, Desh, Scala Sowerby. Cyclostoma, Schum, not Lamarck. Turbina, Browne, scalarius, Dumer.

Epitonium pyramidalis Sowerby, *The pyramidal wentletrap*,
Pl. XIV, Sp. No. 48.

The shell is 1/2 inch in length, turreted, and without umbilicus and is whitish or yellowish in colour with polished surface. There occurs 8 to 11 whorls, in each of this has 10 to 16 strong costae. The aperture is rounded. Operculum is spiral in shape and horny.

Localities :

Bulleji, Karachi Coast Makran Coast, (West Pakistan), St. Martin Island, Sonadia Island Distt. Chittagong (East Pakistan).

Habitat :

They usually creep on rocks but juveniles are found under rocks. Fairly common from low tide mark down and to a depth of 100 fathoms.

Family JANTHINIDAE

Genus *Janthina* Röding, 1798.

Synonymy :

Lodes, Leach. Ametistina, Schunz. Achates, Gist.

Janthina Jantina Linné *The Common Purple sea-snail*,
Pl. XV, Sp. No. 49a, 49b.

The shell is 1-1/2 inches in diameter. The spire is thin, short and translucent. The whorls are slightly angular. The outer lip is slightly sinuate in the middle. The inner lip is reflexed. Aperture is large. The colour of upper portion is purplish-white, the lower is purplish-violet.

Localities :

Patiani creek, Sind, coast, Fasni, Makran Coast (West Pakistan) and Sonadia Island, Distt. Chittagong (East Pakistan).

Habitat :

They are pelagic in habit. It has the power of secreting a purple fluid.

Janthina globosa Swainson *The Globe purple sea-snail*,
Pl. XV, Sp. No. 50a, 50b.

The shell is 1/2 inch in diameter. Shell is globose, well rounded. The spire is short. The whorls are impressed at suture. The outer lip is slightly sinuate. The columella is feeble and is reflected; prolonged. The aperture is large, open, and is situated nearly in the middle, the colour is violet throughout.

Localities :

Patiani Creek, Sind Coast (West Pakistan) and St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

The animals are pelagic in habit.

Super Family CALYPTRAEACEA

Family CALYPTRAEIDAE

Genus *Crepidula* Lamarck, 1799*Crepidula plana* Say*The white slipper shell.*

Pl. XV, Sp. No. 51a, 51b.

The shell is 1/2 to 1-1/2 inches in size it is very flat, either convex or concave and always milky white in colour. The apex is rarely turned to one side. It commonly attaches itself to inside of large dead shells.

Localities :

Bhit Island, Karachi Coast, (West Pakistan) and St. Martin Island Distt. Chittagong, (East Pakistan).

Habitat :

The individuals of *crepidula* live on muddy bottom. They can attach themselves, frequently pile up in groups of six to twelve or more.

Genus *Calyptrea* Lamarck, 1799**Synonymy :**

Calyptra, Humphrey. *Calyptus*, Montf. *Calyptria*, Owen. *Mitrularia*, Schum. *Litedaphus*, *Litholepas*, Owen.

Calyptrea extinctorium Sowerby.*The Common chinese Hat.*

Pl. XV, Sp. No. 52.

The shell is 1/4 to 1/2 inch in diameter, and is sub-conic. The cup shaped apex is subcentral, with circular base. The shell is thin and smooth. The interior of the shell is glossy white or pale-yellow in colour.

Localities :

Bhit Island, Baba Island, Karachi Coast, (West Pakistan) and Sonida, Distt. Chittagong, (East Pakistan).

Habitat :

The shells of the species are not common in shallow water. Where there is a hard bottom, *C. extinctorium* generally adhere to stones, but in a muddy bottom if it manage to survive it attaches particularly to the shell of *Placenta placenta* common in muddy shore.

Super Family STROMBACEA

Family XENOPHORIDAE

Genus *Xenophora* Fischer, 1807

Synonymy :

Phorus, Montf. Henophorus, Phill.

Xenophora solaris Linné,

The solar carrier-shell.
Pl. XVI, Sp. No. 53.

The shell is 2-1/2 inches in diameter, excluding foreign fragments. The umbilicus is very small. The whorls are flat and spire is depressed. Aperture is wide, keeled and spiny at the periphery there occur 10 to 15 keels all around its thin outer edge, and also along the coils to wards the apex. Yellow in colour.

Localities :

Patiani Creek, Sind Coast, West Pakistan, St. Martin Island, Distt. Chittagong, East Pakistan.

Habitat :

The carrier shells are inhabitant of deep water.

Family STROMBIDAE

Genus *Tibia* Röding, 1798

Tibia curta Sowerby,

The short peaked tibia.
Pl. XVI, Sp. No. 54.

The shell is tapering with a spiral form and is smooth. The mouth whorl expands into a wide armed with several short and stout spines along the margin. The anterior end is prolonged into slender, semitubuler rostrum or beak. The colour of the shell is brown.

Localities:

St. Martin Island, Distt. Chittagong, (East Pakistan). West Wharf, Karachi Coast, (West Pakistan).

Habitat:

They are found on rocks.

Genus *Strombus* Linné, 1758

Synonymy ;

Alata, Klein. Alatus, Humph. Cassida, Linné. Olim; not Lang, Lambis, Bolt. Conchilium, Browne. Pyramea, Link, Pugil, Faber.

Strombus canarium Linné,

The canary wing strombs

Pl. XVI Sp. No.55

The shell is small ovate or some what triangular in shape. It is quite heavy and stout. The spire is rather small and sharp. The whorls are smooth and grôoved towards the apex.

Localities :

St. Martin Island, Sonadia Island, Distt. Chittagong (East Pakistan).

Habitat

They live on rocks and found near low tide mark.

Strombus floridus Lamarck

The Flowery strombs

Pl. XIV SP. No. 56 a, 56 b.

The shell is oblong-ovate, thickened and sharply grooved at the base. The spines are generally sharp. Columella is laminately thick and with fine wrinkled all over. The aperture is oblong. The outer lip is thickened.

Localities :

St. Martin Island, Distt. Chittagong (East Pakistan.)

Habitat :

They are found on rocky coast of East Pakistan.

Strombus gibberulus Linné

The Hunch-Backed Strombs.

Pl. XVII SP. No. 57

The shell is oblong and conical. The spire is exserted and sharp. The columella is very smooth. Some fine wrinkles are present at the anterior end of the aperture.

Localities

St. Martin Island. Distt. Chittagong (East Pakistan).

Habitat :

They are found on rocky area.

Strombus guttatus Kiener

The spotted strombs

Pl. XVII SP. No. 58.

The shell is oblong-ovate and it is very much recurve at the base. The spire is acuminate. The whorls are smooth. Columellar callus are present throughout. The outer lip is expanded slightly and it is thickened. The surface spotted all over with white flakes which is enamel white in colour.

Localities:

St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

They are found in rocky shore. Collected in dead condition.

Strombus pulchellus Reeve

The pretty strombs
Pl. XVII Sp. No. 59.

The shell is some what squarely-ovate in shape. The whorls are radiately grooved and rounded at the upper portion. The last whorl has swollen ribs which are behind the lip wing. When some strong wrinkles are present in a radial form. The area of the columella is white while the interior possess a deep purple colouration.

Localities

St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

They are found on rocky shore.

Strombus ruppelli Reeve

The Ruppell's strombs
Pl. XVII SP. No. 60a, 60b.

The shell is oblong-fusiform. The upper area of the whorls are depressed and rounded. It is rather concave in shape and is slightly angled in structure. The tubercles are numerous on the surface. The last whorl is ribbed longitudinally behind the lip. The columella is thick.

Localities :

St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

Fairly common on rocks below low-tide.

Strombus urceus Linné

The Urceus strombs.
Pl. XVII Sp. No. 61.

The shell is some what fusi-formly oblong. The spire is exerted. The whorls are spirally straight and finely grooved at the base which stout around the upper part. Columella is laminated and some part of the columella is wrinkled. The aperture is oblong.

Localities:

St. Martin Island, Distt. Chittagong, (East Pakistan).

Habitat :

They are found on rocks. The dead shells are present.

Genus *Lambis* Röding, 1798

Synonymy :

Strombus, Hump, not Linné. *Digitata*, Fabr. *Pterocera*, Link. *Pteroceres*, Montf. *Pterocera*, Lamarck. *Pteroceras*, Sowerby. *Pterocerus*, Thurm. *Heptadactylus*, Klein. *Heptadactylus*, Kobet.

Lambis limbis Linné,

The common Scorpion shell
Pl. XVII Sp. No. 62.

The shell measures 7 to 8 inches in length. In young animal the outer lip of the shell is very simple, and the claws are gradually appearing in the form of open canals, which after wards become closed and solid. Males are usually larger than female. The shell consists of short, conical spires. The outer lip is dilated into a stout wing-like expansion and is armed with enormous stout finger-like processes. Operculum is claw-shaped, strongly serrate along one side. Corneous is brown and elongated. The outer surface is grenulated in young specimens and smooth in old specimens. The colour of aperture is uniform tan creamy or rarely orange tan or rose. A black-brown blotch may also be present on the upper part of the columellar wall of young specimens. The colour of outer surface is variable; mostly creamy with light or dark brown colour.

Localities :

St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

Occur in colonies on reef flats and sand or coral bottom, usually in association with algae. They are found from lowtide line to a depth of 10 feet.

Super Family NATICACEA

Family NATICIDAE

Genus *Polynices* Montfort, 1810

Synonymy:

Uber, Humph. Albula, Bolt. Mamma, Klein. Mammilla, Gray, not Schum. Eucaryim Ehrenb. Mamillaria, Swainson. Naticina, Guild.

Polynices mamilla Reeve

The Milky Bull's Eye
Pl. XVIII Sp. No. 63.

The shell is 2 inch in length. And is smooth sub-ovate and solid. The spire is small and acute. The whorls are simple. Aperture is semicircular. The inner lip is thick and oblique. An ivory-white, thickened callus is present. The colour of the shell is milky white.

Localities

Patiani Creek; Sind Coast, Makran Coast (West Pakistan).

Habitat

The animals are inhabitant of sand and muddy sands-flats, and may be readily collected at low-water. They are usually collected concealed under little heaps of Sand.

Genus *Natica* Scopoli, 1777**Synonymy:**

Naticus, Monft. *Lunatus*, Humph. *Nacca*, Risso. *Cochlis*, Bolt. *Naticarius*, Dum.

Natica tigrina Röding

The tiger Natica

Pl. XVIII Sp. No. 64 a, 64b.

The shell has narrow umbilicus and is globose. The spire is conical. The whorls are rounded. The shape of aperture is ovate. The columella is thin with spiral callosity. There occurs purple brown spots all over the outer surface. The operculum is horny and spiral. The inside of the shell is brown.

Localities :

West Wharf, Manora Island, Karachi Coast (West Pakistan) and St. Martin Island Distt. Chittagong (East Pakistan).

Habitat :

The animal live on sandy and rocky shore. The eggs are laid in sticky mass of clear jelly, which is moulded over the shell.

Natica didyma Röding

The didyma Natica

Pl. XVIII S. No. 65 a, 65 b.

The shell is globose with depressed spire. The whorls are rounded and the body whorl is very large. The columella is thin with spiral callosity. The spiral callosity is thick. The operculum is large and semilunar. The aperture is ear-shaped, and the shell is highly polished.

Localities

Manora Island, Hawkes-Bay Sonmaini Beach, Karachi Coast, Pasni, Makran Coast (West Pakistan) and St. Martin Island Distt. Chittagong (East Pakistan).

Habitat :

These animals are carnivorous and prey upon smaller pelecypods form which by boring a circular hole they extract the flesh.

Natica lineata Lamarck

The lineat Natica

Pl. XIX Sp. No. 66.

The shell is 2 to 2-1/2 inches in length, globular, glossy and smooth. The spire is somewhat depressed Wavy, brown lines are present on the outer surface of the shell. The aperture is semilunar in out line. Umbilicus is present and the round calius is thick.

Localities :

St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

It has the same habit as *N. didyma*.

Natica vitellus Linné*The vitellus Natica*

Pl. XIX Sp. No. 67 a, 67 b.

The shell is globose, and solid. The spire is short, pointed at the apex. The whorls are rounded and smooth. The aperture is semicircular in out-line. The umbilicus is narrow, and columella callus is present. The colour of the shell is burnt orange with few distinct white blotches. The inner surface near the aperture is white.

Localities :

Manora Island, Sonmiani Beach. Hawks-Bay, Karachi Coast (West Pakistan).

Habitat :

Same habit as other species of this genus.

Genus *Sinum* Röding, 1798

Synonymy:

Stomatia, Hill, not Lamarck. *Auris-Veneris*, Humph. *Auriformis*, Gevers. *Haliotis*, Adams; not Linné. *Cryptostoma*, Blainv. *Catinus*, Klein. *Sigaretus*, Lamarck.

Sinum cuyerianum Recluz*The Striated baby's Ear.*

Pl. XIX Sp. No. 68 a, 68 b.

The shell is 1 to 2 inches in maximum diameter, ear-shape with depressed spire. Its finely striated body-whorl is inflated and ovate in shape. The inner surface of the shell is glossy and iridescent. The spire is minute but visible only in profile. The umbilicus is not present. The aperture is very wide, and oblique. The operculum is very small and rudimentary. The inner lip is curved posteriorly and spread thinly over the body-whorl. The shell is grey in colour.

Localities :

Native jetty, Manora Island, Bulleji, G. M. Hut, Karachi Coast (West Pakistan).

Habitat :

They live upon muddy sand-flats; They are slugish and low-moving. They burrow in the sand.

Super Family CYPRAEACEA

Family CYPRAEIDAE

Genus *Cypraea* Linné, 1758.

Synonymy:

Porcellana, Rumph. *Peribolus*, Adams. *Cypraea*, Montf. *Cypriarius*, Dum. *Erythraea*, Barrel. *Cyprædia*, Sawinson. *Cypræova*, Sawinson. *Cyprovula*, Auct. *Cypreovula*, Flem. *Cypræovulum*, Sowerby; Jun.

Cypraea ocellata Linné

The Eyed Cowery
Pl. XX Sp. No. 69.

The shell is simple slightly oval with speckled or lineate base. It is dorsally coloured fulvous or raw sienna and flecked with close round white spots. Many eyed. In large sized animal there occurs unusual suffusion of intensified dottings and ocellations. A pale pinkish-livid or grey shell is most peculiar and remarkable. The basal lineations are faint, but normal. The colour, however, shows no trace of brown.

Localities :

Bulleji, Manora Island, G. M. Hut, Karachi Coast (West Pakistan).

Habitat

It Occurs on rocks. Upon touching it causes the mantle to withdraw quickly into the shell and exposing the polished back and sides. They are plentiful along Pakistan coasts.

Cypraea turdus Linné

The Turdus Cowery
Pl. XX Sp. No. 70 a, 70 b.

The shell is ovately pyriform. The dorsal surface of the shell is dark cinereous brown. The shell is laterally thin and uniformed. The sides of the shell whitened callous when animal is young. The deeper coloured maculations only being partly visible.

Localities :

Bulleji, Manora Island, Sonmiani, G. M. Hut; Karachi Coast, Astola Island; Makran Coast (West Pakistan).

Habitat

Found on rocky shores. They are very common. Collected at low-tide line.

Cypraea moneta Linné,

The Money Cowery
Pl. XXI Sp. No. 71 a, 71 b.

The shell is 2/3 to 1-1/2 inches in length. It contains a heavy thick angled margin. The base is smooth or noduled and blunt teeth are present in the aperture. The colour of the shell is deep creamy to white.

Localities

Clifton Beach; Karachi Coast, (West Pakistan).

Habitat :

They live on rocks, but are happiest on sandy mud flats. It is rare.

Cypraea annulus Linné

The Annulus Cowery
Pl. X XI Sp. No. 72.

The shell is ovate. The base of the shell is flattened. The outer and inner lips are thick. The dorsal surface is gibbous. It is white or creamy in colour with a regular oval out-line and yellow ring around the top.

Localities :

Manora Island, Bulleji, Karachi Coast (West Pakistan).

Habitat :

It is a very rare species found on rocks.

Cypraea caputserpentis Linné

The serpentis Head Cowery
Pl. XXI Sp. No. 73 a, 73 b.

The shell is ovate and flattened at the base. The sides of the shell is thick polished and dilated. The dorsal surface is gibbous. The shell has broad brown margin with the top is pale with a brown net work.

Localities :

Clifton Beach, Karachi Coast (West Pakistan).

Habitats :

It is very rare species.

Cypraea arabica Linné

The Arab Cowery
Pl. XXI Sp. No. 74 a, 74 b.

The shell is elongate, dorsally gibbous and flattened at the base. The side is thick and dilated. The spire is short. The aperture is narrow and linear. The inner lip is large and outward dilated and flattened. The dorsal surface of the shell posses white patches remarkably distinct and quadrate in form.

Localities :

Manora Island, Bulleji, G. M. Hut, Karachi Coast, Pasni, Gowadar, Astola Island, Makran Coast (West Pakistan).

Habitat :

Generally common, principally they are found under the rocks at low-tide mark.

Cypraea mauritiana Linné

The Maurit Cowery
Pl. XXI Sp. No. 75 a, 75 b.

A large form ovate in out-line. The dorsal surface has pale spots on a drker ground colour and the basel surface is flattened. The callous lips are thickened.

Localities

St. Martin Island Distt. Chittagong, (East Pakistan).

Habitat

They had found them on rocks at extremly lowtide.

Genus *Cypraecassis* Stutchbury, 1837

Synonymy:

Cassidea, Link.

Cypraecassis rufa Linné*The Red Helmet shell*
Pl. XXI Sp. No. 76.

The shell is 5 to 7 inches in length. It has as Cowery-shaped brown shell, ovate in out-line, but with a broad spire. The surface is finely cancellated. The body-whorl has three rows of low knobs. The broad, toothed lips are clouded and barred with bright orange-red and shading darker between the teeth. A wide enamel callus coats around the columella.

Localities :

St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

They principally inhabit the sandy shores, where they are active and voracious, moderately common at low tide mark.

Family CYMATIIDAE

Genus *Cymatium* Röding, 1798

Synonymy :

Triton, Montf., not Laur, Buccinum, Brawne, not Linné. Charonia, Gisted. Tritonium, Link.

Cymatium clearium Linné*The Oil-vessel Triton.*
Pl. XXIII, Sp. No. 77.

The shell is 2 to 6 inches in length. It is thick and broad, with few varices and a blunt spire, which are strongly ribbed and set with tubercles, more or less at equal distance. The general colour is light-brown, spotted alternately with dark-brown and white. The aperture is flesh-coloured, and the columella dark-brown with raised white wrinkles. Anterior siphonal canal is very much produced backwards. The periostracum is very thick, matted, light.

Localities :

Native jetty, G. M. Hut, Light House; Karachi Coast (West Pakistan).

Habitat :

Shell with periostracum are chiefly from muddy, and sandy places from 6 to 30 fathoms, depth.

Cymatium (Septa) pileare Linné

The Hairy Triton.

Pol. XXIII, Sp. No. 78.

The shell is 2 to 6 inches in length. It has bristly coat of live-hued epidermis and it is fusiform in shape. Its red mouth is creased with long white raised ridges. The pale brown exterior is streaked with revolving bands and folds of white colour.

Localities :

Native jetty, West Wharf, G. M. Hut; Karachi Coast (West Pakistan).

Habitat :

They are happiest at muddy sea shore.

Family BURSIDAE

Genus *Bursa* Röding, 1798

Synonymy :

Ranella, Lamarck, *Gyrineum*, Link, *Bufo*, Montf., *Biplex*, Perry. *Rana*, Humph., *Bufo*, Schum.

Bursa spinosa Lamarck

The Spiny frog shell.

Pl. XXIII, Sp. No. 79.

The shell is 2 to 3 inches in length, stout with short spire and a canal. It has two large thorn like tubercles on each of its varices, and short, sharp spines on the ridges between. The aperture is avote in out-line. The colour of the shell is light-brown mottled with darker.

Localities :

Astola Island, Makran Coast (West Pakistan).

Habitat :

They are found on rocky coasts of both wings of Pakistan.

Bursa granularis Röding

The Granulated Frog shell.

Pl. XXIII, Sp. No. 80.

The shell is $\frac{3}{4}$ to 2 inches in length and flattened laterally. The varices are axially placed one below the other. The colour is orange-brown with 3 narrow, white bands which appear as prominent white squares on the varices. There occurs spiral sculpture of several rows of small beads, those on the periphery whorl having the largest beads.

Localities :

Astola Island, Makran Coast, Baluchistan, West Pakistan, and St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

They are found on rocky shores.

Bursa iampus Linné

The Lamp Frog Shell.
Pl. XXIV, Sp. No. 81.

The shell is 3 to 6 inches in length. Its strong revolving ridges are elaborately set with nudes. The flaring lip is deeply crenulated. The outer lip also has a posterior channel equal to the anterior canal. The general colour of the shell is creamy, stained with orange brown. The aperture has a flesh tint. The outer lip and aperture is orange-red in colour.

Localities :

Pasni, Makran Coast (West Pakistan) and St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

Animals are active in movements, creeping on the broad foot over the rocks.

Family TONNIDAE

Genus *Tonna* Bruniich, 1772.

Synonymy :

Dolium, Browne, *Perdix*, Montf., *Galea*, Mart, *Dolites*, Klug, *Cassida*, Lang, not Linné.

Tonna maculatum Lamarck

The Maculated Tun.
Pl. XXIV, Sp. No. 82.

The shell is ovate. The spire is impressed. There are six whorls in number. The ribs are encircled by the whorls and are none in number. The columella is straight in position. The aperture is large and outer lip is single. The inner lip is thin widely expanded. The colour of the shell is creamy. The ribs are spotted with reddish-brown. The inner surface near the aperture is brown.

Localities :

West Wharf, Karachi Coast Astola Island, Makran Coast, (West Pakistan) and Badar Mukam, Distt. Chittagong (East Pakistan).

Habitat :

These are familiar objects thrown ashore on all sandy beaches. When it desires to swim, this process is very interesting. Empty shells were found washed ashore.

Order NEOGASTROPODA

Superfamily MURICACEA

Family MURICIDAE

Genus *Murex* Linné, 1758.**Synonymy :**

Purpura, Hump., *Aranea*, Perry. *Haustellaria*, Swains. *Biontes*, Montf., *Chicoreus*, Montfort.

Murex tenuispina Lamarck

The Thin Spine Murex.
Pl. XXV, S. No. 83.

The shell is 5 to 6 inches in length. The surface of the shell is finely sculptured with alternating large and small spiral ribs. These are crossed by six varices of low ridges bearing closet, slender, curving spines of which three sets are large. All the long spines curve backward at the tips. The aperture is marked with dark lines. The colour of the shell is yellow.

Localities :

St. Martin Island, Distt. Chittagong (East Pakistan), and also found in Pasni, Makran Coast (West Pakistan).

Habitat :

They live on rocky shores, moderately common in low water to fifty fathoms.

Murex adustus Lamarck

The Burnt Murex.
Pl. XXV, Sp. No. 84.

The shell is 2 to 4 inches in length. The spines are short, leaf like, irregular and crowding the varices of the stout spire and also the short canal. The spiral ribs are prominent, dark in colour and irregularly set with tubercles. The inner surface near the aperture is brownish-white, with rose-pink lip and columella.

Localities :

St. Martin Island, Distt. Chittagong (East Pakistan) and Makran Coast (West Pakistan).

Habitat :

They are usually found in abundant on rocky places of East and West Pakistan.

Murex palma-rosae Lamarck

The Rose-branch Murex.
Pl. XXV, Sp. No. 85.

The shell is 2-1/2 to 4 inches in length, solid, oblong and fusiform in shape. The spire is elevated with strong groove and ridge. The varices bear stout and flattened fronds. The columellar lip is closely toothed. The shell is beautifully branched and rosy-pink in colour.

Localities :

St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

They are found on rocky shores of East Pakistan.

Murex haustellum Linnè

The Snip's Head Murex.
Pl. XXV, Sp. No. 86.

The shell is 3 to 4 inches in length, with a broad body, and an elevated spire on a straight, slender stem. The varices have low ridges. The spines are reduced in number and size to a few scattered tubercles. The peristome is rounded and has sharp, exerted rim. The colour of inner surface near aperture is pink, and the outer surface of the shell is fulvous in colour.

Localities :

St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

They are found on rocky shore of East Pakistan.

Genus *Thais* Röding, 1798

Synonymy :

Tribulus, Klein, Canrena, Link, Microtoma, Swainson, Furpurus, Aldrouandus, *Thais*, Bolten.

Thais bufo Lamarck

The Bufo Thais.
Pl. XXVI, Sp. No. 87 a, 87 b.

The shell is 3 to 4 inches in length. The columellar lip develops a remarkable thickening, which may even engulf the apex of the shell. The aperture is ovate and large, with an oblique channel at the anterior part. The outer surface possess nodules. The shell is orange in colour.

Localities :

Manora Island, Karachi Coast; Pasni, Gowadar, Astola Island, Makran Coast (West Pakistan).

Habitat :

Alive specimens were collected in all cases from the sublittoral zone (3—20 meters), usually amongst boulders. At these, and other localities, empty shells were very common, often inhabited by hermit crabs.

Thais rudolphi Chemnitz*The Rudolph's Thais*

Pl. XXVI, Sp. No. 88.

The shell is 4 to 5 inches in length and is oblong-oval in shape. The body whorl is large, the spire is short. The aperture is ovate, wide, with an oblique channel in the fore part. The outer lip is crenulated and the inner lip is broad and more or less flattened. Tubercles are present on upper portion near spire. It has some transverse lines with a black colour gap. The colour of the shell is reddish-brown.

Localities :

Manora Island, Bulleji, West Wharf, Karachi Coast; Makran Coast (West Pakistan).

Habitat :

They are found in rocky area of Karachi Coast and is very common. Their eggs cases are membranous, oval in shape. Each sac containing many embryos.

Thais kiosquiformis Duclos*The Kiosk Thais*

Pl. XXVI, Sp. No. 89.

The shell is pyriform. The spire is elevated and whorls are angular. The aperture is oval-oblong. The outer lip is acute and grooved.

Localities :

Sonadia Island, Distt. Chittagong (East Pakistan).

Habitat :

Found on the rocky areas of East Pakistan Coast.

Genus *Rapana* Schum, 1817*Rapana bulbosa* Solander

Pl. XXVI, Sp. No. 90.

The shell is pyriform 5 to 6 inches in length and produced anteriorly. The spire is depressed and short. The aperture is ear-shaped, narrow anteriorly. The anterior canal is open and slightly recurved. The inner lip is reflected and free anteriorly. The umbilicus is corrugated.

Localities :

Pasni, Gowadar, Astola Island, Makran Coast (West Pakistan) and St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

The animals frequent the coral reefs and most probably feed upon the polyps that construct them.

Family BUCCINIDAE

Genus *Babylonia* Schlut

Synonymy :

Latrunculus, Gray, *Nassa*, Schum, *Eburna*, Lamarck.

Babylonia spirata Linné

The Spiral Ivory shell.

Pl. XXVI, Sp. No. 91 a, 91b.

The shell is 2 to 2-1/2 inches in length, solid and smooth. The rectangular form of the suture divides the whorls. In the young specimens an umbilicus is present. In the age growing specimen the inner lip becomes thickened and eventually inflated over the umbilicus opening. White spots or blotches along with red are present all over the shell.

Localities :

Bhit Island, Manora Island (East Side), Karachi Coast (West Pakistan).

Habitat :

They are abundant at muddy areas, the shells are covered with a very thin, brown, horny periostracum.

Genus *Phos* Montfort 1810

Synonymy :

Rhinodomus, Swainson.

Phos senticosus Linné

Pl. XXVI, Sp. No. 92.

The shell is 1 to 2-1/2 inches in length, cancellated and oblong in shape. It is longitudinally ribbed. The columella has a single fold anteriorly and there is a notch at the anterior part of the outer lip. The canal is not recurved or elongate.

Localities :

Manora Island, Bhit Island, Bulleji, Karachi Coast (West Pakistan).

Habitat :

Moderately common at low-water line.

Genus *Cantharus* Röding, 1798

Synonymy :

Cantharidus, Montfort, *Cantharis*, Ferus; not Bolt *Cantharius*, Voight.
Polia, Gray.

Cantharus undosus Lamarck

The Undosus Cantharus.
Pl. XXVII, Sp. No. 93.

The shell is somewhat spindle-shaped with transversely close-set spiral ribs. The aperture is oval in shape, longer than wide. The outer lip is toothed within, and the upper parietal wall has a small, white, swollen toothed near the top of the aperture. The shells are usually covered with green periostracum.

Localities :

Bulleji, Manora Island, Karachi Coast (West Pakistan).

Habitat :

Fairly common below low-tide mark in the rocky shore area.

Family FASCIOLARIIDAE
Genus *Fasciolaria* Lamarck, 1799

Synonymy :

Pyrula, Perry; not Lamarck, Colus, Bolton; not Humph., Ieranea, Refin.
Fasciolaria filamentosa Röding *The Threaded Blowing Conch*
Pl. XXVII, Sp. No. 94.

The shell is fusiform. The spire is tapering towards the apex. Small spiral groove occur just below the suture. The aperture is oval in form and elongated, and as long as the spire. The siphonal canal is straight. The outer lip is crenulated internally. The colour of the shell is reddish-brown.

Localities :

St. Martin Island Distt., Chittagong (East Pakistan).

Habitat :

Fairly common in low-tide mark.

Superfamily VOLUTACEA
Family OLIVIDAE
Genus *Oliva* Bruguiere 1789

Oliva gibbosa Born

The Gibbous Olive.
Pl. XXVIII, Sp. No. 95.

The shell is 1-1/2 to 2-1/2 inches long, stout, ovate, and almost like a cone in outline. The callus on the columella near the spire, widens and thickens, forming a great swelling, which spreads over the coils and winds into a white band at the apex. The outer surface is creamy white, darkened by an intricate net work of chestnut spiral band and white below.

Localities :

Gowadar, Makran Coast (West Pakistan).

Habitat :

The animals gather by burrowing in companies just below the level of the sand for food with their siphons at the surface for Fresh-water.

Family MITRIDAE

Genus *Mitra* Lamarck, 1799

Synonymy :

Thiarella, Swainson. Mitraria, Rafin. Mitrolites, Krug. Nebularia, Swainson.

Mitra mitra Linné*The Episcopal Mitre.*

Pl. XXVIII, Sp. No. 96.

The shell is 4 to 5 inches in length, tapering and solid. The spire is smooth. The whorls are creamy white in colour, overlaid with orange spots in regular winding rows. The spots just below the sutures, are large and irregular. Those further below are orderly close squares. The large spots are darker than the others. The inner lip is toothed toward its base.

Localities :

St. Martin Island, Distt. Chittagong (East Pakistan)

Habitat :

They are nocturnal in habit avoiding the sunlight, hiding by day under rocks. This species was found in both littoral and sub-littoral (0-8 meters) regions.

Mitra pontificalis Lamarck*The Pontifical Miare.*

Pl. XXVIII, Sp. No. 97.

The shell is 2 to 3 inches in length and is fusiform. The spire is pointed. The whorls are strongly coronated with a spiral row of triangular cups, which stands erect. Below there are some impressed lines deeply punctured with irregular rows of orange red spots.

Localities :

Sonadia Island, Cox's Bazar, St. Martin Island, Distt. Chittagong (East Pakistan).

Habitat :

They burrow in sand usually avoiding light. They are most active at flood-tide.

Family XANCIDAE

Genus *Xancus* Röding, 1798

Synonymy ;

Mazza, Klein, Rapum, Humph., Turbinellus, Lamarck.
Xancus pyrurum Linne

The Shank Shell.

Pl. XXVIII, Sp. No. 98.

The shell is 4 to 6 inches in length, and 4 inches in diameter and weighs about 2-1/2 lbs. The nipple-like protoconch persists in full-grown shell. The spire is obtuse and the body-whorl is large in size. The aperture is oblong, narrow. The canal is long and straight. This occurs prominent tooth-like projection in the middle of the columellar lip. The shell is white in colour.

Localities :

Pasni, Makran Coast, (West Pakistan) and St. Martin Island, Distt. Chittagong, (East Pakistan).

Habitat :

This species are uncommon. The animal is slow-moving.

Family	HARPIDAE
Genus	<i>Harpa</i> Röding, 1798

Synonymy :

Cithara, Klein, Harparia, Rafin, Harpalis, Link, Lyra, Griff, not Linne.

Harpa conoidalis Lamarck

The conoidal Harp.
Pl. XXIX, Sp. No. 99.

The shell is 3 to 4 inches in length with elevated spire and broad sloping shoulders. The longitudinal ribs are short, rounded and distinct. The body-whorl is greatly inflated. The columella is smooth and covered with callus. The operculum is absent. It is a very beautiful, polished shell. The colour scheme is brown in many shades.

Localities :

St. Martin Island, Distt. Chittagong, (East Pakistan).

Habitat :

The animals are found in muddy sand in deep water.

Superfamily	CONACEA
Family	TURRIDAE
Genus	<i>Turricula</i> Klein

Synonymy :

Vexillum, Bolt., Turris, Montf., not Humph., Tiara, Swains., not Bolt; Vulpecula, Gray.

Turricula javana Lamarck

Pl. XXIX, Sp. No. 100.

The shell is 1-1/2 to 2-1/2 inches in length and turreted in shape. The spire is elevated. The whorls are large. There are deep slit near the suture. The aperture is oval in form. The anterior siphonal canal is long and straight. The columella is smooth. The outer lip is detached in the hind portion from the body-whorl and forming a sinus, or the margin is fissured near the last whorl.

Localities :

St. Martin Island, Distt. Chittagong, (East Pakistan).

Habitat :

They are found on rocky area of St. Martin Island East Pakistan.

Genus *Turris* Röding, 1798

Synonymy :

Murex, Gmelin. *Pleurotoma*, Lamarck. *Pleurotomus*, Montfort. *Pleurotoma*, Gray. *Pleurotomaria*, Dum.

Turris *babylonia* Linné

Pl. XXIX, Sp. No. 101.

The shell is 3 inches in length, It is solid, elongate, fusiform, and is rather smooth, and shining white, with bold pattern of clear cut pale-brown spots and rectangular maculations. The sculpture is distinct, made up of broad rounded spiral ribs with intermediate narrow cords. The aperture and canal is moderately long.

Localities :

St. Martin Island Distt. Chittagong, (East Pakistan).

Habitat :

They are found on rocky areas of St. Martin Island East Pakistan.

Family CONIDAE

Genus *Conus* Linné, 1758

Conus *textile* Linne,

The cloth of gold cone.

Pl. XXIX, Sp. No. 102.

The shell 2 to 4 inches in length. It is stout and heavy with low peaked spire. The exterior is covered with longitudinal Zig-zag lines of dark brown and yellowish blotches arranged to form three bands of darker colour on a white ground, divided by brown lines into triangular patches.

Localities :

St. Martin Island Distt. Chittagong, (East Pakistan).

Habitat :

They are found on rocky area at low-tide mark, but one large empty shell was found washed ashore.

Subclass	OPISTHOBRANCHIA
Order	PLEURCOELA
Superfamily	ACTEONIDAE
Family	HYDATINIDAE
Genus	<i>Hydatina</i> Schumacher, 1817

Hydatina physis Linné*The Rose Peta Bubble Shell.*

Pl. XXX, Sp. No. 103a, 103b.

The shell is thin, globular with large body-whorls. The mouth opening is large. It is creamy, with dark-brown folds reflecting over the shell. It has large, shield-shaped, tentacle bearing head and extremely broad flattened foot which covers the entire surface.

Localities :

Bulleji, Manora Island (East Side), Karachi Coast and Pasni, Baluchistan, Makran Coast, (West Pakistan).

Habitat :

It is common in tidal flats and rocky shores. Found either sunken in sandy-mud of sheltered bays below low-tide.

Hydatina velum Gmelin*The Velum Bubble Shell.*

Pl. XXX, Sp. No. 104a, 104b.

The shell is 45 mm in height and 2 inches in diameter. It is like a bubble. The spire is smooth and depressly flattened. The body-whorl is inflated. The aperture is expanded and entire in front. The thin periostracum covers the shell and in the middle of the body-whorl, a circular, thick band is present. The colour of the shell is reddish-blue.

Localities :

Bhit Island, Manora Island (East Side), Bulleji, Karachi Coast Pasni, Baluchistan, Makran Coast, (West Pakistan).

Habitat :

They are brought to shore in fair numbers about July and again towards the end of the year, *e.i.* December. The animal when fully exerted and expanded, is most attractive.

Family BULLIDAE

Genus *Bulla* Linné, 1758*Synonymy ;*

Bullus, Montf., Ampulla, Auct., Cymbium, Lamarck; not Klein. Bullea, Blainv., Bullearius, Dun, Vesica, Swainson, Bullaria, Rafinesque.

Bulla ampulla Linné*The ampulla Bubble shell.*

Pl. XXX, Sp. No. 105.

The shell is 1/2 to 1 inch in length swollen and oval. The shell is mottled with pale transparent brownish-red colour. The foot is fleshy lobe-like and it is reflected over the shell on both the sides and also behind.

Localities :

Keamari, Karachi Coast, (West Pakistan).

Habitat :

The species inhabit sandy mud-flats.

Subclass	PULMONATA
Order	BASOMMATOPHORA
Superfamily	HYGROPHILA
Family	LYMNAEIDAE
Genus	<i>Lymnaea</i> Lamarck, 1799

Synonymy :

Limnaeus, *Drap Lymnus*, *Montf Limnea*, *Flem Lymnula*, *Cyclemis*, *Espiphylla*, *Lomastoma*, *Rafin. Leachia*, *Jeffreys*.

Lymnaea acuminata Lamarck,*The acuminated Pond snail.*

No. 106a, 106b. Pl. XXXI, Sp.

The shell is thin, oblong-ovate, smooth, gloosy and somewhat translucent externally. The spire is short, narrow, with the whorls attenuated, terminating in sharply exerted spire and acuminate apex above. The body-whorl is inflated and slightly angular above. The columellar lip is spirally twisted.

Localities :

Jamrood, Peshawar and Tori Village, Distt. Jacobabad (West Pakistan).

Habitat :

Living specimens inhabit ponds, lakes and pools. They attached to the aquatic plants. Where there is no solid object they attached themselves to their object.

Lymnaea luteola Lamarck*The Luteol Pond-Snail.* Pl.

XXX, Sp. No. 107a, 107b.

The shell is thin, rather broadly ovate with a large, inflated body-whorl which is rather broad anteriorly. The apex is short and pointed. The spire is short and broadly conical. The whorls of the spire are few in number and are slightly but distinctly inflated. The aperture is narrow and ovate in shape and angular above but evenly rounded anteriorly. The columellar lip bears a strong spiral fold which is opaque white. The colour of the shell is pale horny yellow tinge. The apex of spire is brownish,

Localities :

Tori Village Distt. Jacobabad, Sind, (West Pakistan).

Habitat :

Similar to preceding species.

Lymnaea pinguis Dohrn

The Pinguis Pond-snail.

Pl. XXXI, Sp. No. 108a, 108b.

The shell is more or less broadly spindle-shaped, ovately acuminate and thin. The spire is distinctly elevated, with an acute apex which is short and conical. The upper most whorls are very small and the one below somewhat larger. The body-whorl is comparatively very large, inflated and ovate. The aperture is oblique in shape. The outer lip is very thin. The columellar lip is reflected out and bearing a thin layer of callus. The colour of the shell is pale horny brown.

Localities :

Cox's Bazar, Distt. Chittagong, (East Pakistan).

Habitat :

The habits of this species are very similar to preceding species.

Lymnaea auricularia Draparnaud

The auricular Podn-snail.

Pl. XXXI, Sp. No. 109a, 109b.

The shell is thin and somewhat squarely ovoid, smooth and glossy. The apex is sharp and pointed. The spire is conical. The body-whorl is rather abruptly enlarged and widely inflated. The surface of the shell is finely and closely transpirally striated throughout. The most prominent character of this species is that the aperture is very large, broad and the outer lip becomes thin and expanded ear-like structure. The columellar lip of the aperture is covered with a callus layer which is spirally twisted. The colour of the shell is pale horny yellow.

Localities :

Mancher Lake, Distt. Dadu, Sind, (West Pakistan).

Habitat :

Similar to other species.

Family PLANORBIDAE

Genus *Planorbis* Müller, 1774Subgenus *Indoplanorbis* Annandale & Prashad, 1920

Synonymy:

Coretus, Adanson. Angarius, Martini. Orbis, Schrot; not Lea.
 spirodiscus, Stein. Planorbina, Hald.

Planorbis (*Indoplanorbis*) *exustus* Deshayes *The common Pond-snail*
 Pl. XXXI, Sp. No. 110 a, 110 b.

The shell is moderately large, thick, depressed, discoidal and more or less concavely flattened on both sides. The spire is deeply engraved. The whorls are convex three in number and spirally coiled in one horizontal plane. The body-whorl is much larger and strongly inflated. The under side of the shell is broadly concave. The umbilicus is widely open. The aperture is wide and ear-shaped. The edge of the lip of the aperture is somewhat reflected outwards and more or less thickened in adult forms. Fine transpiral ridges are present throughout the surface. The colour of the shell is reddish-brown.

Localities

National stadium. Botany Pond, University of Karachi, Kalri Lake, Distt. Thatta, Sind, (West Pakistan).

Habitat:

They inhabitant Fresh-water. Attached to leaves of aquatic plants.

Order	STYLOMMATOPHORA
Superfamily	VERTIGINACEA
Family	ENIDAE
Subfamily	Napaeinae
Genus	<i>Rachis</i> Albers, 1850

Synonymy:

Rachisellus, Bourguiere. *Bulimus*, Lamarck.

Rachis bengalensis Lamarck

The Bengal's Land Snail
 Pl. XXXII Sp. No. 111 a, 111 b.

The shell is ovately conical, acuminate above, rather thin and smooth and translucent. The whorls of spire somewhat convex and sutures are depressed. The spire is conical, with an acute apex.

The body-whorl is moderately inflated and rounded and nearly equal in height to remaining part of the shell. The aperture is broadly ovate and simple. The columellar margin dilated. The shell is pale yellowish-white. The body-whorl is encircled by two or more fairly broad, chestnut-brownish spiral bands.

Localities:

Tejgaon, Green Road, Dacca, (East Pakistan).

Habitat:

Living chiefly on trees and also found near water about trees.

Superfamily	ACHATINACEA
Family	SUBULINIDAE
Subfamily	OPEATINAE
Genus	<i>Opeas</i> Albers, 1850

Synonymy:

Bulimus, Hutton, Reeve, Blandford, Hanely & Theobald, Godwin-Austin. *Stenogyra*, Von Martens. *Stenogyra*, Semper, Peile. *Spiraxis*, Blandford.

Opeas gracile Hutton

The slenderical land-snail
Pl. XXXII Sp. No. 112.

The shell is small, thin-walled, and turreted. The surface of the shell is smooth and glossy the striae can be seen under the binocular. The apex is rounded in shape and the spire is gradually tapering. The number of whorls are variable from eight to twelve. The aperture is longer than broad, semi-ovate, but slightly narrowed above. The outer lip is thin and sharp-edged while columellar lip is more or less straight, partly reflected. The colour of the shell is pale-horny but variable in the different hues of yellow colour.

Localities:

Bahadur Yar Jang Housing Society, Karachi, (West Pakistan).

Habitat :

Living specimens inhabit moist places. They are preyed upon in large numbers by the carnivorous land snail with *Ennea bicolor*. It is frequently found in association with the *Ennea bicolor*. They are abundant only during July & August.

Subfamily	RUMININAE
Genus	<i>Zootecus</i> Westerlund, 1887

Synonymy:

Bulimus, Pfeiffer, Pupa, Von Martens, *Cylindrus*, Theobald, *Bulimina*, Pfeiffer & Clessin, *Rumina*, Ancey, *Mastus*, Ancey, *Chilogymnus*, Jousseaume.

Zootecus chion Pfeiffer*The Chion Land-snail*
Pl. XXXII Sp. No. 113.

The shell is small smooth and glossy. The spire is elongated and terminates in a conical apex. The body-whorl is somewhat larger and about one third of the total length and well rounded below. Thus the shell has a cylindrical pupiform appearance. The aperture is vertical more or less semiovate, with the peristome slightly thickened with callus and beveled-edge. The columellar margin of the aperture is rather short, and somewhat expanded and reflected. The shell is uniformly dirty white in colour.

Localities :

Nallah near Department of Zoology, University of Karachi, (West Pakistan).

Habitat :

Living specimens inhabit moist areas of Karachi. They are found in abundance.

Family ACHATINIDAE

Genus *Achatina* Lamarck, 1799

Synonymy:

Helix, Ferussac. *Achatinus*, Montf. *Cochlitoma*, Ferus. *Oncaea*, Gist. *Archachatina*, Albers. *Ampulla*. Bolten.

Achatina Fulica Férussac*The Gaint Land Snail*
Pl. XXXII Sp. No. 114 a, 114 b.

The shell is large, avoid with a well-developed conical spire and it grows to a length of 5 inches. The whorls are eight in number, somewhat convex and inflated. The body-whorl is more or less ventricose. The aperture is large and elongately ovate, with the peristome straight and acute. The columella is slightly concave, rather twisted, and narrowly truncated below. The outer surface is somewhat glossy and is a fine sculpture of close-set transpiral striae. The colour of the shell is pale yellowish, irregularly streaked and clouded with brownish markings all over but the upper most is whitish in colour.

Localities :

Nawabganj, Distt. Rajshahi, Alam Nagar Distt. Khulan, (East Pakistan.)

Habitat :

The members of this species are preyed upon by the glow worm, larvae of *Lamprophorus tenelerosus*. They are causing considerable damage to vegetable gardens e. g. Tomatos. They live in humid places.

Superfamily	HELICACEA
Family	PLEURODONTIDAE
Genus	<i>Planispira</i> Beck, 1837.

Synonymy:

Helix, Ferussac. *Trachia*, Theobald.

Planispira proxima Ferussac

The Common dark banded Land snail
Pl. XXXII Sp. No. 115a, 115 b.

The shell is moderate in size, thicker, more solid much less conoidly depressed and is rather globose. The spire is distinctly convex and sutures are deeply depressed. The upper most whorles of the spire are smooth and glossy. The apex is rounded and swollen. The body-whorl is slightly inclined towards the aperture, which is somewhat oblique to the axis and is broadly ovate. The columellar margin is expanded into a distinct sheet of callus which over hangs the umbilical opening considerably on that side. The peristome is thickened, expanded and reflected. The umbilicus is small, open, with narrow circular opening. The sculpturation consists of close-set, rather coarse oblique transpiral striations. The shell is light fawn with brown band at the periphery.

Localities :

Lai nallah, South East of Rawalpindi, (West Pakistan.)

Habitat :

They live near the rivers and humid places.

ACKNOWLEDGEMENT

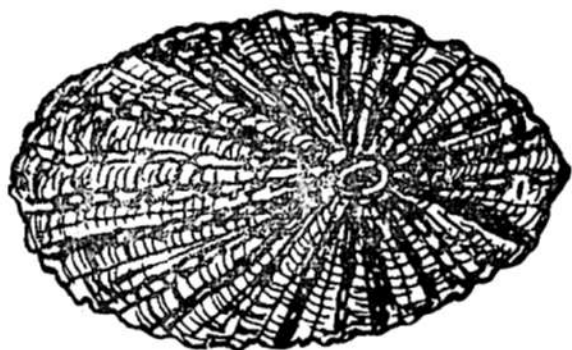
The systematic studies of Mollusca of Pakistan could not have been contemplated, muchless written, without the help and guidance of Mr. M. S. U. Siddiqi, Director, Zoological Survey of Pakistan. We acknowledge our sincere gratitude for this encouragement.

We wish to express our appreciation to Mr. Nooruddin, Zoologist, Zoological Survey of Pakistan, for his suggestions and critical evaluation of the manuscript.

This research is being made possible by the generosity of our Field Assistant, Ahmad Khan, who helped us in the project in various ways.

We are also indebted to Agricultural Research Council for financial assistance.

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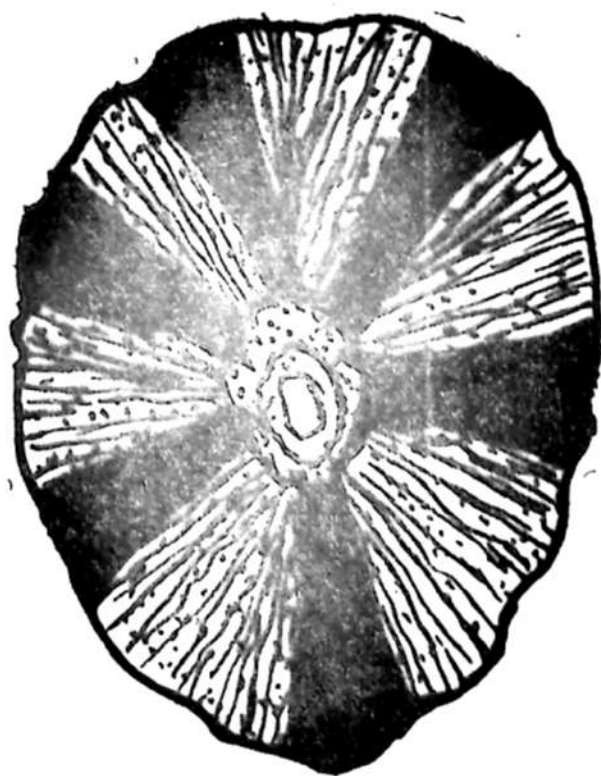
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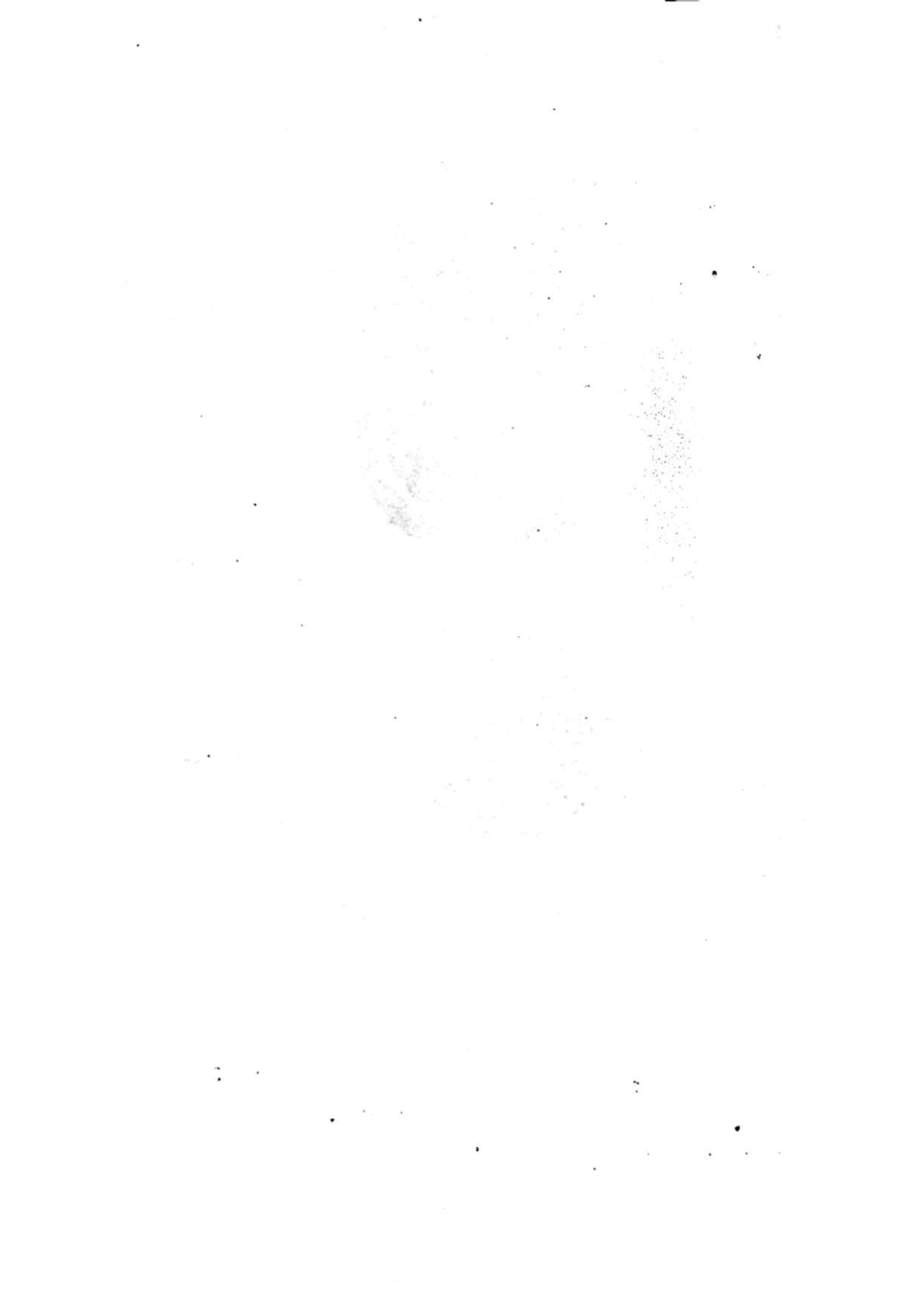


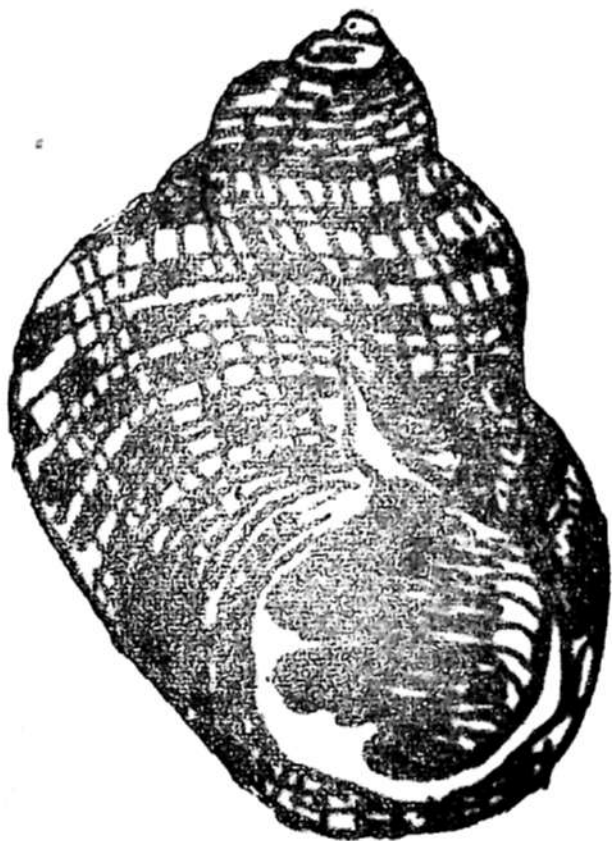
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3

- Figs. 1. 1a, 1b, *Diodora funiculata* : Outer and side views.
Fig. 2. *Diodora tecaonica* : Outer view.
Fig. 3. *Cellana radiata* : Outer view.





4



5



6a



6b



7

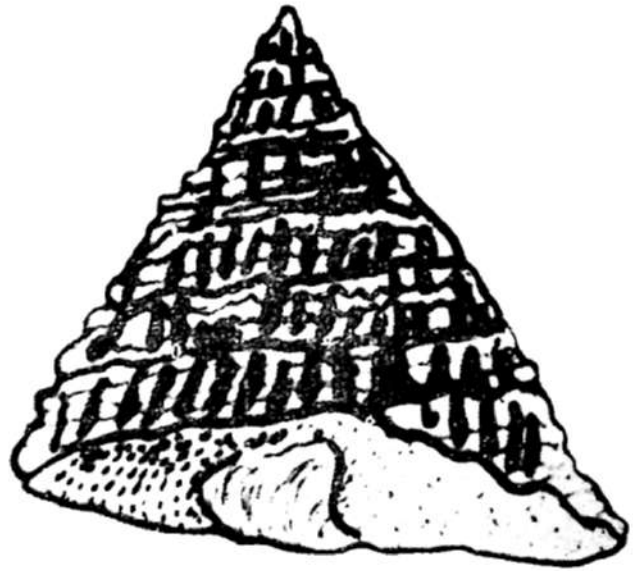
Fig. 4. *Monodonta canalicifera* : Apertural view.
 Fig. 5. *Monodonta labio* : Apertural view.
 Figs. 6a, 6b. *Clanculus microdon* : Basal and outer views.
 Fig. 7. *Eucheilus asper* : Apertural view.



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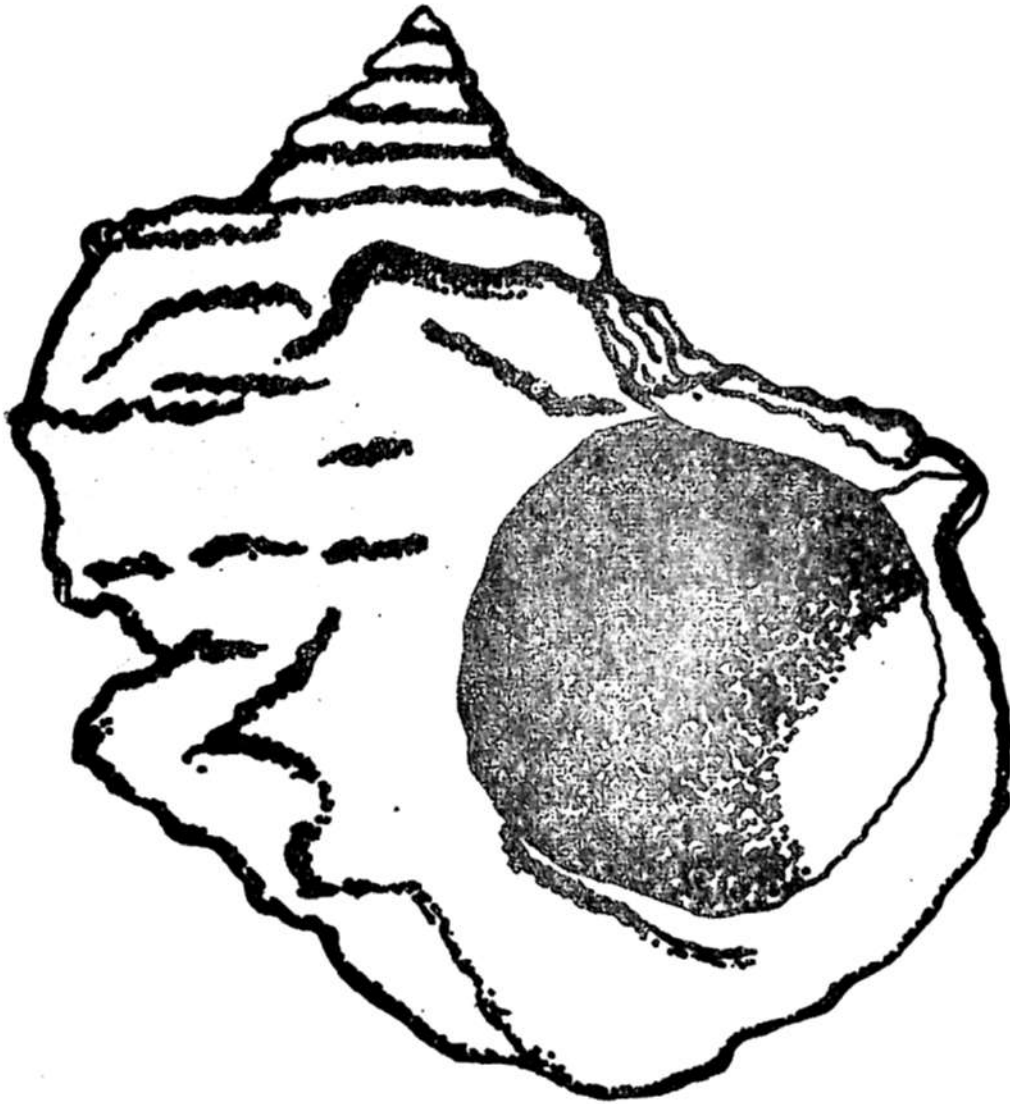


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- Fig. 8. *Trochus nitoticus*. Apertural view.
 Fig. 9. *Trochus maculatus*. Apertural view.
 Fig. 10. *Trochus virgatus*. Apertural view.
 Fig. 11. *Trochus radiatus*. Outer view.
 Fig. 12. *Umbonium vestiarium*. Outer view.



13



14a



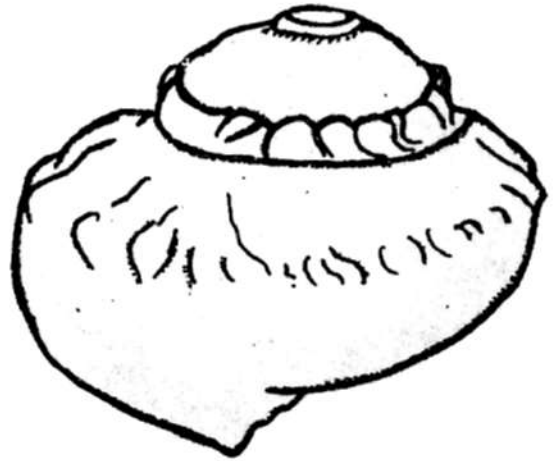
14b

Fig. 13. *Turbo marmoratus*. Apertural view.

Figs. 14a, 14b. *Turbo intercostajis*. Apertural and outer view.



15a



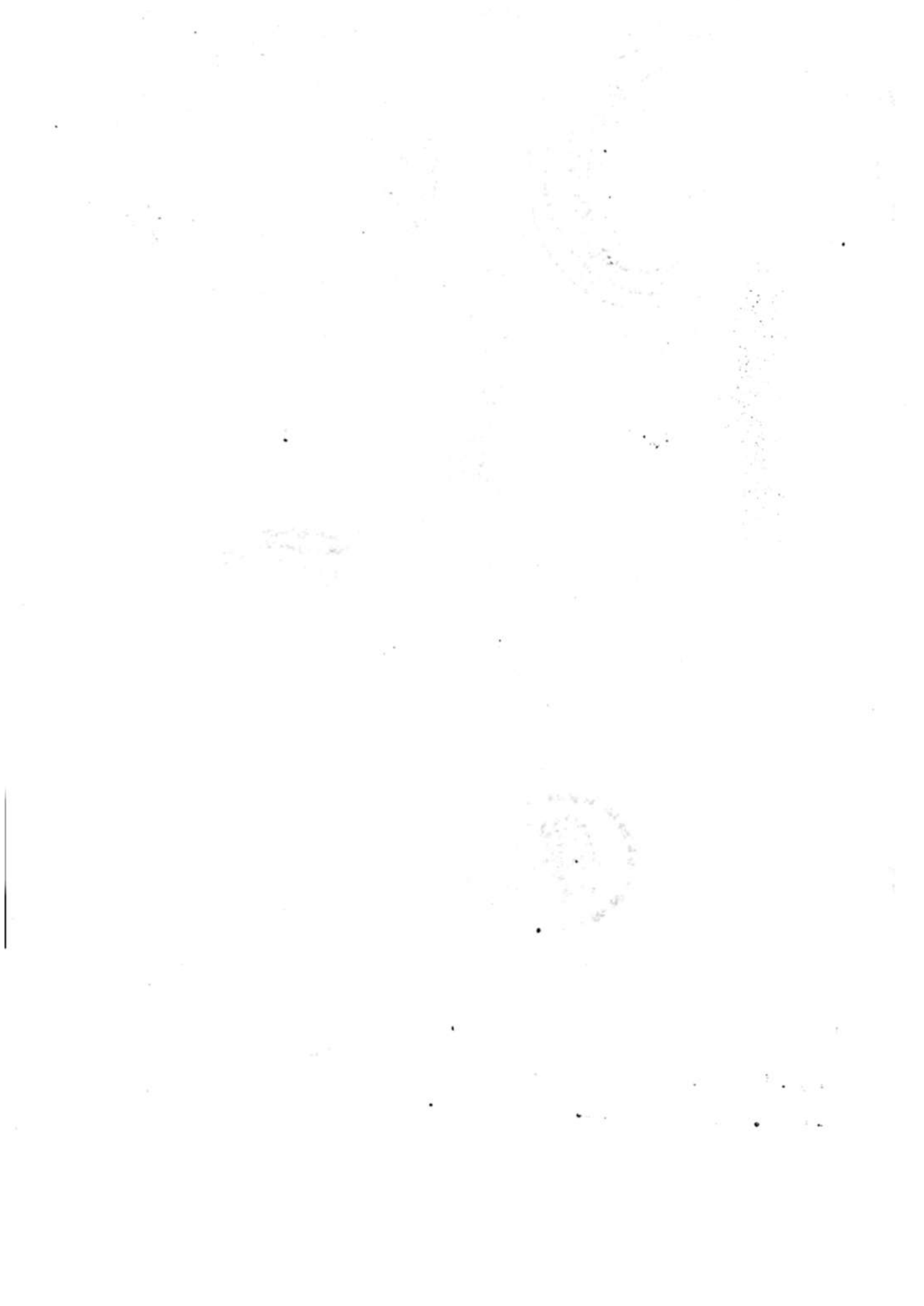
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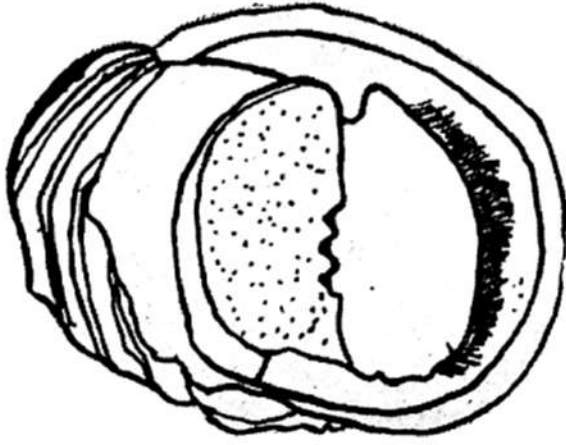


16

Figs. 15a, 15b. *Turbo coronatus*. Apertural and outer view.

Fig. 16. *Astraea semicosta*. Apertural view.





17a



17b



18a



18b



19a



19b

Figs. 17a, 17b. *Nerita plexa*. Apertural and outer views.

Figs. 18a, 18b. *Nerita albicilla*. Outer and Apertural views.

Figs. 19a, 19b. *Nerita Costata*. Apertural and outer views.

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20



21



22a



22b



23a



23b

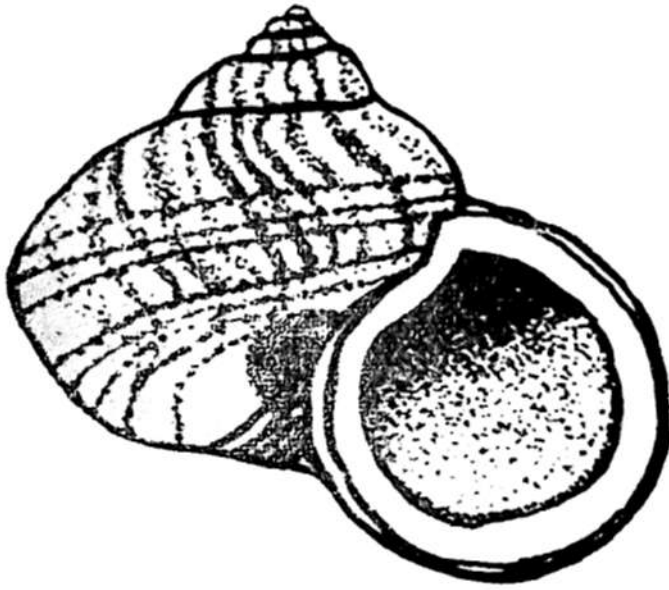
Fig. 20. *Nerita polita*. Apertural view.

Fig. 21. *Nerita rumphii* Outer view.

Figs. 22a, 22b. *Nerita lineata*. Apertural and outer views.

Figs. 23a, 23b. *Neritina neglecta*. Outer and Apertural views.





24



25a



25b



26a



26b



27a



27b

- Fig. 24. *Cyclophorus* (*Annularia*) *aurantiacus*. Apertural views.
 Figs. 25a, 25b. *Viviparus bengalensis*. Apertural and outer views.
 Figs. 26a, 26b. *Viviparus crassa*. Apertural and outer views.
 Figs. 27a, 27b. *Viviparus naticoids*. Apertural and outer views.

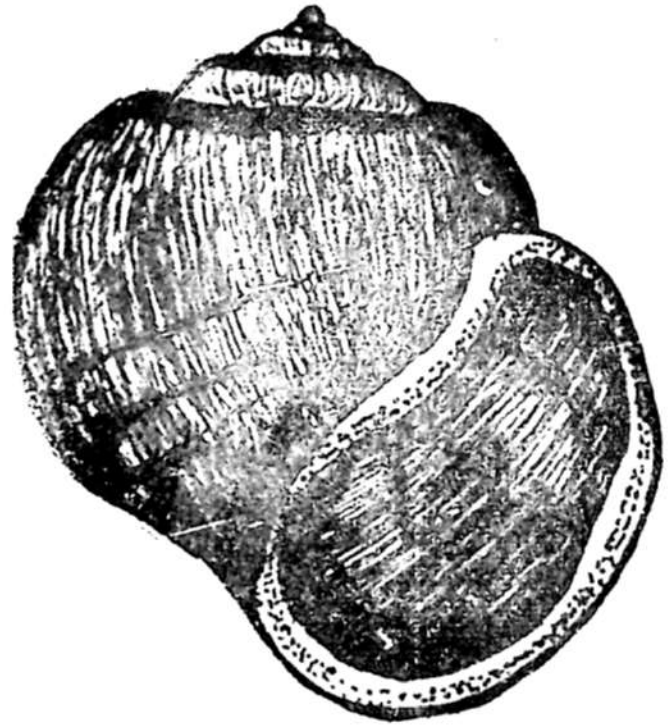
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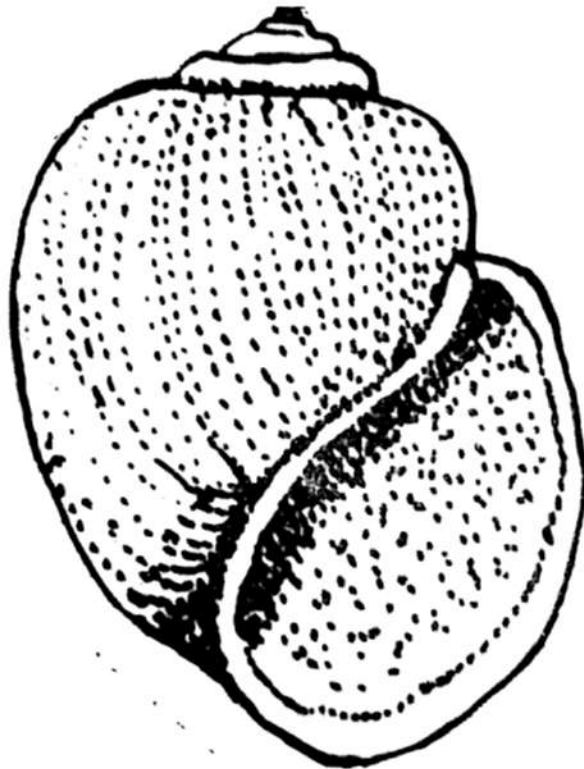
28a



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29



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Figs. 28a, 28b. *Viviparus remossii*. Apertural and outer views.

Fig. 29. *Piqa globosa*. Apertural view.

Fig. 30. *Piqa virens*. Apertural view.



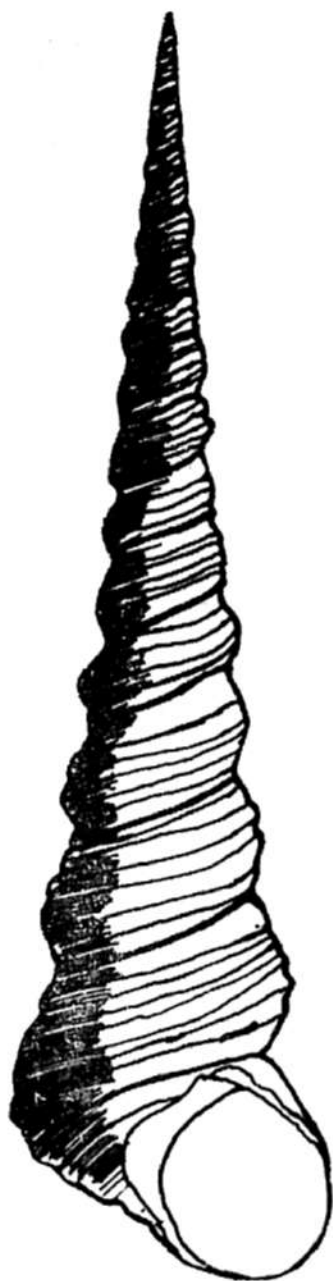
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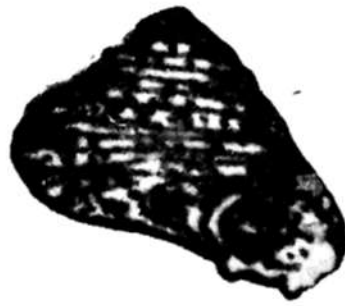
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Figs. 31a, 31b. *Littorina angulifera*. Outer and Apertural views.
 Fig. 32. *Littorina angulifera* Lineata. Apertural view.
 Fig. 34. *Turritella duplicata*. Apertural view.





35



36a



36b



37a



37b

Fig. 35. *Torinia variegata*. Apertural view.

Figs. 36a, 36b. *Architectonica perspectivum*. Apertural and basal views.

Figs. 37a, 37b. *Architectonica granulata*. Apertural and basal views.





38a



38b



39a



39b



40a



40b



41

Figs. 38a, 38b. *Melania* (*Striatella*) *tuberculata*. Apertural and outer views.

Figs. 39a, 39b. *Melania* (*Plotia*) *scabra*. Apertural and outer views.

Figs. 40a, 40b, *Melania* (*Plotio*) *scabra* var. *elegans*. Apertural and outer views.

Fig. 41. *Cerithidea obtusa*. Apertural view.





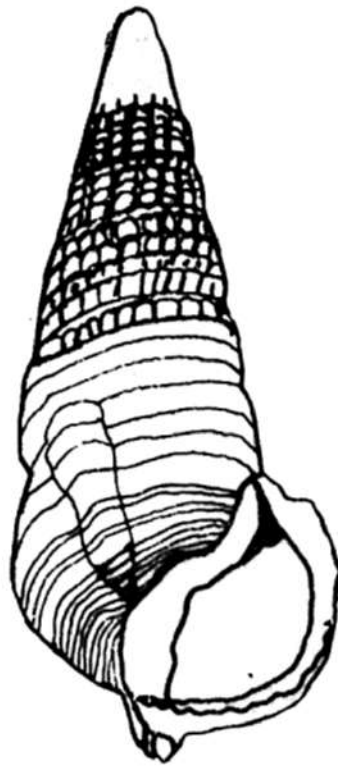
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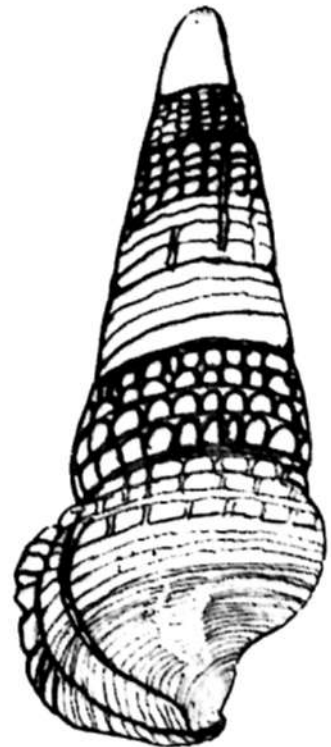
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44a



44b

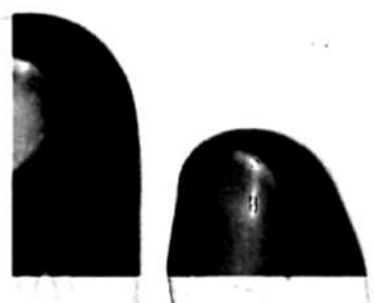
Figs. 42a, 42b, *Cerithidea fluviatilis*. Apertural and outer views.

Fig. 43. *Telescopium telescopium*. Apertural view.

Figs. 44a, 44b. *Terebrajia pajustris*. Apertural and outer views.

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46a



46b

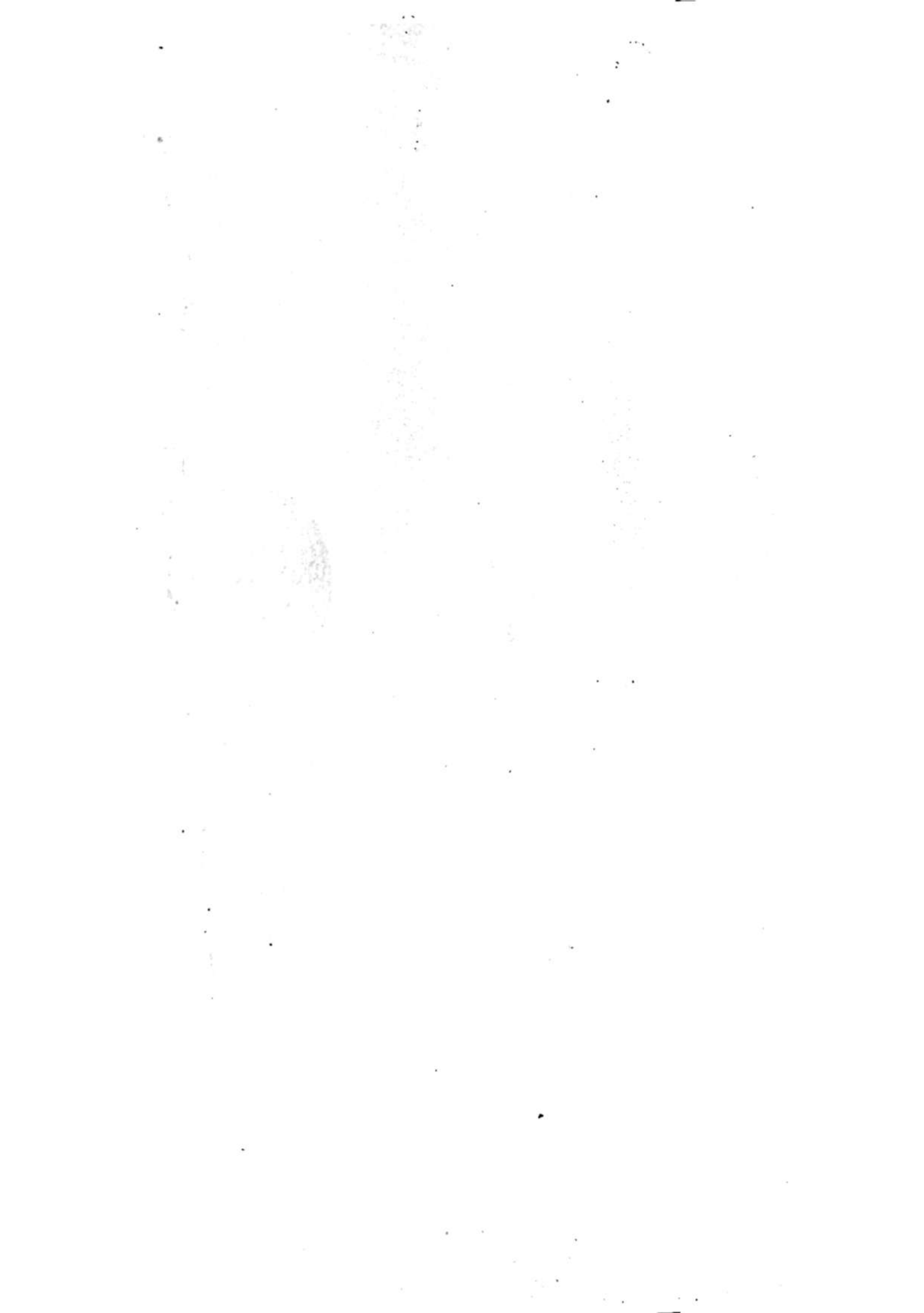


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Fig. 45. *Cerithium morus*. Apertural view.
 Figs. 46a, 46b. *Cerithium sinensis*. Apertural and outer views.
 Fig. 47. *Cerithium citrinum*. Apertural view.
 Fig. 48. *Epitonium pyramidalis*. Apertural view.





49a



49b



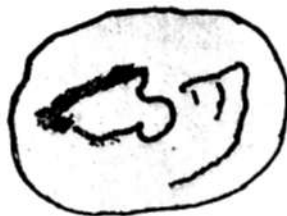
50a



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51a



51



52

Fig. 49a, 49b. *Janthina janthina*. Apertural and outer views.

Figs. 50a, 50b. *Janthina globosa*. Apertural and outer views.

Figs. 51a, 51b. *Crepidula plana*. Outer and inner views.

Fig. 52. *Calyptraea extincorium*. Inner view.



53



55



54



56a



56b

Fig. 53. *Xenophora solaris*. Front view.
 Fig. 54. *Tibia curta*. Outer view.
 Fig. 55. *Strombus canarium*. Apertural view.
 Figs. 56a, 56b. *Strombus floridus*. Apertural and outer views.





57



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59



60a



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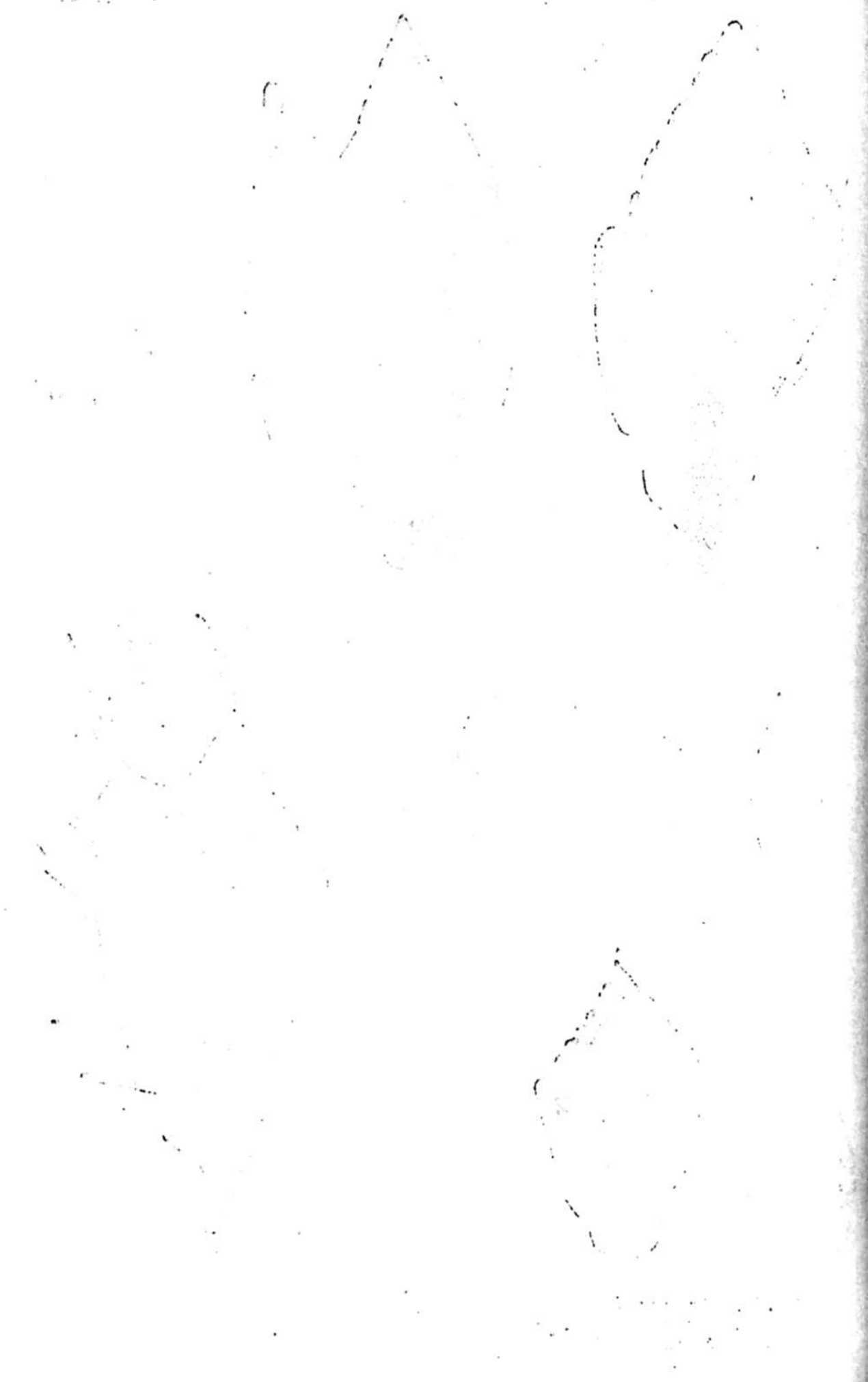


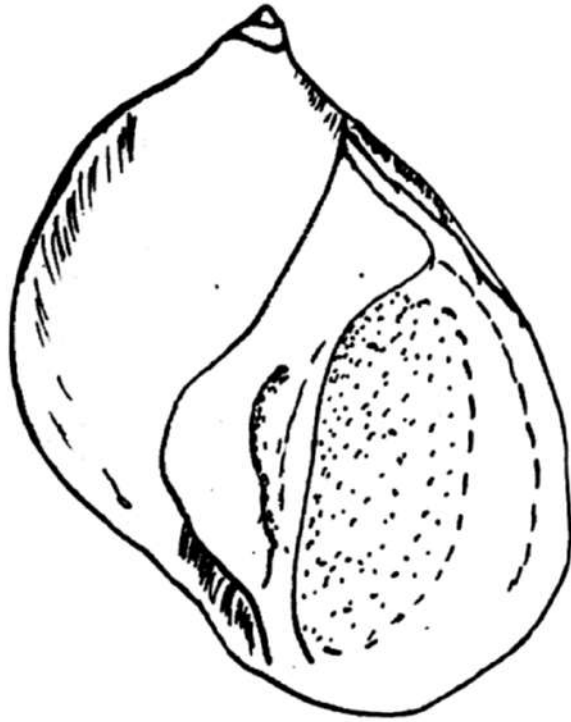
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- Fig. 57. *Strombus gibberulus*. Apertural view.
 Fig. 58. *Strombus guttatus*. Apertural view.
 Fig. 59. *Strombus pulchellus*. Apertural view.
 Figs. 60a, 60b. *Strombus ruppelli*. Apertural and outer views.
 Fig. 61. *Strombus urceus*. Apertural view.
 Fig. 62. *Lambis lambis*. Apertural view.

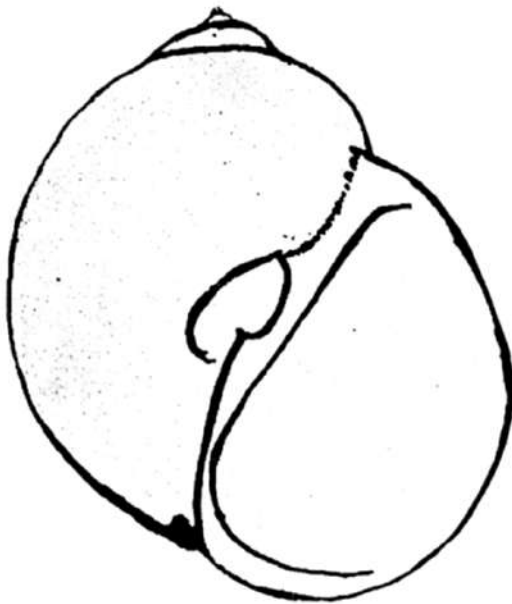
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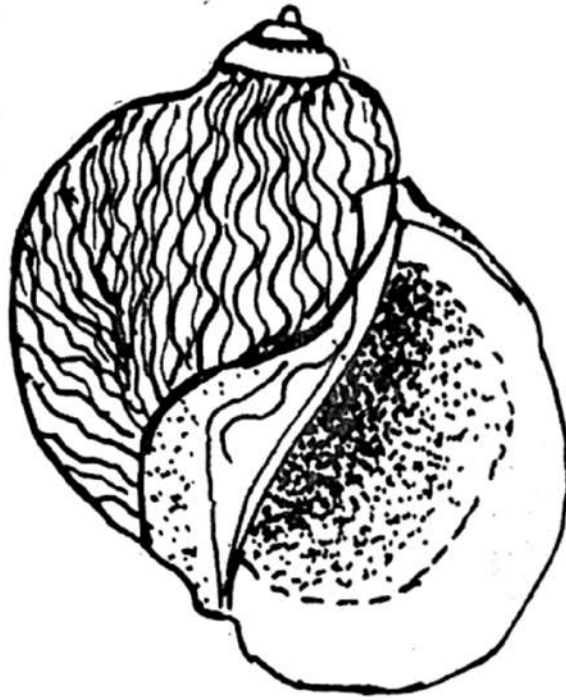
65a



65b

Fig. 63. *Natica mamilla*. Apertural view.
 Figs. 64a, 64b. *Natica tigrina*. Apertural and outer views.
 Figs. 65a, 65b. *Natica didyma*. Outer and Basal views.





66



67a



67b



68a

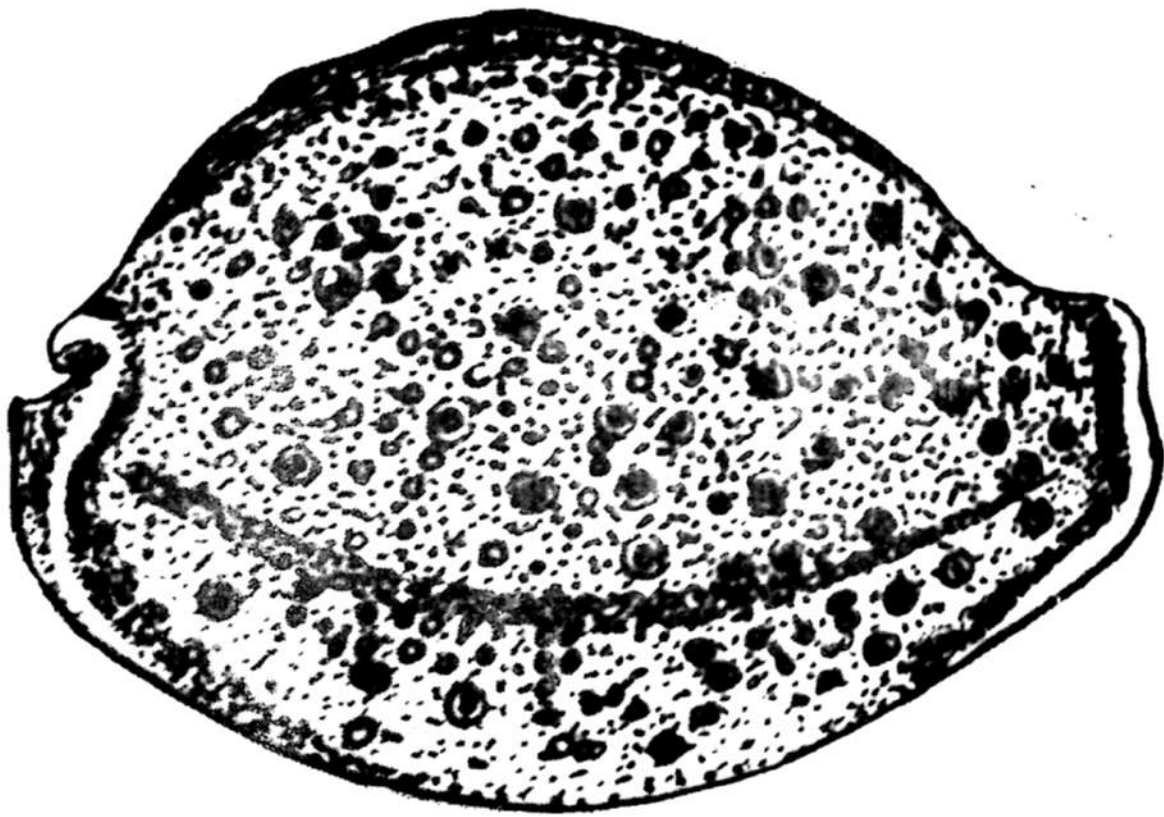


68b

Fig. 66. *Natica lineata*. Apertural view.
 Figs. 67a, 68b. *Natica vitejlus*. Outer and apertural views.
 Figs. 68a, 68b. *Sinum cuvierianum*. Outer and apertural views.

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69



70a



70b

Fig. 69. *Cypraea ocellata*. Side view.

Fig. 70a, 70b. *Cypraea turdus*. Side and outer views.

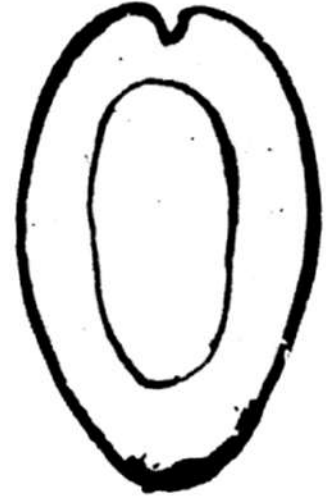




71a



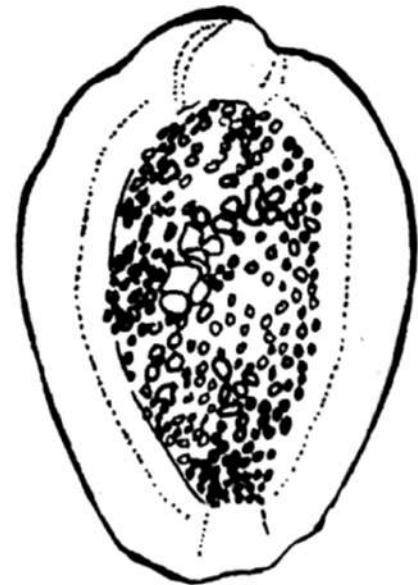
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73a



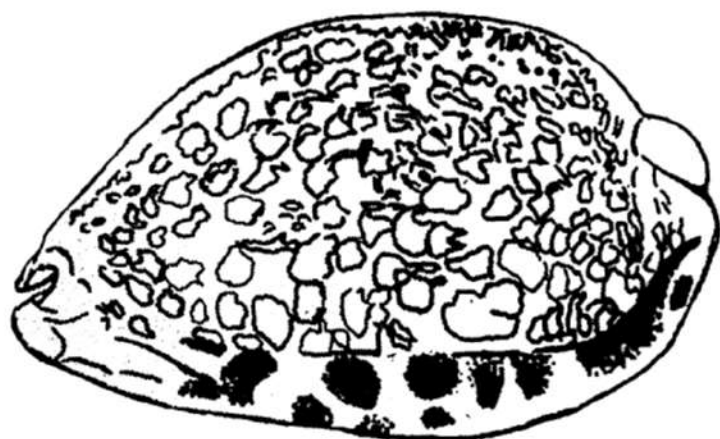
73b

Figs. 71a, 71b. *Cypraea moneta*. Basal and outer views.

Fig. 72. *Cypraea annulus*. Outer view.

Figs. 73a, 73b. *Cypraea caput-serpentis*. Side and outer views.

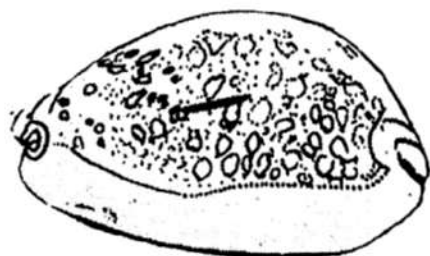




74a



74b



75a



75b



76

- Figs. 74a, 74b. *Cypraea arabica*. Side and outer views.
 Figs. 75a, 75b. *Cypraea mauritiana*. Side and outer views.
 Fig. 76. *Cypraecassis rufa*. Apertural view.





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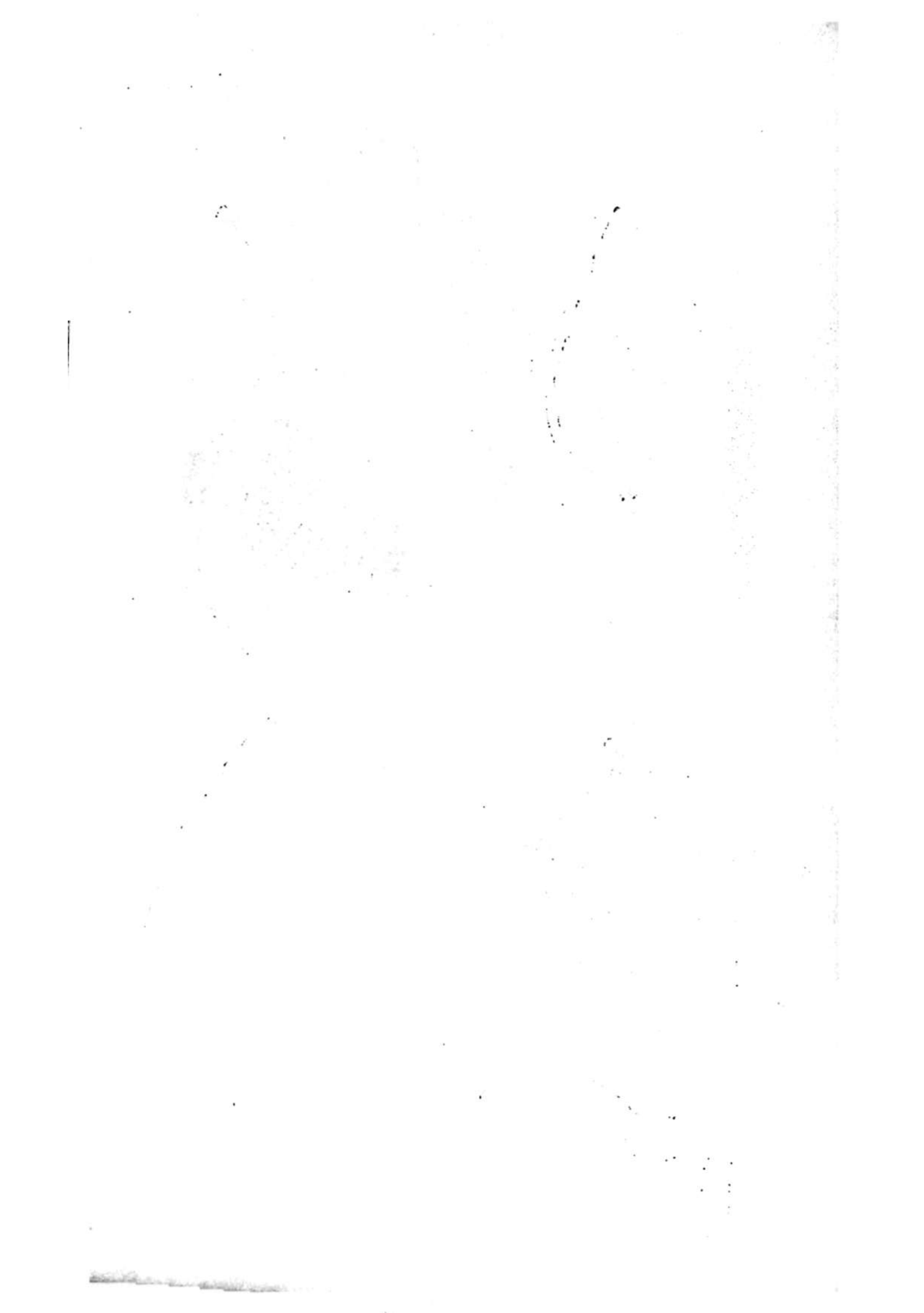


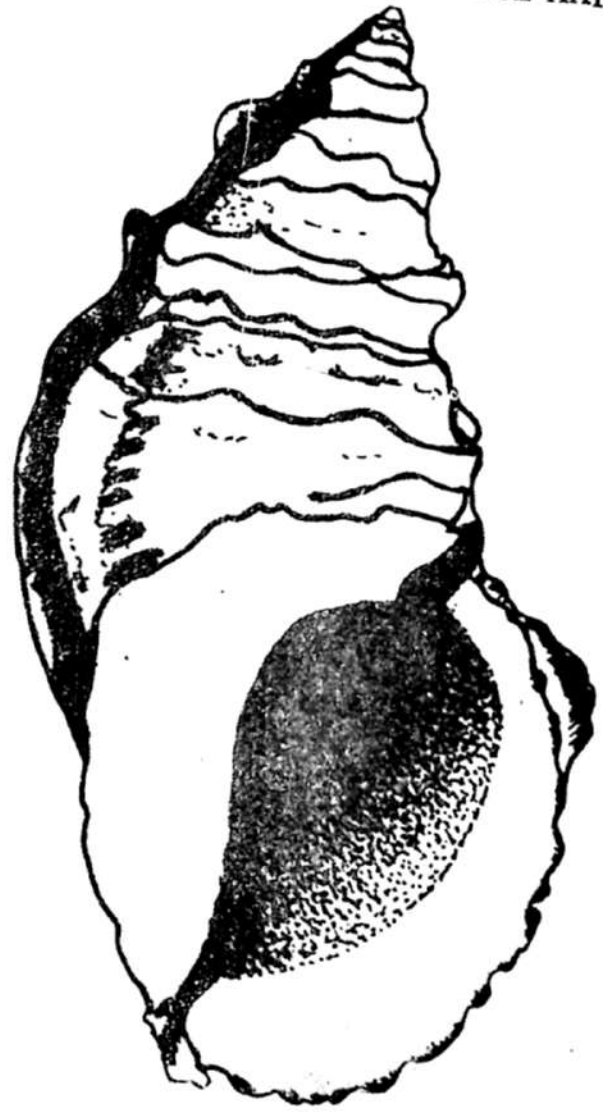
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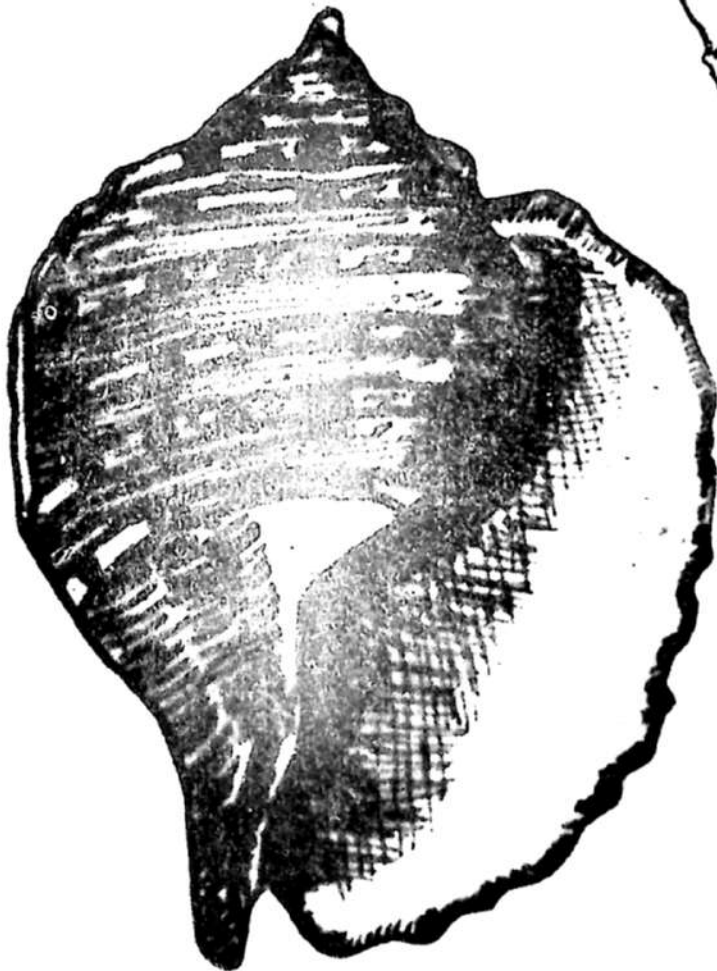
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- Fig : 77. *Cymatium Olearium*. Apertural view.
 Fig : 78. *Cymatium (Septa) pileare*. Apertural view.
 Fig : 79. *Bursa spinosa*. Apertural view.
 Fig : 80. *Bursa granulatis*. Apertural view.





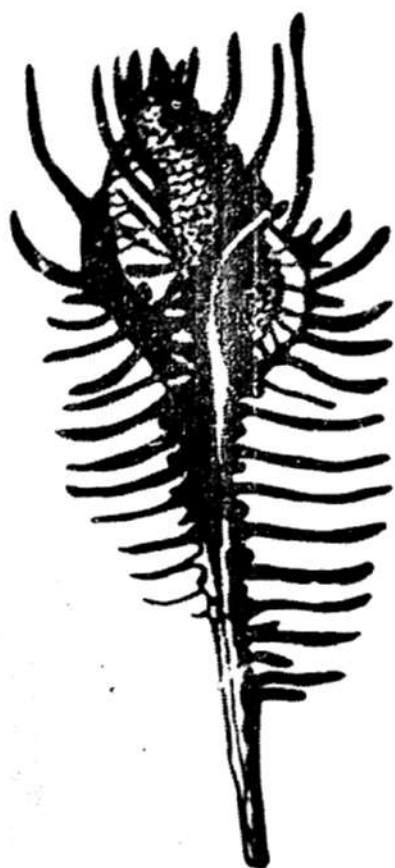
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Fig : 81. *Bursa lampus*. Apertural view.
Fig : 82. *Tonna maculatum*, Apertural view.

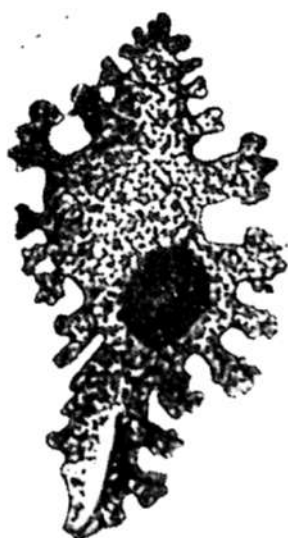




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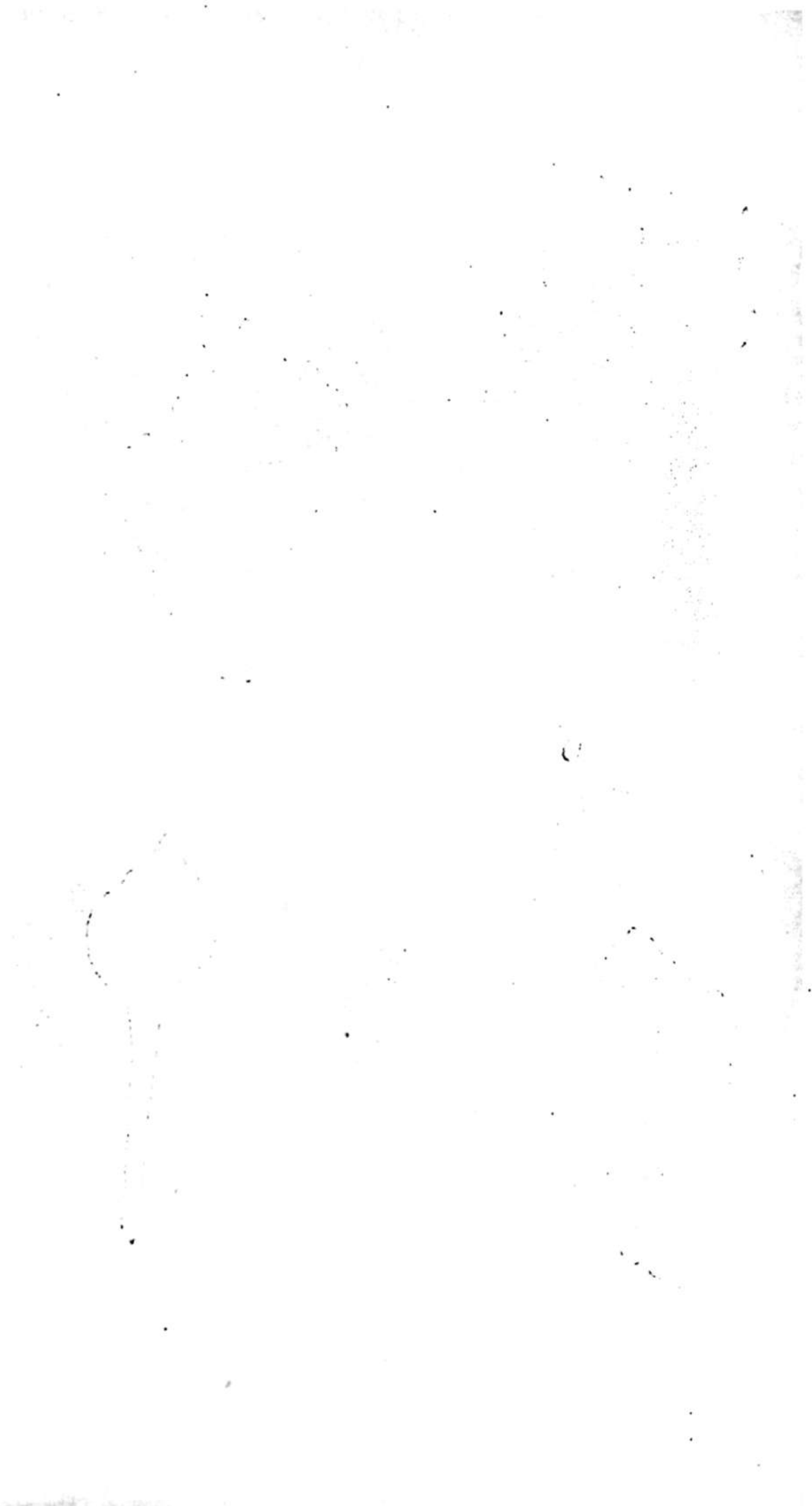
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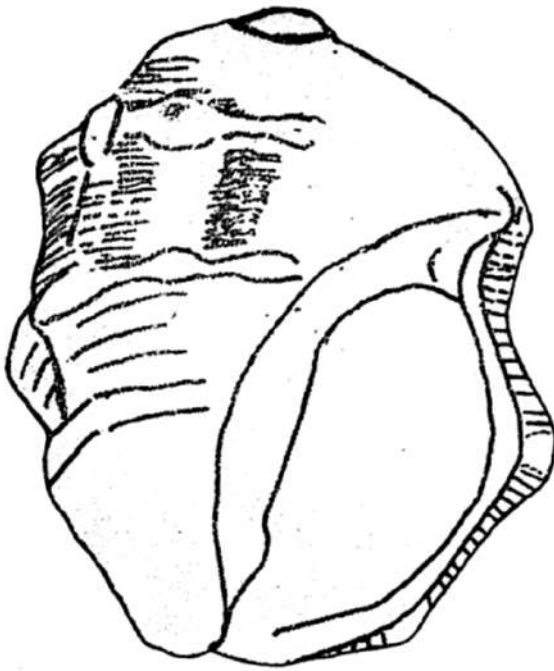


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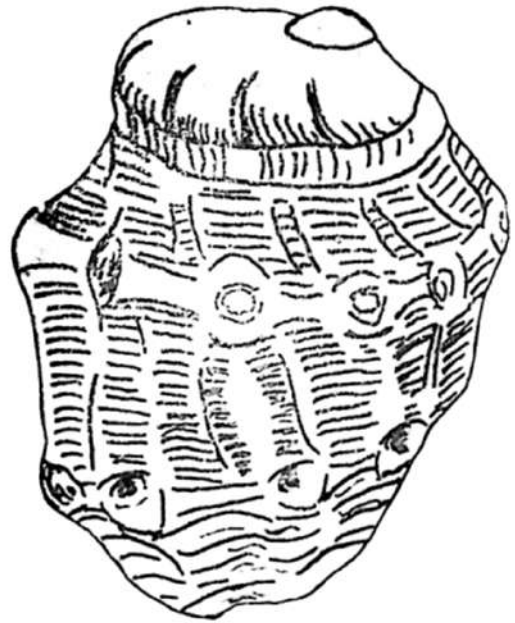
- Fig : 83. *Murex tenuispina*. Apertural view.
 Fig : 84. *Murex adustus*. Apertural view.
 Fig : 85. *Murex palma-rosae*. Apertural view.
 Fig : 86. *Murex haustellum*. Apertural view.

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87a



87b



88



89



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Figs : 87a, 87b. *Thais bufo*. Apertural and outer view.

Figs : 88. *Thais rudolphi*. Apertural view.

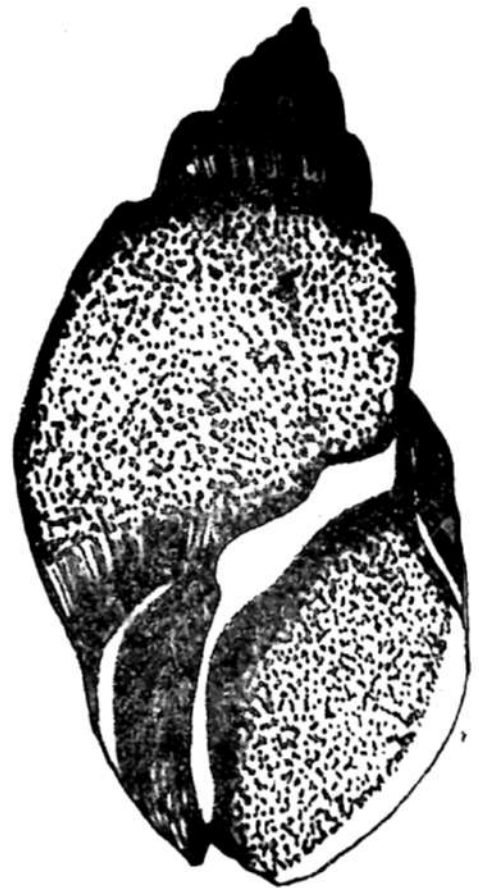
Fig. 89. *Thais kiosquiformis*. Apertural view.

Fig. 90. *Rapana bulbosa*. Apertural view.

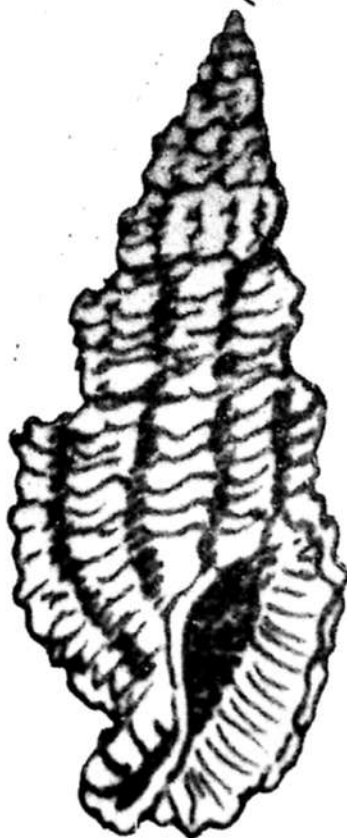




91a



91b



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93



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Figs. 91a, 91b. *B. hylonia spirata*. Outer (without Periostracum) and apertural views.
 Fig. 92. *Phcs senticosus*. Apertural view.
 Fig. 93. *Cantharus undosus*. Apertural view.
 Fig. 94. *Fasciolaria filamentosa*. Apertural view.





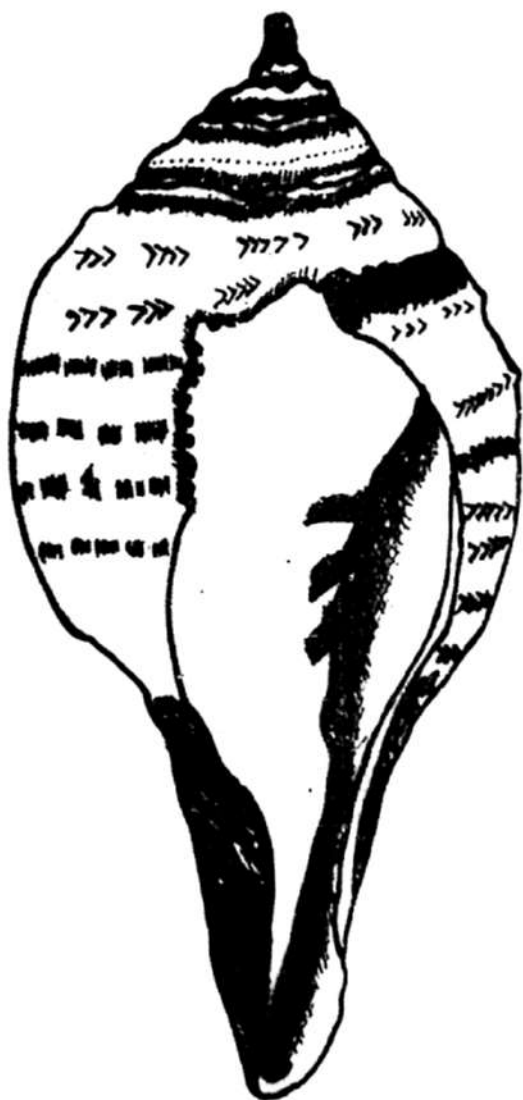
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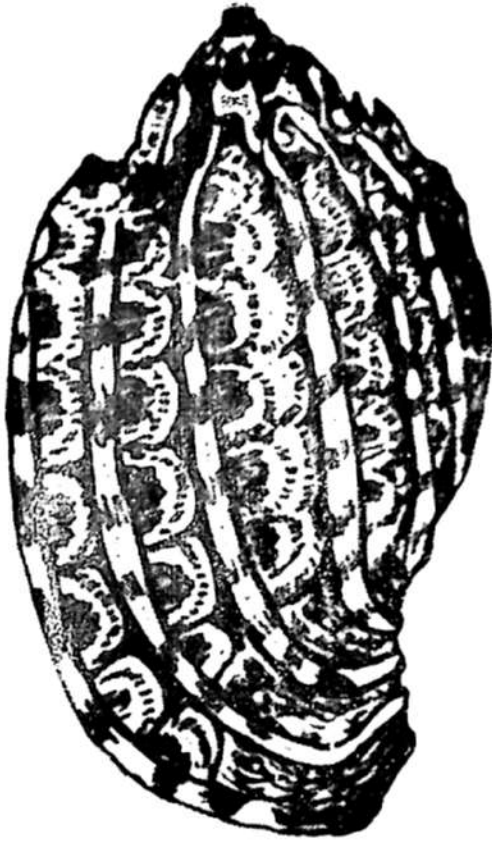


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Fig. 95. *Oliva gibbosa*. Apertural view.
 Fig. 96. *Mitra mitra*. Apertural view.
 Fig. 97. *Mitra pontificalis*. Apertural view.
 Fig. 98. *Xancus pyrum*. Apertural view.

PLATE 1





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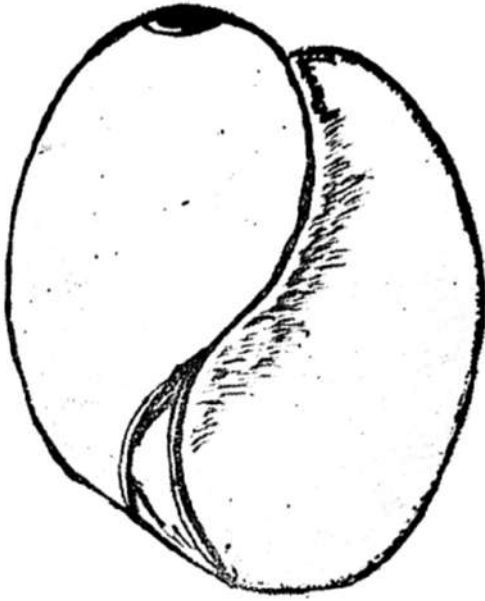
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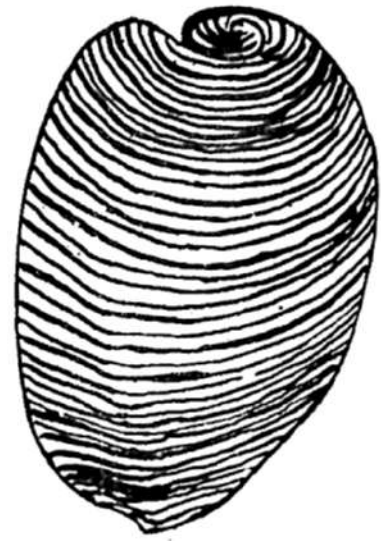
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Fig. 99. *Harpa Conoidalis*. Outer view.
 Fig. 100. *Turricula javana*. Apertural view.
 Fig. 101. *Turris babylonica*. Apertural view.
 Fig. 102. *Cous textile*. Outer view.

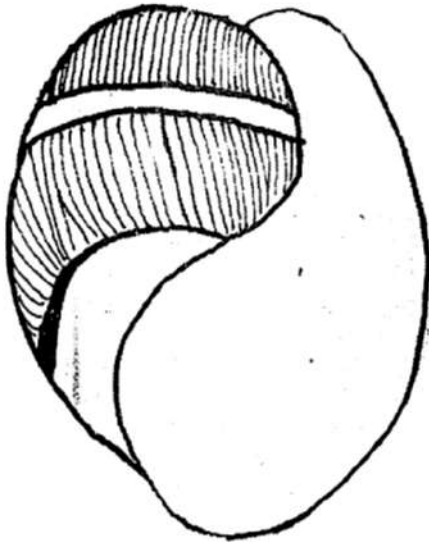




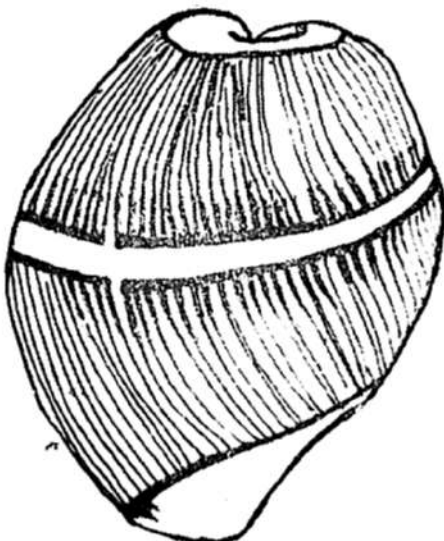
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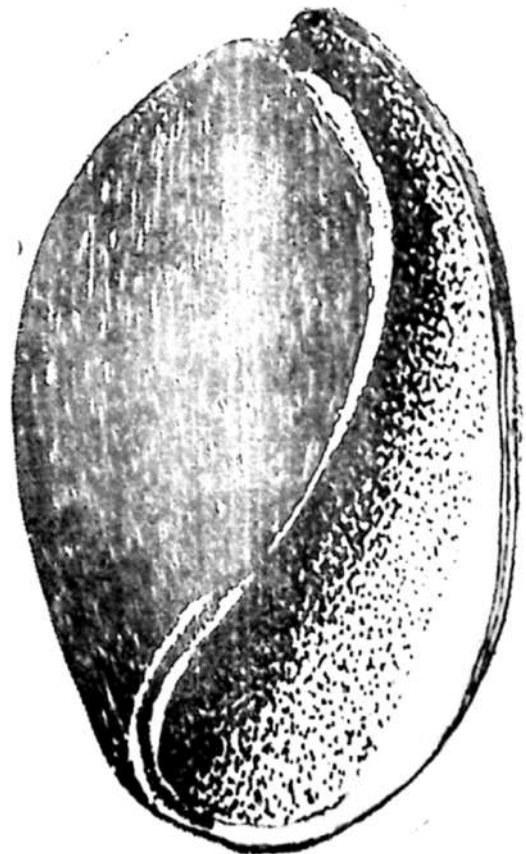
103b



104a



104b



105

Figs. 103a, 103b. *Hydatina physis*. Apertural and outer views.
 Figs. 104a, 104b, *Hydatina velum*. Apertural and outer views.
 Fig. 105. *Bulla ampulla*. Apertural view.





106a



106b



107a



107b



108a



108b



109a



109b



110a



110b

- Figs. 106a, 106b. *Lymnaea acuminata*. Outer and Apertural views.
 Figs. 107a, 107b. *Lymnaea lutcola*. Outer and Apertural views.
 Figs. 108a, 108b. *Lymnaea pinguis*. Outer and Apertural views.
 Figs. 109a, 109b. *Lymnaea auricularia*. outer and Apertural views.
 Figs. 110a, 110b. *Planorbis (Indoplanorbis) exustus*. Basal and front views.



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111a



111b



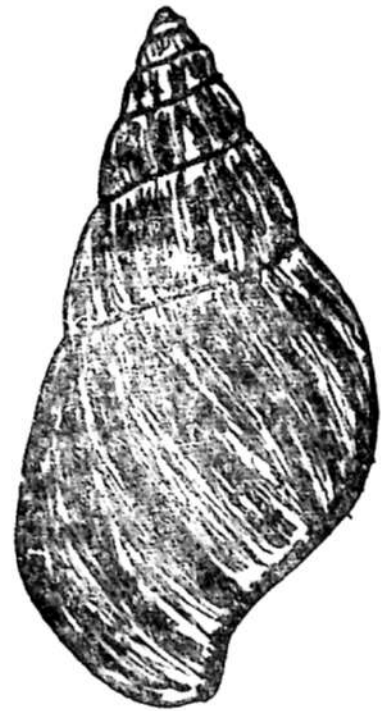
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114a



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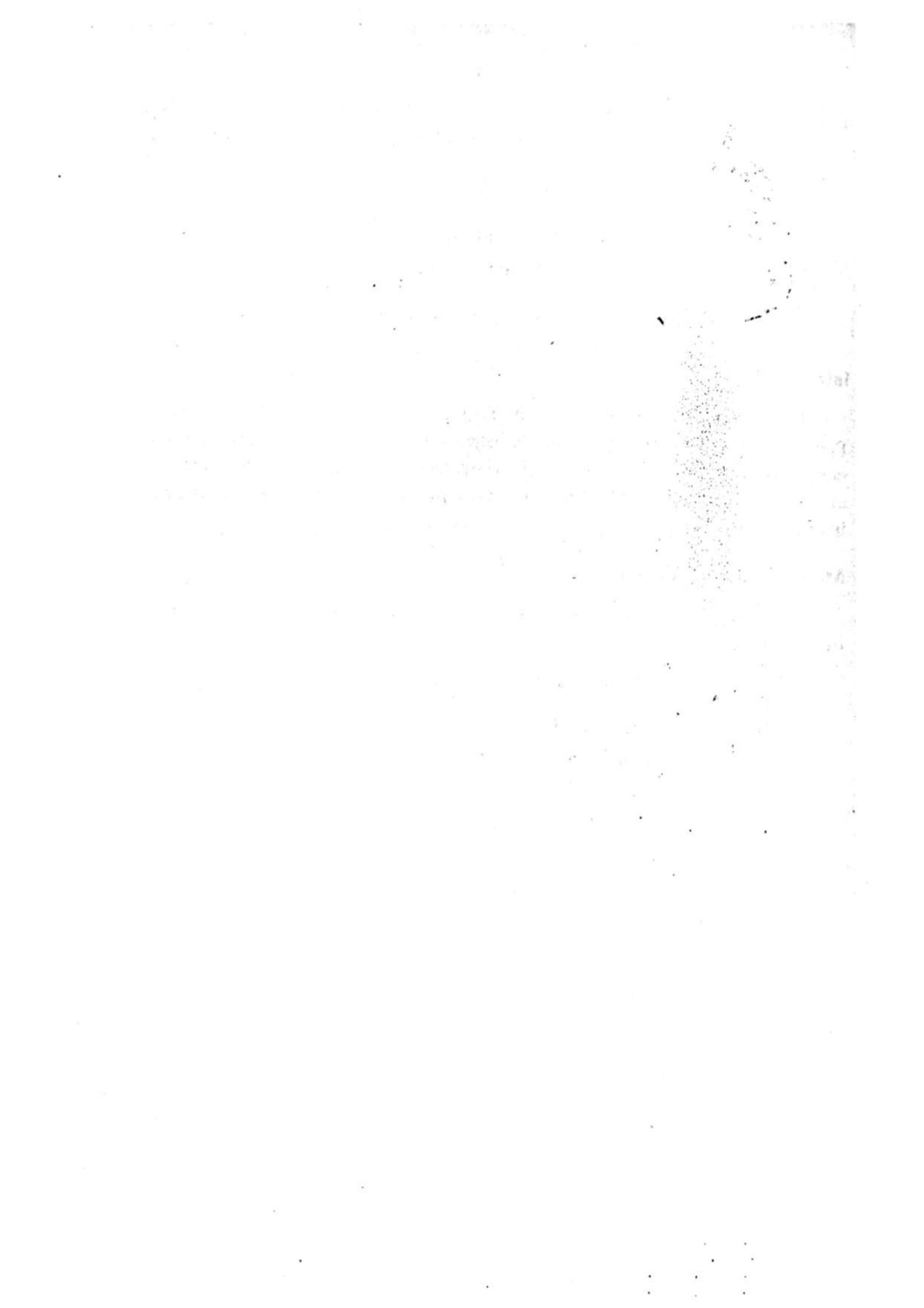


115a



115b

Figs. 111a, 111b. *Rachis bengalensis*. Outer and Apertural views.
 Figs. 112. *Opeas gracile*. Apertural view.
 Fig. 113. *Zootecus chion*. Apertural view.
 Figs. 114a, 114b. *Achatina fulica*. Apertural and outer views.
 Figs. 115a, 115b. *Planispira proxima*. Apertural and Basal views.



MORPHOLOGY OF THE AIR-BLADDER OF SCIAENOID FISHES AND ITS SIGNIFICANCE IN THE CLASSIFICATION.

BY

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Introduction :

The Sciaenidae or Croakers, represent a family of marine fishes in the order Perciformes. The air-bladder, in the fishes of this family, is very large and shows most extraordinary development of arborescent appendages on the sides and at the two extremities. All these fishes are physoclistous by nature of their air-bladders.

Material And Method :

The family is common and most of the species are available almost throughout the year.

These studies are based on the following species :—

1. *Sciaena dussumieri* (C.V.)
2. *Johnius belengeri* (C.V.)
3. *Johnius dussumieri* (C.V.)
4. *Johnius maculatus* Bloch, Sch.
5. *Otolithus argenteus* (C.V.)
6. *Pama pama* (Ham. Buch.)
7. *Otolithoides biauritus* (Cantor)
8. *Pseudosciaena coiber* (Ham.)
9. *Pseudosciaena soldado* (Lac.)

Pama pama is rather rare and only two specimens were collected after visiting the Fish Harbour for about one year. All the other species are very common and are available throughout the year.

The material consisted of about 250 specimens in all. In order to take as correct an appraisal as possible of the shape and size of the air-bladder in the living fish, dissections were done on freshly killed specimens. Fishes were dissected from the ventral side.

Measurements were taken in order to compare the size of the fish and the airbladder. The length of the air-bladder is considered as the distance

between the anterior and posterior extremities. Observations on dissected specimens are given below :—

Sciaena dussumieri (C.V.)

The air-bladder is large (about one third of the total length of the fish), hammer-shaped and pointed behind. In a fish measuring 21.2 cms, in length the air-bladder was found to be 7.8 cms long. Its anterior part bulges out laterally in a transverse manner to the rest (Fig. 1). The pointed posterior region ends in the vicinity of the anal opening.

On either side the air-bladder is furnished with 14-15 short caecae, which are sub-divided into smaller branches, and are surrounded by voluminous lobes of fat. Last one or two caecae in the hindermost part of the air-bladder on either side remain undivided. The cavity of the air-bladder continues in these caecae as well, which contain the same gas as that inside the air-bladder. A cluster of caecae of one of the anterior branches ends under the fine transparent skin of the opercle. In the region of the head, the caecae enveloped by fat and conjunctiva tissues and the cephalic prolongations, need a very careful dissection in order to separate them.

The gas-gland :

It is situated on the ventral wall of the anterior region of the air-bladder and can be noticed after opening the bladder.

The oval :

The oval is situated on the dorsal side of the air-bladder opposite the gas-gland, and can be noticed after opening the bladder from the anterior side as shown in fig. 1. This organ of the air-bladder is meant for removing gas from the air-bladder and is functionally analogous to the pneumatic duct of physostomous fishes.

Ear-air-bladder connection :

Caecae of the anterior most branch of the air-bladder proceed upwards and forwards by the side of corresponding auditory capsule which has on its anterior side an opening closed by a thin membrane. The caecal prolongation of the air-bladder comes into contact with the membrane on the outer side which on the inner side has the perilymph surrounding the internal ear.

Johnius belengeri (C.V.) :

The air-bladder of *Johnius belengeri* (Fig. 2) is similar to that of *S. dussumieri*. The bladder is shining and is 6. cms in length in a fish measuring 15 cms. Anteriorly the air-bladder bulges out laterally in the same manner as in *S. dussumieri*. Posteriorly it tapers and ends in the vicinity of the anal opening. On

the sides, the air-bladder is furnished with 16-17 caecal outgrowths, which are branched. The lumen of the air-bladder is continuous with those of the caecae. Caecal outgrowths proceed forward so much so as to connect the air-bladder to the auditory capsule.

The shape of the air-bladder and position of gas-gland and the oval are more or less the same as in *S. dussumieri*.

Johnius dussumieri (C.V.):

The air-bladder of *J. dussumieri* (Fig. 3) is very much similar to those already described. In a fish measuring 22.7 cms. the air-bladder measures 8.2 cms. Anteriorly the air-bladder bulges out laterally in the same pattern as already mentioned. Posteriorly also it tapers and ends in the vicinity of the anal opening. Each side of the air-bladder is furnished with 13-14 caecal outgrowths which are branched. As in the other sciaenoid fishes, caecae are covered over by fat. The air-bladder is connected to the auditory capsule in the same manner as in *S. dussumieri* and *J. belengeri*. The shape and the position of the oval and gas-gland are similar to those already described in foregoing species.

Johnius maculatus Bloch, Sch.

The air-bladder in *J. maculatus* (Fig. 4) is a large and prominent structure having more glistening silvery colour than that of other species. In a fish measuring 21. cms. the length of air-bladder was 7.8 cms. The air-bladder is shining and is more branched than those of previously described species. From the bladder are given off on each side 19-21 caecal outgrowths which branch dicotomously. These outgrowths are more prominent. Max Weber and de Beaufort (1936) have described this species with 14 or 15 and Dutt and Thankam (1968) with 16 or 17 lateral processes on either side, whereas according to author's observations no specimen has been recorded with less than 19 close-set heavily ramified branches. The ear-air-bladder connection is lacking in this species. The position and shape of the gas-gland and oval are more or less the same as in those previously mentioned.

Otolithes argenteus (C.V.):

The air-bladder is a very prominent structure in *Otolithes argenteus* (Fig. 5). The bladder has shining silvery appearance, gradually tapers posteriorly till it becomes pointed and extends to a short distance beyond the anal opening. In a fish measuring 21.5 cms. the air-bladder was 7.8 cms. long. The lumen of the air-bladder is continuous with that of the caecae. The air-bladder on the side is proliferated into 35-40 caecal outgrowths of a simple nature. The outgrowths do not proceed forward and as such the ear-air-bladder connection is lacking. Day (1878) has described this species with 25 lateral processes. Dutt and Thankam (1968) have in their study of this Sciaenoid fish described 30-35 lateral branches on either side of the air-bladder. My observations based on a number

of specimens indicate not less than 35 lateral processes. This shows an inconsistency in their number. The position of gas-gland and oval are identical to those of the previously described fishes.

Pama pama (Ham. Buch.)

The air-bladder is a very prominent structure in the body cavity beneath the vertebral column (Fig. 6). In a fish 19.5 cms. long, the air-bladder was found to be 9 cms. in length. The bladder has a shining silvery appearance and gradually tapers posteriorly till it becomes pointed and from the hindermost part of the air-bladder arise two narrow tubes which extend anteriorly without dividing. At the point where the bladder ends anteriorly the tubes divide into a number of caecae and one of the caecum of either side proceeds upwards and becomes connected with the auditory organs just as in the case of *S. Dussumieri* with the only difference that in *Pama pama*, only one caecum becomes connected with the membrane on the anterior side of the auditory capsule, whereas in *S. Dussumieri* a cluster of caecae is attached.

Otolithoides biauritus (Cantor) :

The shape and structure of the air-bladder of *Otolithoides biauritus* (Fig. 7) is very much similar to that of *Pama pama* except with such difference that from the anterior extremity of bladder arise a caecum which proceed forward having more convolutions and ends a little behind the terminal end of the auditory capsule. The air-bladder is very large in this species *i.e.* about 1/2 the total length of the fish. In a fish measuring 32.5 cms. the air-bladder was found to be 15.5 cms. long. The position of gas gland and oval is the same as described in the foregoing species.

Pseudosciaena coiber (Ham.) :

The air-bladder is furnished with 27 caecal outgrowths of simple nature (Fig. 8). In a fish measuring 15 cms. the size of the air-bladder was found to be 5.2 cms. The caecal outgrowths do not extend forwards and therefore ear-air-bladder connection is wanting. The position of gas-gland and oval are the same as described in previous cases.

Pseudosciaena soldado (Lac.) :

From each side of the air-bladder are given off 15-16 caecal outgrowths (Fig. 9). In a fish measuring 16.4 cms. the air-bladder measures 5.4 cms. Posteriorly the air-bladder tapers down and ends in the vicinity of the anal opening. The caecal outgrowths branch dicotomously as in the case of *Johnius maculatus*. The ear-air-bladder connection is lacking. The positions of gas gland and oval are very much similar to the previously described species. My observations confirm Srivastava's observations (1955), and differ from Dutt and Thankam (1968), who have described the species with 17-20 caecal outgrowths. The difference is not only in the number of caecae, but the branching pattern is also different.

Significance of air-bladder in classification of family Sciaenidae

Max Weber and L.F. de Beaufort (1936) have given a very good account of the systematic differentiation between the subfamilies *Otolithinae* and *Sciaeninae* of the family *Sciaenidae*.

The characters as described by them are briefly described below :—

Mouth terminal, snout more or less pointed, intermaxillaries forming front border of mouth; Cleft of mouth oblique; Jaws subequal or lower conspicuously prominent; Canine teeth present.....*Otolithinae*.

Mouth inferior, snout bluntly rounded or inflated, its top more or less prominent before intermaxillaries. Cleft of mouth more or less horizontal, Upper Jaw more or less protractile over-lapping lower. Teeth villiform in both jaws, no true canines or caninoids.....*Sciaeninae*.

Under the subfamily *Otolithinae*, genera *Otolithes*, *Pama*, *Otolithoides* and *Pseudosciaena* have been indicated and under *Sciaeninae*, *Johnius* and *Sciaena*. Day (1878) has given a systematic account of the genera of the family *Sciaenidae* but has not mentioned the subfamilies. Munro (1955, 1967) has not dealt with the two subfamilies. Similarly, Misra (1959) has given distinctive characters of only the genera of the family.

During the work on the air-bladder in the family *Sciaenidae* it has been noticed that it is of different shapes, the outgrowths of the air-bladder vary in number in different genera which may to some extent form distinctive character. Subfamily *Otolithinae* has a simple air-bladder which does not bulge out laterally and transversally. In subfamily *Sciaeninae* the anterior most part of the bladder generally bulges out laterally in a transverse manner, the rest of the bladder continues posteriorly.

SUMMARY

In the fishes of the family *Sciaenidae* the air-bladder is very large in size and with a few exceptions shows the most extra-ordinary development of short ramified caecae on the sides and at the two extremities. The material consisted of about 250 specimens comprising of the following species :

1. *Sciaena dussumieri* (C.V.)
2. *Johnius belengeri* (C.V.)
3. *Johnius dussumieri* (C.V.)
4. *Johnius maculatus* Bloch, Sch.
5. *Otolithus argenteus* (C.V.)
6. *Pama pama* (Ham. Buch).
7. *Otolithoides biauritus* (Cantor)
8. *Pseudosciaena coiber* (Ham.)
9. *Pseudosciaena soldado* (Lac.)

Measurements were taken in order to compare the size of the fish and the air-bladder. The gas-gland and oval are well developed and situated opposite to each, the former being on the ventral wall of the anterior region of the air-bladder and the later on the dorsal wall in all the cases.

All the air-bladders are of physoclistous type. The general shape of the bladder does not vary a great deal within the family, although the number and pattern of caecal outgrowths differ in the species.

Conclusion :

Among the above described species of sub-family *Otolithinae* the ear-air-bladder connection is lacking except *Pama pama* and *Otolithoides biauritus*, whereas in the subfamily *Sciaeninae* the ear-air-bladder connection is present except *Johnius maculatus*. All the fishes of the family *Sciaenidae* having anteriormost part of the air-bladder bulged out laterally in a transverse manner, belong to the subfamily *Sciaeninae* and have ear-air-bladder connection present. The air-bladder may, therefore, be helpful to some extent in the classification of the family *Sciaenidae*.

ACKNOWLEDGEMENT

The author is indebted to Dr. M. R. Qureshi, for his guidance and encouragement throughout the work. My thanks are also due to Mr. M. S. Jamal, Photo-artist of the Department for preparing drawings.

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ABBREVIATIONS USED

AB-Air-bladder; Au. Cap Auditory capsule; Cae Caecal outgrowths; G. Gl Gas gland; Tub. Tubular outgrowth of the air bladder; Ov Oval.

EXPLANATION OF FIGURES

- FIGURE 1. *Sciaena dussumieri*, dissected to show the air-bladder, position of the gas-gland and oval, and connection of air-bladder with the auditory capsule.
- FIGURE 2. *Johnius belengeri*, dissected ventrally to show the air-bladder and the arborescent appendages.
- FIGURE 3. *Johnius dussumieri*, dissected to show the air-bladder with caecal outgrowths.
- FIGURE 4. *Johnius maculatus*, dissected showing the air-bladder with dichotomously branched caecal outgrowths.
- FIGURE 5. *Otolithes avgenteus*, dissected to show the air-bladder and caecal outgrowths.
- FIGURE 6. *Pama pama*, dissected ventrally to show the air-bladder in situ; Two tubes arising from the posterior end of the air-bladder and their connection with the auditory capsule may be seen.
- FIGURE 7. *Otolithoides biauritus*, dissected to show the air-bladder with the tubes and their connection with the auditory capsule.
- FIGURE 8. *Pseudosciaena coiber*, dissected to show the air-bladder and the caecal outgrowths.
- FIGURE 9. *Pseudosciaena soldado*, dissected to show the air-bladder with dichotomously branched caecal outgrowths.

1964

1. The first part of the report deals with the general situation of the country and the progress of the work during the year. It is divided into two main sections: the first section deals with the general situation and the second section deals with the progress of the work.

2. The second part of the report deals with the results of the work during the year. It is divided into two main sections: the first section deals with the results of the work in the field of research and the second section deals with the results of the work in the field of education.

3. The third part of the report deals with the conclusions and recommendations. It is divided into two main sections: the first section deals with the conclusions and the second section deals with the recommendations.

4. The fourth part of the report deals with the appendixes. It is divided into two main sections: the first section deals with the appendixes and the second section deals with the references.

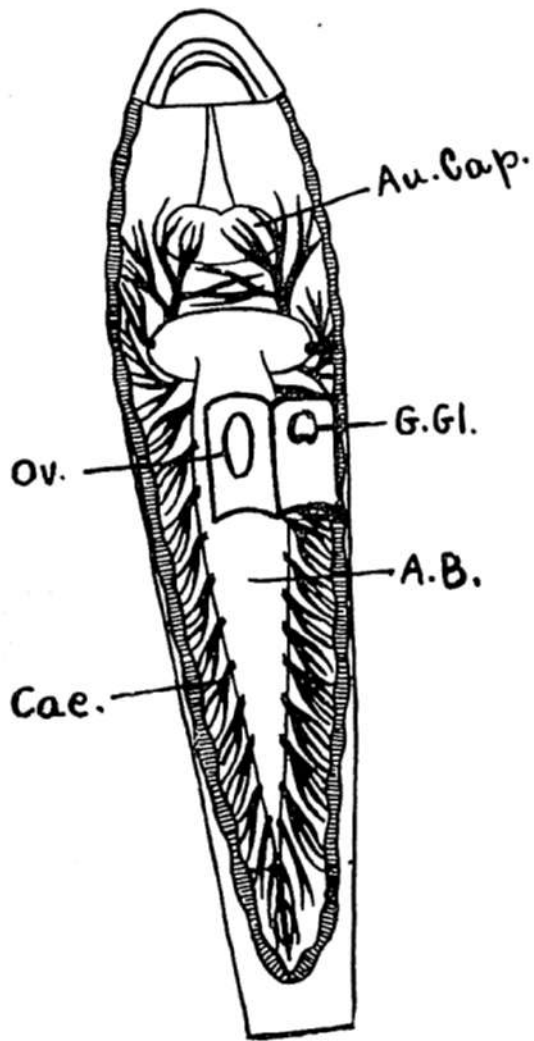


Fig. 1

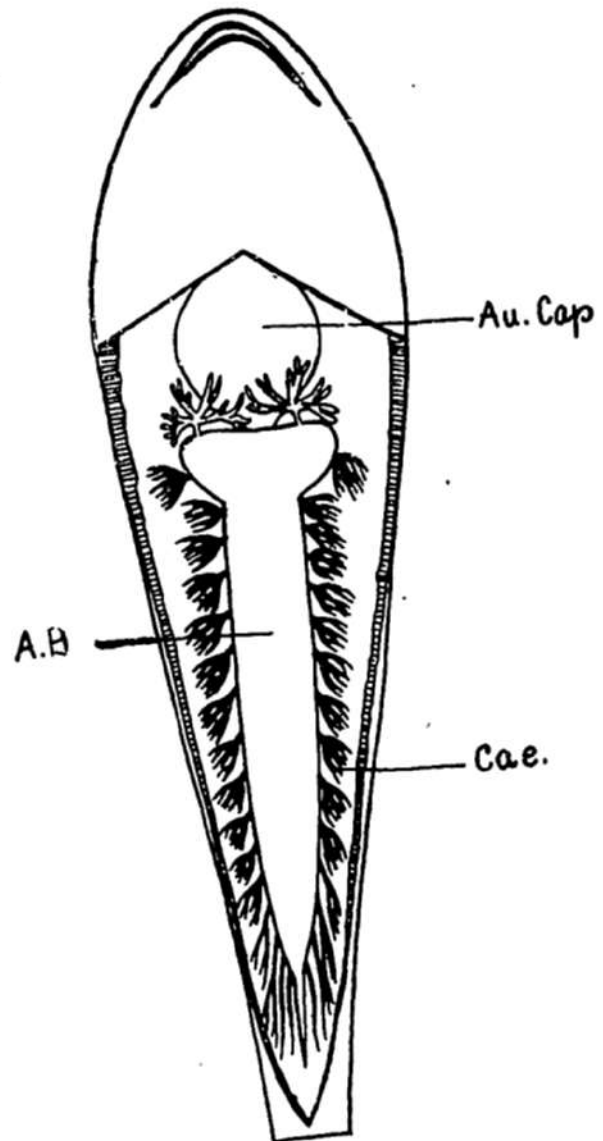


Fig. 2

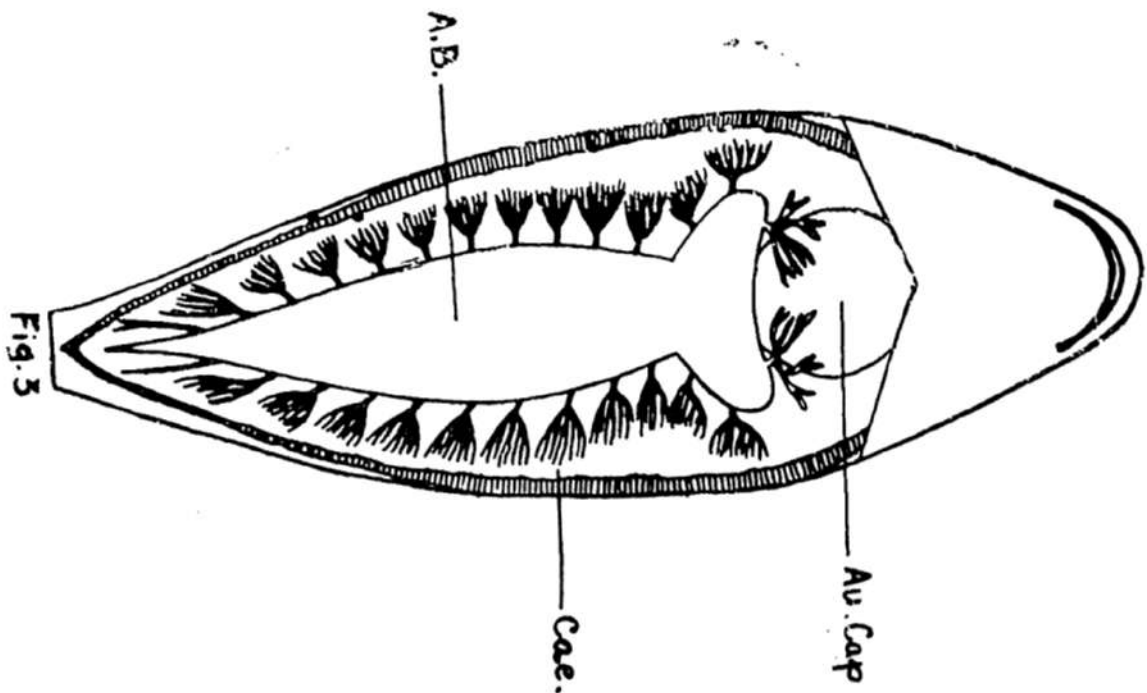


Fig. 3

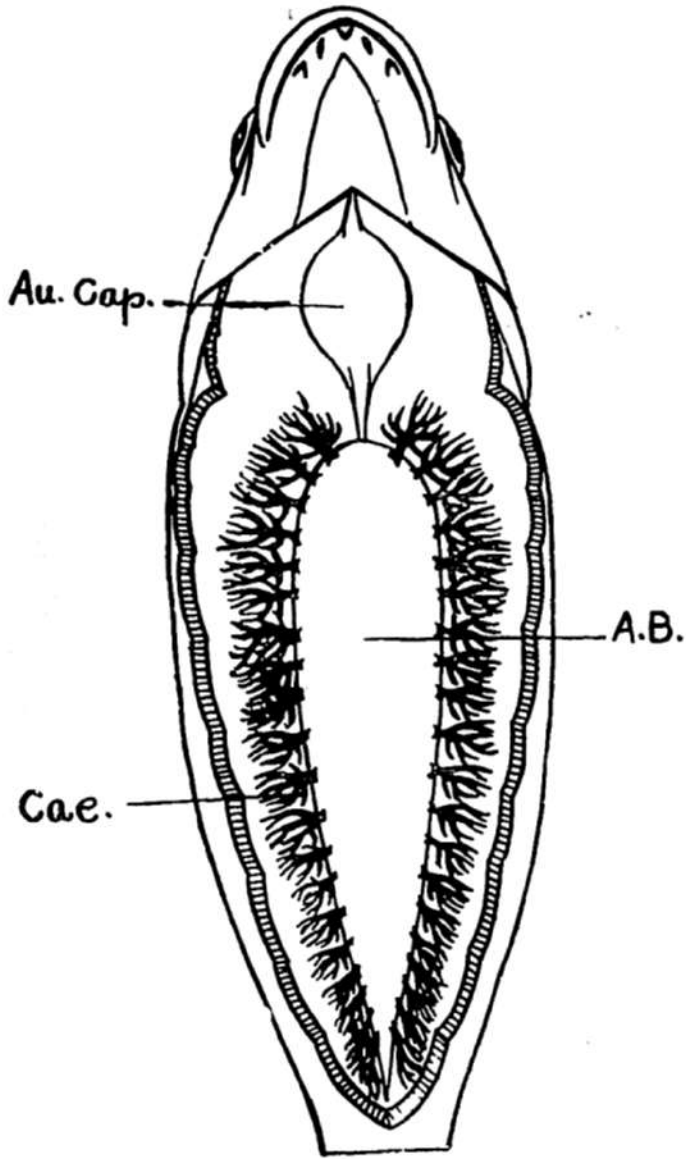


Fig. 4

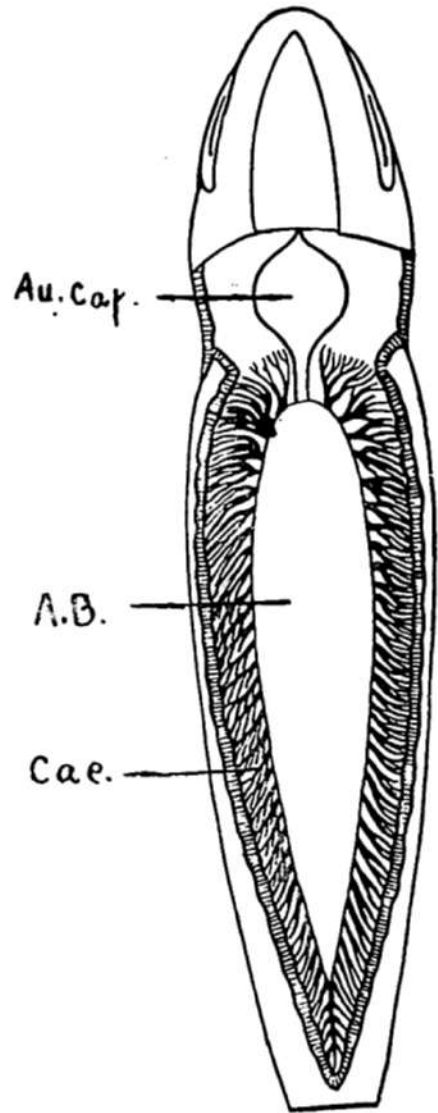


Fig. 5

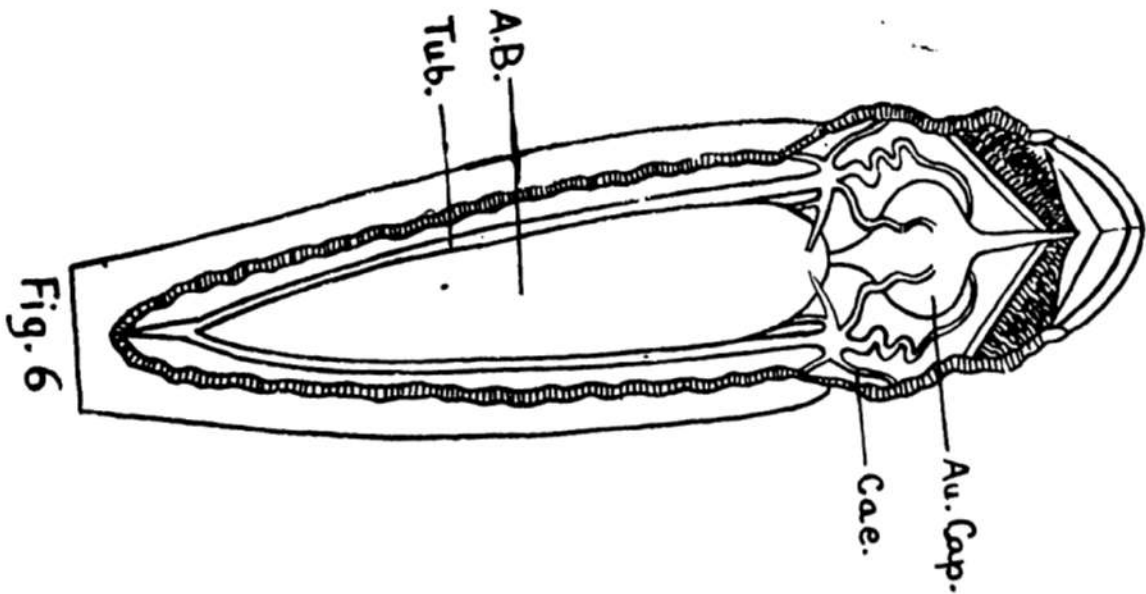
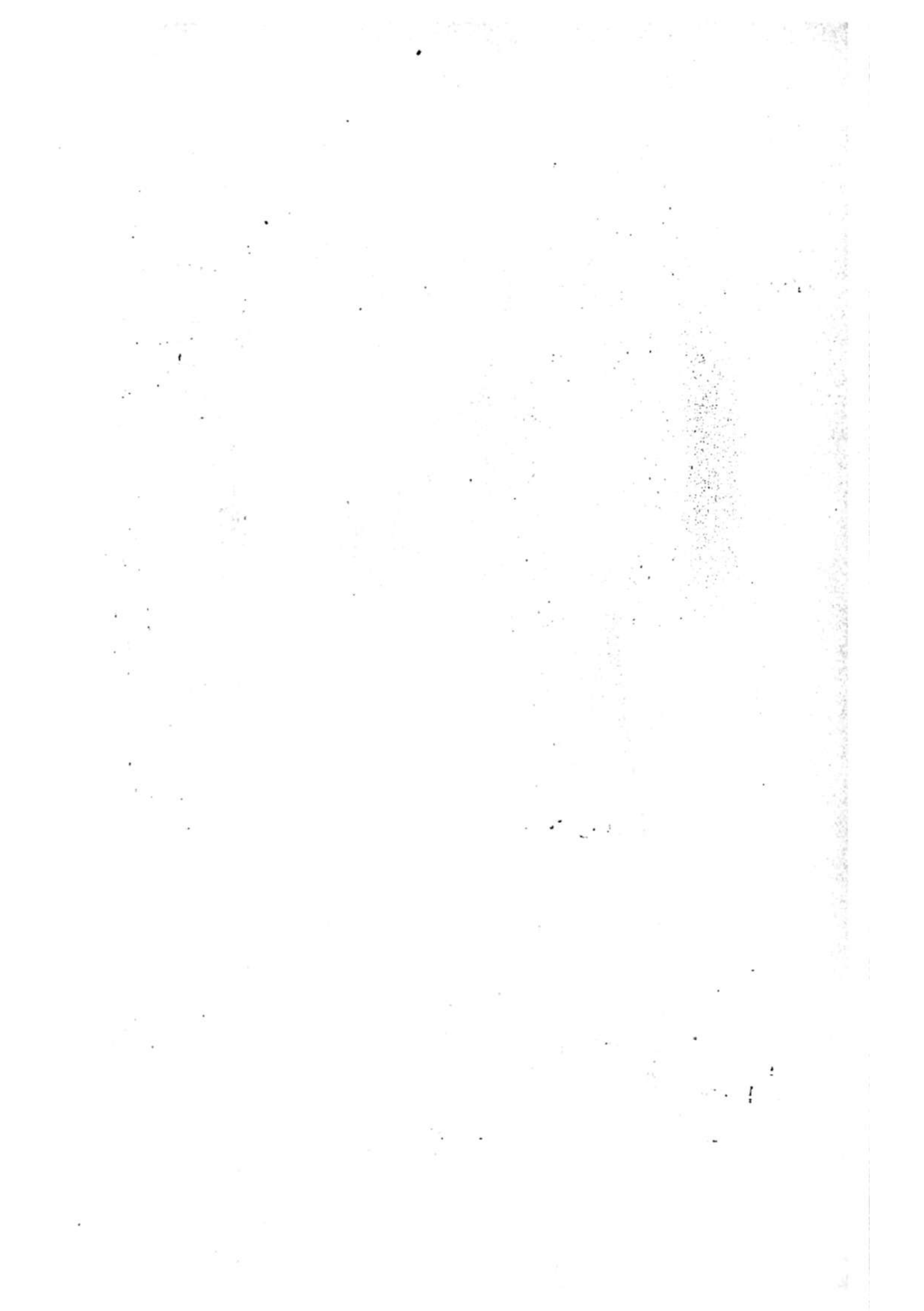
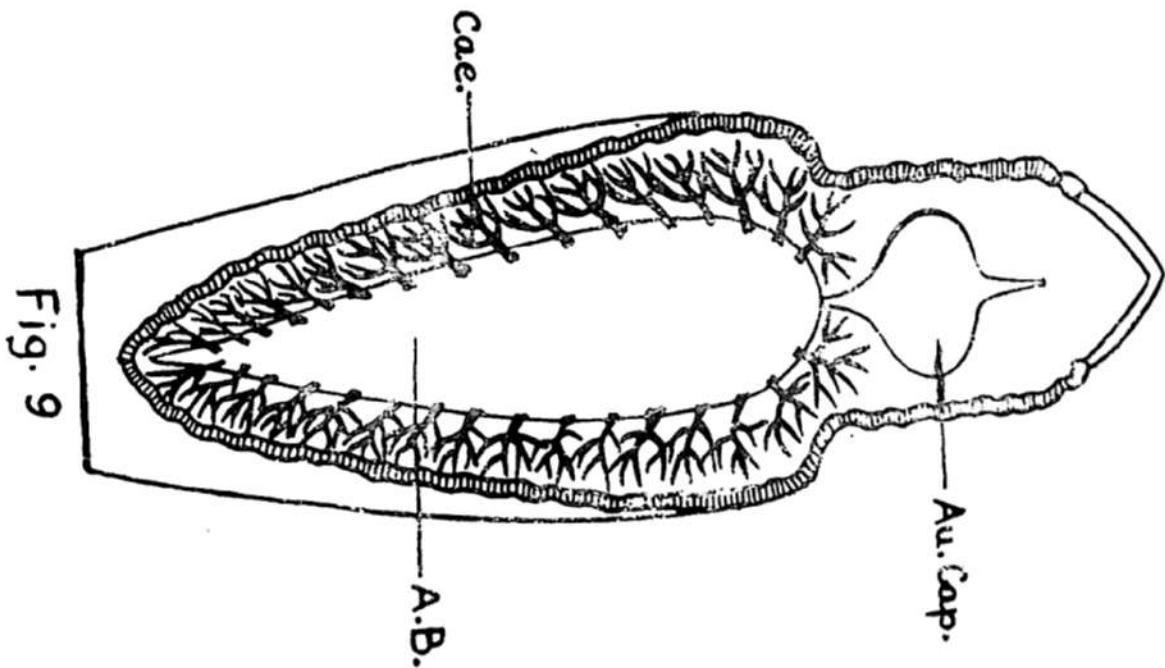
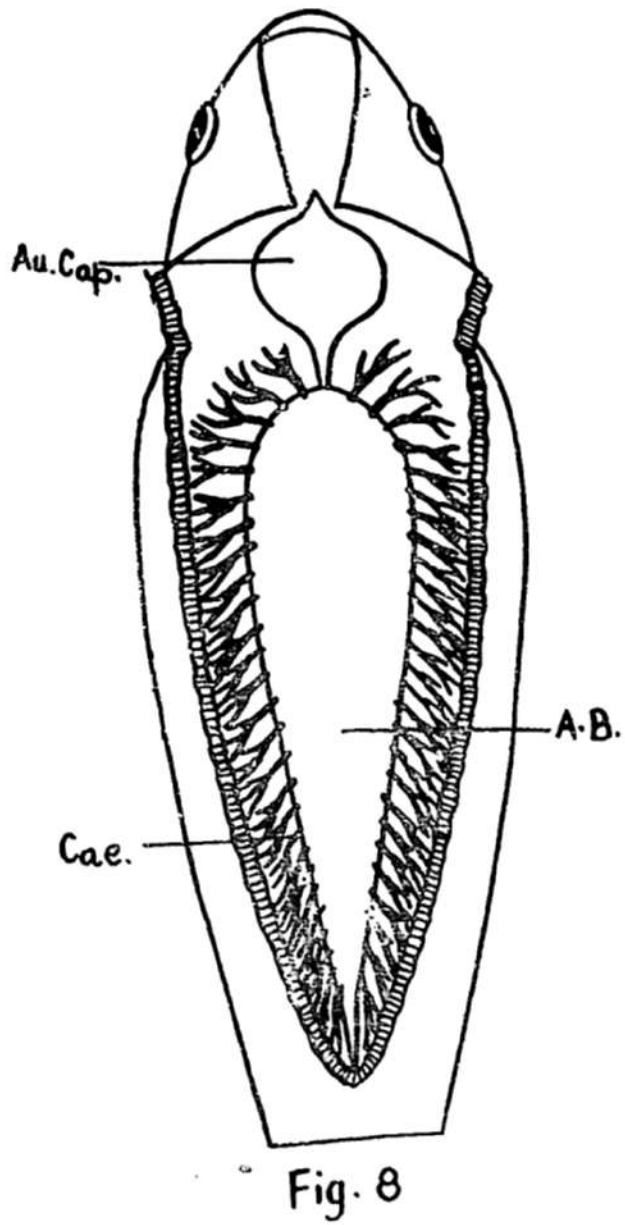
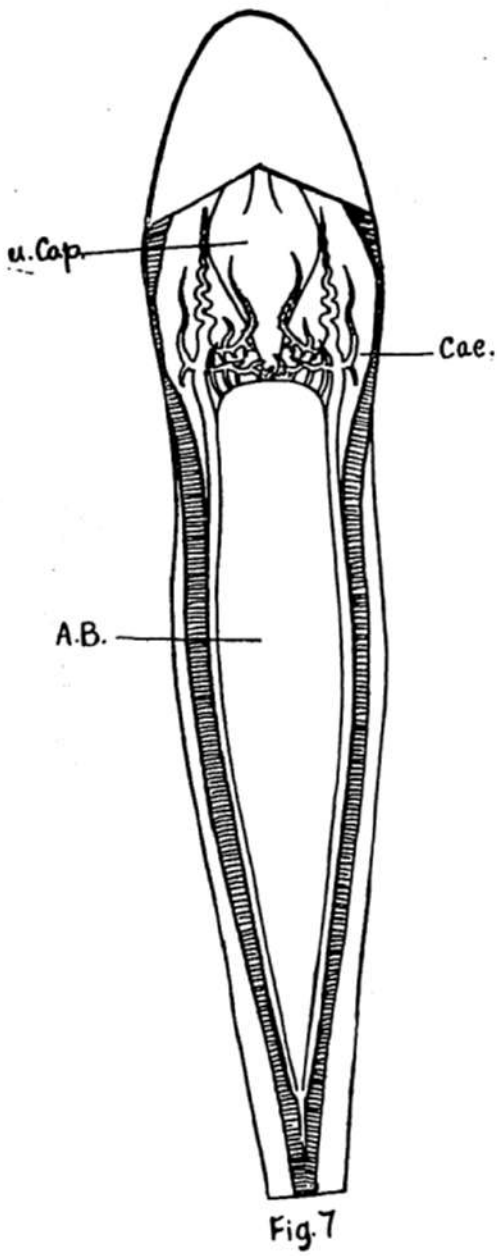


Fig. 6







GYROMETRA MUGILITAENIA SP. NOV. (CESTODE: SUB-FAMILY
GYROMATRINAE YAMAGUTI 1954) FROM THE BODY CAVITY
OF A MUGIL SP.

BY

ISMAT PARVEEN

Zoological Survey of Pakistan

While making investigations for enlisting helminth parasites of marine food fishes, a new cestodaria was found in the body cavity of a *Mugil sp.*, which was made available to me from a local fish market of Karachi. This new parasitic form is alike to Genus *Gyrometra* Yamaguti, 1954, in its generic organisations. This new parasite is not conspecific to the previously described *G. alboaenia* recorded from the fish *Digrama sp.*, but has many pertinent distinguishing characteristics. It is particularly visible in the organisation of reproductive system as well as in absence of accessory seminal receptacle. This species is thus proposed as a new with the following description.

Description:

Body is long, with out-proglottides, resembling a fleshy ribbon highly extensible and attaining a total length of 15 cm. (after pressing). It is widened uniformly and nearly 1.5 cm. in width. Anterior extremity is conical with an apical pit accommodating the openings of uterus and the frontal gland ducts. Posterior extremity is with a papilliform projection. Testes are in the form of two narrow bands originating a little distance behind the anterior extremity and extending on one side to the upper level of ovarian zone, and on the other, far above, anteriorly. Vas efferentia connecting the two testes is in a more or less straight line along the upper margin of seminal receptacle and just below the descending limb of uterus, anterior to ovary. Vas deferens is simple long and opening into the terminal male pore. Ovary is symmetrical two winged, unequal, the larger 3.125×2.795 mm, the smaller 2.365×2.365 mm. Shell-gland larger, spherical, 0.860 mm in diameter and is closely approximated on either side of the ovary. Seminal receptacle is large, pyriform, and is a dilation of vagina, 3.870×2.365 mm in length lying immediately anterior to ovary. Vagina descend from the seminal receptacle and extend a little above the male pore with sphincter muscular opening. Vitellaria are in the form of small sessile follicles arranged smoothly along the lateral margin, closer to testes, and commencing a little distance behind the anterior extremity and extending as far a little above the vaginal pore and then uniting on one side to form a common vitelline duct which extend upto shell gland.

Median terminal limb of uterus is wide, loosely coiled, broader proximally and narrowing distally, occupying only a small area in the median field. Eggs spherical large and without filament, measures, 0.129 mm in diameter.

Host:— *Mugil sp.*

Location:— Body cavity.

Locality:— Karachi Coast.

Holotype *G. mugilitaenia* sp. nov. Registration No. 3693 deposited in the Zoological Survey Department, Karachi.

Discussion:

Gyrometra albotaenia Yamaguti 1954, the only described species was obtained from the fish *Diagramma* sp. (Macassar Celebes). The new species *G. mugilitaenia* recovered from *Mugil sp.* from Karachi differs from the previously described species in quite a number of respects. The very remarkable distinction is to be noted in the shape and the point of junction of the vasa efferentia to the testes in the ovarian zone. The ovary also differ in shape and is subequal. A further differentiation is being noticed in the shape of the seminal receptacle which is pyriform. The accessory receptacle is altogether absent. The extension of testes is variable and terminate in the pre-ovarian zone. The median terminal limb of uterus is rather loosely coiled and occupy a very meager area in the median field. The vitellaria consist of smoothly arranged sessile follicles.

ACKNOWLEDGEMENT

I wish to record my deep appreciation to Mr. M. S. U. Siddiqi, Director, Zoological Survey Department, Government of Pakistan, Karachi, for providing facilities and Kind encouragement. My thanks are also due to Mr. Nooruddin, Zoologist, Zoological Survey Department for the assistance rendered by him, and to the members of library staff for their help.

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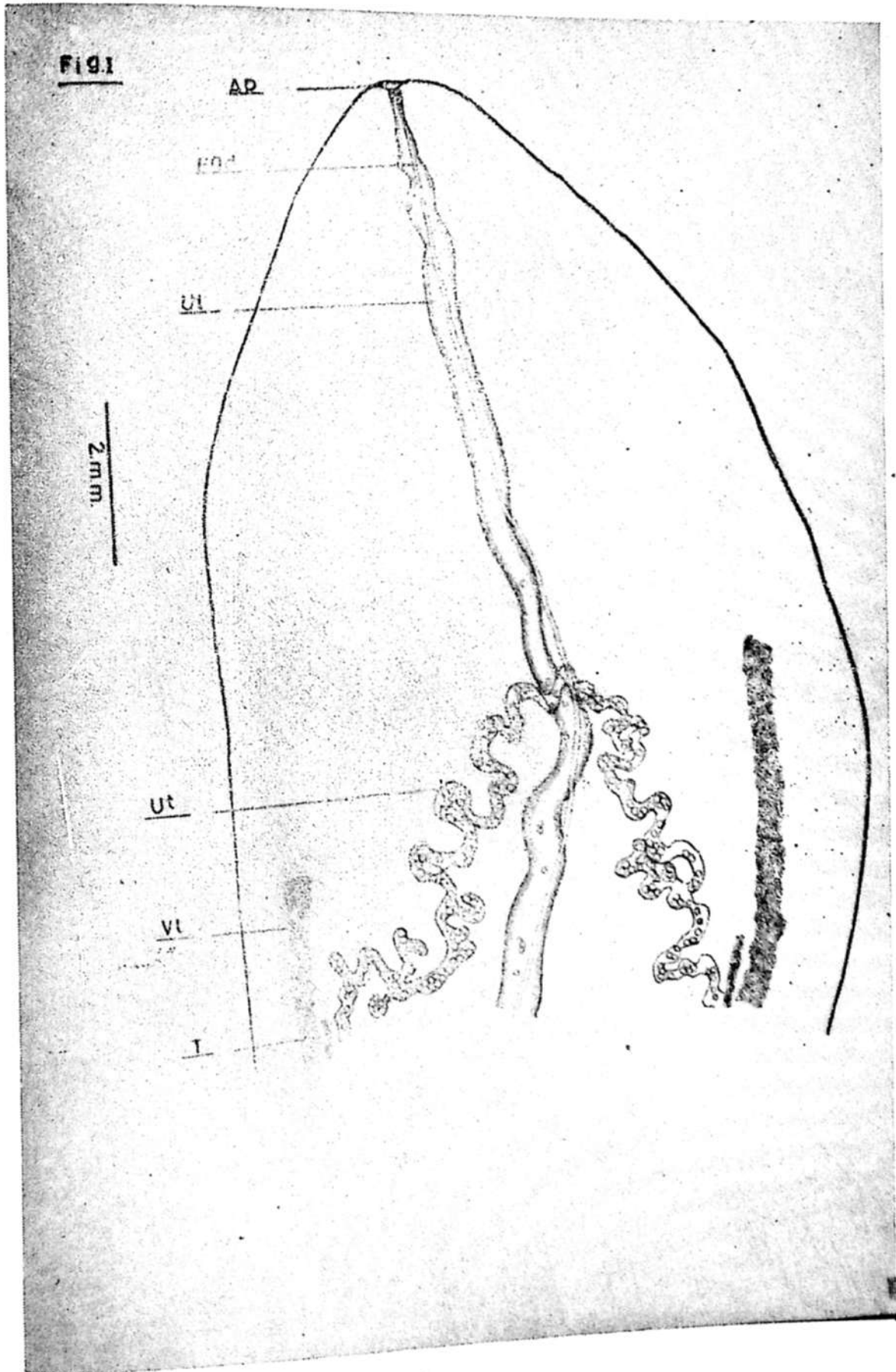
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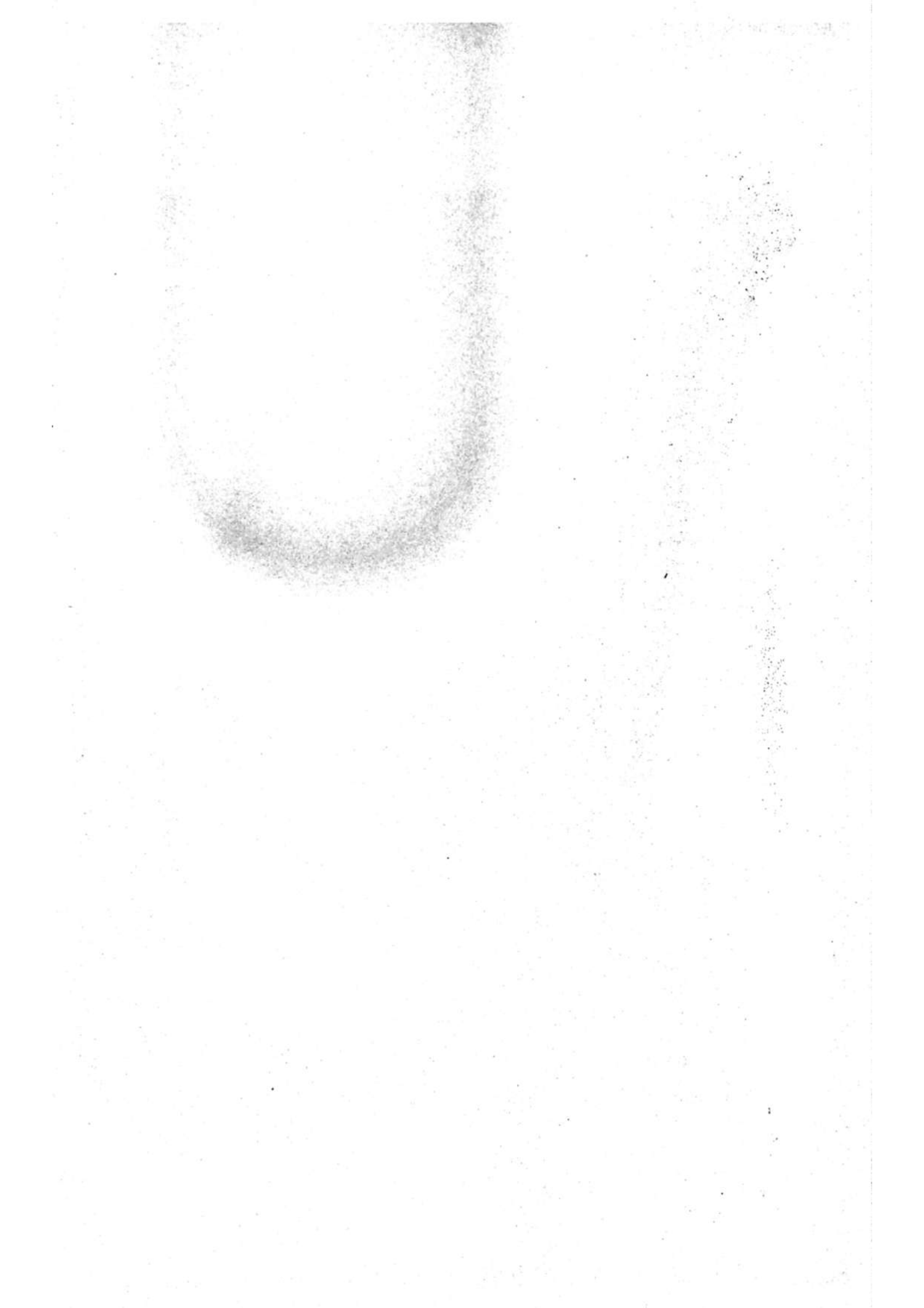
Figures:

1. Anterior extremity.
2. Middle portion.
3. Posterior extremity.

Abbreviation Used

AP.....	Apical pit.
Fgd.....	Frontal gland duct.
MP.....	Male pore.
O.....	Ovary.
Sr.....	Seminal receptacle.
Sh.....	Shell gland.
T.....	Testes
Ut.....	Uterus.
Vt.....	Vitellaria.
Vtd.....	Vitelline duct.
Vg.....	Vagina.
Vp.....	Vaginal pore.
Vef.....	Vasa efferentia.
Vd.....	Vasa deferens.





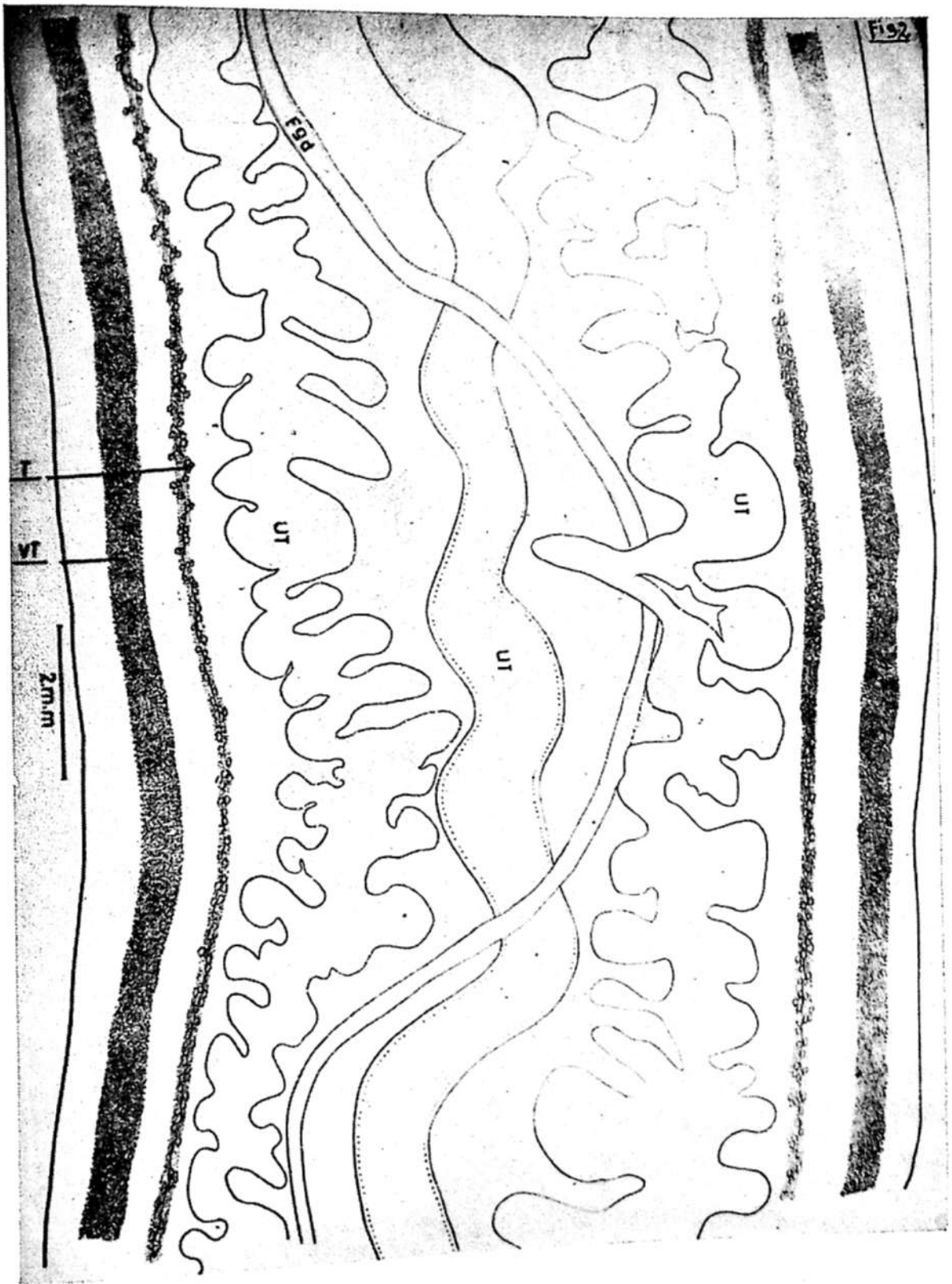
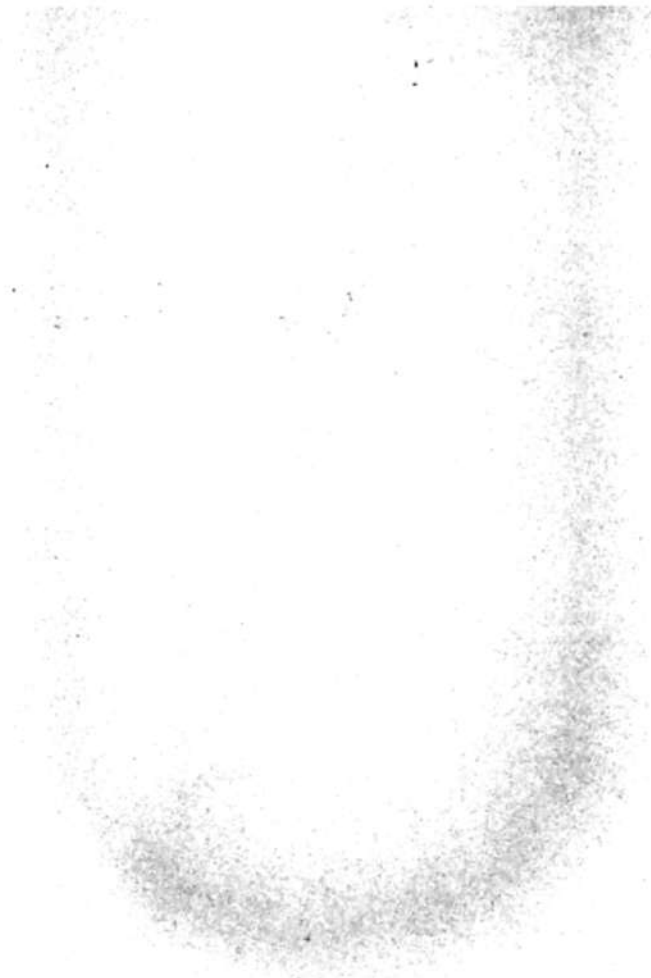
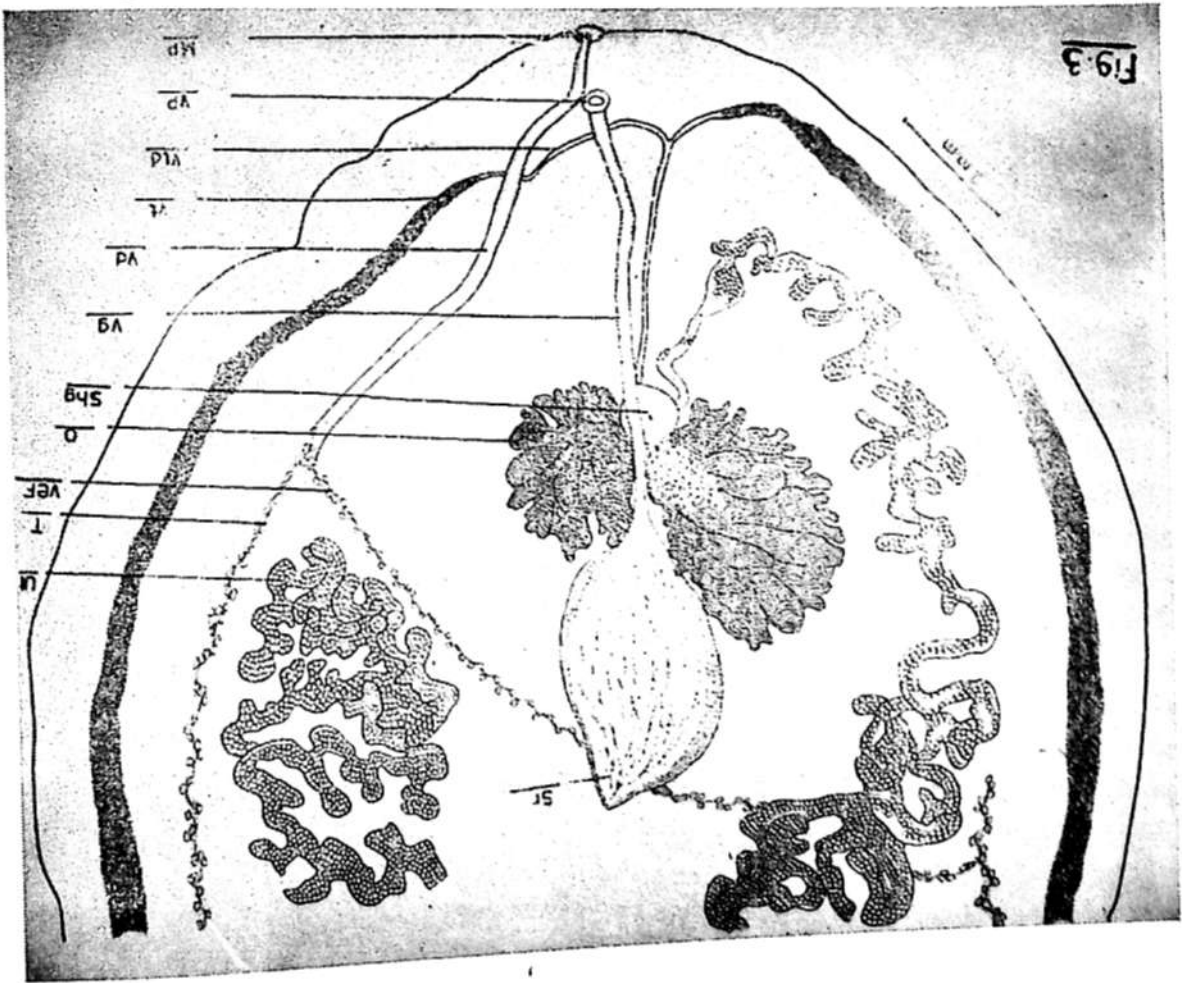
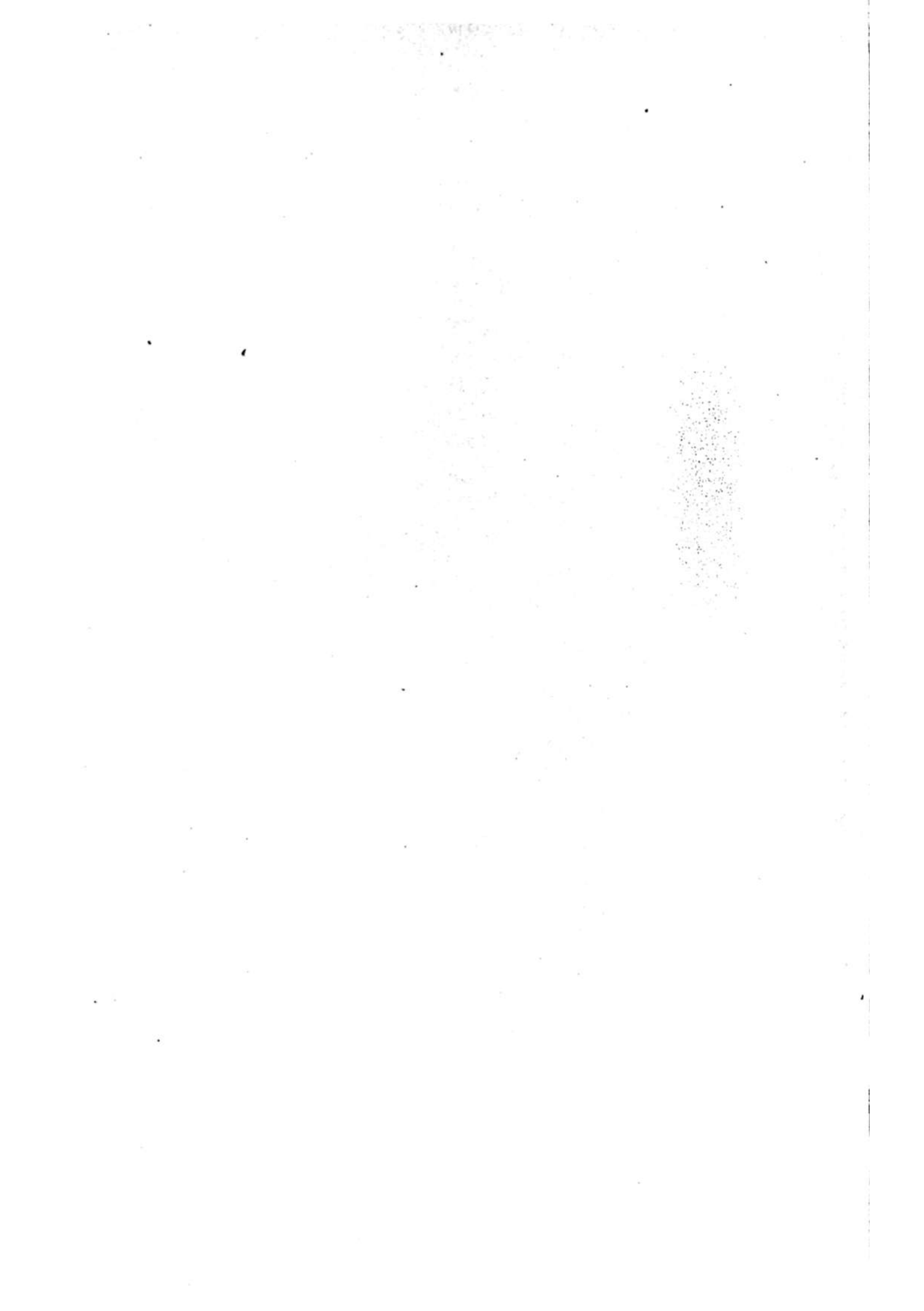


Fig 92







ON THE SYSTEMATIC POSITION OF SOME INTESTINAL NEMATODES OF FOWL FROM WEST PAKISTAN.

BY

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INTRODUCTION

A study of morphology of intestinal nematodes of fowl shows some interesting features which are intermediate in character between families SUBULURIDAE Travassos, 1914 and HETERAKIDAE Railliet and Henry, 1914. While an enface view of these nematodes present such structures which seem to be transitory between genera *PRIMASUBULURA* Inglis, 1958 and *TARSUBULURA* Inglis, 1958.

MATERIAL AND METHOD

Nematodes have been collected from the intestine of the fowl from West Pakistan and were preserved by the usual method and were cleared in lectophenol.

MORPHOLOGY

The males are much smaller and narrower than the females. Well developed, chitinized striated cervical alae are present both in males and females. These are very broad and usually extend back about $\frac{1}{3}$ the length of the specimen.

The vestibule is divided into two parts. And the pharyngeal portion comprises three lobes, probably chitinous, each bearing a chitinous tooth.

The tail of both males and females is usually provided with a long and pointed spike. This varies in length and shape and may be absent altogether.

The caudal alae present in males are chitinous and bear cuticular striations.

The pre-cloacal sucker in males is chitinous and possesses a definite rim and cuticular lamellae. It projects outwardly from the general body surface like that of heterakids.

The spicules are similar in shape but may be equal or unequal. A gubernaculum is always present in males.

There are usually ten pairs of caudal papillae in males of which first five pairs are pre-anal while remaining five are post anal. Eleven or twelve pairs of caudal papillae in males are also not unusual. There is also a pair of phasmids behind the third pair of posts anal caudal papillae.

The vulva in females is usually about the middle of the body or a bit anteriorly.

DISCUSSION

It was noted during the study that the systematic position of these nematodes present some difficulty and their correct systematic position is still open to discussion. The superfamily ASCAROIDEA Railliet and Henry, 1915 is characterised by the esophagus which is more or less enlarged posteriorly but without a definite spherical posterior bulb containing a valvular apparatus. These nematodes differ from the typical members of ASCAROIDEA in the presence of a prominent posterior bulb in the esophagus. In the males in some members of ASCAROIDEA a pre-cloacal sucker is present which is invariably true for these nematodes too. In the females the posterior extremity is usually conical in ASCAROIDEA but long and pointed in these nematodes.

The present nematodes differ from the typical members of the super-family SPIRUROIDEA Railliet and Henry, 1915 on morphological grounds. In the SPIRUROIDEA a pre-cloacal sucker is absent in males, a prominent posterior esophageal bulb is lacking and esophagus is long and cylindrical.

These nematodes are also not the typical members of the super family STRONGYLOIDEA Weinland, 1858 in that a caudal bursa is missing and a prominent posterior esophageal bulb is present.

These nematodes probably show closest relation to the members of the super-family OXYUROIDEA Railliet, 1916 which are defined by the possession of an esophagus with a posterior bulbous enlargement and by a pre-cloacal sucker in males and that the caudal extremity of females is largely prolonged into a finely pointed tail. All these typical characters of the members of oxyurids are present in these nematodes.

These nematodes possess a head like the members of SUBULURIDAE in conjunction with a pre-cloacal sucker like the members of HETERAKIDAE. These two families can be separated by the structure of the anterior end as well as by the shape of the pre-cloacal sucker. The characters of the anterior end are probably more indicative of the relationships between these two families than is the structure and shape of the pre-cloacal sucker (Inglis, 1955).

The anterior end of these nematodes is morphologically more close to the members of the family SUBULURIDAE Travassos, 1914 in the absence of the lips and in the presence of a definite cylindrical vestibule armed with three teeth at its base while the pre-cloacal sucker is more identical with the members of the family HETERAKIDAE Railliet et Henry, 1914 in shape and appearance and being extend outwardly from the general body surface. This shows that these nematodes have more close relation with the subulurids and a further study reveals that they are more identical with the parasubulurids. In 1938 van den Berghe and Vuylsteke erected a new family, PARASUBULURIDAE, and a new genus, PARASUBULURA, to take a new species they described, *P. gerardi*. This family is considered to be intermediate in characters between families

SUBULURIDAE and HETERAKID. The erection of this family by Berghe and Vuylsteke is the result of placing too much importance on the shape of the pre-cloacal sucker and too little on the details of the anterior end of the body. Therefore, the family PARASUBULURIDAE is reduced in rank by Inglis (1955) and considered a subfamily of the family SUBULURIDAE Travassos, 1914.

The member of the subfamily PARASUBULURIDAE Berghe and Vuylsteke, 1938 in fact, do not show intermediate characters to fit in the definition for which purpose this subfamily was erected. The members of this subfamily, no doubt, possess the same type of head with a distinct buccal capsule with three teeth at the base but vastly differ in the shape and structure of the pre-cloacal sucker, which are more subulurid being simply an elaboration of the sucker type found in subulurids not with a definite rim which is so characteristic of the heterakids. But these intestinal nematodes of fowl on one hand serve in a greater capacity for the definition of the subfamily PARASUBULURIDAE while on the other hand provide morphological grounds supporting the view of Berghe and Vuylsteke for assigning the rank of family to PARASUBULURIDAE.

The mouth opening as well as the buccal cavity of these nematodes is hexagonal in cross section becoming narrower towards the ventral side assuming intermediate shape between fully hexagonal and fully triangular forms of mouth openings. This condition is not represented by the typical members of parasubulurids where the mouth opening as well as the buccal cavity are regularly hexagonal in cross section.

These nematodes differ from the typical members of the genus *TARSUBULURA* Inglis, 1958 in the absence of fully developed lip-lobes.

The shape of mouth opening and that of buccal cavity in these nematodes is identical with the typical members of the genus *PRIMASUBULURA* Inglis, 1958 but the presence of small lip-lobes on one hand serve as a point of difference while on the other hand as intermediate character between the genera *PRIMASUBULURA* and *TARSUBULURA*. The host of these nematodes which is a bird and not primate or rodent is also a point of difference from primasubulurids.

In the light of these facts the writer is of the opinion that a new genus should be erected under PARASUBULURIDAE to accommodate these intestinal nematodes of fowl.

SUMMARY

1. These intestinal nematodes of fowl show intermediate morphological characters between families SUBULURIDAE Travassos, 1914 and HETERAKIDAE Railliet et Henry, 1914.

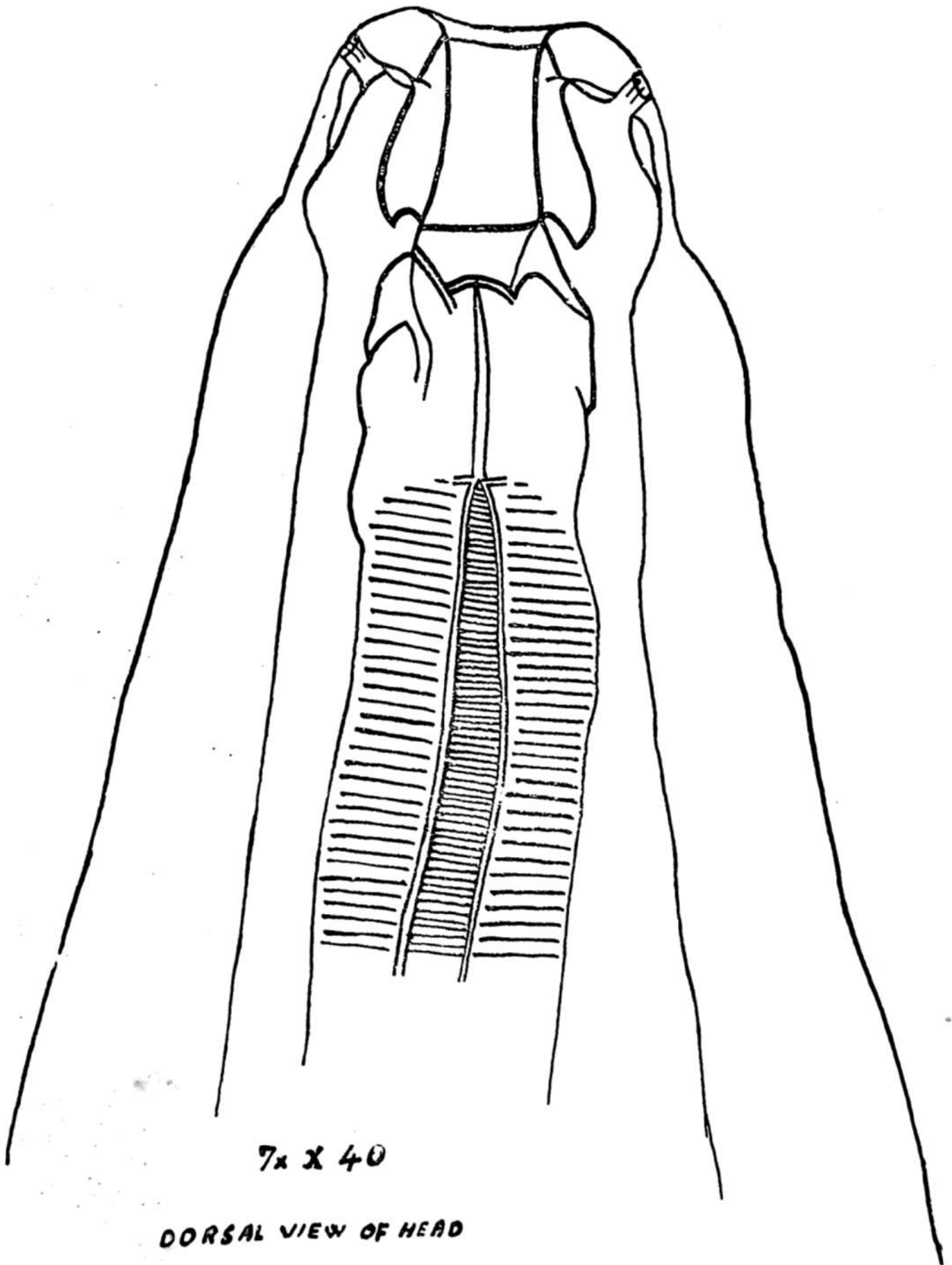
2. Morphological characters of these nematodes support the view of Berghe and Vuylsteke for the erection of PARASUBULURIDAE as family.
3. The head structure seems to be transitory between the genera *PRIMASUBULURA* Inglis, 1958 and *TARASUBULURA* Inglis, 1958.

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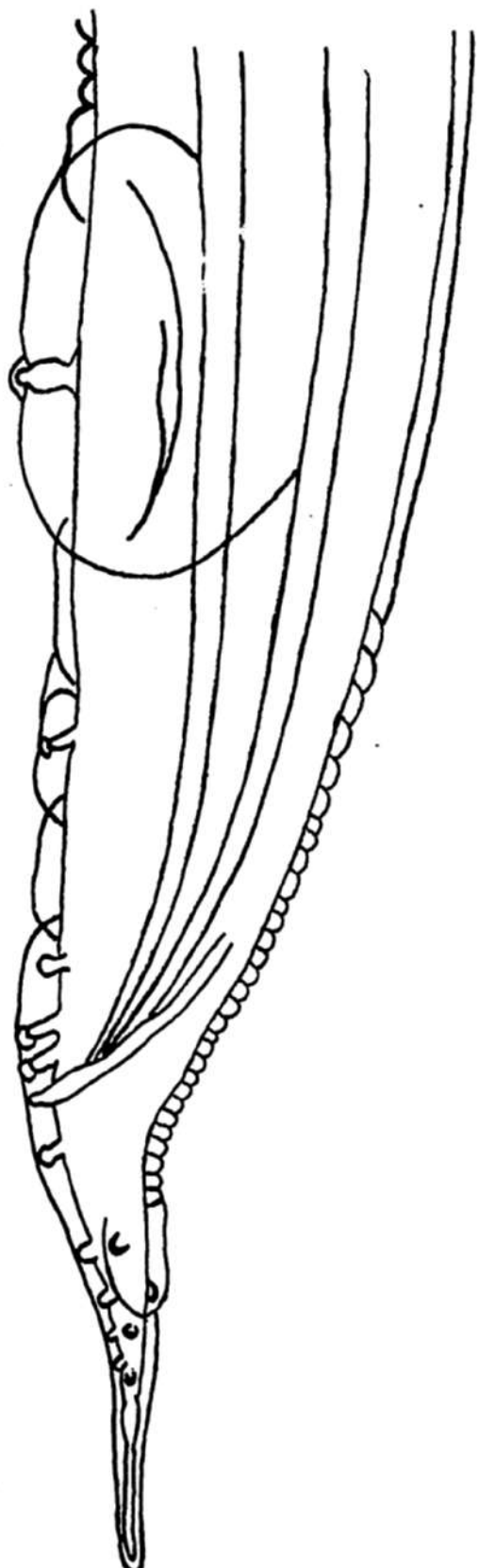


7x X 40

DORSAL VIEW OF HEAD



1/2



10x x 8x

LATERAL VIEW OF MALE TAIL

