

RECORDS

of the

INDIAN MUSEUM

(A JOURNAL OF INDIAN ZOOLOGY)

Vol. XXXVIII, Part I

MARCH, 1936

	Page.
Notes on Fishes in the Indian Museum.	
XXVI. On a small collection of Fish from the Chitaldrug District, Mysore. <i>S. L. Hora</i>	1
Notes on the Systematic Position of the two Gobioid Fishes <i>Gobiella pellucida</i> Smith and <i>G. birtwistlei</i> Herre, with special remarks on the validity of the Genus. <i>Dev Dev Mukerji</i> ..	9
Notes on Fishes in the Indian Museum.	
XXVII. On two collections of Fish from Maungmagan, Tavoy District, Lower Burma. <i>S. L. Hora & Dev Dev Mukerji</i> ..	15
The Morphology of <i>Kalinga ornata</i> (Ald. & Han.). <i>K. Virabhadra Rao</i> .. .	41
The Helminths Parasitic in the Fresh-water Turtles of Rangoon. <i>R. C. Chatterji</i> .. .	81
<i>Branchiura sowerbyi</i> Beddard, and its Synonymy. <i>W. Michaelsen</i>	95

Calcutta :
PUBLISHED BY THE DIRECTOR, ZOOLOGICAL SURVEY OF INDIA

1936

Price Rupees Three and annas eight or six shillings

RECORDS
of the
INDIAN MUSEUM

(A JOURNAL OF INDIAN ZOOLOGY)

Vol. XXXVIII, 1936.

EDITED BY
THE DIRECTOR,
ZOOLOGICAL SURVEY OF INDIA.



Calcutta:
PUBLISHED BY THE DIRECTOR, ZOOLOGICAL SURVEY OF INDIA
1937.

Price As. 6 or 8d.

CONTENTS.

Page.

PART I.—*Published March, 1936.*

Notes on Fishes in the Indian Museum. XXVI. On a small collection of Fish from the Chitaldrug District, Mysore	1
Notes on the Systematic Position of the two Gobioid Fishes, <i>Gobiella pellucida</i> Smith and <i>G. birtwistlei</i> Herre, with special remarks on the validity of the Genus	9
Notes on Fishes in the Indian Museum. XXVII. On two collections of Fish from Maungmagan, Tavoy District, Lower Burma	15
The Morphology of <i>Kalinga ornata</i> (Ald. & Han.)	41
The Helminths Parasitic in the Fresh-water Turtles of Rangoon	81
<i>Branchiura sowerbyi</i> Beddard, and its Synonymy	95

PART II.—*Published June, 1936.*

Ueber einige Isopoda aus Süd-Indien	97
Ueber einige Indische Chilognathen gesammelt von Herrn S. Jones, Madras	103
Chalcids (Parasitic Hymenoptera) from India	125
A New Encyrtid Parasite (Chalcidoidea : Hymenoptera) of a Cockroach from India	131
Fish of the Eastern Doons, United Provinces	133
Isopods collected by the R. I. M. S. "Investigator"	147
Studies on Indian Itonididae (Cecidomyiidae : Diptera). III. On a collection of Midges from South India	193
Siluroid Fishes of India, Burma and Ceylon II. Fishes of the genus <i>Akysis</i> Bleeker. III. Fishes of the genus <i>Olyra</i> McClelland. IV. On the use of the generic name <i>Wallago</i> Bleeker. V Fishes of the genus <i>Heteropneustes</i> Müller	199
Scientific Results of the Yale North India Expedition. <i>Biological Report No. 20.</i> Helminth Parasites of Fishes from North India, with special reference to Acanthocephalans	211
On the Sipunculoidea from Indian Waters in the Indian Museum, Calcutta	231

PART III.—*Published September, 1936.*

On a collection of Trichoptera from the Indian Museum. Part II.—Integripalpia	239
<i>Phyllacanthus forcipulatus</i> , sp. nov., A new Cidarid from the Indian Ocean	307

	<i>Page.</i>
Studies on the Acanthocephalan Fauna of Burma	311
On a further collection of Fish from the Naga Hills	317
Some New and Little-known Parasitic Hymenoptera from India	333
Sexual Dimorphism in the Carp <i>Labeo dero</i> (Hamilton)	341
Two new Races of Indian Bats	343
Siluroid Fishes of India, Burma and Ceylon. VI. Fishes of the genus <i>Clarias</i> Gronovius. VII. Fishes of the genus <i>Silurus</i> Linnaeus. VIII. Fishes of the genus <i>Callichrous</i> Hamilton	347
The Indian Aphodiinae of the sub-genus <i>Trichonotulus</i> (Coleoptera : Lamellicornia)	363
The Biology of the Shore-fly <i>Sarcophila cinerea</i> Fabricius (Diptera : Metopiidae)	367
Notes on Helminth Parasites from Afghanistan	373

PART IV.—*Published December, 1936.*

The Earthworms of Burma. V	377
On a collection of Parasitic Hymenoptera from the Government Museum, Madras	469
Observations on the Rate of Growth and Longevity of <i>Trochus niloticus</i> Linn. in the Andaman Is.	473
A statistical study of the data of Growth in the shells of <i>Trochus niloticus</i> Linn. in the Andaman Waters	499
Ueber einige Myriapoden und Isopoden aus Dekan, gesammelt von Herrn S. Jones, Madras	503
On a species of <i>Eutyphoeus</i> from Calcutta	513
A New species of <i>Oligodon</i> from the United Provinces (India)	519

LIST OF PLATES.

	<i>Follow page.</i>
Plate I. Fish from Maungmagan, Lower Burma	40
Plate II. Fish from Maungmagan, Lower Burma	40
Plate III. <i>Kalinga ornata</i> (Ald. & Han.)	80
Plate IV Isopoda aus Süd Indien	102
Plate V Indische Chilognathen	124
Plate VI. Indische Chilognathen	124
Plate VII. Indische Chilognathen	124
Plate VIII. Indische Chilognathen	124
Plate IX. Indian Sipunchuloidea	238
Plate X. <i>Phyllacanthus forcipulatus</i> , sp. nov.	310
Plate XI. <i>Phyllacanthus forcipulatus</i> , sp. nov.	310
Plate XII. <i>Phyllacanthus forcipulatus</i> , sp. nov.	310
Plate XIII. <i>Sarcophila cinerea</i> Fabr.	372
Plate XIV Habitat, etc., of <i>Trochus niloticus</i>	498
Plate XV Myriapoden und Isopoden aus Dekan	512
Plate XVI. Myriapoden und Isopoden aus Dekan	512

LIST OF AUTHORS.

	<i>Page.</i>
ACHARJI, M. N.	
A New species of <i>Oligodon</i> from the United Provinces (<i>in collaboration with Ray, H. C.</i>)	519
AKHTAR, S. A.	
Notes on Helminth Parasites from Afghanistan	373
ALLEN, GLOVER M.	
Two new Races of Indian Bats	343
BARNARD, K. H.	
Isopods collected by the R. I. M. S. "Investigator"	147
CHATTERJEE, R. C.	
The Helminths Parasitic in the Fresh-water Turtles of Rangoon	81
DATTA, M. N.	
Scientific Results of the Yale North India Expedition. <i>Biological Report No. 20.</i> Helminth Parasites of Fishes from North India, with special reference to Acanthocephalans	211
GATES, G. E.	
The Earthworms of Burma	377
GATES, G. E.	
On a species of <i>Eutyphoeus</i> from Calcutta (<i>in collaboration with Kyaw, Maung Hla</i>)	513
HORA, S. L.	
Notes on Fishes in the Indian Museum. XXVI. On a small collection of Fish from the Chitaldrug District, Mysore	1
HORA, S. L.	
Notes on Fishes in the Indian Museum. XXVII. On two collections of Fish from Maungmagan, Tavoy District, Lower Burma (<i>in collaboration with Mukerji Dev Dev</i>)	15
HORA, S. L.	
Fish of the Eastern Doons, United Provinces (<i>in collaboration with Mukerji Dev Dev</i>)	133

	<i>Page.</i>
HORA, S. L.	
Siluroid Fishes of India, Burma and Ceylon. II. Fishes of the genus <i>Akysis</i> Bleeker. III. Fishes of the genus <i>Olyra</i> McClelland. IV On the use of the generic name <i>Wallago</i> Bleeker. V Fishes of the genus <i>Heteropneustes</i> Müller	199
HORA, S. L.	
On a further collection of Fish from the Naga Hills	317
HORA, S. L.	
Sexual Dimorphism in the Carp <i>Lebeo dero</i> (Hamilton) (<i>in collaboration with Misra, K. S.</i>)	341
HORA, S. L.	
Siluroid Fishes of India, Burma and Ceylon. VI. Fishes of the genus <i>Clarias</i> Gronovius. VII. Fishes of the genus <i>Silurus</i> Linnaeus. VIII. Fishes of the genus <i>Callichrous</i> Hamilton	347
KYAW, MAUNG HLA.	
On a species of <i>Eutyphoeus</i> from Calcutta (<i>in collaboration with Gates, G. E.</i>)	513
MANI, M. S.	
Chalcids (<i>Parasitic Hymenoptera</i>) from India	125
MANI, M. S.	
A New Encyrtid Parasite (<i>Chalcidoidea : Hymenoptera</i>) of a Cockroach from India	131
MANI, M. S.	
Studies on Indian Itonididae (<i>Cecidomyiidae : Diptera</i>). III. On a collection of Midges from South India	193
MANI, M. S.	
Some New and Little-known Parasitic Hymenoptera from India	333
MANI, M. S.	
On a collection of Parasitic Hymenoptera from the Government Museum, Madras	469
MARTYNOV, A.	
On a collection of Trichoptera from the Indian Museum. Part II. Integripalpia	239

	Page.
MICHAELSEN, W.	
<i>Branchiura sowerbyi</i> Beddard and its synonymy	95
MISRA, K. S.	
Sexual Dimorphism in the Carp <i>Labeo dero</i> (Hamilton) (<i>in collaboration with Hora, S. L.</i>)	341
MORTENSEN, TH.	
<i>Phyllacanthus forcipulatus</i> , sp. nov., A new Cidarid from the Indian Ocean	307
MUKERJI, DEV DEV.	
Notes on the Systematic Position of the two Gobioid Fishes, <i>Gobiella pellucida</i> Smith and <i>G. birtwistlei</i> Herre, with special remarks on the validity of the Genus	9
MUKERJI, DEV DEV.	
Notes on Fishes in the Indian Museum. XXVII. On two collections of Fish from Maungmagan, Tavoy District, Lower Burma (<i>in collaboration with Hora, S. L.</i>)	15
MUKERJI, DEV DEV.	
Fish of the Eastern Doons, United Provinces (<i>in collaboration with Hora, S. L.</i>)	133
PAULIAN, RENAUD.	
Indian Aphodiinae of the Subgenus <i>Trichonotulus</i> (Coleoptera : Lamellicornia)	363
PRASHAD, B.	
On the Sipunculoidea from Indian Waters in the Indian Museum, Calcutta	231
RAJA, K. C. K. E.	
A statistical study of the data of Growth in shells of <i>Trochus niloticus</i> Linn. in Andaman Waters (<i>in collaboration with Rao, H. S.</i>)	499
RAO, H. SRINIVASA.	
Observations on the Rate of Growth and Longevity of <i>Trochus niloticus</i> Linn. in the Andaman Is.	473
RAO, H. SRINIVASA.	
A statistical study of the data of Growth in shells of <i>Trochus niloticus</i> Linn. in Andaman Waters (<i>in collaboration with Raja, K. C. K. E.</i>)	499

	<i>Page.</i>
RAO, K. VIRABHADRA.	
The Morphology of <i>Kalinga ornata</i> (Ald. & Han.) . . .	41
RAY, H. C.	
A New species of <i>Oligodon</i> from the United Provinces (India), (<i>in collaboration with Acharji, M. N.</i>) .	519
SUBRAHMANIAN, K.	
Studies on the Acanthocephalan Fauna of Burma	311
VENKATRAMAN, T. V.	
The Biology of the Shore-fly, <i>Sarcophila cinerea</i> Fabricius (Diptera : Metopiidae) .	367
VERHOEFF, K. W.	
Ueber einige Isopoda aus Süd-Indien .	97
VERHOEFF, K. W.	
Ueber einige Indische Chilognathen gesammelt von Herrn S. Jones, Madras	103
VERHOEFF, K. W.	
Ueber einige Myriapoden und Isopoden aus Dekan, gesammelt von Herrn S. Jones, Madras	503

INDEX.

[N.B.—An asterisk (*) preceding a name denotes a new variety or sub-species ; a dagger (†) indicates a new species ; a double dagger (‡) a new genus or sub-genus ; a double asterisk (**) a new family or sub-family : synonyms are printed in italics.]

	Page.		Page.
A		<i>Allocreadium</i>	84
<i>Abudofduf bengalensis</i>	20, 27	<i>Ambassidae</i>	18, 19
<i>biocellatus</i>	20, 26, 27	<i>Ambassis nama</i>	18, 19
<i>Acantheucoila</i>	334	<i>Amblycepidae</i>	199, 318
<i>Acanthocephala</i>	211, 212, 213	<i>Amblyceps</i>	199, 200, 203, 204, 206, 207
<i>Acanthocephalus</i>	212, 213, 216	<i>horae</i>	203
<i>acerbus</i>	216	<i>mangois</i>	133, 135, 137, 204
<i>anguillae</i>	216	<i>Amia fraenata</i>	20
<i>echigoensis</i>	216	<i>Amidostomum railletti</i>	373
<i>gotoi</i>	216	<i>Amiidae</i>	20
<i>gracilacanthus</i>	216	<i>Ammodytes</i>	16, 26
† <i>kashmirensis</i>	211, 213, 215, 216	<i>kallolepis</i>	26
<i>lucii</i>	216	<i>lanceolatus</i>	15, 19, 26
<i>paroni</i>	216	<i>Ammodytidae</i>	19, 26
<i>Acanthocobitis longipinnis</i>	355	<i>Amphiprion percula</i>	20
<i>Acanthogobius</i>	32	<i>Anabantidae</i>	18
<i>Accalathura</i>	148	<i>Anacryptus</i>	126
<i>gigas</i>	148	<i>anpingius</i>	126
<i>sladeni</i>	148	† <i>chilkaensis</i>	127
<i>Acentrogobius</i>	30, 32	<i>ferrugineus</i>	126
<i>Acmaea dorsuosa</i>	473	<i>impulsator</i>	126
<i>Acrochordonichthys</i>	199, 200	<i>insidiosus</i>	126
<i>pleurostigma</i>	199	<i>kankauensis</i>	126
<i>Adicella</i>	279	<i>rufinus</i>	126
† <i>biramosa</i>	279, 280, 302	<i>sudanensis</i>	126
<i>nigropunctata</i>	280	<i>Anas sp.</i>	374
<i>pulcherrima</i>	280	<i>Andropogon annulatus</i>	195
<i>reducta</i>	280	<i>Aniculus</i>	191
<i>Aega</i>	157	<i>Anilocra</i>	165, 166, 167
<i>crenulata</i>	159	<i>amboinensis</i>	165
<i>dubia</i>	159	<i>capensis</i>	165, 166, 167
<i>gracilipes</i>	158	<i>cavicauda</i>	167
<i>ommatophylax</i>	158, 159	<i>dimidiata</i>	165, 166, 167
<i>ventrosa</i>	147, 157, 158	<i>gigantea</i>	165
<i>vigilans</i>	159	<i>laticauda</i>	165, 167
<i>Aegidae</i>	157	<i>leptosoma</i>	165, 166, 167
<i>Agapetus</i>	305, 306	<i>longicauda</i>	165
<i>Agarna</i>	169, 170	<i>rhodotaenia</i>	165
<i>Agrypnia picta tibetana</i>	304	<i>Anisocentropus</i>	245
<i>Ainigmabolus</i>	504	† <i>kempi</i>	245, 246, 301
<i>Akysidae</i>	199, 200	<i>longulus</i>	301
<i>Akysis</i>	199, 200, 202	<i>Annulipalpia</i>	239, 247
<i>armatus</i>	200	<i>Anoplodesmus</i>	110, 111
<i>macronema</i>	200	<i>Anthuridae</i>	148
<i>pictus</i>	200, 202	<i>Anurostreptus</i>	103, 104
† <i>prashadi</i>	200, 201, 202	<i>Apatania</i>	300
<i>variegatus</i>	199, 200, 202	<i>Apataniinae</i>	300
<i>variegatus variegatus</i>	200	<i>Apatelia</i>	300
<i>Alectis indica</i>	19, 24	‡ <i>Apatelina</i>	300
<i>indicus</i>	21	† <i>incerta</i>	300, 304
<i>Alitropus typus</i>	160	<i>Aphelidesmus</i>	110
‡ <i>Allagapetus</i>	304, 305	<i>Aphia</i>	9
<i>cocandicus</i>	305	<i>pellucidus</i>	9, 13
† <i>punjabicus</i>	305, 306	<i>Aphodiinae</i>	363
‡ <i>Allagapetus (Agapetus) cocandicus</i>	305	<i>Aphodius (Trichonotulus)</i>	363, 365
<i>Allocreadiidae</i>	81, 83	<i>biseriatus</i>	363, 365
<i>Allocreadiinae</i>	81, 83	† <i>castetsi</i>	363, 364, 365
		<i>fulvescens</i>	365

	Page.
<i>Aphodius</i> (<i>Trichonotulus</i>) †moorei	363, 364 , 365
scrofa	363
<i>Aplysia</i>	56
<i>Apocryptes brachypterus</i>	9
<i>Apodoglanis</i>	357
<i>Archidoris</i>	65
<i>Arctopsyche composita</i>	306
<i>Argana tengraulidis</i>	169 , 170
<i>Argathona</i>	148 , 155
normani	156
reidi	155, 156
<i>Ariidae</i>	18
<i>Arius arius</i>	18, 21
sagor	163
<i>Armadillidae</i>	101, 511
<i>Armadillo</i>	511, 512
†elevatus	511, 512
officinalis	511, 512
rouxi	511
<i>Armadillo</i> (<i>Armadillo</i>) †elevatus	511
<i>Arretoceroides</i>	128
†ceylonensis	128
feralis	128
<i>Ascaridia galli</i>	373
<i>Ascaroidea</i>	90
<i>Asotocerus</i>	241, 247
†flexuosus	241 , 242, 243, 244, 246, 301
fuscipennis	241 , 301
ochraceellus	242
†sinuatus	242, 243 , 244, 246, 301
<i>Asphondylariae</i>	194
<i>Asphondylia morindae</i>	194
<i>Astacotrema</i>	84
<i>Atherina forskali</i>	20
<i>Atherinidae</i>	20

B

<i>Badis badis</i>	331
<i>Bagridae</i>	18, 200, 203, 205, 318, 331
<i>Barbus</i>	2
chagunio	134, 135, 138, 139 , 321, 341
clavatus	317, 318, 319
dorsalis	1, 2, 4, 5
hexagonolepis	318, 319, 324, 325, 326, 329, 330 , 331
hexastichus	139, 319, 326
layardi	4, 5
macrocephalus	326, 330
megalepis	326, 330
mosal	326
progeneius	318, 319, 324, 325, 326, 328 , 329
puckelli	2, 4
putitora	134, 135, 136, 138, 141 , 142, 143, 319, 324, 325, 326, 328, 329, 330
sarana	1
sophore	18
sp.	331
spilopholus	139, 341
tetraspilus	2, 4
ticto	1, 134, 331
tor	134, 135, 136, 138, 139 , 140, 141, 142, 318, 319, 324, 325, 326 , 327, 328, 329, 330

	Page.
<i>Barbus</i> (<i>Puntius</i>) chola	1
dorsalis	1, 2, 3, 4
parrah	1
sophore	1
ticto	1
<i>Barilius</i>	146
barila	318
bendelisis	317, 318, 319, 330
chedra	134 , 137 , 138
<i>Barilius bola</i>	138
<i>Barybrotes</i>	156
agilis	157
indus	156 , 157
<i>Batagur baska</i>	81
<i>Bathydoris</i>	60
<i>Bathynomus</i>	147
giganteus	147
<i>Belodontichthys</i>	207, 208
macrochir	208
<i>Bleekeria</i>	26
<i>Blennechis punctatus</i>	35
<i>Blenniidae</i>	17, 20, 32
<i>Blennius victorae</i>	33
pholis	15 , 17, 19, 33
semifasciatus	19, 21, 32
<i>Bola</i>	138
<i>Bola coitor</i>	138
<i>Bopyridae</i>	191
<i>Branchiosteus</i>	203
<i>Branchiura</i>	96
sowerbyi	95
<i>Breitensteinia</i>	199
<i>Brochopeltis</i>	110
<i>Brotherus</i>	155

C

<i>Cainocreadium</i>	84
<i>Calamoceratidae</i>	239, 246, 247, 301
<i>Callichrous</i>	203, 352, 355, 356, 357, 358, 360, 361
bimaculatus	356, 358, 359, 360, 361
ceylonensis	361
egertonii	361
gangelicus	358
leiacanthus	358
macrophthalmus	358, 361
malabaricus	358
nigrescens	361
notatus	361
pabda	356, 358, 360, 361
pabo	358, 361
sindensis	358
<i>Calliphorinae</i>	371
<i>Camallanidae</i>	92
<i>Camallanus</i>	81, 92
sp.	92
† <i>Camorta</i>	190
†nicobarica	190 , 191
<i>Camponotus compressus</i>	127
<i>Carangidae</i>	19, 20, 24
<i>Caranx armatus</i>	21, 25
auricoronae	17, 25
<i>Caranx</i> (<i>Carangoides</i>) armatus	19, 25
auricoronae	19, 25
<i>Caranx</i> (<i>Caranx</i>) carangus	19, 24 , 25

	Page.		Page.
<i>Caranx</i> (<i>Caranx</i>) <i>sexfasciatus</i>	20	<i>Cirolana latistylis</i>	148
<i>Caranx</i> (<i>Selar</i>) <i>boops</i>	20	<i>Cirolanidae</i>	148
<i>Cardium</i>	74	<i>Cirolaninae</i>	148
<i>Caudotestis</i>	84	<i>Cirrhinia fulungee</i>	1, 2, 5, 6, 7
<i>Cecidomyia</i>	196	<i>Cleantis</i>	186
<i>†eragrostisae</i>	196	<i>annandalei</i>	186, 187
<i>Cecidomyidae</i>	193	<i>japonica</i>	186, 187
<i>Cephalandra indica</i>	194	<i>natalensis</i>	147, 186, 187
<i>Cephalogonimidae</i>	84	<i>occidentalis</i>	187
<i>Cephalogonimus</i>	84	<i>planicauda</i>	186, 187
<i>americanus</i>	86	<i>prismatica</i>	187
<i>†burmanica</i>	84, 85	<i>Clarias</i>	208, 209, 347, 351
<i>compactus</i>	86	<i>assamensis</i>	347, 350, 351
<i>europoeus</i>	86	<i>batrachus</i>	348, 349, 350, 351
<i>mehri</i>	86	<i>brachysoma</i>	347, 348, 349, 350, 351
<i>vesicaudus</i>	86	<i>†dayi</i>	350, 351
<i>Cerceis</i>	183	<i>dussumieri</i>	347, 349
<i>acuticaudata</i>	185	<i>jagur</i>	347, 348
<i>aspericaudata</i>	184, 185	<i>magur</i>	347, 348
<i>†bicarinata</i>	183, 184	<i>marpus</i>	351
<i>bidentata</i>	184	<i>melanoderma</i>	348, 349, 350, 351
<i>intermedia</i>	184, 185	<i>melasoma</i>	349
<i>ovata</i>	185	<i>punctatus</i>	351
<i>picta</i>	183, 184, 185	<i>teysmanni</i>	347, 348, 349, 350
<i>tridentata</i>	184	<i>Claridae</i>	205, 206, 209
<i>trilobata</i>	185	<i>Clupeidae</i>	18, 20
<i>trispinosa</i>	185	<i>Cobitidae</i>	319
<i>Ceylonpeltis</i>	507	<i>Coleoptera</i>	363
<i>Chalcididae</i>	126, 338	<i>Colisa fasciatus</i>	18
<i>Chalcidinae</i>	340	<i>Corallanidae</i>	155
<i>Chalcidoidea</i>	333, 338, 470	<i>Corallaninae</i>	155
<i>Chela clupeoides</i>	1	<i>Cottidae</i>	19, 38
<i>Cheumatopsyche</i>	306	<i>Cottus</i>	17
<i>processuata</i>	306	<i>bubalis</i>	15, 17, 19, 38
<i>Chilopoda</i>	508	<i>Crossochilus</i>	143
<i>Chilostigma</i>	300	<i>†burmanicus</i>	319, 324
<i>Chirocentridae</i>	18	<i>latius</i>	134, 143, 318, 319, 323, 324
<i>Chirocentrus dorab</i>	18, 21	<i>Crunoeiella</i>	288, 289
<i>Chirolophius</i>	39	<i>Cryptopterus</i>	355, 357
<i>Chironomidae</i>	247	<i>sindensis</i>	355
<i>Choanostoma</i>	84	<i>Cryptopterus gangeticus</i>	355
<i>Chondrostoma fulungee</i>	5	<i>latovittatus</i>	361
<i>Chromis ternatensis</i>	17, 20, 27, 28	<i>Crystallogobius</i>	9
<i>Chromodoris</i>	70	<i>nilssonii</i>	9, 13
<i>Cilicæa</i>	181	<i>Ctenogobius</i>	32
<i>canaliculata</i>	181, 182, 183	<i>†meggitti</i>	20, 30, 31, 32
<i>latreillei</i>	183	<i>Cymbephellus</i>	84
<i>Cilicæopsis dakini</i>	181	<i>Cymodoce</i>	179, 180
<i>Circeis</i>	183	<i>bicarinata</i>	180, 181
<i>Cirolana</i>	148, 153, 157	<i>coronata</i>	181
<i>albicaudata</i>	152, 153, 157	<i>longistylis</i>	179, 180, 181
<i>albicaudata japonica</i>	152, 153	<i>mammifera</i>	180
<i>arabica</i>	154	<i>pelsarti</i>	179, 180
<i>borealis</i>	151	<i>setulosa</i>	180
<i>cranchii</i>	155	<i>zanzibarensis</i>	179, 180, 181
<i>elongata</i>	149, 150	<i>Cymothoa</i>	169
<i>fluvialis</i>	154	<i>Cymothoidae</i>	160
<i>harfordi japonica</i>	153	<i>Cymothoinae</i>	160
<i>hirtipes</i>	147, 150, 151, 157	<i>Cynipidae</i>	333
<i>japonicus</i>	151	<i>Cynipoidea</i>	333
<i>parva</i>	154, 155	<i>Cyprinidae</i>	18, 319, 320, 331
<i>†perlata</i>	153, 154	<i>Cyprinodontidae</i>	18
<i>pleonastica</i>	151, 152, 154	<i>Cyprinus</i>	5
<i>†porcellana</i>	149, 150	<i>bola</i>	138
<i>pumicea</i>	149, 150	<i>chagunio</i>	139
<i>rossi</i>	151	<i>dero</i>	142
<i>sculpta</i>	152, 154	<i>goha</i>	138
<i>spp.</i>	155	<i>mosal</i>	140, 141, 326, 330
<i>willeyi</i>	153, 154		

	Page.
<i>Cyprinus mrigala</i>	5
putitora	140, 141, 326
tor	139, 140, 326
<i>Cyprinus (Labeo) dyocheilus</i>	320

D

<i>Danio aequipinnatus</i>	212, 331
dangila	317, 331
malabaricus	1
naganensis	317
<i>Danio (Brachydanio) rerio</i>	133
<i>Danio (Danio) dangila</i>	318
naganensis	318
<i>Daphnia pulex</i>	375
Dasybatidae	18
<i>Dasybatus zugei</i>	18
Decemtestis	84
†Dekanoscia	97, 99
†longicornis	98
Detonidae	148, 190
<i>Diagrama crassispinum</i>	20
<i>Dieucoila</i>	333
†indica	334
subopaca	333
Digenea	81
<i>Dinarthrella</i>	286
†betteni	286, 287, 288, 303
destructa	287, 288
sp.	287, 288
<i>Dinarthrella (Maniconeura) destructa</i>	303
<i>Dinarthrodes</i>	284
albardana	286
armata	303
†inequalis	284, 285, 303
<i>Dinarthrum</i>	281, 287, 291
ferox	282, 303
<i>Dinarthrum (Indodinarthrum) †latum</i>	282, 283, 284, 303
†punjabicum	282, 283, 284, 303
<i>Dinarthrum (Paradinarthrum) longi-</i>	
plocatum	283
mesoplicatum	283
<i>Dinogoerodes</i>	288
relica	289
<i>Dinopterus</i>	205
Diplobulbus	83
Diplopoda	503
<i>Dipseudopsis buddha</i>	306
Diptera	193, 247, 367
<i>Diptychus maculatus</i>	212, 219, 222
<i>Dirona picta</i>	64
<i>Dischistodus notophthalmus</i>	29, 30
<i>Discodoris fragilis</i>	75
Dissolcus	336
†indicus	335
tetartus	335
<i>Doridoeides gardineri</i>	54, 71
<i>Doris</i>	46, 47, 50, 55, 60, 68
tuberculata	62, 67
<i>Drepane punctata</i>	19, 21
Drepanidae	19
<i>Drepanopus</i>	104, 108, 109
enslini	107, 109
Drusus	298
<i>Dussumieria hasselti</i>	18
Dussumieriidae	18

E

Echinorhynchidae	213
<i>Echinorhynchus</i>	211
rigidus	212
<i>Echinorhynchus clavaceps</i>	217
rutili	217
tuberosus	217
<i>Echinostoma revolutum</i>	373
<i>Echinuria</i>	375
uncinata	373, 374, 375
Embolus	504
<i>Emyda scutata</i>	81, 84
Engraulidae	18
<i>Engraulis dussumieri</i>	18
setirostris	169
Entelurus	23
Eolis	50, 63, 64, 67, 71
Eosentis	212, 222
†devdevi	211, 212, 222, 223, 224, 225
rigidus	222, 224, 225
†yalei	211, 212, 225
<i>Eothremma</i>	296, 297
†hindustana	296, 297, 303
japonica	297
<i>Epexochlaenoides pyriformis</i>	338
Epicaridea	147
†Episetodes	265, 266
†angustipennis	265, 266, 302
<i>Epitranus</i>	126
<i>Eragrostis amabilis</i>	197
<i>Eremobolus</i>	104
†Erythroprosopon	503, 504, 505, 506
†phoenix	505
<i>Eubasilissa mclachlani</i>	303
regina	303
tibetana	304
<i>Eubranchiate</i>	183
<i>Euchalcis †myrmeleonae</i>	469, 470
trichiocephalus	470
Eucoilinae	333
<i>Euplocamus</i>	42
<i>Eurycope</i>	188, 189
murrayi	188
<i>Eurycopini</i>	188
<i>Eurycreadium</i>	84
<i>Eurydice</i>	148
orientalis	148
<i>Eurydicidae</i>	148
<i>Eutyphoeus</i>	513
bastianus	517
masoni	513, 517
orientalis	517

F

Farzandia	315
<i>Fasciola hepatica</i>	373
<i>Ferganopsyche</i>	247
<i>Frenata</i>	247

G

<i>Ganonema</i>	239
brunneum	241, 301
longipenne	241, 301
salsum	239, 240, 241, 301

	Page.
Garra . . .	143
gotyla . . .	134, 135, 143, 144 , 318
naganensis . . .	317-318
Gastropoda . . .	60, 473
Gerres lucidus . . .	19, 25
Gerridae . . .	19, 25
<i>Glyphidodon antjerius</i> . . .	26
bengalensis . . .	27
Glyphopsyche . . .	300
Glyptothorax pectinopterus . . .	133, 137
Gobiella . . .	9, 10, 11
birtwestlei . . .	9, 11
pellucida . . .	9, 10, 11
Gobiidae . . .	15, 19, 20, 30
Gobiopterus . . .	9, 10, 11
brachypterus . . .	12
chuno . . .	9, 10, 11, 12, 13
sp. . .	12
Gobius . . .	30
ornatus . . .	30
Goera nigricornis . . .	303
relicta . . .	303
Goerodes . . .	295
piscina . . .	295 , 296
sp. . .	303
Gonieucoila . . .	334
Gurida . . .	155, 156
caelata . . .	155, 156
Gymnostomus . . .	5
<i>Gymnostomus fulungee</i> . . .	5

H

Halesinus albipunctatus . . .	304
Haliotis tuberculata . . .	473
Harpagophora . . .	104
Harpagophoridae . . .	103
Helicometra . . .	83, 84
Helicometrina . . .	83
Helicometroides . . .	83, 84
Hemacreadium . . .	84
Hemibranchiatae . . .	177
Hemirhamphidae . . .	18
Hemirhamphus limbatus . . .	18, 21
<i>Hemisilurus</i> . . .	356, 357
Hermisenda . . .	70
Heroldia . . .	99
Heterakis gallinae . . .	373
Heterobranchioidei . . .	209
Heterobranchus . . .	205, 208, 209
Heteropneustes . . .	208, 209
fossilis . . .	209
microcephalus . . .	209
microps . . .	209
singio . . .	209
Heteropneustidae . . .	209
Hexabanchus . . .	64, 75
Hippocampus histrix . . .	18, 21 , 22
Hipposideros larvatus . . .	345
larvatus *grandis . . .	345 , 346
Histiophorus gladius . . .	164
<i>Holostomis</i> . . .	303
<i>Holostomus mclachlani regina</i> . . .	303
Hoploteleia . . .	469
†gravelyi . . .	469
Hydrophis obscurus . . .	163
Hydropsyche . . .	306
†lobulata . . .	306
obscura . . .	306

Hydropsyche †sagittata . . .	306
tenuicornis . . .	306
Hymenoptera . . .	125, 333
Hypodinarthrum . . .	281

I

Idoteidae . . .	185
Ignasala fuscata . . .	303
†Indocrunoecia . . .	293 , 295
†heterolepidia . . .	293 , 294, 295, 303
†Indodinarthrum . . .	281
Integripalpia . . .	239, 247
Ipomea carica . . .	194
sepiaria . . .	194
Isopoda . . .	97, 510
Itonida . . .	196
†paspalumi . . .	196
penniseti . . .	196
seminis . . .	196
Itonididae . . .	193
Itonididinariae . . .	195

J

†Jonespeltis . . .	110, 115 , 116
†splendidus . . .	115

K

Kalinga . . .	42
ornata . . .	41, 42, 44, 46, 47, 49, 50, 53, 54, 55, 56, 60, 62, 63, 64, 65, 67, 68, 69, 71, 74, 75, 76
Kathlaniidae . . .	90
Kathlaniinae . . .	90
†Kaurma . . .	83, 84
†longicirra . . .	81 , 82, 83
<i>Kawamura japonica</i> . . .	95
<i>Kryptopterichthys</i> . . .	356, 357
Ktenostreptus . . .	104, 108, 109

L

Labeo calbasu . . .	212
dero . . .	134, 135, 138, 142 , 143, 319, 320, 321, 322, 323, 324, 330, 341, 342
†devdevi . . .	319, 324
diplostomus . . .	142, 321, 324
dyocheilus . . .	318, 319, 320 , 321, 322, 323
rohita . . .	212
Lactaridae . . .	18
Lactarius lactarius . . .	18, 21
Lamellicornia . . .	363
<i>Lampito mauritii</i> . . .	388
Lasiopterariae . . .	193
Lates . . .	159
calcarifer . . .	163
Lebouria . . .	84
Leiognathidae . . .	19, 20
Leiognathus blochi . . .	20
insidiator . . .	19
insidiatrix . . .	20

	Page.
<i>Lepidocephalichthys guntea</i> .	134
<i>thermalis</i> .	1
<i>Lepidoptera</i> .	247
<i>Lepidostomatinae</i> .	281
<i>Leptocella</i> .	254
<i>maculata</i> .	302
<i>Leptocella bakeri</i> .	254
<i>Leptoceridae</i> .	247, 249, 301
<i>Leptocerinae</i> .	249
<i>Leptoecrus aterrimu</i> .	251
<i>annulicornis</i> .	251, 252
† <i>distinguendus</i> .	247, 251, 252, 301
† <i>forcipatus</i> .	253, 301
(?) <i>indicus</i> .	301
<i>marginatus</i> .	301
<i>sp.</i> .	254
<i>Lethrinidae</i> .	20
<i>Lethrinus nebulosus</i> .	20
<i>Leuciscus binotatus</i> .	2, 4
<i>Leucospidinae</i> .	338
<i>Leucospis tassamensis</i> .	339
<i>bengalensis</i> .	339
* <i>mackenziei</i> .	339
<i>indiensis</i> .	339
<i>meenakshiae</i> .	339
<i>Ligia</i> .	189, 190
<i>exotica</i> .	189
<i>Ligiidae</i> .	189
<i>Ligula intestinalis</i> .	211, 212, 226
<i>Limnocentropus</i> .	297
<i>fletcheri</i> .	304
<i>insolitus himalayanus</i> .	304
<i>Limnophilidae</i> .	247, 297, 304
<i>Limnoria</i> .	174, 177
<i>japonica</i> .	176, 177
<i>lignorum</i> .	175, 176
<i>pfefferi</i> .	176
† <i>septima</i> .	175, 176
<i>Limnoriidae</i> .	174
<i>Liobagrus</i> .	199, 200
<i>Lioterphus</i> .	125
† <i>orissaensis</i> .	125
<i>Livoneca</i> .	160, 163, 170, 172
<i>propinqua</i> .	147, 171
<i>Livoneca dubia</i> .	160, 161
<i>Lobothorax</i> .	168
<i>laevis</i> .	168
<i>Lophiidae</i> .	19, 39
<i>Lophiomus</i> .	39
<i>Lophius</i> .	16, 39
<i>piscatorius</i> .	15, 19, 39
<i>Lophoscytus</i> .	120
<i>lobulatus</i> .	120
<i>Lucerne</i> .	195
<i>Lutjanidae</i> .	20
<i>Lutjanus lineolatus</i> .	20

M

<i>Macropteronotus jagur</i> .	347
<i>magur</i> .	351
<i>Macrurus</i> .	171
<i>Maculifer</i> .	84
<i>Maniconeura</i> .	288, 289
<i>batumica</i> .	289, 290, 291
† <i>indica</i> .	289, 290, 291, 303
<i>peniculata</i> .	288, 289
<i>relica</i> .	291

	Page.
<i>Marilia</i> .	248, 249
† <i>ceylonica</i> .	248, 249
<i>elongata</i> .	249
<i>flexuosa</i> .	249
<i>minor</i> .	249
<i>sp.</i> .	249, 301
<i>Mastacembelidae</i> .	18, 145, 319
<i>Mastacembelus armatus</i> .	134, 145, 146
<i>pancalus</i> .	1
<i>zebrinus</i> .	18
<i>Mecoptera</i> .	247
<i>Megalispis cordyla</i> .	19
<i>Megascolecidae</i> .	377, 379
<i>Megascolecinae</i> .	377, 379
<i>Megascalex</i> .	377, 388
<i>armatus</i> .	388
<i>mauritii</i> .	377, 388
<i>Megascalex diffringens</i> .	412
<i>Megascolides oneili</i> .	383
<i>Megasolena</i> .	84
<i>Melibe</i> .	56, 62, 74
<i>leonina</i> .	53, 62, 64
<i>Metadinarthrum</i> .	281
<i>Metopiidae</i> .	367
<i>Micrapocryptes fragilis</i> .	10
<i>sp.</i> .	12
<i>Micronema</i> .	356, 357
<i>Molanna</i> .	249
<i>falcata</i> .	249
<i>sp.</i> .	249, 301
<i>Molannidae</i> .	249, 301
<i>Monodontomerus</i> .	125
<i>trichiophthalmus</i> .	125
<i>Morenia ocellata</i> .	81, 86, 88, 90, 92
<i>Morinda tinctoria</i> .	194
<i>Moringa</i> .	195
<i>Mugil</i> .	37
<i>vaigiensis</i> .	19, 21, 37
<i>Mugilidae</i> .	19, 37
<i>Mullidae</i> .	19
<i>Munneurycope</i> .	188
<i>tjalfiensis</i> .	188
<i>Munnopsidae</i> .	188
<i>Munnopsini</i> .	189
<i>Mycodiplosis indica</i> .	195
<i>Mystacides</i> .	280
<i>dentata</i> .	281
† <i>indica</i> .	280, 281, 302
<i>longicornis</i> .	280
<i>Mystus gulio</i> .	18
<i>bleekeri</i> .	331
<i>cavasius</i> .	1

N

<i>Nagara</i> .	99, 510
<i>formosana</i> .	100
<i>incisa</i> .	100, 510
<i>insularum</i> .	100
<i>modesta</i> .	99
<i>teretifrons</i> .	100, 510
† <i>travancoria</i> .	100, 102, 510
<i>Nagara (Nagara) †clavigera</i> .	510
<i>Nagaroides</i> .	99
<i>Nandidae</i> .	319, 331
† <i>Nannocapichthys</i> .	22, 23
† <i>gigas</i> .	18, 22, 23

	Page.
<i>Nannocampus</i>	23
<i>Nectiophylax abrupta</i>	306
<i>Nemachilus</i>	133, 212, 341, 354
<i>barbatula</i>	212
<i>botia</i>	134, 146
<i>denisonii</i>	1
<i>hutchinsoni</i>	211, 212, 226, 227
<i>kangjupkhulensis</i>	317, 318
<i>pavonacaeus</i>	355
<i>rupecola</i>	134, 144, 145, 212
<i>savona</i>	134, 135, 145
<i>scaturigina</i>	134, 135, 145
<i>sp.</i>	227
<i>stoliczkae</i>	212, 217, 219
<i>vittatus</i>	212, 217, 219
<i>Nematoda</i>	90, 373
<i>Nematodirus abnormalis</i>	373
<i>Neoanacryptus</i>	126
<i>Neochalcis forticaudis</i>	471
† <i>myrmeleoneae</i>	469, 471
<i>Neoechinorhynchidae</i>	217, 222
<i>Neoechinorhynchus</i>	212, 217, 218, 219, 221, 222
<i>agilis</i>	221
<i>australis</i>	221
<i>crassus</i>	221
<i>cylindratus</i>	221
† <i>hutchinsoni</i>	211, 219, 220, 221
<i>magnus</i>	221
<i>octonucleatus</i>	221
<i>rutili</i>	211, 212, 217, 218, 219, 221
<i>tenellus</i>	221
<i>variabilis</i>	221
<i>zucconis</i>	221
<i>Neolasioptera cephalandrae</i>	193
<i>Neopronocephalinae</i>	86
<i>Neopronocephalus</i>	86
<i>gangeticus</i>	88
† <i>mehri</i>	86, 87, 88
<i>triangularis</i>	88
<i>Neosentis</i>	313, 314, 315
<i>celatus</i>	314, 315
<i>Nerocila</i>	160, 163, 172
<i>cephalotes</i>	165
<i>orbigny</i>	165
<i>phaeopleura</i>	163, 164, 173
<i>serra</i>	163, 164
<i>sp.</i>	164
<i>sundaica</i>	163, 189
<i>trivittata</i>	164
<i>Nerophis</i>	23
<i>Nesodillo</i>	101
† <i>jonesii</i>	101, 102
<i>medius</i>	101
<i>murinus</i>	101, 102
<i>schellenbergi</i>	102
<i>Neurocyta arenata</i>	304
<i>Neuronia</i>	303
<i>Notanatolica</i>	249, 250
<i>magna</i>	250, 251, 301
<i>opposita</i>	251
<i>Notopteridae</i>	18
<i>Notopterus notopterus</i>	18
<i>Notoscolex birmanicus</i>	379
<i>choprai</i>	379
<i>depressus</i>	379
<i>lunatus</i>	380
<i>oneili</i>	383
<i>Nymphon parasiticum</i>	75

	Page.
O	
<i>Oecetina mahadeva</i>	276, 277
<i>Oecetis</i>	266, 270, 271
† <i>bengalensis</i>	269
† <i>bengalica</i>	266, 267, 302
† <i>biramosa</i>	269, 270, 302
<i>jacobsoni</i>	270
<i>paula</i>	272
<i>punctulata</i>	302
<i>rufescens</i>	302
<i>scutata</i>	266, 268, 269, 270
† <i>scutulata</i>	268, 269, 302
<i>sp.</i>	270, 271, 302
<i>tripunctata</i>	272
<i>Oecetis (Oecetina) insignis</i>	302
<i>pretiosa</i>	302
<i>Odonteucoila</i>	333, 334
<i>chapadae</i>	334
† <i>kurseongensis</i>	334
<i>Odontoceridae</i>	248, 301
<i>Oligodon</i>	519
<i>kheriensis</i>	519, 520
<i>purpurascens cyclurus</i>	519
<i>Olyra</i>	202, 203, 204, 205, 206
<i>burmanica</i>	206, 207
<i>elongata</i>	203, 206, 207, 331
<i>horae</i>	205, 207
<i>inermis</i>	204
<i>kempi</i>	206, 207, 331
<i>longicaudata</i>	203, 204, 205, 206, 207, 331
<i>Olyra latipes</i>	203, 204, 207
<i>Olyridae</i>	206, 331
<i>Ompok</i>	356, 357, 358
<i>siluroides</i>	357, 359
<i>Oniscidae</i>	97
<i>Oniscoidea</i>	147
<i>Oopterygia asiatica</i>	304
<i>brunnea</i>	303
<i>minor</i>	303
<i>Ophicephalidae</i>	18, 319, 331
<i>Ophicephalus gachua</i>	1, 134, 318, 314
<i>marulius</i>	315
<i>punctatus</i>	331
<i>striatus</i>	18, 311, 315
<i>Ophichthyidae</i>	20
<i>Orcilana</i>	155, 156
<i>Oreinus molesworthi</i>	317, 319
† <i>Organognathus</i>	103, 104, 106, 108, 109
† <i>multidentatus</i>	105, 107
<i>Oroscia</i>	97
<i>Oxyethira angustella</i>	306
† <i>ramosa</i>	306

P

<i>Pachytomus</i>	126
† <i>mantisiphagus</i>	126
<i>Pagurus</i>	191
<i>Pallisentis</i>	313, 314, 315
<i>gaboes</i>	314
<i>nagpurensis</i>	311, 312, 313, 314
<i>ophicephali</i>	312, 313, 314
<i>umbellatus</i>	314
<i>Panchax lineatus</i>	1
<i>panchax</i>	18, 21
<i>Pangasidae</i>	18
<i>Pangasius pangasius</i>	18

	Page.		Page.
Paradinarthrum	281	Pheretima canaliculata	377, 410
Paramphistomidae	88	carinensis	441
Paramunnopsis	189	corrugata	456
Paranacryptus	126	diffringens	377, 412
sanguineus	127	elongata	377, 413, 415
Paraphlegopteryx	293, 294, 295	excavatus	466
†compositus	291, 292, 293, 303	exigua	377, 415
tonkinensis	292, 293	typica	415
Paraplagusia blochi	20	exigua	400, 401
Parasetodes	254	austrina	400
bakeri	254, 301	fida	443
respersella	254	flavarundoida	443
Parasetodes (Leptocella) bakeri	254	fokiensis	456
Parasilurus	319, 320, 351, 352, 356, 357	fucosa	441
Parathelges	191	glabra	464, 465
aniculi	191	harrietensis	392
weberi	191	hawayana	377, 417
whiteleggei	191	hawayana	437, 439
Paratrachoptera	247, 252, 257	lineata	437
Paroligosthenus	125	typica	417
trichiophthalmus	125	hesperidum	456
Paspalum scrobiculatum	196	hesperidum	406
Patella vulgata	473, 476	heterochaeta	412, 413
Pecten	74	himalayana	456
Pedunculacetabulum	84	houletti	377, 419, 435, 436
Pellona sp.	18, 21	houletti	406, 407, 410, 434
Penetopteryx	23	rugosa	409
Pennisetum typhiodeum	195	tortuosa	406
Pentatoma ligata	335	typica	419
sayi	335	inclara	377, 422
Perichaeta campanulata	406	insolita	396
elongata	413	kiangensis	406
hawayana	417	lauta	456
houletti	419	lobosa	460
morrisi	437	lohri	456
peguana	444	longicauliculata	377, 423
posthuma	448	†lorella	377, 425
robusta	454	†luxa	377, 427, 428, 429
Perionyx	378, 465, 466, 467	†malaca	377, 429
arboricola	378, 465, 466	mamillana	377, 430
excavatus	378, 466, 467	manicata	377, 432
spp.	378, 467	typica	432
Periplaneta americana	131	meridiana	377, 434, 436, 407
Petroscirtes punctatus	19, 35, 36	m'intoshii	467
Phalacronotus	356, 357	minuta	415
Phascolosoma	238	mirabilis	413
Phascolosoma australe	237	modesta	406
Pheretima	377, 386, 387, 389, 400, 443, 465	molesta	404
abditia	450	montana	389, 450
†aculeata	377, 390, 391	morrisi	377, 437, 439
analecta	377, 392, 452	nugalis	377, 439, 440
analecta promota	451	ophoides	443
andamanenses	377, 392, 393, 394	ornata	454
andersoni	324, 377, 395	osmatoni	392
anomala	377, 396, 397	†pannosa	377, 441
†arboricola	377, 399, 400	†pauzellula	377, 442, 443
austrina	377, 400, 401	peguana	377, 444, 445
balteolata	377, 402	planata	378, 446
bellatula	377, 403	posthuma	378, 448, 450
berhalana	458	promota	378, 451, 452
browni	404, 437	rimosa	378, 453
californica	377, 404, 406, 456	robusta	378, 454, 456
campanulata	377, 406, 407, 408, 410, 421, 435, 436	rugosa	409
penetrans	406	†scitula	378, 457, 458
rugosa	407, 409, 410	siemsseni	458
typica	406	†sonella	378, 428, 429, 458, 460
complanulata meridiana	434	suctoria	378, 461
		suctoria manicata	432
		typica	461

	<i>Page.</i>
<i>Pheretima ultoria</i>	456
† <i>vieta</i>	378, 462, 463, 464
<i>wimberleyana</i>	406
<i>zoysiae</i>	440
<i>Pheretima</i> (<i>Planapheretima</i>)	399, 400
<i>Philoscia</i>	190
<i>Phryganeidae</i>	247, 303
<i>Phyllacanthus</i>	307, 308, 309
† <i>forcipulatus</i>	307, 309
<i>imperialis</i>	309
<i>Phyllogonostreptus</i>	104
<i>Phylostenax himalus</i>	297, 304
<i>Pila globosa</i>	68
<i>Pisoodonophis boro</i>	20
<i>Platacidae</i>	19
<i>Platax teira</i>	19, 21
<i>Platycephalidae</i>	18, 20
<i>Platycephalus</i>	17
<i>indicus</i>	18
<i>spp.</i>	20
<i>Platyphylax rufescens</i>	304
<i>Platyscelio</i>	333, 337
<i>punctatus</i>	337
<i>Pleopodias</i>	147, 166, 167
<i>elongatus</i>	166, 167
<i>Pleurobranchus</i>	60
<i>Plocamophorus</i>	42, 74
<i>Plocamophorus ceylonicus</i>	62
<i>Plotosidae</i>	20
<i>Plotosus anguillaris</i>	20
<i>Podocotyle</i>	84
<i>Podocotyloides</i>	84
<i>Polistomorpha indica</i>	338
† <i>paivai</i>	338
<i>Polycera</i>	74
<i>quadrilineata</i>	67, 73
<i>Polyceridae</i>	42
<i>Polydesmoidea</i>	111, 120
† <i>Polydesmopeltis</i>	110, 111, 112, 113, 115, 507
<i>anthracinus</i>	111
<i>kelaarti</i>	111, 112, 113, 114, 115
<i>carli</i>	112
<i>longipes</i>	111, 112, 113
<i>valparaiensis</i>	111, 112
<i>saussurei</i>	111
<i>xanthotrichus</i>	111, 113, 114
† <i>Polydesmopeltis</i> († <i>ceylonpeltis</i>)	113
<i>xanthotrichus</i> * <i>hamuligerus</i>	507
* <i>hirsutus</i>	114, 115
<i>Polynemidae</i>	19
<i>Polynemus plebius</i>	19
<i>sexfilis</i>	19, 21
<i>Pomacentridae</i>	20, 26
<i>Pomacentrus cyanomos</i>	28
<i>littoralis</i>	20
<i>notophthalmus</i>	17, 20, 29, 30
<i>taeniurus</i>	17, 20, 28, 29
<i>Pomadisidae</i>	20
<i>Pontodrilus</i>	377, 379
<i>Pontodrilus bermudensis</i>	379
<i>sp.</i>	377, 379
<i>Poratophilus</i>	104
<i>Porcellionidae</i>	510
<i>Prionopeltidae</i>	110
<i>Prionopeltis</i>	110, 111, 115
<i>xanthotrichus</i>	507, 508
* <i>hamuligerus</i>	508
* <i>hirsutus</i>	508

	<i>Page.</i>
Proctotrypoidea	333, 335, 469
Proctotrupidae	335
Pronocephalidae	86
Propyrgodesmus	121
Prosopodesmus jakobsoni	116, 117
Protracheoniscus	99
<i>Psenes anomalus</i>	36
Psenopsis anomala	15, 19, 36
Pseudapocryptes lanceolatus	21
Pseudeutropius	203
Pseudocheneis sulcatus	318, 319, 320
Pseudohalesus	298
Pseudorhombus triocellatus	20
Pseudophiloscia	97
sundaica	97
<i>Pseudosilurus</i>	356, 357
<i>macrophthalmus</i>	360
Pseudosphaerillo	511
Pseudostenophylax	297, 298
fumosus	297
griseolus	304
himalayanus	304
secretus	297
sp.	298, 304
Psilorhynchidae	319
Psilorhynchus homaloptera	317, 318, 319
<i>Pterocryptes</i>	355, 356, 357
<i>gangetica</i>	355
Pteropus ariel	344
giganteus	344
hypomelanus	344
*maris	343
subniger	344
<i>Puntius dorsalis</i>	2, 4
<i>Puntius (Capoeta) puckelli</i>	2
Pygodon	503, 505

R

Raiamas	.	.	138
bola	.	134, 135, 138,	143
Raodiplosis			195
orientalis	.		195
Rasbora daniconius		1, 18,	133
<i>Regina</i>			303
Renocila			160
dubia			161
indica	.	.	161
ovata		161, 162,	174
periophthalmi			161
Rhinobatidae			18, 21
Rhinobatus granulatus			18, 21
Rhyacophila			262
†thorai			306
pallida			306
Rhyacophilidae			304
Rhynchium			338
nitidum			339
Rhynchoproctus			104
Rivea hypocrateriformis	.	.	194
Rocinela		159, 160,	172
granulosa	.	.	160
latis		159, 163,	172
mundana		.	159
orientalis		159,	160
simplex		159,	160
Rohtee belangeri	.		18
duvaucelii	.	.	18

		Page.			Page.
S					
<i>Saccobranchus</i>		203, 208, 209	<i>Setodellina brunnescens</i>		271, 273, 274
<i>fossilis</i>		208	<i>gradata</i>		275, 276
<i>Salarias</i>		17, 35	† <i>indivisa</i>		271, 272, 273, 302
<i>anomalus</i>		35	<i>mahadeva</i>		271, 275, 276, 277, 302
† <i>burmanicus</i>		20, 34	† <i>tenuis</i>		271, 273, 274, 302
<i>dussumieri</i>		17, 19, 20, 33	<i>Setodellina (Oecetina) mahadeva</i>		271
<i>rivulatus</i>		20	<i>Setodellina (Oecetis) gradata</i>		271, 273
<i>vermiculatus</i>		20	<i>maculipennis</i>		271, 273
<i>Sarcophaginae</i>		367	<i>Shorea robusta</i>		125
<i>Sarcophila</i>		367	<i>Sicydiaphiinae</i>		9
<i>cinerea</i>		367, 371	<i>Sillaginidae</i>		19, 20
<i>Scelio †calcuttaensis</i>		337	<i>Sillago sihama</i>		17, 19, 20, 21
<i>fulvipes</i>		336	<i>Silurichthys</i>		205, 356, 357, 360
† <i>thorai</i>		336, 337	<i>Silurichthys berdmorei</i>		352, 355
<i>longiventris</i>		337	<i>Siluridae</i>		209, 318, 319
<i>luzonicus</i>		336	<i>Silurodes</i>		356, 357
<i>microcerus</i>		336	<i>Silurus</i>		203, 205, 208, 209, 351, 352, 356, 357, 360
† <i>paivai</i>		336, 337	<i>afghana</i>		352, 353, 354
<i>vulgaris</i>		336, 337	<i>asotus</i>		320, 351, 352, 353
<i>Scelionidae</i>		335	<i>cochinchinensis</i>		318, 319, 320, 352, 353, 354, 355, 356, 357, 358
<i>Scelioninae</i>		336	<i>glanis</i>		351
<i>Schizomyia</i>		194	<i>japonicus</i>		351
† <i>cheriani</i>		194	<i>wynaadensis</i>		356
<i>Schizopygopsis</i> sp.		212, 227	<i>Silurus anastomus</i>		260
<i>stoliczkae</i>		213, 216	<i>anguillaris</i>		351
<i>Schizothorax esocinus</i>		225	<i>attu</i>		207, 208
<i>planifrons</i>		224	<i>batrachus</i>		348
sp.		212, 227	<i>bimaculatus</i>		356, 357, 358
<i>zarudnyi</i>		212	<i>boalis</i>		356
<i>Sciaena cuja</i>		18	<i>canio</i>		356, 360
<i>Sciaenidae</i>		18	<i>chedra</i>		360
<i>Scolodesmus</i>		121	<i>chekra</i>		356
<i>Scomber microlepidotus</i>		20	<i>duda</i>		356, 360
<i>Scombridae</i>		20	<i>fossilis</i>		208
<i>Scorpaenidae</i>		20	<i>garua</i>		356
<i>Scorpaenopsis venosa</i>		20	<i>indicus</i>		360
<i>Scutigera</i>		508	<i>lamghur</i>		360
<i>Scyllea</i>		64	<i>malabaricus</i>		352, 360
<i>Scyphacella</i>		190	<i>microcephalus</i>		360
<i>Scyphacidae</i>		190	<i>Silurus mysoricus</i>		360
<i>Scyphax ornatus</i>		191	<i>pabda</i>		356
<i>Sericostomatidae</i>		281, 303	<i>pabo</i>		356
<i>Serranidae</i>		20	<i>singio</i>		208
<i>Serranus summana</i>		20	<i>Simotes</i>		519
<i>undulosus</i>		20	<i>Simuliidae (Diptera)</i>		247
<i>Setodes</i>		242, 247, 252, 254, 265	<i>Simulium</i>		247
<i>amurensis</i>		263	<i>Siphonosoma</i>		231, 235, 237
<i>argentifera</i>		259, 302	<i>australe</i>		231, 237, 238
<i>argentoaurea</i>		259	<i>Sipunculoidea</i>		231
<i>bifasciipennis</i>		262	<i>Sipunculus</i>		231, 237
† <i>bimaculata</i>		261, 262, 302	<i>aequabilis</i>		231, 236
<i>falcata</i>		260, 261	<i>edulis</i>		235
<i>furcata</i>		302	<i>norvegicus</i>		236
† <i>inlensis</i>		254, 255, 256, 257, 302	<i>nudus</i>		231, 232, 233, 234, 236
<i>lineata</i>		301	<i>porrectus</i>		231, 235
<i>postica</i>		301	<i>robustus</i>		231, 233, 234, 236
<i>similis</i>		262	<i>Sipunculus australis</i>		237
† <i>sternalis</i>		262, 263, 302	<i>Sipunculus (Phascolomum) australis</i>		237
† <i>tenuifalcata</i>		259, 260, 302	<i>Sisoridae</i>		318, 320
<i>tineiformis</i>		262	<i>Soleidae</i>		20
<i>uncinata</i>		260, 261	<i>Solindenia</i>		131
† <i>unispina</i>		257, 258, 259, 302	† <i>blattiphagus</i>		131, 132
<i>viridella</i>		302	<i>picticornis</i>		131
<i>viridis</i>		261	<i>Sparidae</i>		18
<i>Setodellina</i>		271, 273, 277	<i>Sparus datnia</i>		18
<i>albopunctata</i>		271, 273	<i>Sphaeroma</i>		177
† <i>angustipennis</i>		271, 274, 275, 302	<i>annandalei</i>		178

	Page.		Page.
<i>Sphaeroma terebrans</i>	178	<i>Thereuopodina queenslandica</i>	509
<i>triste</i>	177, 178	<i>tenuicornis</i>	508, 509
<i>venustissimum</i>	179	<i>Thremminae</i>	296
<i>walkeri</i>	178	<i>Thyropygus</i>	103, 104
<i>Sphaeromidae</i>	177	<i>amphelictus</i>	103
<i>Spheroides</i>	339	<i>Tonoscolex</i>	377, 379, 385
<i>Sphoeroides</i>	39	<i>conversus</i>	387
<i>oblongus</i>	19, 21, 39	<i>depressus</i>	377, 379, 380
<i>Spilochalcis</i> † <i>fletcheri</i>	340	<i>scutatus</i>	379
<i>indica</i>	340	<i>lunatus</i>	377, 380
<i>Spiromimidae</i>	503, 504	† <i>montanus</i>	377, 381, 383
<i>Spiromimus</i>	503, 505	<i>oneili</i>	377, 383, 384, 385
<i>Spironoura</i>	90, 91	<i>monorchis</i>	383
<i>brevispiculata</i>	91	† <i>parvus</i>	377, 386, 387
<i>catesbeianae</i>	91	<i>Torymidae</i>	125
<i>masculum</i>	91	<i>Toxotes chatareus</i>	19, 21
<i>onama</i>	92	<i>Toxotidae</i>	19
† <i>trangoonica</i>	90, 91	<i>Trachinidae</i>	19, 37
<i>Spirostreptidae</i>	103	<i>Trachinus</i>	16, 38
<i>Spiruroidea</i>	92	<i>draco</i>	15, 19, 37, 38
<i>Stenopara</i>	83, 84	<i>Trachynotus anomalus</i>	36
<i>Stenophylina</i>	298	<i>Trachynotus blochi</i>	19
<i>mittelli</i>	298, 299, 304	<i>Trematoda</i>	81, 373
<i>Stenopsyche himalayana</i>	306	<i>Triacanthidae</i>	19
<i>pallidipennis</i>	306	<i>Triacanthus brevirostris</i>	19, 21
<i>Stenurostreptus</i>	103, 104	<i>Triaenodes</i>	278
<i>Stictodiplosis</i> † <i>moringae</i>	195	<i>hastata</i>	278
<i>pulcherrima</i>	195	† <i>indica</i>	278, 302
<i>Stolephorus indicus</i>	20	<i>ornata</i>	278, 279
<i>Stomatoceroidea</i>	471	<i>Trichoptera</i>	239, 242, 247, 252, 257
† <i>indicus</i>	471	<i>Trichoptera-Integripalpia</i>	301
<i>Stomatocerus</i>	471	<i>Trichosetodes</i>	263, 266
<i>Stromateidae</i>	19, 36	<i>argentolineatus</i>	265
<i>Stunkardia</i>	88	† <i>composita</i>	263, 264, 302
<i>dilymphosa</i>	88, 89	<i>Trichurus ovis</i>	373
† <i>Styloceylonius</i>	120, 123	<i>Trigoniulidae</i>	503, 504
† <i>lobatus</i>	120, 121	<i>Triplectides</i>	249, 250
<i>Stylodesmidae</i>	116	<i>Triplectidinae</i>	249, 250
<i>Stylodesmus</i>	117, 119	<i>Triteleia</i>	469
<i>Symphitoneura</i>	249	<i>Tritonia hombergi</i>	63
<i>Syngnathidae</i>	15, 18, 21, 22	<i>Trochus</i>	231, 473, 478, 482
<i>Synidotea</i>	185	<i>conuloides</i>	482
<i>hirtipes</i>	185, 186	<i>magnus</i>	482
<i>variegata</i>	185, 186	<i>niloticus</i>	473, 474, 476, 477, 479, 480, 482, 483, 484, 485, 487, 488, 496, 497, 499
<i>Synopia scheeleana</i>	149	<i>striatus</i>	482
<i>Systomus dorsalis</i>	2	<i>umbilicalis</i>	482
<i>tristis</i>	4, 5		

T

<i>Tanaidacea</i>	147
<i>Telenominae</i>	335
<i>Telenomus ashmeadi</i>	335
† <i>sagei</i>	335
<i>verticillatus</i>	335
<i>Telotha indica</i>	170
<i>Terapon jarbua</i>	17, 19, 20
<i>Teraponidae</i>	19, 20
<i>Tethys</i>	54
<i>Tetraodontidae</i>	19, 39
<i>Tetrastichus asthenogmus</i>	131
<i>Tetradon oblongus</i>	39
<i>Teuthidae</i>	20
<i>Teuthis oramin</i>	20
<i>Thereuopoda</i>	510
<i>Thereuopodina</i>	508, 510
† <i>adjutrix</i>	508, 509, 510

U

<i>Upeneus</i> sp.	19
<i>Upenoides</i> sp.	21
<i>Urodesmus</i>	117, 118, 119, 120
<i>Urodesmus</i> († <i>Attemsocypus</i>)	118, 119, 120, 121, 123
<i>erinaceus</i>	118
† <i>serratus</i>	118
<i>simplex</i>	118

W

<i>Wallago</i>	203, 207, 208
<i>attu</i>	208
<i>dinema</i>	207, 208

NOTES ON FISHES IN THE INDIAN MUSEUM.

XXVI.—ON A SMALL COLLECTION OF FISH FROM THE CHITALDRUG DISTRICT, MYSORE.

By SUNDER LAL HORA, D.Sc., F.R.S.E., F.A.S.B., Assistant Superintendent, Zoological Survey of India, Calcutta.

While engaged in a general study of the flora and fauna of the step-wells in the Chitaldrug District, Mysore, in connection with investigations on the biological method of control of dracontiasis, Dr. V N. Moorthy made a small collection of fish which he sent to the Zoological Survey of India for identification. It contained 185 specimens belonging to the following 16 species :—

1. <i>Mystus cavasius</i> (Ham.)	. . .	1 specimen.
2. <i>Cirrhina fulungee</i> (Sykes)	.	1 specimen.
3. <i>Barbus sarana</i> (Ham.)	.	1 specimen.
4. <i>Barbus</i> (<i>Puntius</i>) <i>sophore</i> (Ham.)		8 specimens.
5. <i>Barbus</i> (<i>Puntius</i>) <i>chola</i> (Ham.)		2 specimens.
6. <i>Barbus</i> (<i>Puntius</i>) <i>dorsalis</i> (Jerdon)	.	74 specimens.
7. <i>Barbus</i> (<i>Puntius</i>) <i>ticto</i> (Ham.)		15 specimens.
8. <i>Barbus</i> (<i>Puntius</i>) <i>parrah</i> Day	.	3 specimens.
9. <i>Rasbora daniconius</i> (Ham.)		20 specimens.
10. <i>Danio malabaricus</i> (Jerdon)	. . .	5 specimens.
11. <i>Chela clupeoides</i> (Bloch.)		3 specimens.
12. <i>Nemachilus denisonii</i> Day		5 specimens.
13. <i>Lepidocephalichthys thermalis</i> (C. V.)		27 specimens.
14. <i>Panchax lineatum</i> C. V.	.	5 specimens.
15. <i>Mastacembelus pancalus</i> (Ham.)		2 specimens.
16. <i>Ophicephalus gachua</i> Ham.		13 specimens.

Dr. Moorthy observes that *B. dorsalis*, *B. ticto*, *R. daniconius* and *L. thermalis* are the species that have proved useful in guinea-worm control measures. With the exception of *Mystus cavasius*, *Cirrhina fulungee*, *Barbus sarana*, *Mastacembelus pancalus* and *Ophicephalus gachua*, which grow to a fairly big size, all the other smaller species should prove helpful in the biological control of the guinea-worm disease. It should be noted, however, that in the step-wells of the Chitaldrug District *B. dorsalis* is commonly met with—it was collected at 19 of the 38 localities investigated—and as the species has already proved useful, its cultivation for stocking other pieces of water should be encouraged.

In 1927, Narayan Rao and Seshachar¹ published a list of the fresh-water fishes of Mysore. In Dr. Moorthy's collection there are specimens of the following six species, viz., *Cirrhina fulungee* (Sykes), *B. (Puntius) chola* (Ham.), *B. (Puntius) sophore* (Ham.), *B. (Puntius) dorsalis* (Jerdon), *B. (Puntius) ticto* (Ham.), and *Danio malabaricus* (Jerdon), which are not included in that list.

¹ Narayan Rao and Seshachar, *Half-yearly Journ. Mysore University* I, No. 2, pp. 1-29 (1927).

The study of the material collected by Dr. Moorthy has enabled me to show that *Leuciscus binotatus* Blyth¹ and *Puntius* (*Capoeta*) *puckelli* Day² are juvenile forms of *Systemus dorsalis* Jerdon³. It is also clear that *Barbus tetraspilus* Günther⁴ is a synonym of *B. dorsalis* (Jerdon). So far as I am aware, *Cirrhina fulungee* (Sykes)⁵ is a very rare species in museum collections and its specific limits are not properly defined. I, therefore, give below a description of a fresh specimen of *Cirrhina fulungee* (Sykes) and also discuss briefly the synonymy of *Barbus* (*Puntius*) *dorsalis* (Jerdon).

***Barbus* (*Puntius*) *dorsalis* (Jerdon).**

1849. *Systemus dorsalis*, Jerdon, *Madras Journ. Lit. & Sci.*, XV, p. 314.
 1858. *Leuciscus binotatus*, Blyth, *Journ. As. Soc. Bengal*, XXVII, p. 290.
 1868. *Barbus dorsalis*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 142.
 1868. *Barbus tetraspilus*, Günther, *ibid.*, p. 142.
 1868. *Puntius* (*Capoeta*) *Puckelli*, Day, *Proc. Zool. Soc. London*, p. 197.
 1878. *Barbus dorsalis*, Day, *Fish. India*, p. 573, pl. cxlii, fig. 2.
 1878. *Barbus Puckelli*, Day, *ibid.*, p. 574, pl. cxliii, fig. 5.
 1889. *Barbus dorsalis*, Day, *Faun. Brit. Ind. Fish.*, I, p. 319.
 1889. *Barbus puckelli*, Day, *ibid.*, p. 321.
 1911. *Barbus dorsalis*, Willey, *Spolia Zeylanica*, VII, p. 103.
 1916. *Barbus dorsalis*, Raj, *Rec. Ind. Mus.*, XII, p. 255.
 1930. *Puntius dorsalis*, Deraniyagala, *Spolia Zeylanica*, XVI, p. 12.

In 1849, Jerdon described a small species of *Barbus* under the name *Systemus dorsalis* from "the tanks and rivers in the neighbourhood of Madras" and characterised it as follows:—

"Head is $3\frac{1}{2}$ times in total length; height is 3 times in the same; snout irregular; 26 scales along the sides in 8 rows; 2 labial cirri; profile rising to dorsal and descending rapidly to the end of that fin; thence nearly straight; bluish above, yellowish on the sides, silvery beneath, a black spot on each side of the tail occasionally; fins with a yellowish tinge; D. 3-8, A.7, etc. Dorsal fin with a black spot on its base behind; 4 to 5 inches long."

B. dorsalis is a well known South Indian fish and, according to Day (1878), it is found in "Kurnool, Mysore, throughout Madras as low as the Cauvery and Coleroon rivers and Ceylon." In Dr. Moorthy's collection there are several young, half-grown and adult specimens of *B. dorsalis*. The colouration of the species differs at various stages of its growth. Further, in the young the last dorsal spine is weak and flexible but in specimens over four inches in length it becomes hard and bony. In differentiating small species of *Barbus*, considerable reliance is placed on the structure of the last dorsal spine and on the nature of the colour markings and it is no wonder, therefore, that *B. dorsalis* has been described under different names at various stages of its growth.

In very young specimens about 23 mm. in total length (text-fig. 1a) there is a deep, black spot on the basal portion of the posterior dorsal rays, a second similar spot at the centre of the base of the caudal fin on each side and a smaller spot at the base of the posterior anal rays

¹ Blyth, *Journ. As. Soc. Bengal*, XXVII, p. 290 (1858).

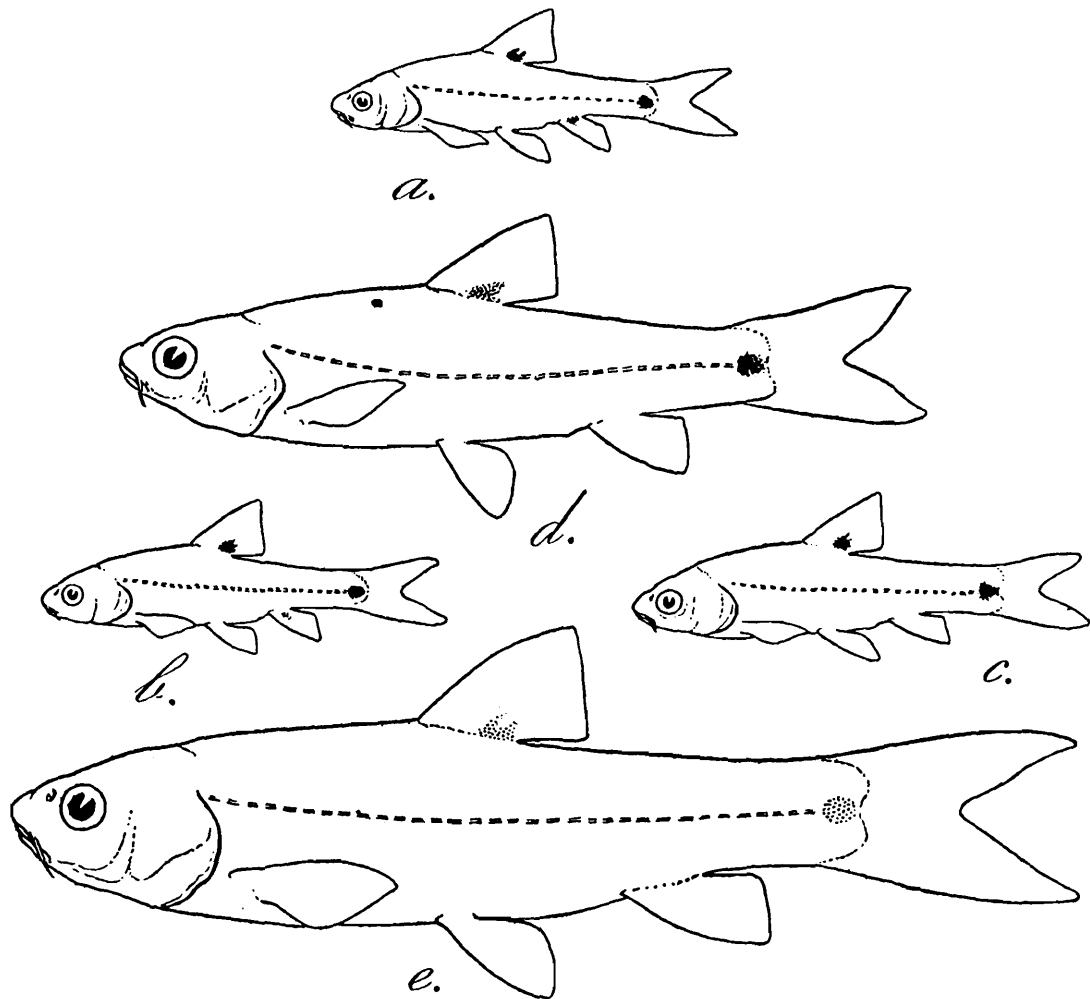
² Day, *Proc. Zool. Soc. London*, p. 197 (1868).

³ Jerdon, *Madras Journ. Lit. & Sci.*, XV, p. 314 (1849).

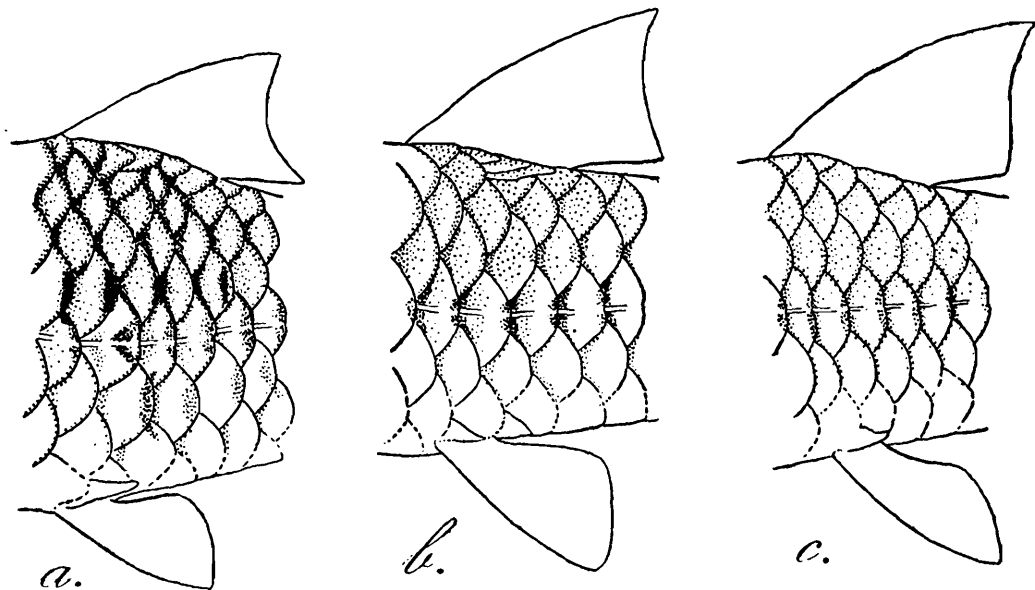
⁴ Günther, *Cat. Fish. Brit. Mus.*, VII, p. 142 (1868).

⁵ Skyes, *Trans. Zool. Soc. London*, II, p. 358 (1841).

The bases and margins of the scales, especially in the dorsal region, are covered with minute, irregularly scattered, small, black dots (text-



TEXT-FIG. 1.—Growth stages of *Barbus (Puntius) dorsalis* (Jerdon), showing the gradual disappearance of anal, dorsal and caudal spots. $\times$ ca. $1\frac{1}{2}$.



TEXT-FIG. 2.—Portion of body in the region of dorsal fin, showing gradual appearance of colour markings on scales in three growth stages of *Barbus (Puntius) dorsalis* (Jerdon).

a.	From a specimen	144 mm. in total length.	$\times$	$\frac{7}{8}$.
b.	"	63	"	$\times 2\frac{1}{2}$.
c.	"	34	"	$\times 4\frac{1}{2}$.

fig. 2c). The last dorsal spine is very weak at this stage. With the growth of the fish, the anal spot disappears (text-fig. 1, *b* and *c*), the markings on the scales become more prominent (text-fig. 2*b*) while the dorsal and the caudal spots persist in a fairly well-marked condition in specimens up to 83 mm. in length, though they are sometimes reduced and become lighter in colour (text-fig. 1, *d* and *e*). The dorsal spine is still very weak.

Attention may be directed here to *Barbus puckelli* (Day) described from a single specimen, 3 inches long, collected at Bangalore. The species is characterised, among other peculiarities, by the presence of a "deep-black mark on the dorsal fin from the base of the third to the base of the sixth branched ray. Very fine dark dots over scales, especially at their bases. An indistinct black mark on lateral line from nineteenth to twenty-first scale." No other author seems to have recorded this species though it is stated by Day (1878) to be very common at Bangalore. I have several examples in Dr. Moorthy's collection which agree with Day's description in almost every respect, but from the series of specimens before me it is certain that *B. puckelli* is only a juvenile form of *B. dorsalis*. A very characteristic feature of the species at this stage is, as already noted by Day, that the extremity of the lower jaw is not covered by the lip.

In describing the colouration of the Ceylonese specimens of *Puntius dorsalis*, Deraniyagala says that "In immature specimens from localities such as Jaffna, Mankulam (N. P.) and Kahavatta (Sab. P.) there is a well marked lateral band extending from the shoulder along the lateral line to the caudal blotch; while the posterior half of the basal sheath of the dorsal is also black, and often the upper and lower margins of the caudal are dark. These marks usually persist until the fish is 90 mm. long"

The description of the colour of *Leuciscus binotatus* Blyth, based on a specimen 1.5 inches in length from Ceylon, agrees with what is stated above by Deraniyagala and there seems to me no doubt that Blyth's species has also to be regarded as a juvenile form of *B. dorsalis*.

In Indian specimens there is no lateral band and the margins of the caudal fin are not stained black.

Under the synonymy of *B. dorsalis*, Day (1878) included *Systemus tristis* Jerdon, with a query, *B. tetraspilus* Günther and *B. layardi* Günther. He, however, remarked that "*B. tetraspilus* differs from *B. dorsalis* in having a dark spot before the base of the caudal fin" As regards the persistence of caudal and dorsal spots, it may be noted that in specimens up to 80 mm. the former is sometimes fainter than the latter (text-fig. 1*d*) or *vice versâ*, but on the whole the caudal spot disappears earlier. In an old specimen from Day's collection 117 mm. in total length, there is an indication of the dorsal spot whereas the caudal spot is altogether faded. In describing *B. tetraspilus*, Günther had one adult, 7.5 inches in length, and one young specimen before him. There can be no doubt that his young specimen had the spots prominently marked, while they may have been faintly represented in the adult I agree with Day in regarding *B. tetraspilus* as a synonym of *B. dorsalis*

B. layardi Günther lacks all the colour markings of *B. dorsalis* and besides has only 23 scales along the lateral line. I have examined a specimen of *B. dorsalis*, 142 mm. in total length, in which though the dorsal and the caudal spots are absent, but the black markings at the bases of the scales are very prominent (text-fig. 2a). Without an examination of the types, it is very difficult to be certain about the systematic position of *B. layardi*, but I am inclined to regard it, for the time being, as a distinct species.

The description of *Systomus tristis* Jerdon is inadequate for judging its precise specific limits. The species was based on a single specimen, 3 inches long. In the description of its colour there is neither any reference to the characteristic dorsal and caudal spots, nor to the markings on the scales. In all probability, *B. tristis* is not conspecific with *B. dorsalis*.

According to Willey's¹ observations the spawning season of *B. dorsalis* in Ceylon is about August, but Dr. Moorthy collected a large number of young specimens during March and April.

***Cirrhina fulungee* (Sykes).**

1841. *Chondrostoma Fulungee*, Sykes, *Trans. Zool. Soc. London*, II, p. 358.
1868. *Gymnostomus fulungee*, Günther, *Cat. Fish. Brit. Mus.*, VII, p. 76.
1878. *Cirrhina fulungee*, Day, *Fish. India*, p. 549, pl. cxxxii, fig. 1.
1889. *Cirrhina fulungee*, Day, *Faun. Brit. Ind. Fish.*, II, p. 280.

In describing *Chondrostoma fulungee*, Sykes indicated that the species "would be referred to Dr. Hamilton's third subgenus of *Cyprinus* "*Bangana*", but it is not to be identified with any of the species, although in outline it has a close resemblance to the figure of *Cyprinus Mrigala*, and has other general points of resemblance" Unfortunately the species was not illustrated and, judged by modern standards, the description is very inadequate. Günther included this species in the composite genus *Gymnostomus* and made no reference to its distinguishing features. Day recognised the species but remarked that "*Cirrhina fulungee*, Sykes, is very closely allied to *C. mrigala*, but its barbels are shorter" In making this statement Day seems to have been influenced by the observations of Sykes, for even according to Day's descriptions the two species differ in *lepidosis* and in the number of branched rays in the dorsal fin (12 to 13 in *C. mrigala* and 8 in *C. fulungee*). There are in addition marked differences in the body proportions also.

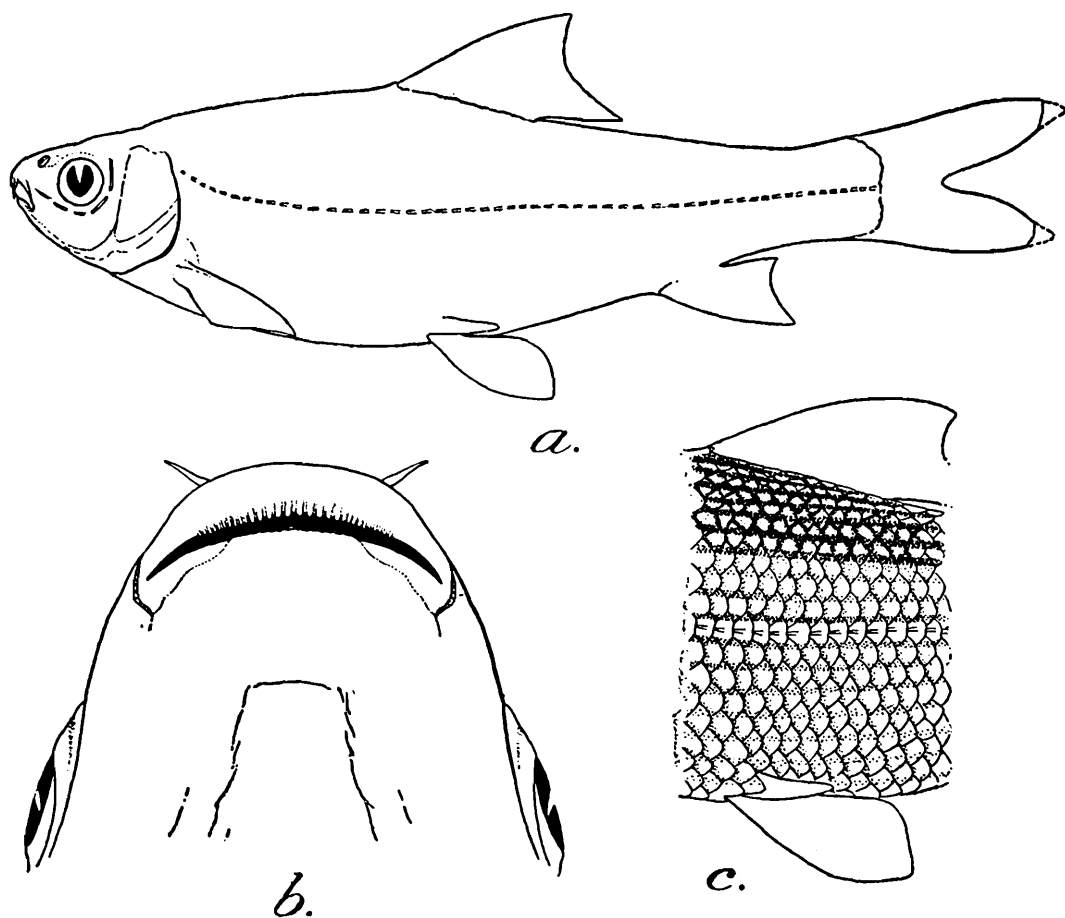
The original of Day's description and figure in the *Fishes of India* is now preserved in the collection of the Indian Museum; it is 92 mm. in total length without the caudal and is in a tolerably good state of preservation. The locality label is faded but with proper illumination and magnification the locality can be made out as "Poonna" In the fish register of presentations to the Indian Museum it is numbered 2360 and is noted to have been purchased from Day in 1879; but its locality is given as "Burma" This is obviously wrong for Day never had a specimen of this species from Burma. In fact, it seems probable that Day had examined only one specimen of the species which is now preserved in the Indian Museum.

¹ Willey, *Spolia Zeylanica*, VII, p. 103 (1911).

In Dr. Moorthy's collection there is a fully mature female specimen with ripe gonads ; it is 123 mm. in total length without the caudal and on account of its large size it differs in proportions from the specimen described by Day. It may be described as follows :—

D. $\frac{3}{8}$; A. $\frac{3}{5}$; P. 15 ; V. 9 ; C. 19 ; L. I. 53.

The dorsal profile is slightly convex but the ventral profile is greatly arched. The body is deepest between the commencements of the dorsal and ventral fins and thence it tapers towards both ends. The head is small and bluntly pointed ; its length is contained 4·8 times in the total length without the caudal. The width of the head is contained 1·3 times and height of the head 1·1 times in its length. The eyes are lateral and are situated mostly in the anterior half of the head ; the diameter of the eye is contained 3·6 times in the length of the head, 1·2 times in the length of the snout and 1·8 times in the interorbital width. The



TEXT-FIG. 3.—*Cirrhina fulunjee* (Sykes). *a.* Lateral view. $\times \frac{2}{3}$; *b.* Ventral surface of head and anterior part of body. $\times 3\frac{1}{2}$; *c.* Portion of body in the region of dorsal fin, showing leipdosis and colour markings. Nat. size.

interorbital space is slightly convex. There is only one pair of small rostral barbels which are about one-third the diameter of the eye. The mouth is distinctly inferior and is overhung by a rostral fold which is slightly fimbriated. The two lips are continuous at the angles. The lower lip is free from the jaw anteriorly ; the lower jaw has a sharp margin. There are shallow grooves at the sides of the snout which commence round the angles of the mouth,

The depth of the body is contained 3·6 times in the total length without the caudal. The scales are small but firmly set ; there are 53 scales along the lateral line, which is complete, 10 transverse series of scales between the lateral line and the commencement of the dorsal and $6\frac{1}{2}$ series between the former and the base of the ventral fin. There are 17 predorsal scales and about 22-23 scales round the caudal peduncle. There are well-developed scaly sheaths in the axils of the ventral fins. The least height of the caudal peduncle is contained 1·8 times in its length.

The commencement of the dorsal fin is slightly in advance of that of the ventral and is much nearer to the tip of the snout than to the base of the caudal ; the free border of the fin is concave and its longest ray is almost equal to the length of the head and considerably shorter than the depth of the body below it. The anal fin is similar to the dorsal in form but it is much shorter. The pectoral fins are pointed in the middle and are shorter than the head ; they are separated from the ventrals by a distance equal to their length. The ventral fins are not so pointed as the pectorals and, when spread out, appear rounded ; they are separated from the anal opening by a distance equal to the postorbital part of the head. The caudal fin is deeply bifurcate and has pointed lobes.

The colouration is spirit in dark above and very pale olivaceous below. The borders of the scales are marked with fine black spots and the general impression they give is that the body is marked with a series of longitudinal bands. The dorsal fin and the basal half of the caudal fin is gray.

Dr. Moorthy has kindly presented this specimen¹ to the Zoological Survey of India.

Measurements in millimetres.

Total length excluding caudal	.	123·0
Depth of body	.	36·0
Length of head		25·5
Width of head		19·5
Height of head	.	22·4
Length of snout	. .	8·5
Diameter of eye	.	7·0
Interorbital width	.	12·5
Length of rostral barbel		2·5
Longest ray of dorsal	.	26·0
Longest ray of anal	.	18·8
Length of pectoral	. . .	21·0
Length of ventral	.	20·0
Length of caudal peduncle	. .	22·0
Least height of caudal peduncle		14·0

¹ Dr. Moorthy has since sent 3 more specimens of *Cirrhitina fulunjee* from Mysore.

NOTES ON THE SYSTEMATIC POSITION OF THE TWO GOBIOID FISHES, *Gobiella pellucida* SMITH AND *G. birtwistlei* HERRE, WITH SPECIAL REMARKS ON THE VALIDITY OF THE GENUS.

By DEV DEV MUKERJI, M.Sc., Zoological Survey of India, Calcutta.

In 1931, Smith¹ erected the genus *Gobiella* for his new Siamese translucent goby, *G. pellucida*, and observed: "This diminutive goby has as yet been found only in Bangkok, but may doubtless be looked for anywhere in Central Siam. Its only known habitat is a small canal or ditch and a small pond in the grounds of the Department of Fisheries; the pond and canal are ultimately connected with the Menam Chao Phya." Recently, while examining collections of a similar goby, *Gobiopterus chuno* (Hamilton)², from the brackish water areas of the Gangetic Delta, I became doubtful about the validity of the Siamese genus *Gobiella* and the species *pellucida* and tentatively believed that *Gobiella pellucida* was the same as *Gobiopterus chuno*. In order to clarify my views, request was made to the Director-General of the Department of Fisheries, Bangkok, to send to the Indian Museum a few specimens of *G. pellucida* for examination, and 15 specimens of both sexes, 7 from the original series, and the rest freshly collected from the type-locality, were received. In December, 1934, Herre³ described another similar goby, *Gobiella birtwistlei* from brackish water tidal creeks on the Singapore Island. A comparison of its description with that of *G. pellucida* induced me to think that the two forms were conspecific. To confirm this view 4 co-types, one male and three females, were procured by the Indian Museum through the courtesy of the Director of the Raffles Museum, Singapore.

The genus *Gobiopterus* of the subfamily Sicydiaphiinae⁴ was proposed by Bleeker⁵ in 1874 for his species "*Apocryptes brachypterus*" described⁶ in 1855 from the Grati Lake in Java. It comprises small translucent, pelagic or lake gobies which fairly correspond in habits with similar gobies of the European waters, such as *Aphia* Risso (1826) and *Crystallogobius* Gill (1863). It is of interest to note that according to Collet⁷ certain species of the genera *Aphia* and *Crystallogobius* (for example *A. pellucidus* and *C. nilssonii*) are annual forms. It is not known whether species of the genus *Gobiopterus* of the Oriental waters have also a similar duration of life. From a study of the description of

¹ Smith, H. M.—*Proc. U. S. Nat. Mus.*, LXXIX, pp. 33-35, fig. 16, (1931).

² Hora, S. L.—*Rec. Ind. Mus.*, XXXVI, pp. 487, 488, (1934).

³ Herre, A. W. C. T.—*Bull. Raff. Mus. Singapore*, No. 19, pp. 85, 86, (1934).

⁴ Koumans, F. P.—*Pre. Rev. Genera Gobioïd Fish.*, p. 24, (1931).

⁵ Bleeker, P.—*Esquisse Arch. Neerl. Sc. ex. et nat.*, IX, p. 311, (1874).

⁶ Bleeker, P.—*Nat. Tijds. Ned. Ind.*, IX, p. 402, (1855).

⁷ Collet, R.—*Forsk. Vid. Selsk. Christiana*, pp. 1-12 (1876); *Proc. Zool. Soc. London*, pp. 318-339, (1878).

Gobiopterus Bleeker and *Gobiella* Smith, as also from an examination of extensive material of *Gobiopterus chuno* from the Salt Lake areas near Calcutta, Chilka Lake in Orissa and other places and the para- and topo-types of *Gobiella pellucida* at my disposal, I am unable to separate the two genera. For convenience of comparison I give below in a table the salient features of *Gobiopterus* and *Gobiella* as accepted by Koumans (*op. cit.*).

Gobiopterus Bleeker.

Gobiella Smith.

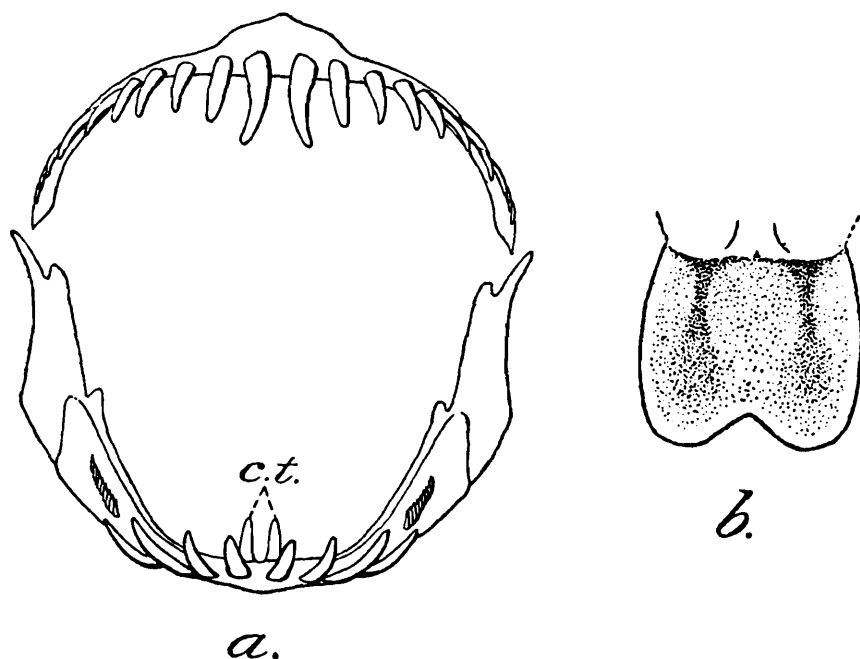
- | | |
|--|--|
| 1. "Body elongate, compressed, covered with 25-36 scales, ctenoid?" | "Body elongate, compressed, covered with.... about 25 ctenoid scales". |
| 2. "Head compressed, naked" | "Head very slightly compressed, naked". |
| 3. "Eyes in anterior half of head" | "Eyes large, in anterior half of head" |
| 4. "Cleft of mouth nearly vertical, lower jaw prominent" | "Mouth very oblique, lower jaw prominent". |
| 5. "Teeth in both jaws in one row, in upper jaw caninoid, in lower jaw anterior ones caninoid, lateral ones smaller" | "Minute teeth in bands in each jaw". |
| 6. "Dorsal fins separate. D ₁ with 5-6 spines, D ₂ with 8-9 rays" | "Dorsal fins widely separate. D ₁ with 5 spines. D ₂ with 9 rays". |
| 7. "A. with 8-14 rays" | "A. with 12 rays". |
| 8. "V. united, but free from belly" | "V. united" (free from belly). |
| 9. "C. truncate" | "C. truncate". |

From the above table it is abundantly clear that there is not a single character that can be taken into consideration in separating the two genera, excepting the superficial disparity in regard to the nature of dentition. Unfortunately Smith's account of the teeth in *Gobiella* is inadequate and inaccurate, and Koumans (*op. cit.*) having had no chance of examining the type of *Gobiella pellucida*, adopted Smith's description of the teeth in his synopsis of the genus *Gobiella*, and was naturally influenced to regard it as distinct from *Gobiopterus*. A careful examination, however, reveals that, like *Gobiopterus*, *Gobiella* exhibits marked sexual differences in the character of dentition. In the adult males and females of *Gobiella pellucida*, the type species of the genus, the teeth are conical in both the jaws and are arranged in a single row and not in "bands".¹ In the upper jaw the teeth are comparatively small in both the sexes. In females, the teeth are considerably smaller in both the jaws, very minute and set somewhat close together. In males, like those of *Gobiopterus chuno*,² the teeth in both the jaws are better developed and distinctly caniniform. The anterior ones of the lower jaw are fairly enlarged, curved and are widely spaced, while the lateral ones are somewhat smaller, close-set and implanted slightly inwards. In the upper jaw the teeth are also large and caninoid, but smaller than those of the lower jaw and are more or less uniformly arranged. Besides these, the males of *G. pellucida* are provided with a pair of enlarged canine teeth on the mandibular symphysis, implanted inwards (Text-fig. 1, a). As in *Gobiopterus*, the labial teeth are

¹ In certain specimens the teeth in one or both the jaws appear to be irregularly distributed and arranged in interrupted bands, but this is either an abnormality or individual variation.

² For an account of the nature of dentition of *Gobiopterus chuno* (= "*Micrapocryptes fragilis*" Hora) vide Hora, S. L.—*Mem. Ind. Mus.*, V, pp. 752, 753, text-fig. 32, 1923.

absent in *Gobiella*. It is thus seen that the nature of dentition of *Gobiella* is absolutely the same as that of *Gobiopterus*.



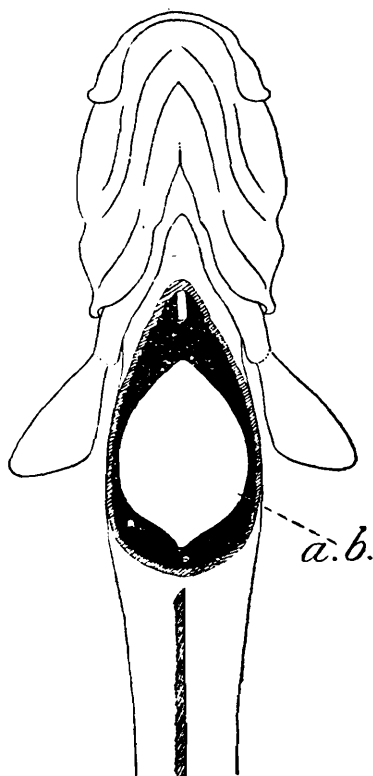
TEXT-FIG. 1.—a. Tooth-bands of a paratype (male) of "*Gobiella pellucida*" from Bangkok, Siam. $\times 18$. c. t. = canine teeth.
b. Dorsal view of tongue of a paratype (male) of "*Gobiella pellucida*" from Bangkok, Siam. $\times 22$.

Another important character to which reference must be made in considering gobioid genera is the structure of the tongue. Smith made no reference to this character in defining the genus *Gobiella*, but an examination of the paratypes of *G. pellucida* reveals that the tongue is, like that of *Gobiopterus chuno*, definitely bilobate (Text-fig. 1, b). Thus taking all the features of *Gobiella* and *Gobiopterus* into consideration, it is evident that *Gobiella* has to be considered as a synonym of *Gobiopterus*.

Apart from the morphological questions discussed above, about the systematic position of the two genera, a study of the geographical distribution of the genus *Gobiopterus* also throws sufficient light on the matter and leads to the conclusion that *Gobiopterus*, described under different names in different countries, is a widely distributed genus, and its hitherto known sporadic distribution in Java on the one hand and India on the other is largely due to its being overlooked in the intervening areas in the past probably owing to its invisibility in water and its small size. It is, however, now known that the distribution of the genus extends from Java, through Singapore, Siam to Bengal and Orissa in India. It appears to me highly probable, judging the path of migration of the genus, that it is equally prevalent, in suitable habitats, in Sumatra, Malay Peninsula, and the coastal areas of Burma and Assam.

In regard to the affinities of the species "*Gobiella pellucida*" from Siam and "*Gobiella birtwistlei*" from the Singapore Island Herre (*op. cit.*, p. 86) thinks that the latter species "is near *Gobiella pellucida*. . . but differs in the second dorsal and anal fins, in scalation, teeth and other details". After a careful examination and comparison of the

cotypes of the two species and large series of *Gobiopterus chuno*, I am convinced that they are inseparable from each other as also from *G. chuno* and that they should be considered as synonyms of *G. chuno*. In this connection reference may be made to a form described by Hora¹ under the name "*Micrapocryptes* sp." (= *Gobiopterus* sp., *vide* Hora, *op. cit.*, 1934) from "the channel between B. Pak Raw and B. Pak Cha", Talé Sap, Siam. As already pointed out by Hora, the species cannot be reconciled with either *G. chuno* or *G. brachypterus*, but shows a much closer agreement with the latter and may, when we have more material and better knowledge of the two fishes, turn out to be conspecific with it.



TEXT-FIG. 2.—Ventral view *in situ* of air-bladder (a. b.) of a male specimen of *Gobiopterus chuno* from Salt Lakes, Calcutta. $\times 5$.

Gobiopterus chuno is a widely distributed little pelagic or lake goby, usually found in great abundance in the brackish water areas. Its present range extends from the Singapore Island, through Siam (Bangkok) to Bengal (Gangetic Delta) and Orissa (Chilka Lake) in India. The species differs in several respects from most of the typical gobies. Its light, slender and compressed body and the more or less laterally placed eyes indicate that it does not, like the greater number of gobies, live at the bottom, but swims about freely. The proportionally large and free air-bladder, which is pear-shaped and occupies a considerable part of the abdominal cavity (Text-fig. 2), also indicates the pelagic habits of the fish. Moreover, the narrow and funnel-shaped united ventrals which are free from the belly, point to the fact that they do not constitute a regular and functional organ of adhesion as in the case of the bottom dwelling gobies. The species has been found (Hora,

¹ Hora, S. L.—*Mem. Asiat. Soc. Bengal*, VI, p. 495, fig. 7, (1924).

op. cit., 1934) to feed on microscopic Copepoda and other planktonic organisms.

In Bangkok, Smith collected egg-bearing females of the species from January to May. Herre's collection from the Singapore Island, which includes gravid females, was made in March. The Indian Museum collections of the species from different areas of the Chilka Lake in Orissa and the Gangetic Delta in Bengal are dated March (Orissa), July (Bengal), August (Bengal) and November (Orissa). Among these collections there are large numbers of both gravid and spent-up females. It is evident, therefore, that the egg-laying period of *Gobiopterus chuno* of the Oriental waters is protracted and varies in different places in accordance with the changes in the salinity of the water in which the fish lives and other ecological conditions. According to Collet (*op. cit.*) the normal period of spawning season of *Aphia pellucidus* and *Crystallogobius nilssonii* of the European waters is the end of June or the beginning of July.

NOTES ON FISHES IN THE INDIAN MUSEUM.

XXVII.—ON TWO COLLECTIONS OF FISH FROM MAUNG MAGAN, TAVOY DISTRICT, LOWER BURMA.

By SUNDER LAL HORA, D.Sc., F.R.S.E., F.A.S.B., and DEV DEV MUKERJI, M.Sc., Zoological Survey of India, Calcutta.

(Plates I & II.)

Early in January 1934, the Zoological Survey of India received for determination an extensive collection of fish from Professor F. J. Meggitt of the University College, Rangoon. It consisted of two lots: (i) 19 specimens collected at Rangoon comprising 11 families, 13 genera and 14 species (*vide* list on p. 18). Almost all the species represented in this lot are fairly common and do not call for any comments. (ii) 238 specimens collected at Maungmagan¹, Tavoy District, Lower Burma, comprising 32 families, 40 genera and 44 species (*vide* list on pp. 18, 19). Besides representatives of two new species belonging to the families Syngnathidae and Gobiidae, there were specimens of six species, *viz.*, *Ammodytes lanceolatus* Le Sauvage, *Blennius pholis* Linn., *Psenopsis anomala* (T. & S.), *Trachinus draco* Linn., *Cottus bubalis* Euphrasen, and *Lophius piscatorius* Linn., which had not been previously recorded from the Indian waters. Of these, *P. anomala* has hitherto been found in the seas of Japan and China, while the others are generally restricted to the Atlantic Ocean and had so far been recorded from the Western Coasts of Europe and the Mediterranean Sea.

The occurrence of the European species in Burmese waters seemed so remarkable that Professor Meggitt was requested to supply exhaustive notes with ecological observations about the localities in which the fish were collected. In reply Professor Meggitt wrote:—

“Most of the fish—these are the small ones—were collected in rock pools by myself with a net. Some of the small fish were caught by local fishermen, standing in the surf and casting a hand-net. The big fish were caught by a drag-net from boats, very fragile craft which did not go more than 1 mile (estimated) from shore. I saw other boats further out, but do not think we had anything from them. The bay is fairly shallow and is partly closed by a reef: sharks are absent.”

“All fish caught at Maungmagan (Tavoy) were labelled.”

On further enquiries, Professor Meggitt sent a rough sketch of Maungmagan which is reproduced here (text-fig. 1). He observed as follows:—

“The rock pools all contain salt water and are renewed by each tide. They may be divided into (1) sandy pools, usually round the base of a rock, free from vegetation, containing a few small prawns, numerous “puffers” and gobies. (2) algal pools of small size, in the midst of rock masses, rich in sea-weeds, containing prawns, crabs, sponges, anemones, gobies and striped fish. (3) Estuarine pools, in the course of a small valley down which the water drains, full of stones, containing chiefly crabs.

“Except (1) all are very small, only a few feet across, and even (1) are not much larger.”

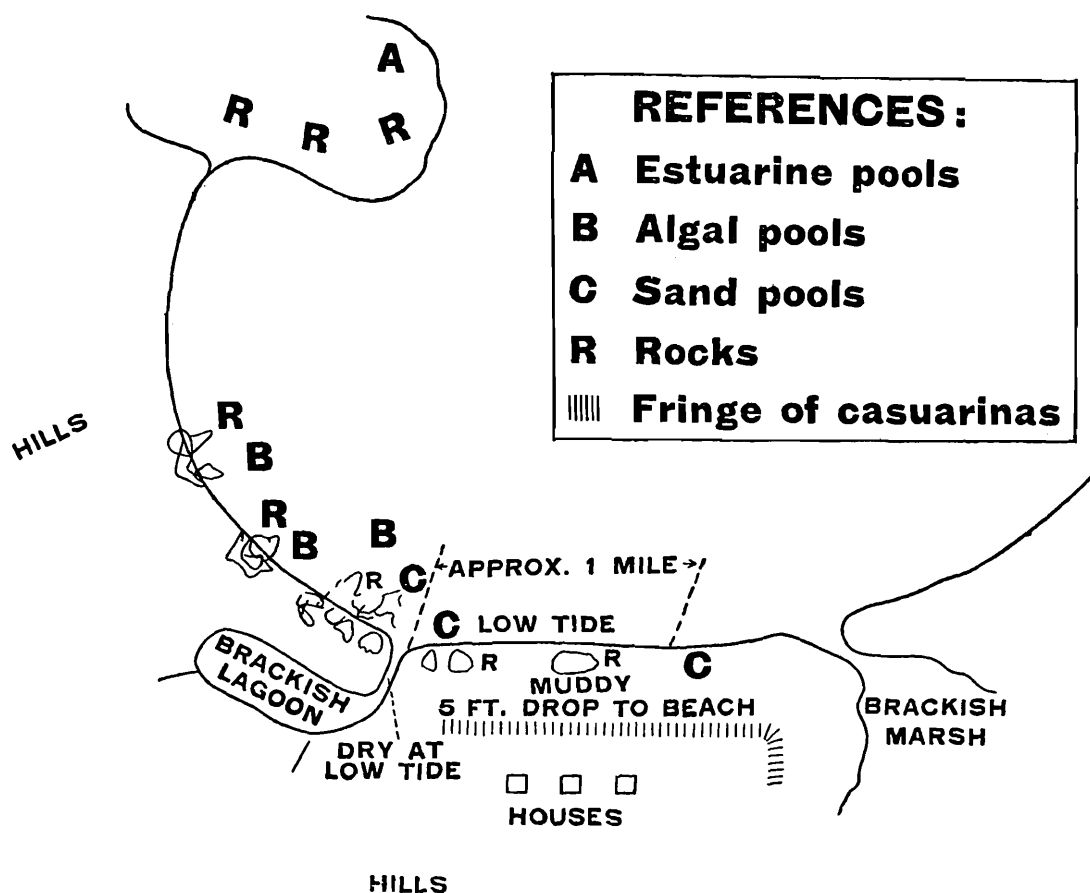
¹ Maungmagan (14.5 N. and 97.50 E.) is a village on the Tavoy coast north-west of Tavoy; it has a fine sandy beach and is a popular resort for sea-bathing. In its neighbourhood there are several sandy pools, rock pools and estuarine pools.

Some of the determined material was sent to Professor Meggitt with a request to indicate the precise localities in which the species were found, but as the European forms had been sent to the British Museum for verification of our determinations they could not be included in the consignment. However, we directed Professor Meggitt's attention to the presence of certain European species in his collection from Maungmagan.

Professor Meggitt kindly arranged the species of which specimens were sent to him according to their habitats (*vide* list on p. 21) and with regard to the European species remarked:—

"I have no knowledge of having imported *Trachinus* or *Lophius* from Europe, in fact I think it extremely unlikely, nor have I had any in my private collection. About *Ammodytes* I could not be so certain. If you found the fish in a jar with a label¹ Maungmagan you may take it as certain that I personally collected it there: otherwise I should assume for safety, it is an intrusion.....I am personally of the opinion that the 3 specimens you mention (*Ammodytes*, *Trachinus*, *Lophius*) have been obtained locally as I do not see how we could have them otherwise, but in the absence of definite evidence I naturally do not wish to put this on record as a statement."

MOSCOS ISLES APPROX. 5 MILES OUT



TEXT-FIG. 1.—Diagrammatic representation of the coast at Maungmagan, Tavoy District, Burma.

On hearing from Mr. J. R. Norman about the correctness of our determinations of the European species, a request was made to Professor

¹ The fish was found in a jar along with other fish and was labelled "Maungmagan". We were not dealing with any European material at the time nor were any of these species represented in the Indian Museum collection, so there was no possibility of mixing up European forms with the material from Maungmagan.

Meggitt to have further material of these forms collected so as to remove all possible chances of error. To this Professor Meggitt replied as follows :—

“ I am sorry to be of so little use in the matter. I can only say I have no recollection, nor can find any record, of having obtained European fishes.

“ On looking up the figures, I appear to recollect collecting the blenny (*Blennius pholis*) and *Cottus* (*C. bubalis*) but cannot be certain.

“ I am writing to Tavoy to ask if further material can be sent to you, this may clear up the point. But please do not be optimistic, as there are no zoologists there.”

In March 1935, more fishes (*vide* list on p. 20) were received from Tavoy without any label and on referring the matter to Professor Meggitt he wrote :—

“ The fish you just received represents all which will be sent prior to October, during this last month, if all goes well, a collection of larger fish will be made and sent you. For some reason which I do not know, my collector assures me that it is now possible to obtain only small fish.”

This collection contains mostly small coral fishes and it is significant that only three species, *viz.*, *Terapon jarbua*, *Sillago sihama* and *Salarias dussumieri*, are common to the above lots from Maungmagan. This suggests a marked ecological segregation in the habitats of the species represented in the two collections made at different times of the year.

A new species of *Salarias* (Blenniidae) is represented in the second collection, while we have not yet been able to determine two specimens belonging to the family Platycephalidae. These are included in the list as *Platycephalus* (*s. l.*) spp. and will be dealt with later in the revision of the Indian members of this family. The range of *Chromis ternatensis* (Bleeker) has been extended from the East Indies and the Philippines and of *Pomacentrus taeniurus* Bleeker from the East Indies, Australia and Japan to Tavoy. The occurrence of *Pomacentrus notophthalmus* Bleeker and *Caranx auricoronae* Chaudhuri at Maungmagan deserves special notice.

As no further collection is expected from Professor Meggitt for some time, we take this opportunity to publish descriptions of the new species and notes on forms that need special comments. The species contained in the two collections are listed below for convenience of reference.

We offer to Professor Meggitt our warmest thanks for making collections of fishes and presenting the same to the Zoological Survey of India. The material is in a very good state of preservation and Professor Meggitt's notes have been very helpful in understanding the ecology of some of the species. To Dr. Baini Prashad, Director, Zoological Survey of India, we are indebted for reading the manuscript and for help in connection with the photographs of fishes. Babu D. N. Bagchi, Babu S. C. Mondul and Babu R. C. Bagchi, the artists of the Zoological Survey of India, have executed the drawings with their usual skill and care and we record here our thanks to them,

List of Fishes collected at Rangoon.

	No. of specimens.
Cyprinidae :	
<i>Rasbora daniconius</i> (Hamilton) 1822	1
<i>Barbus sophore</i> (Hamilton) 1822	2
<i>Rohtee duvaucelii</i> (Cuv. & Val.) 1844	1
<i>Rohtee belangeri</i> (Cuv. & Val.) 1844	1
Bagridae :	
<i>Mystus gulio</i> (Hamilton) 1822	2
Pangasidae :	
<i>Pangasius pangasius</i> (Hamilton) 1822	1
Ambassidae :	
<i>Ambassis nama</i> (Hamilton) 1822	2
Sciaenidae :	
<i>Sciaena cuja</i> (Hamilton) 1822	2
Sparidae :	
<i>Sparus datnia</i> (Hamilton) 1822	1
Anabantidae :	
<i>Colisa fasciatus</i> (Bl. & Schn.) 1801	2
Ophicephalidae :	
<i>Ophicephalus striatus</i> Bloch 1793	1
Notopteridae :	
<i>Notopterus notopterus</i> (Pallas) 1769	1
Platycephalidae :	
<i>Platycephalus indicus</i> (Linn.) 1766	1
Mastacembelidae :	
<i>Mastacembelus zebrinus</i> Blyth 1859	1

List of Fishes collected at Maungmagan during October, 1933.

	No. of specimens.
Rhinobatidae :	
<i>Rhinobatus granulatus</i> Schn. 1801	1
Dasybatidae :	
<i>Dasybatus zugei</i> (Müll. & Henle) 1841	1
Clupeidae :	
<i>Pellona</i> sp. juv.	2
Dussumieriidae :	
<i>Dussumieria hasselti</i> Bleeker 1851	33
Engraulidae :	
<i>Engraulis dussumieri</i> Cuv. & Val. 1848	19
Lactariidae :	
<i>Lactarius lactarius</i> (Bl. & Schn.) 1801	4
Chirocentridae :	
<i>Chirocentrus dorab</i> (Forskål) 1775	1
Ariidae :	
<i>Arius arius</i> (Hamilton) 1822	2
Hemirhamphidae :	
<i>Hemirhamphus limbatus</i> Cuv. & Val. 1846	3
Cyprinodontidae :	
<i>Panchax panchax</i> (Hamilton) 1822	5
Syngnathidae :	
<i>Hippocampus histrix</i> Kaup 1856	1
<i>Nannocampichthys gigas</i> , gen. et sp. nov.	1

List of Fishes collected at Maungmagan during October, 1933—contd.

	No. of specimens.
Ambassidae :	
<i>Ambassis numa</i> (Hamilton) 1822	4
Terapontidae :	
<i>Terapon jarbua</i> (Forskål) 1775	2
Sillaginidae :	
<i>Sillago sihama</i> (Forskål) 1775	6
Carangidae :	
<i>Megalaspis cordyla</i> (Linn.) 1758	5
<i>Caranx</i> (<i>Carangoides</i>) <i>armatus</i> (Forskål) 1775	2
<i>Caranx</i> (<i>Carangoides</i>) <i>auricoronae</i> Chaudhuri 1909	1
<i>Caranx</i> (<i>Caranx</i>) <i>carangus</i> Bloch 1793	2
<i>Alectis indica</i> (Rüppell) 1828	8
<i>Trachinotus blochi</i> (Lacépède) 1802	1
Leiognathidae :	
<i>Leiognathus insidiator</i> (Bloch) 1787	12
Gerridae :	
<i>Gerres lucidus</i> Cuv. & Val. 1830	9
Ammodytidae :	
<i>Ammodytes lanceolatus</i> Le Sauvage 1825	1
Mullidae :	
<i>Upeneus</i> sp. juv.	10
Gobiidae :	
<i>Gobius ornatus</i> Rüppell 1828	3
<i>Ctenogobius meggitti</i> , sp. nov.	32
<i>Pseudapocryptes lanceolatus</i> (Bl. & Schn.) 1801	3
Blenniidae :	
<i>Blennius semifasciatus</i> Rüppell 1835	3
<i>Blennius pholis</i> Linn. 1766	1
<i>Petroscirtes punctatus</i> (Cav. & Val.) 1836	7
<i>Salarias dussumieri</i> Cuv. & Val. 1837	2
Stromateidae :	
<i>Psenopsis anomala</i> (T. & S.) 1850	1
Mugilidae :	
<i>Mugil vaiyaiensis</i> (Q. & G.) 1824	13
Polynemidae :	
<i>Polynemus plebius</i> Broussonet 1782	2
<i>Polynemus sexfilis</i> Cuv. & Val. 1831	9
Trachinidae :	
<i>Trachinus draco</i> Linn. 1766	1
Cottidae :	
<i>Cottus bubalis</i> Euphr. 1786	1
Toxotidae :	
<i>Toxotes chatareus</i> (Forskål) 1775	1
Platacidae :	
<i>Platax teira</i> (Forskål) 1775	3
Drepanidae :	
<i>Drepane punctata</i> (Linn.) 1758	6
Lophiidae :	
<i>Lophius piscatorius</i> Linn. 1766	1
Triacanthidae :	
<i>Triacanthus brevirostris</i> T. & S. 1850	4
Tetraodontidae :	
<i>Sphoeroides oblongus</i> (Bloch) 1785	9

List of Fishes collected at Maungmagan during January, 1935.

	No. of specimens.
Clupeidae :	
<i>Stolephorus indicus</i> (Van Hasselt) 1823	Several
Plotosidae :	
<i>Plotosus anguillaris</i> Bloch 1794	Several
Ophichthyidae :	
<i>Pisoodonophis boro</i> (Hamilton) 1822	1
Serranidae :	
<i>Serranus undulosus</i> (Q. & G.) 1824	4
<i>Serranus summana</i> (Forskål) 1775	2
Teraponidae :	
<i>Terapon jarbua</i> (Forskål) 1775	7
Amiidae :	
<i>Amia fraenata</i> (Val.) 1832	3
Pomadisidae :	
<i>Diagrama crassispinum</i> Rüppell 1838	2
Lutjanidae :	
<i>Lutjanus lineolatus</i> (Rüppell) 1838	5
Sillaginidae :	
<i>Sillago sihama</i> (Forskål) 1775	3
Carangidae :	
<i>Caranx (Caranx) sexfasciatus</i> Q. & G. 1824	7
<i>Caranx (Selar) boops</i> Cuv. & Val. 1833	2
Leiognathidae :	
<i>Leiognathus blochi</i> (Cuv. & Val.) 1835	5
<i>Leiognathus insidiatrix</i> (Bloch) 1787	1
Lethrinidae :	
<i>Lethrinus nebulosus</i> (Forskål) 1775	7
Pomacentridae :	
<i>Amphiprion percula</i> (Lacépède) 1802	2
<i>Abudefduf bengalensis</i> (Bloch) 1787	1
<i>Abudefduf biocellatus</i> (Q. & G.) 1825	Several
<i>Pomacentrus littoralis</i> Cuv. 1830	Several
<i>Pomacentrus taeniurus</i> Bleeker 1856	5
<i>Pomacentrus ? notoptthalmus</i> Bleeker 1853	3
<i>Chromis ternatensis</i> (Bleeker) 1856	1
Teuthidae :	
<i>Teuthis oramin</i> (Bl. & Schn.) 1801	1
Scombridae :	
<i>Scomber microlepidotus</i> Rüppell 1835	5
Gobiidae :	
<i>Ctenogobius meggitti</i> , sp. nov.	Several
Blenniidae :	
<i>Salarias vermiculatus</i> Cuv. & Val. 1837	2
<i>Salarias dussumieri</i> Cuv. & Val. 1837	1
<i>Salarias rivulatus</i> Rüppell 1828	1
<i>Salarias burmanicus</i> , sp. nov.	1
Atherinidae :	
<i>Atherina forskali</i> Rüppell 1838	Several
Scorpaenidae :	
<i>Scorpaenopsis venosa</i> (Cuv. & Val.) 1840	4
Platycephalidae :	
<i>Platycephalus (s. l.)</i> spp.	2
Soleidae :	
<i>Paraplagusia blochi</i> (Bleeker) 1851	1
<i>Pseudorhombus triocellatus</i> (Bl. & Schn.) 1801	2

*Ecological Associations of certain species of fish collected at Maungmagan during October, 1933.**Sand Pools :*

Panchax panchax (Hamilton).
Sphoeroides oblongus (Bloch).
Hemirhamphus limbatus Cuv. & Val.

Rock Pools :

Panchax panchax (Hamilton).
Mugil vaigiensis (Q. & G.) Juv.
Pseudapocryptes lanceolatus (Bl. & Sehn.).
Pellona, sp. juv.
Blennius semifasciatus Rüppell.

Estuarine Pools :

Polynemus sexfilis Cuv. & Val.
Pellona, sp. juv.

Open sea between mainland and Moskos Island :

Mugil vaigiensis (Q. & G.).
Alectis indicus (Rüppell).
Caranx armatus (Linn.).
Platax teira (Forskål).
Toxotes chatareus (Forskål).
Drepane punctata (Linn.).
Sillago sihama (Forskål).
Upenoides, sp. juv.
Lactarius lactarius (Bl. & Schn.).
Chirocentrus dorab (Forskål).
Triacanthus brevirostris T. & S.
Arius arius (Hamilton).

RHINOBATIDAE.

***Rhinobatus granulatus* Cuvier.**

(Plate II, fig. 1.)

1913. *Rhinobatus granulatus*, Garman, *Mem. Mus. Comp. Zool. Harvard College*, XXXVI, p. 272.

There is a young specimen of *Rhinobatus granulatus* about 12½ inches in length in Professor Meggitt's collection from Maungmagan. The usual colour of the species is "Greenish gray ; lower surfaces, and sides of snout, white." In the young specimens almost the whole of the snout is whitish and the edges of the body including the outer margin of the fins are of a lighter colour. The dorsal surface is light gray while the ventral surface is of a dull pink colour.

R. granulatus is found off the coasts of India.

SYNGNATHIDAE.

***Hippocampus histrix* Kaup.**

1922. *Hippocampus histrix*, Weber and de Beaufort, *Fish. Indo-Austral. Archipel.*, IV, pp. 109, 110.

1928. *Hippocampus histrix*, Fowler, *Mem. Bernice P. Bishop Mus.*, X, p. 115.

In Professor Meggitt's collection *Hippocampus histrix* is represented by a single, weather-beaten specimen taken at Maungmagan. The snout is straight and almost twice in the length of the head. The eyes are situated in the middle of the head and their diameter is contained a little less than 7 times in the length of the head. As usual, the coronet is provided with a cluster of 4 spines. The opercula have indistinct radiating ridges. The two spines on the occipital keel behind the coronet are not well defined.

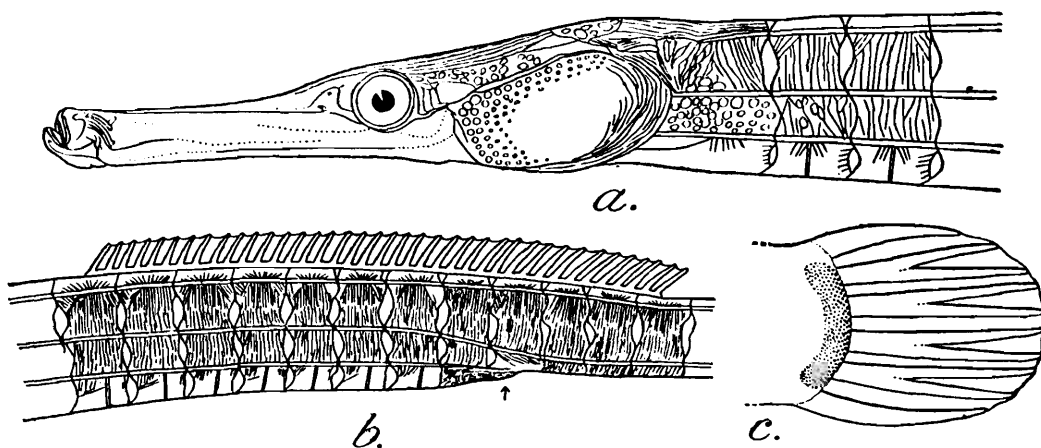
The colouration of the specimen is uniformly light brown. The characteristic dark transverse lines on the snout are not discernible.

Hippocampus histrix is widely distributed in the Indian and Pacific Oceans.

Nannocampichthys, gen. nov.

The genus *Nannocampichthys* is proposed in the family Syngnathidae and may be defined as follows :—

It comprises long and narrow fishes in which the body is smooth ; the ridges, though not very prominent, are fairly well defined. The shields are finely striated transversely, but the striae gradually become indistinct posteriorly and vanish altogether after the 8th shield behind the vent. The operculum is devoid of any prominent ridge but is finely pitted or ridged in the peripheral region. The snout is long and slender ; it is much longer than the remaining part of the head and its ventral profile almost forms a straight line with the ventral profile of the head. The snout is marked with a few low, sharp ridges on the dorsal surface, otherwise it is entirely smooth. The dorsal profile of the head is horizontal anteriorly but from a short distance in front of the eyes it rises gradually to the occiput. The eyes are dorso-lateral in position and are situated entirely in the posterior half of the head. The occipital and nuchal shields are only faintly indicated. The supra-orbital ridge is not well marked. The superior cristae of the trunk and tail are continuous. The median cristae of the trunk are continuous with the inferior cristae of the tail. The inferior cristae of the trunk become obsolete slightly in front of the anal opening. The intermedial shields or scutellae are fairly well marked ; they are more developed in the tail region and are faintly marked in the trunk region. The tail is considerably longer than the trunk. The dorsal fin is placed on an elevated ridge and con-



TEXT-FIG. 2.—*Nannocampichthys gigas*, gen. et sp. nov.

a. Lateral view of head and anterior part of body. $\times 1\frac{1}{2}$.

b. Lateral view of body below dorsal fin, showing position of anus and nature of cristae. Nat. Size.

c. Caudal fin. $\times 14$.

tains 39 rays ; it extends over 12 rings of the body (8 trunk+1 anal+3 caudal). The anal and the pectoral fins are absent. The caudal fin is very small but distinct. The characters of the brood-pouch and the eggs are not known.

Genotype.—*Nannocampichthys gigas*, gen. et sp. nov.

Locality.—Maungmagan, Tavoy District, Burma. Professor Meggitt informs us that “The large pipe fish was obtained from a fishing boat, i.e., was probably caught between the Moscos Islands and the mainland.”

Remarks.—There are several remarkable features of the genus *Nannocampichthys*¹ and we have not succeeded in tracing its close allies from among the genera known to us in the family. If the absence of the pectoral fins is taken into consideration, there are two other genera, *Penetopteryx* and *Nannocampus*, known from the Indian and Indo-Australian regions in which these fins are absent. *Penetopteryx* is further characterised by the absence of the dorsal fin, while *Nannocampus* is insufficiently known and its species are mostly small and ill-defined. So far as is known, in *Nannocampus* the body is short, the snout is usually of the size of the diameter of the eye, the dorsal fin is short and the inferior cristae of the trunk and the tail are continuous. There are two other genera, *Entelurus* and *Nerophis*, in which the pectoral fins are absent and the positions of the various cristae correspond with those described for *Nannocampichthys*. In *Entelurus* the shields are covered with skin and there are adipose folds of skin both along the dorsal and the ventral surfaces; while *Nerophis* has a smooth and rounded body with indistinct ridges, and is mostly confined to the Atlantic Ocean and the coasts of Europe.

***Nannocampichthys gigas*, sp. nov.**

D. 39; C. 6; Rings 28+63-64; sub-dorsal rings 3+9.

Most of the specific characters of *Nannocampichthys gigas*² have been included in the description of the genus.

The length of the trunk is contained 1.18 times in the length of the tail. The length of the head is contained 11.5 times and the depth of the body 32.8 times in the total length of the fish. The snout is long and slender; it is contained 1.9 times in the length of the head. The diameter of the eye is contained 9.5 times in the length of the head and 5 times in the length of the snout. The caudal fin is only half as long as the diameter of the eye. The anal opening is situated in a shallow depression and the folds of skin in front of it are studded with fine papillae.

The specimen is uniformly pale-brown. The rays of the dorsal fin are somewhat deeper in colour and at the base of each ray there is a black spot.

The species is known from a single specimen, 443 mm. in total length.

Type-specimen.—F. 11870/1, Zoological Survey of India (Ind. Mus.), Calcutta.

¹ The name *Nannocampichthys* is employed to indicate the absence of pectoral fins which this genus shares with *Nannocampus*, an Indo-Australian genus; it should not, however, be interpreted to indicate any close affinity between the two genera.

² The specific name *gigas* has been proposed to indicate the very large size of the unique specimen.

Measurements in millimetres.

Total length	443.0
Length of trunk (tip of snout to vent)	203.0
Length of tail	240.0
Length of head	38.0
Depth of body	13.5
Length of snout	20.0
Diameter of eye	4.0
Length of caudal fin	2.0
Length of base of dorsal	56.0

CARANGIDAE.

***Alectis indica* (Rüpp.).**

1931. *Alectis indica*, Weber & de Beaufort, *Fish. Indo-Austral. Archipel.*, VI, pp. 271, 272, fig. 53.

Alectis indica is represented in Professor Meggitt's collection from Maungmagan by 8 half-grown specimens varying from 65 to 75 mm. in length excluding the caudal fin. The specimens are well preserved and closely agree with Weber & Beaufort's description of the species.

In addition to the 6 small and slender predorsal spines, there is, in some specimens, a very fine procumbent spine inserted in front of the first spine. Two pre-anal spines are present. The straight part of the lateral line, that is, the portion below and behind the 10th dorsal ray is destitute of distinct keels, and of scutes in the region of the caudal peduncle. Apparently these characters begin to develop at a much later stage of growth of the fish. The prolongations of the two outer rays of the ventrals extend beyond the caudal. The filiform terminations of the dorsal, anal and ventrals are black in colour.

Alectis indica is very widely distributed in the tropical and sub-tropical parts of the Indo-Pacific region.

***Caranx (Caranx) carangus* Bloch.**

1931. *Caranx (Caranx) carangus*, Weber & de Beaufort, *Fish. Indo-Austral. Archipel.*, VI, pp. 257, 258.

In the collection under report this species is represented by two well preserved specimens, taken at Maungmagan; they are 97 and 105 mm. long excluding the caudal fin.

The head is somewhat higher than long. In grown-up specimens the snout is almost equal to the diameter of the eye, while in immature examples it is slightly shorter. The maxillaries extend as far as the centre of the eye. One or two teeth near the symphysis are caniniform. The squamation is rather indistinct. The keeled scutes of the straight part of the lateral line are broadest in the middle. The anterior rays of the dorsal as also of the anal are long and form a falciform lobe. Usually the falciform pectorals are much longer than the head but in some specimens they may be almost equal in length. The ventrals are half as long as the head; they extend beyond the vent and just reach the anal fin.

The colouration of the specimens is darker above with a golden sheen, and is silvery below. There are faint indications of four broad, dark, complete vertical bands. A dark opercular patch is present. The margin of the second dorsal and the inner edge of the caudal are blackish.

As already indicated by Weber & Beaufort, *Caranx carangus* is a very widely distributed species.

***Caranx (Carangoides) armatus* (Forskål).**

1931. *Caranx (Carangoides) armatus*, Weber & de Beaufort, *Fish. Indo-Austral Archipel.*, VI, pp. 233-235.

Caranx armatus is represented in the collection from Maungmagan by two specimens, about 105 mm. long excluding the caudal fin.

The snout is somewhat shorter than the diameter of the eye. The interorbital space is almost equal to the length of the snout. The maxillaries reach to almost below the centre of the eye. The anterior rays of the dorsal and of the anal form elevated falcate lobes; those of the former are considerably prolonged and when adpressed almost reach the middle of the caudal fin.

The colouration in alcohol is dark greyish above and silvery below. The opercular spot is very faint. The spinous dorsal, the produced rays of the second dorsal, the ventrals and the inner edge of caudal are black.

Weber & Beaufort have already remarked on the very wide distribution of *C. armatus*.

***Caranx (Carangoides) auricoronae* Chaudhuri.**

1907. *Caranx auricoronae*, Chaudhuri, *Rec. Ind. Mus.*, III, p. 142, fig. 2.

Caranx auricoronae was described by Chaudhuri from two examples, 1 male and 1 female, caught by the steam trawler "Golden Crown" off the coast of Chittagong. There is a single, half-grown, female specimen about 95 mm. in total length in Professor Meggitt's collection from Maungmagan. Except for slight variations in proportions, the specimen agrees with the typical examples of the species.

C. auricoronae has so far been found only in the Bay of Bengal.

GERRIDAE.

***Gerres lucidus* Cuvier.**

1875. *Gerres lucidus*, Day, *Fish. India*, p. 99, pl. xxv, fig. 5.

1933. *Gerres lucidus*, Fowler, *Bull. U. S. Nat. Mus.*, XII, No. 100, p. 229, fig. 13.

Gerres lucidus is represented by 9 specimens in Professor Meggitt's collection from Maungmagan. The vertical, narrow, colour bands are more marked in the young specimens though they are fairly distinct in specimens up to 112 mm. in total length. The membrane near the tip of each dorsal spine is deeply coloured. In every other respect the specimens under report agree with Fowler's description of the species.

Gerres lucidus is the most common Indian species of the genus, and, as stated by Day, visits the coasts in enormous numbers. Its range extends from the seas of India to the Malay Archipelago and China.

Family AMMODYTIDAE.

Ammodytes lanceolatus Le Sauvage.

(Plate II, fig. 4.)

1880-1884. *Ammodytes lanceolatus*, Day, *Fish. Great Brit. & Ireland*, I, p. 329, pl. xcii, fig. 1.

Professor Meggitt collected a single specimen of *Ammodytes lanceolatus*, about $13\frac{1}{2}$ inches in length from Maungmagan. The specimen is a gravid female with ripe eggs. The longitudinal and oblique transverse folds on the body are well marked; the number of transverse folds being approximately 183. The colour is dark brown above and pale below.

Day gives the habitat of the species as follows: "from the Atlantic shores of northern Europe and coasts of the German Ocean, and very rarely found in the Mediterranean." In view of the above distribution the discovery of the species in Burmese waters is of special interest. We have compared the Burmese specimen with examples of *A. lanceolatus* obtained from Dr. Oscar Sund of the Norwegian Fisheries. Mr. J. R. Norman of the British Museum has also confirmed our identification.

The genus *Ammodytes* is known to occur in Indian waters, though only a single specimen of the Madras species—*A. kallelepis* (Günther)¹—is known so far. Probably on geographical grounds Günther proposed the genus *Bleekeria* for the Madras species. Jordan² remarked that "In the tropical genera there is a much smaller number of vertebrae and the body is covered with ordinary scales instead of delicate, oblique cross-folds of skin. These tropical species must probably be detached from the Ammodytidae to form a distinct family, Blekeriidae." The occurrence of the typically European *A. lanceolatus* in the Indian waters shows that the tropical waters are not inimical to the Ammodytidae.

Though *Ammodytes* is essentially a genus of the northern Pacific and Atlantic, one species is known from India (*op. cit.*), and another from South Africa.³

Family POMACENTRIDAE.

Abudefduf biocellatus (Quoy & Gaimard).1877. *Glyphidodon antjerius*, Day, *Fish. India*, p. 387, pl. lxxxi, figs. 4 and 5.1928. *Abudefduf biocellatus*, Fowler, *Bull. U. S. Nat. Mus.*, VII, No. 100, p. 166.

There is a fine series of 20 well preserved specimens of *Abudefduf biocellatus* from Maungmagan. The dorsal surface is considerably lighter. The pectoral fins are white, the ventrals black and the vertical fins deep gray. There is a prominent, backwardly inclined, oval, dark mark at the bases of the posterior dorsal rays. The upper lobe of the caudal fin is longer and better developed than the lower.

¹ Günther, *Cat. Fish. Brit. Mus.*, IV, p. 387 (1862).² Jordan, *Guide to the Study of Fishes*, II, p. 521 (1905); *Classification of Fishes*, p. 230 (1923).³ Barnard, A Monograph of the Marine Fishes of South Africa, Part II, *Ann. South African Mus.*, XXI, p. 430 (1927).

In the collection of the Zoological Survey of India there are specimens in which two black blotches are present on the posterior rays of the dorsal fin.

A. biocellatus is widely distributed in the Indo-Pacific region.

***Abudefduf bengalensis* (Bloch).**

1877. *Glyphidodon bengalensis*, Day, *Fish. India*, p. 387.

1928. *Abudefduf bengalensis*, Fowler, *Bull. U. S. Nat. Mus.*, VII, No. 100, p. 128.

Abudefduf bengalensis is represented by a single specimen in Professor Meggitt's second collection from Maungmagan. The colour bands are much narrower than the interspaces between them. As pointed out by Fowler, Day's illustration of this species (pl. lxxxiii, fig. 3) is either highly inaccurate or is that of another species. A specimen purchased from Day and now preserved in the collection of the Zoological Survey of India, however, is correctly identified and shows the characteristic colour marking.

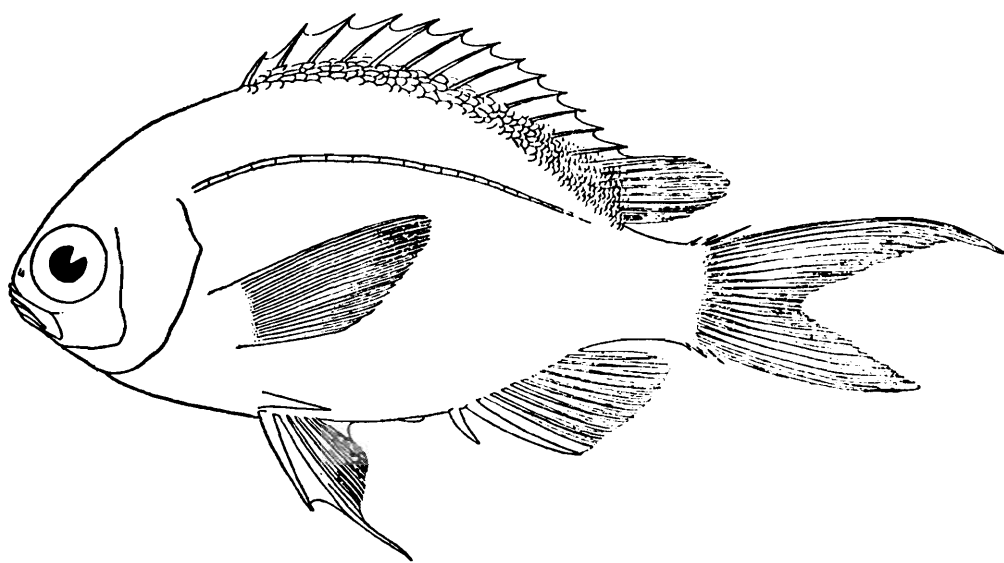
A. bengalensis is found in the Red Sea, Mozambique, India, East Indies and China.

***Chromis ternatensis* (Bleeker).**

1877. *Chromis ternatensis*, Bleeker, *Atlas Ich. Ind. Néerl.*, IX, pl. cccliii (4), fig. 4.

1928. *Chromis ternatensis*, Fowler, *Bull. U. S. Nat. Mus.*, VII, No. 100, p. 31.

Chromis ternatensis is represented by a single specimen, about 90 mm. in total length, in Professor Meggitt's second collection from Maungmagan. It agrees fairly closely with Bleeker's figure and Fowler's description of the species. According to Fowler "The obtuse head and strongly ovoid contour of this species are quite distinctive. It is one of the most compact in form of the genus, or in fact of the family. The



TEXT-FIG. 3.—Lateral view of a specimen of *Chromis ternatensis* (Bleeker) from Maungmagan. $\times 1\frac{1}{8}$.

black bordered caudal and pale paired fins will distinguish it from the related species." In the Burmese example the black border of the caudal

fin is diffuse but fairly well defined. The outer rays of the upperlobe of the caudal fin and the first ray of the ventrals are greatly produced. Attention may also be directed to the precaudal spines which form a very characteristic feature of the species. In front of the caudal fin, both above and below, there is a series of three spines of varying lengths, the last one being the longest.

C. ternatensis has hitherto been found in the East Indies and the Philippines, and is recorded here from the Burmese waters for the first time.

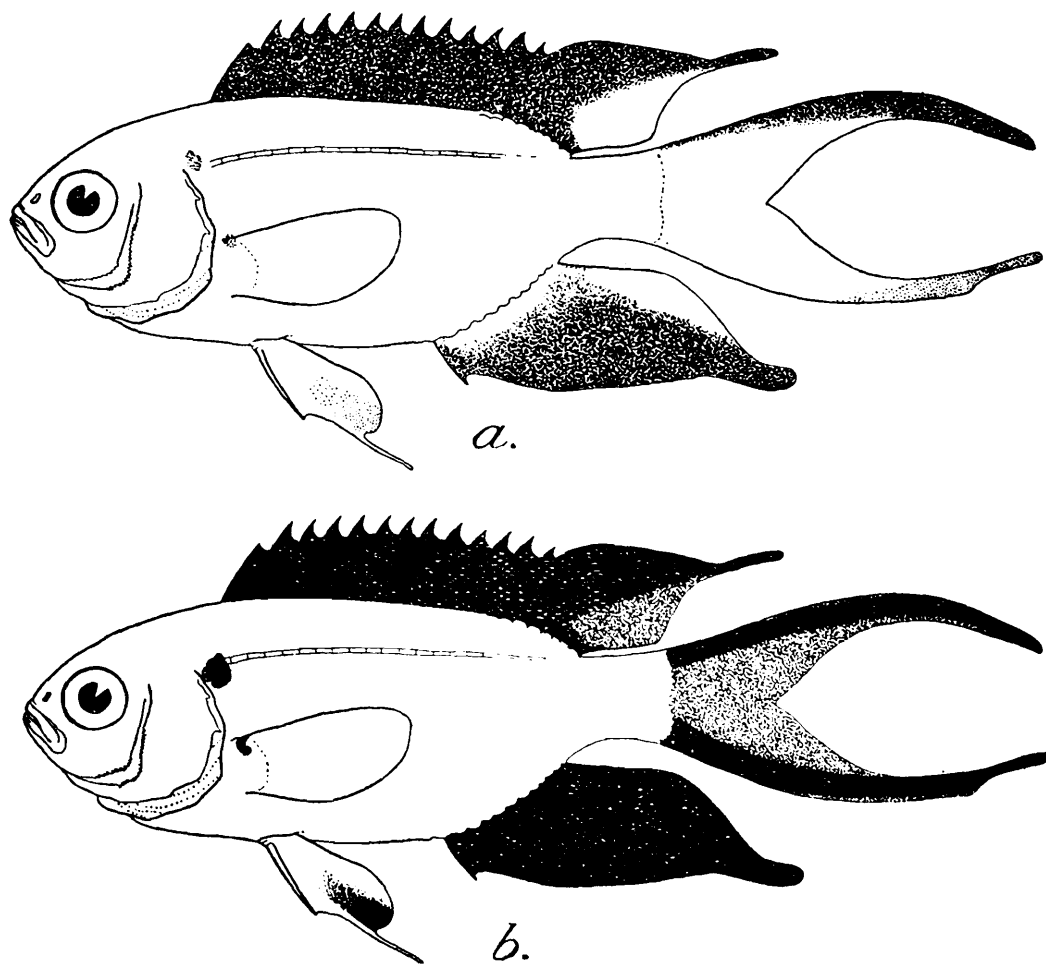
***Pomacentrus taeniurus* Bleeker.**

1877. *Pomacentrus taeniurus*, Bleeker, *Atlas Ich. Ind. Néerl.*, IX, pl. ccccviii (9), fig. 2.

1877. *Pomacentrus cyanomos*, Bleeker, *Atlas Ich. Ind. Néerl.*, IX, pl. ccccviii (9), fig. 3.

1928. *Pomacentrus taeniurus*, Fowler, *Bull. U. S. Nat. Mus.*, VII, No. 100, p. 72.

Pomacentrus taeniurus is represented by five examples, ranging in length from 54 to 68 mm. in total length (including the filamentous rays of the caudal fin), in Professor Meggitt's second collection from



TEXT-FIG. 4.—Colour variation in two specimens of *Pomacentrus taeniurus* Bleeker from Maungmagan. $\times 1\frac{1}{2}$.

a. Abnormal specimen ; b. Normal specimen.

Maungmagan. Except for one specimen, the colouration of the other examples agrees with Bleeker's figure and Fowler's description. In

the exceptional specimen, the whitish blotch on the last dorsal rays is more extensive, while a similar, but narrower, blotch is also present on the last rays of the anal fin. The upper dark border of the caudal fin is very narrow and almost indistinct near the base, while the lower border is restricted to the filamentous portion of the prolonged rays. The distal half of the caudal peduncle and a greater part of the caudal fin is white. The general colour of the body is also lighter than that of the other specimens.

P. taeniurus has hitherto been known from the East Indies, Australia and Japan, and is recorded here from the Burmese waters for the first time.

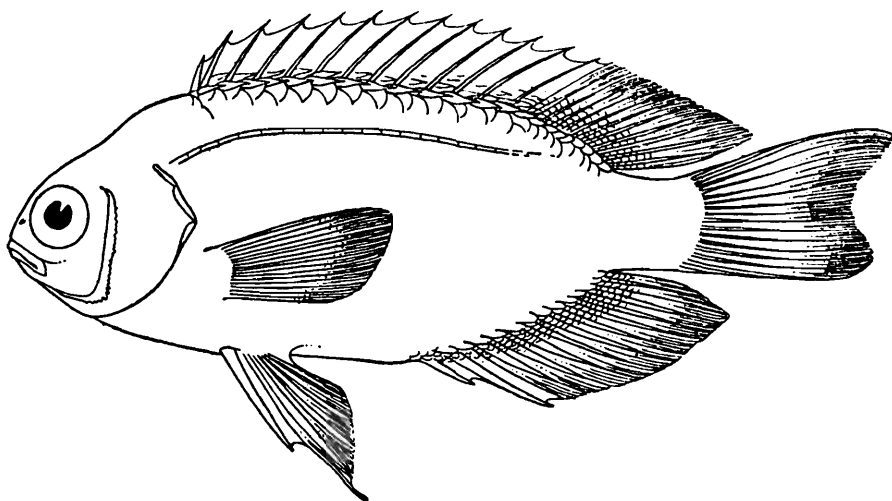
***Pomacentrus ? notophthalmus* (Bleeker).**

(Plate I, fig. 7.)

1877. *Dischistodus notophthalmus*, Bleeker, *Atlas Ich. Ind. Néerl.*, IX, pl. cccci (2), fig. 4.

1928. *Pomacentrus notophthalmus*, Fowler, *Bull. U. S. Nat. Mus.*, VII, No. 100, p. 107.

There are three specimens in Professor Meggitt's second collection from Maungmagan which we refer to *Pomacentrus notophthalmus* Bleeker with some hesitation. According to Fowler's description, it is a "very handsome species, showing a fairly constant design in the white blotches on the head. These, together with its other combinations, especially in the large deep brown blotch at the vent, will easily distinguish the species." In the specimens before us the white blotches on the head are faintly marked and there is no deep brown blotch at the vent. The general colour is deep gray, somewhat lighter on the ventral surface. The pectoral and ventral fins are white whereas the dorsal and anal fins are black. The caudal peduncle and the caudal fin are pinkish white with the distal end of the lower lobe of the caudal fin dusky.



TEXT-FIG. 5.—Lateral view of a specimen of *Pomacentrus? notophthalmus* (Bleeker) from Maungmagan. $\times 1\frac{1}{2}$.

There is a black, vertical, oval spot at the upper corner of the operculum. The upper lobe of the caudal fin is longer and better developed than the lower. Our figures show some of the salient features of the Burmese examples.

It may be mentioned that Bleeker's illustration of *Dischistodus notophthalmus* on plate 402, fig. 4 appears to represent a different form and not this species. The colour markings are very different in the two illustrations reproduced under the same specific name by Bleeker.

P. notophthalmus has so far been recorded from Ceylon and the East Indies.

Family GOBIIDAE.

Gobius ornatus Rüppell.

1927. *Gobius ornatus*, Herre, *Monograph Bur. Sci. Manila*, No. 23, p. 108, pl. vii, fig. 4.

1928. *Gobius ornatus*, Fowler, *Journ. Bombay Nat. Hist. Soc.*, XXXIII, p. 118.

Gobius ornatus, which is represented by a single specimen in Professor Meggitt's collection from Maungmagan, is readily distinguished by its characteristic colouration.

Day¹ pointed out that, according to Bleeker's system of classification, *G. ornatus* should be included in the genus *Acentrogobius*, but this genus is so closely allied to *Gobius* that it has not been possible to evaluate the differentiating characters of the two genera in the case of *G. ornatus*. Koumans² has stated that in *Acentrogobius* the outer row of teeth in the mandible "extends only to half of the jaw, the last teeth are recurved canines; in both jaws some caninoid teeth larger than the rest." In *G. ornatus* there are enlarged teeth in both the jaws, but even an examination under a microscope has not revealed the presence of recurved canines in the mandible.

Gobius ornatus was originally described from the Red Sea; its range is now known to extend as far east as the Malay Archipelago and the Philippine Islands.

Ctenogobius meggitti, sp. nov.

(Plate I, figs. 3-4.)

D. VI, 1/6-9; V. 5; A. 1/8; P. 14+silken rays; C. 14; L. 1. 42-44; L. tr. 13.

Ctenogobius meggitti is a small, well-built species in which the body is greatly compressed, especially in the tail region and the head is markedly depressed. The dorsal profile behind the eyes is almost straight and horizontal, while the ventral profile is slightly arched. The head is broadly pointed; its length is contained from 4 to 4.3 times in the total length and from 3.2 to 3.4 times in the length without the caudal fin. The width of the head is contained 1.1 times and the height of the head at the occiput from 1.3 to 1.5 times in its length. The eyes are situated entirely in the anterior half of the head and are dorso-lateral in position; the diameter of the eye is contained from 3.2 to 3.8 times in the length of the head. The snout is usually shorter than or equal to the diameter of the eye. The bony interorbital is about $\frac{1}{3}$ the diameter of the eye and in young specimens it is still

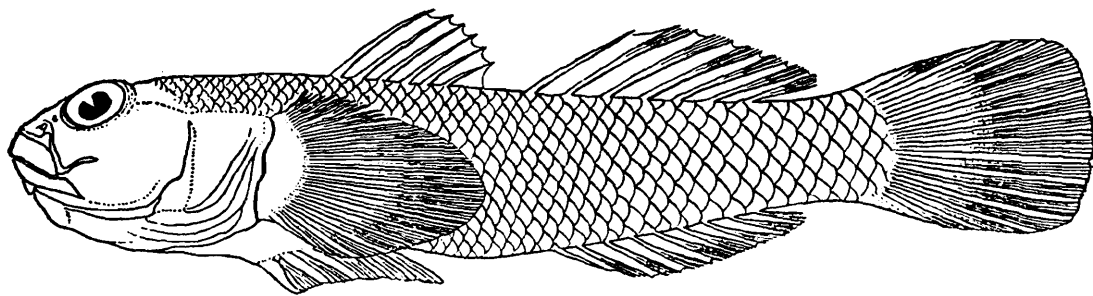
¹ Day, *Fish. India*, p. 294, (1876).

² Koumans, *Pre. Rev. Genera Gobioïd Fishes. Proefschrift Lisse*, p. 94, (1931).

shorter. The nostrils are situated wide apart, the anterior nostril lies in a short, conical tube placed slightly behind the upper jaw, while the posterior nostril is situated just in front of the anterior border of the orbit. The mouth is small, semicircular and oblique. The jaws are subequal. There are many rows of teeth in both jaws, those of the outer row being enlarged. In certain specimens a number of teeth in the outer row of the upper jaw, especially in the middle, are greatly enlarged.¹ The tongue is slightly emarginate.

The body is elongate; its depth is contained from 5.7 to 6.6 times in the total length and from 4.5 to 5.2 times in the length without the caudal. The body is covered with small, firmly-set, ctenoid scales but those on the anterior part of the body, on the chest and the belly are embedded in the skin and are cycloid. The head is entirely naked with the exception of a small, longitudinal patch of indistinct scales behind the eyes. The lateral line is absent. From below each nostril begins a mucous canal which curves to the angle of the mouth where it bends sharply backwards and runs over the preoperculum for a short distance. There is also a canal which runs along the lower jaw and encircles the posterior margin of the preoperculum and ends in a wide, open pore. The gill-openings are restricted to the sides and are separated by a broad isthmus. There are 4 branchiostegal rays. The caudal peduncle is almost as deep as long.

The pectoral fin is fan-shaped; it is provided with a muscular base devoid of scales, and a number of free silken rays. The pelvic fins are well developed and are united anteriorly by a strong basal membrane. The two dorsals are close together. The second dorsal and the anal are of a similar nature. The caudal fin is more or less rounded.



TEXT-FIG. 6.—Lateral view of a specimen of *Ctenogobius meggitti*, sp. nov. from Maungmagan. $\times 2\frac{2}{5}$.

In young specimens about 27 mm. in total length the body is marked with four dark, broad bands separated by narrow, pale-olivaceous interspaces. About the middle of the body this arrangement is replaced by an alternate series of dark and pale spots. The upper surface of the head is dusky while the ventral surface of the body is pale-olivaceous. The two dorsals, pectorals, anal, and the caudal are banded with rows of spots or sometimes they are grayish. With the growth of the fish, the bands gradually disappear and only a row of elongated, longitudinal spots is left along the lateral line. In fully grown specimens all the fins become dusky or the spots on the fins become large.

¹ In certain specimens the enlarged teeth are almost caninoid and may be, as Gill believed, a sexual character.

and more pronounced. The general colouration also tends to become dusky.

Locality :—Rocky pools, Maungmagan, Tavoy District, Lower Burma, October 1933. In the collection of the Zoological Survey of India there is a young goby collected by Mr. H. Abdulali from an ebb-pool at Kihim, Kolaba District, Bombay Presidency, which seems to belong to this species. Its colouration, however, is much lighter than that of the Burmese examples.

Type-specimen :—F. 11871/1, *Zoological Survey of India* (Ind. Mus.), Calcutta.

Remarks :—*Ctenogobius meggitti* judged by the characters of the genus, as given by Koumans¹, is distinguished from all other species of the genus in the possession of free silken rays of the pectoral fins. This character, though useful in distinguishing species, does not merit generic recognition, for in *Acanthogobius* Gill and *Acentrogobius* Bleeker Koumans has characterised the pectorals as “without or with free silk-like rays.” By an emendation of the diagnosis of *Ctenogobius* along similar lines our new species can be included in it. *Ctenogobius meggitti* further differs from the description of the genus in having an inner row of enlarged teeth in the lower jaw, in the bases of the pectoral fins being devoid of scales, and the presence of four branchiostegals. These characters do not appear to us of much significance in this widely distributed genus. If, however, later researches establish a correlation between the characters of the pectoral fins, teeth, and branchiostegals, it may be desirable to separate the group as a subgenus of *Ctenogobius*, but the material now available does not justify such a separation.

Measurements in millimetres.

Total length including caudal	54.0	49.0	45.0	37.0
Length of caudal	10.0	10.0	9.0	7.0
Length of head	13.5	11.5	10.3	9.0
Width of head	12.0	10.2	10.0	8.0
Height of head at occiput	9.5	8.0	7.3	6.0
Depth of body	9.2	7.4	7.2	6.5
Length of snout	3.0	3.0	3.0	2.8
Diameter of eye	3.5	3.2	2.8	2.8
Bony interorbital	1.2	1.0	1.0	0.9

Family BLENNIIDAE.

Blennius semifasciatus Rüppell.

1935. *Blennius semifasciatus*, Mukerji, *Rec. Ind. Mus.*, XXXVII, pp. 273-275, pl. vi, fig. 5.

Professor Meggitt collected four half-grown specimens of *Blennius semifasciatus* at Maungmagan varying in length (excluding the caudal fin) from 19 to 32 mm. One of us (*op. cit.*) has redescribed this interesting species recently from specimens collected along the Orissa Coast and at Ross Island, Andamans. We have nothing to add to this description except to record the occurrence of the species along the coast of Burma.

¹ Koumans, Pre. Rev. Genera Gobioid Fishes. *Proefschrift Lisse*, p. 88, (1931).

Blennius pholis Linn.

(Plate I, fig. 2.)

1880-84. *Blennius pholis*, Day, *Fish. Great Brit. & Ireland* I, p. 203, pl. Ix, fig. 2.

A large blenny about 120 mm. in length excluding the caudal fin was obtained by Professor Meggitt from Maungmagan. It did not agree with the descriptions of any of the species known to us from India, but showed certain affinities with an Australian species—*Blennius victorae*—described by Fowler.¹ The specimen was sent to Mr. J. R. Norman of the British Museum for favour of identification and he has very kindly informed us that it is *Blennius pholis* Linn., the common Shanny of Great Britain.

Day gives the habitat of the species as : “ From Scandinavia and the Atlantic coasts of Europe, but it does not appear to extend far, if at all, into the Mediterranean.” The present record of the species from the Burmese waters is of interest.

Salarias dussumieri Cuv. & Val.

1927. *Salarias dussumieri*, Barnard, *Ann. S. African Mus.*, XXI, pt. ii, p. 846.

1928. *Salarias dussumieri*, Fowler, *Mem. Bernice P. Bishop Mus.*, X, p. 439.

Professor Meggitt's first collection from Maungmagan contains two specimens, one male and one female, of *Salarias dussumieri*. They are 62 mm. and 58 mm. long respectively excluding the caudal fin. In the second collection from the same locality there is a young female specimen.

The head is deeper than wide and its length is contained about 5.5 times in the length of the body excluding the caudal. The depth of the body is nearly equal to or slightly shorter than the length of the head. The eye is fairly large, and superior ; its diameter is contained about 3.5 times in the length of the head. The interorbital space is narrow, concave and less than half the diameter of the eye. The gape of the mouth is wide and equal to the postorbital part of the head. The maxilla reaches almost below the hind edge of the eye. The lips are not crenulate. There are no canines. Both the nasal and the supra-orbital tentacles are fringed. A fairly low occipital crest is present in males only.

The dorsal fin is separated by a distinct notch. The first dorsal is almost half as high as the body below it ; while the second, which may be slightly higher, is continuous with the caudal. The pectorals, which are longer than the head, are rather broad and semi-ovate. The caudal fin is nearly equal to the head and rounded.

The colouration of the specimens is dark brownish above and greenish yellow below. The entire body is more or less banded with irregular and often discontinuous cross-bars and stripes, sometimes in pairs. The dorsal, caudal and anal fins are provided with dark spots

¹ Fowler, *Proc. Acad. Nat. Sci. Philad.*, pp. 442-444, fig. 10, 1907 (1908) ; McCulloch, *Mem. Austral. Mus.*, V, p. 346, (1927).

which may be arranged in regular bands. The anal is dark edged. A dark spot is present between the first and the second dorsal spine.

The species is distributed along the east coast of Africa and in the Indian seas.

***Salarias burmanicus*, sp. nov.**

(Plate I, fig. 1.)

D. 28 ; A. 20 ; P. 13 ; V 2 ; C. 13.

Salarias burmanicus is a greatly compressed and slender species in which the body is broadest anteriorly and tapers gradually towards the posterior end. The head is almost rounded ; its length is contained 6.6 times in the total length and 4.8 times in the length without the caudal. The head is almost as high as long, and its width is about half its length. The eyes, which are dorso-lateral in position, are directed forwards ; they are not visible from the ventral surface. The antero-superior border of the eye projects beyond the dorsal profile of the head. The diameter of the eye is contained about 3.1 times in the length of the head. The anterior border of the eye is in line with the tip of the upper jaw. The interorbital space is almost flat in front and convex behind ; its width is slightly less than half the diameter of the eye. The nostrils, which are just in front of the eyes, are situated about the middle of the level of the eyes ; the anterior nostril is provided with a pair of simple tentacles which are united at the base forming a small tube round the nostril. The posterior tentacle is longer than the anterior and is almost as long as the diameter of the eye. There are no supraorbital or other tentacles. There are open pores round the eyes, on the snout, along the mandible and the border of the preoperculum. The series of pores on the head are continued backwards into the lateral line, which consists of a few, short, prominent tubes and ends abruptly below the base of the 13th ray of the dorsal fin. There is a low, median ridge along the head ; it commences above the middle of the eyes and becomes continuous with the dorsal fin. The body is smooth and its greatest depth is somewhat greater than the length of the head. The caudal peduncle is about one and a half times as long as deep.

The dorsal fin commences at the level of the superior angle of the gill-opening and contains 28 rays arranged in a continuous series. The 2nd to the 4th dorsal rays are the longest, their length being equal to the head behind the eyes. The anal fin is similar to the dorsal but its longest ray is about half the length of the longest ray of the dorsal fin. The pectoral fin is short, rounded and lateral in position ; it is shorter than the head and is provided with a muscular base. The ventral fin consists of two rays which are united at the base. The caudal fin is longer than the head and two of its outer rays are greatly produced.

The dorsal surface and sides of the body are of a purplish brown colour which becomes lighter on the head and towards the posterior part of the body. In the region of the caudal peduncle the colour is pale-olivaceous. The bases of the dorsal and anal fins are grayish while the margins and the distal half of the caudal fin are grayish. The

filamentous rays are somewhat darker. The pectorals are whitish while the ventrals are covered with minute black dots. The regions of the operculum, interoperculum, suboperculum and the bases of the pectorals are white.

Locality :—Maungmagan, Tavoy District, Lower Burma.

There is only one specimen of this interesting species in Professor Meggitt's second collection from Maungmagan.

Type-specimen :—F. 11872/1, *Zoological Survey of India* (Ind. Mus.), Calcutta.

Remarks :—This remarkable blenny appears to be well adapted for living among corals. The greatly compressed head and body, elongated caudal rays, forwardly directed eyes near the tip of the snout and colouration are very distinctive features of the species. We are not familiar with any similar species in the genus *Salarias*, but attention may be directed to *S. anomalus* Regan¹ described from the Persian Gulf and the Mekran Coast. Though the outer rays of the caudal fin are somewhat produced in this species also, the dorsal fin and the colouration are very different. Moreover, the number of rays in the dorsal and anal fins is greater in *S. anomalus*.

Measurements in millimetres.

Total length including caudal	77.0
Length of caudal	21.3
Depth of body	12.0
Length of head	11.6
Width of head	6.0
Height of head	11.0
Diameter of eye	3.7
Interorbital width	2.0
Longest ray of dorsal	8.5
Longest ray of anal	4.5
Length of pectoral fin	9.5
Length of ventral fin	5.5
Length of caudal peduncle	4.5
Least height of caudal peduncle	6.3

***Petroscirtes punctatus* (Cuv. & Val.).**

1836. *Blennechis punctatus*, Cuvier & Valenciennes, *Hist. Nat. Poiss.*, XI, p. 287.

1861. *Petroscirtes punctatus*, Günther, *Cat. Fish. Brit. Mus.*, III, p. 231.

1878. *Petroscirtes punctatus*, Day, *Fish. India*, II, p. 326.

1889. *Petroscirtes punctatus*, Day, *Faun. Brit. Ind., Fish.*, II, p. 308.

1929. *Petroscirtes punctatus*, McCulloch, *Mem. Austral. Mus.*, V, pt. iii, p. 342.

In Professor Meggitt's collection from Maungmagan there are seven half-grown specimens of *Petroscirtes punctatus*, varying from 20 to 32 mm. in length excluding the caudal fin. The existing description of *P. punctatus*, although short, agrees fairly well with these specimens, and we have, therefore, little hesitation in referring them to this species. There are, however, certain differences in body proportions etc., which

¹ Regan, *Journ. Bombay Nat. Hist. Society*, XVI, p. 327, pl. ii, fig. 4. (1905).

are almost certainly due to the specimens being immature. For convenience of reference in future a short description of the specimens is given below :

D. XII-XIII/19-21 ; A. 21-23 ; P. 14 ; C. 13.

The head and the body are greatly compressed laterally. The head is considerably higher than broad and its length is contained from 5 to 5.5 times in the length of the body excluding the caudal fin. The depth of the body is nearly equal to the length of the head excluding the snout. The anterior profile of the snout is subvertical. The snout is short and obtuse and is equal to the diameter of the eye. The eye is circular and moderate ; it is situated close to the upper profile and in the anterior half of the head. Its diameter is contained about 4.5 times in the length of the head. The dorsal fins are almost equal in length ; the rayed dorsal is comparatively higher than the fairly low spinous. The insertion of the dorsal is almost vertically above the upper base of the pectorals, which are equal to the length of the head excluding the snout. Posteriorly the dorsal just meets the root of the caudal. The ventrals are much shorter than the pectorals. The insertion of the anal is midway between the root of the caudal and the anterior margin of the eye. The anal rays are subequal ; the posterior ones, however, are the longest. The caudal is shorter than the head and is rounded. In most specimens all the fin rays have free fleshy tips.

The incisiform teeth are short, slender, sharp and closely set. In the upper jaw there are from 24 to 26 teeth, while in the lower from 20 to 22. Both the jaws are provided with sharp canines ; those in the lower jaw are larger and stronger.

The general colour of the specimens is grayish. In addition, there are from 7 to 9 pairs of longitudinally arranged blackish specks below the base of the dorsal fin. Two other similar longitudinal rows of paired specks are present along the sides. Both the dorsal and the anal fins are tipped with black.

The range of *Petroscirtes punctatus* is stated by Day to extend from the " seas of India to Australia ", though we have not seen many records of the species from the Indian waters. So far as we are aware it is here recorded from the Burma coast for the first time.

Family STROMATEIDAE.

***Psenopsis anomala* (Temm. & Schgl.).**

(Plate II, fig. 2.)

1850. *Trachynotus anomalus*, Temminck & Schlegel, *Faun. Japon. Pisces*, p. 107, pl. lvii, fig. 2.

1860. *Psenes anomalus*, Günther, *Cat. Fish. Brit. Mus.*, II, p. 495.

1862. *Psenopsis anomalus*, Gill, *Proc. Acad. Nat. Sci. Philad.*, p. 127.

1902. *Psenopsis anomala*, Regan, *Ann. Mag. Nat. Hist.* (7) X, p. 131.

1929. *Psenopsis anomala*, Fowler, *Proc. Acad. Nat. Sci. Philad.*, LXXXI, p. 604.

Psenopsis anomala is represented in Professor Meggitt's collection from Maungmagan by a single specimen about 70 mm. in length without

the caudal fin. We have compared it with a specimen of about the same size collected at Tonkin, China, and now preserved in the collection of the Zoological Survey of India. The Burmese example is much darker in colour, otherwise the two specimens are almost identical.

The species has hitherto been known from the seas of Japan. Fowler (*op. cit.*) recorded it from Hong Kong, China and the present record extends its range to the Burmese waters.

Family MUGILIDAE.

Mugil vaigiensis (Q. & G.).

1922. *Mugil vaigiensis*, Weber and de Beaufort, *Fish. Indo-Austral. Archipel.*, IV, pp. 244, 245.

1933. *Mugil Vaigiensis*, Pellegrin, *Mem. Acad. Malgache*, XIV, pp. 180, 181, fig. 98.

Three specimens of *Mugil vaigiensis*, nearly 105 mm. long excluding the caudal fin, were obtained by Professor Meggitt from Maungmagan. They agree in all essential characters with the description of the species given by Weber and de Beaufort.

Six dark, fairly broad longitudinal bands are characteristic of the species. The upper half of the pectorals is deep black. The dorsals as well as the anal are also blackish. The ventrals are whitish with indistinct dusky patches.

Besides the three examples referred to above, ten immature specimens of a species of *Mugil* were also collected by Professor Meggitt from Maungmagan. The specimens vary from 22 to 45 mm. in length, excluding the caudal fin. Although they differ in certain body proportions from the adults of *M. vaigiensis*, in view of the characteristic colouration of the fins it seems probable that these immature Mulletts should be referred to *M. vaigiensis*. The general facies, lepidosis and the longitudinal bands on the body also indicate the very close affinity of these examples with *M. vaigiensis*.

Mugil vaigiensis is widely distributed in the Indian Ocean where it is generally found in seas and estuaries. Sometimes, however, it ascends fresh waters also.

Family TRACHINIDAE.

Trachinus draco Linn.

(Plate II, fig. 3.)

1880-1884. *Trachinus draco*, Day, *Fish. Great Brit. & Ireland*, I, pp. 79-81, pl. xxx.

1927. *Trachinus draco*, Barnard, *Ann. S. African Mus.*, XXI, pt. ii, pp. 439, 440.

Trachinus draco is represented in Professor Meggitt's collection by a single specimen taken at Maungmagan, Lower Burma. The specimen is in a good state of preservation and is about 8½ inches long, excluding the caudal fin. According to Day (*op. cit.*) the species "attains at

least 17 inches in length " The specimen under report agrees in all respects with the descriptions of the species given by Day and other authors.

The spines at the antero-superior angle of the orbit are fairly stout and sharp. There are no flat spines on the preopercle. The opercular spines are long, very sharp and strong and have the usual loose skin covering. Both the supra-scapulars and scapulars are flat plates and have serrated free margins.

The third spine of the first dorsal is the longest. There is a low membraneous attachment between the first and the second dorsal. The caudal fin is slightly emarginate.

The colouration of the specimen is uniformly greyish, or slightly darker on the back. There are some dusky oblique stripes irregularly arranged on the body and the head. The first dorsal is black in its upper three-fourths; the black patch extends posteriorly as far as the fourth spine. The caudal fin is dusky. The rest of the fins are yellowish with dark edges.

T. draco is distributed on the west coast of Europe, Mediterranean, the west coast of Africa as far south as Guinea Coast, Madeira. Barnard (*op. cit.*) records it from the Cape seas on the authority of Günther.

Remarks :—Hithertofore, no species of the genus *Trachinus* has been reported from any of the Indian seas, and the present record of *T. draco* from the Burmese waters is, therefore, of extraordinary interest. The specimen under report was sent to Mr. J. R. Norman of the British Museum who confirmed our identification.

COTTIDAE.

Cottus bubalis Euphrasen.

(Plate I, figs. 5 and 6.)

1880-84. *Cottus bubalis*, Day, *Fish. Great Brit. & Ireland*, I, p. 51, pl. xx, fig. 2.

Not being able to determine specifically a Cottid fish in the collection of Professor Meggitt from Maungmagan, the specimen was sent to Mr. J. R. Norman of the British Museum for favour of identification. He has very kindly informed us that "it agrees almost exactly with specimens of the European *Cottus bubalis*, Euphr. in our collection." According to Day, its habitat is: "From the Arctic region in both hemispheres, the Baltic, North Sea, British Isles, and coasts of France and Spain." The occurrence of the species in Burmese waters is, of unusual interest.

Our specimen, which is 135 mm. in total length, differs from Day's figure of the species in the form of the head, depth of the body, proportions, etc. These differences are clearly shown in our figures of the Burmese specimen.

Family LOPHIIDAE.

Lophius piscatorius Linn.

(Plate II, fig. 5.)

1880-1884. *Lophius piscatorius*, Day, *Fish. Great Brit. & Ireland*, I, p. 73, pl. xxix.1903. *Lophius piscatorius*, Regan, *Ann. Mag. Nat. Hist.* (7), XI, p. 283.1927. *Lophius piscatorius*, Barnard, *Ann. South African Mus.*, XXI, p. 999.

Professor Meggitt's collection from Maungmagan contains a single specimen of *Lophius piscatorius*, $6\frac{1}{2}$ inches long without the caudal. It entirely agrees with Regan's description of the species. Mr. J. R. Norman very kindly examined the specimen and has confirmed our determination.

The humeral spine is very strong and ends in three short and blunt spines. The rays of the spinous dorsal are fairly well marked. The first ray ends in a simple flap. The second ray is nearly as long as the first but the third is much shorter.

According to Regan, *L. piscatorius* is found on "Coasts of both sides of the North Atlantic, Mediterranean", but Barnard extended its range to the coasts of the South Atlantic also. Its present record from the Burmese waters is of interest, as all the species of the genus *Lophius* hitherto described from the Indian waters have been transferred by Regan (*loc. cit.*, p. 279) either to the genus *Chirolophius* Regan or to *Lophiomus* Gill.

Family TETRAODONTIDAE.

Sphoeroides¹ oblongus (Bloch).1878. *Tetrodon oblongus*, Day, *Fish. India*, p. 702, pl. clxxxii, fig. 3.1924. *Sphoeroides oblongus*, Hora, *Mem. Asiat. Soc. Bengal*, VI, p. 498.1927. *Sphoeroides oblongus*, McCulloch, *Mem. Austral. Mus.* V, p. 431.1928. *Sphoeroides oblongus*, Fowler, *Mem. Bernice P. Bishop Mus.*, X, p. 467.

There are nine specimens of *Sphoeroides oblongus* in the collection of Professor Meggitt from Maungmagan; of these some are young. The specimens agree almost in every respect with Day's description and figure of the species. The young specimens vary slightly in colouration and in the form and arrangement of the spines.

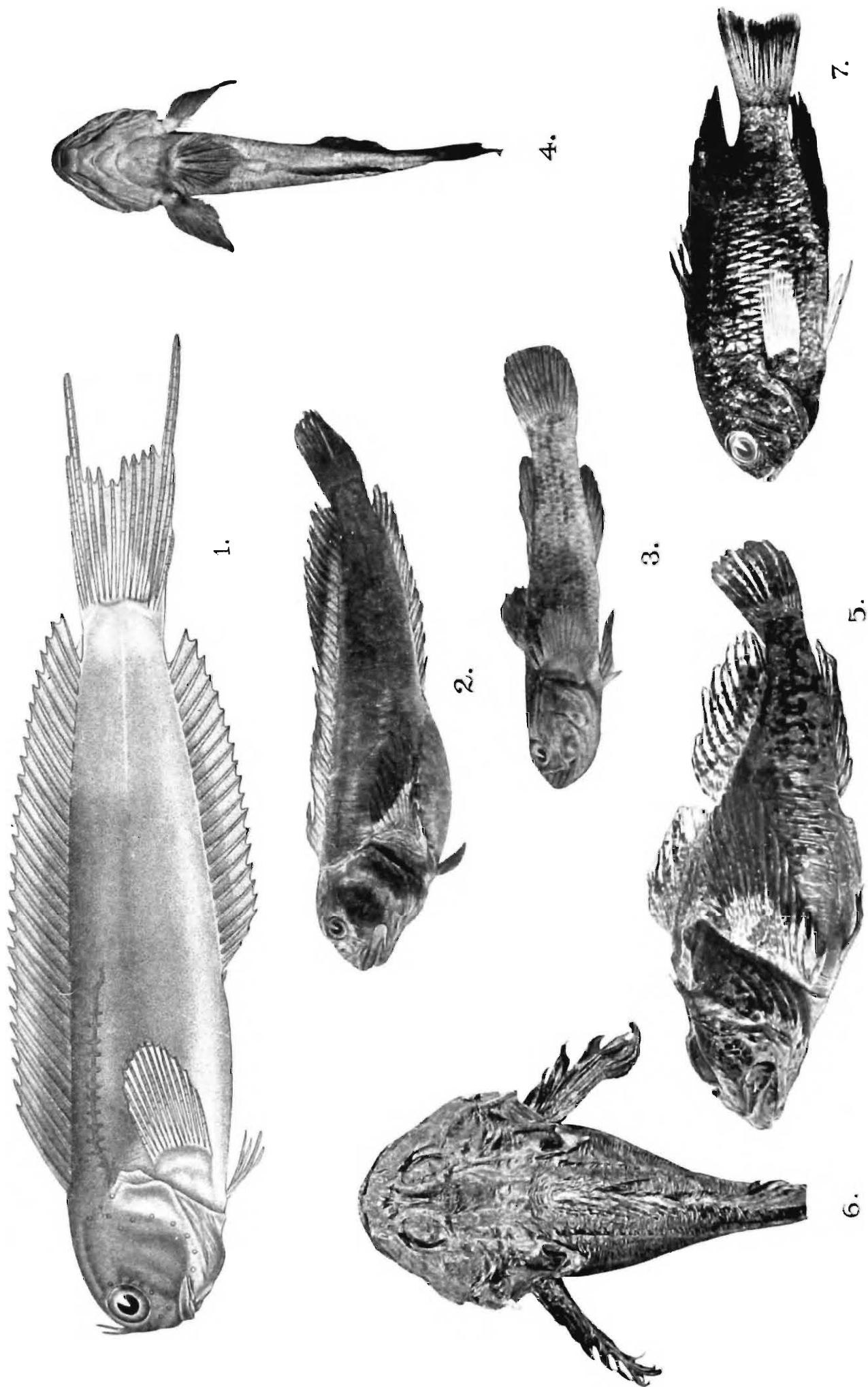
The teeth of the upper jaw are slightly smaller than those of the lower jaw. The interorbital space becomes broader with age. The back and the belly are covered with double-rooted small and sharp spines; the snout and the tail are devoid of spines. The areas covered with spines are equally well marked in the young individuals.

Sphoeroides oblongus is a widely distributed Indo-Pacific species.

¹ Often written *Spherooides* as adopted by Dumeril (1806), but originally spelt by Lacépède (1798) as *Sphoeroides*. *Sphoeroides* replaces *Spherooides* (Jordan, *Classification of Fishes*, p. 24, 1923).

EXPLANATION OF PLATE I.

- FIG. 1.—Lateral view of the type-specimen of *Salaria burmanicus*,
sp. nov. $\times 2$.
- FIG. 2.—Lateral view of *Blennius pholis* Linn. $\times \frac{2}{3}$.
- FIG. 3.—Lateral view of *Ctenogobius meggitti*, sp. nov. $\times 1\frac{1}{2}$.
- FIG. 4.—Ventral view of *Ctenogobius meggitti*, sp. nov. $\times 1\frac{1}{2}$.
- FIG. 5.—Lateral view of *Cottus bubalis* Euphr. $\times \frac{2}{3}$.
- FIG. 6.—Dorsal surface of head and anterior part of body of *Cottus*
bubalis Euphr. $\times \frac{2}{3}$.
- FIG. 7.—Lateral view of *Pomacentrus ? notophthalmus* (Bleeker).
Slightly enlarged.



Fish from Maungmagan, Lower Burma.

B. P. Photo.

EXPLANATION OF PLATE II.

FIG. 1.—Dorsal view of a young specimen of *Rhinobatus granulatus* Cuv. $\times \frac{2}{5}$.

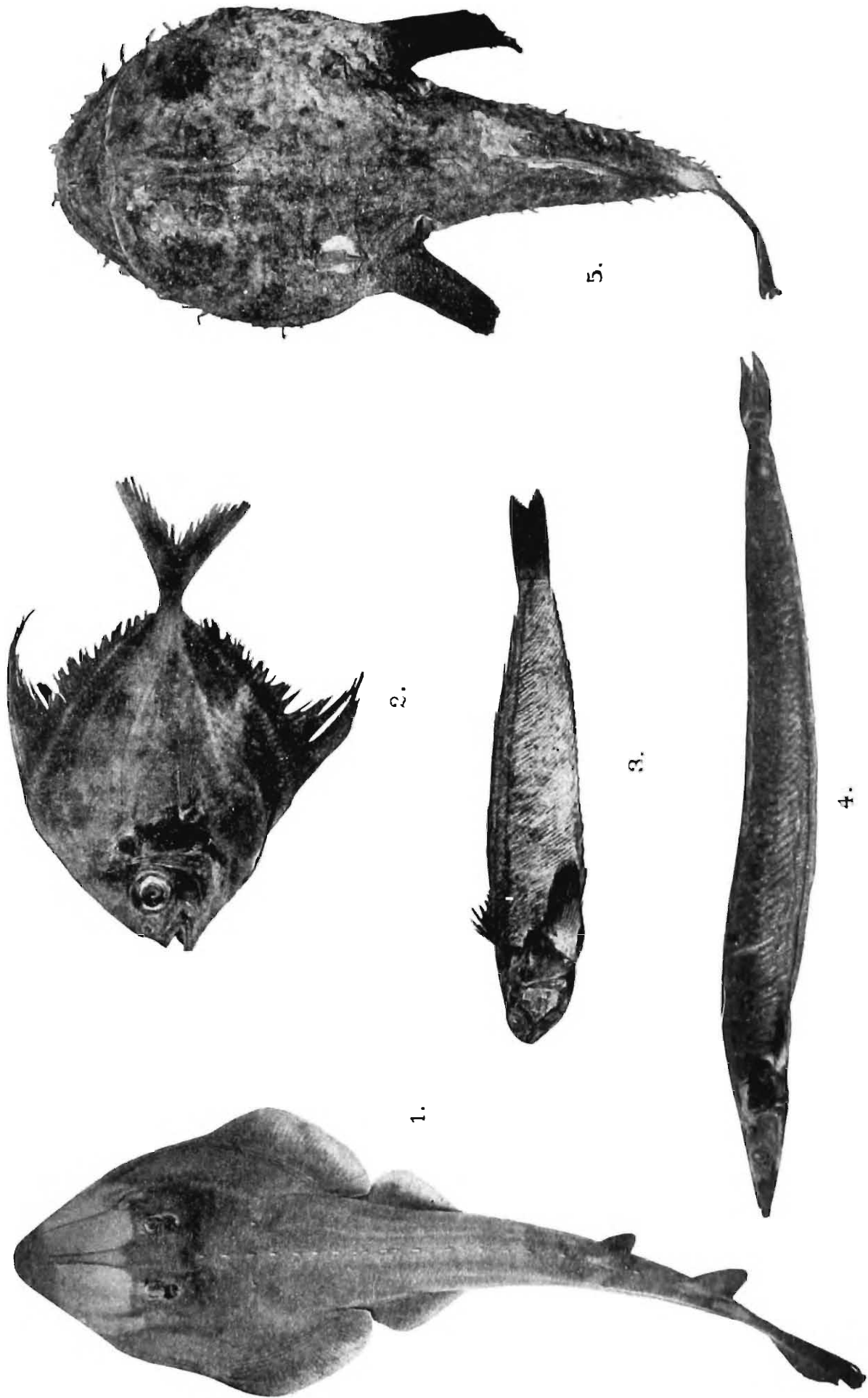
FIG. 2.—Lateral view of *Psenopsis anomala* (T. & S.) $\times \frac{4}{5}$.

FIG. 3.—Lateral view of *Trachinus draco* Linn. $\times \frac{1}{3}$.

FIG. 4.—Lateral view of *Ammodytes lanceolatus* Le Sauvage. $\times \frac{2}{5}$.

FIG. 5.—Dorsal view of *Lophius piscatorius* Linn. $\times \frac{1}{2}$.

The photographs reproduced here are of the specimens collected at Maungmagan.



Fish from Maungmagan, Lower Burma.

B. P. Photo.

THE MORPHOLOGY OF *KALINGA ORNATA* (Ald. & Han.).

By K. VIRABHADRA RAO, *B.Sc. (Hons.)*.

(From the University Zoological Research Laboratory, Madras).

(Plate III).

CONTENTS.

	PAGE.
Introduction	41
Historical Résumé	41
Occurrence	42
External Features	43
Foot	44
Body-wall	45
Digestive System	46
Circulatory System	56
Respiratory System	61
Renal System	61
Nervous System	64
Sense Organs	68
Reproductive System	70
Biological Notes	74
Summary	76
Bibliography	76

INTRODUCTION.

My object in taking up this work was to furnish a detailed morphological account of a typical holohepatic Nudibranch Mollusc of the tropics; and for this purpose *Kalinga ornata* (Alder and Hancock); which is widely distributed in the Indian and the Pacific Oceans, has been chosen.

The present work has been carried out in the University Zoological Research Laboratory, Madras, and I am grateful to Professor R. Gopala Aiyar, Director of the Laboratory, for his kind suggestions and criticism; to Dr. B. Prashad, Director of the Zoological Survey of India, for having kindly lent me several books for reference; and to him and Dr. H. Srinivasa Rao for going through the manuscript and suggesting some improvements. My thanks are due to Mr. S. Ramaswami Iyengar of the Government Fisheries Station, Ennur, for having supplied some material for my work. To the Syndicate of the Madras University I am indebted for the award of a Research Studentship.

HISTORICAL RÉSUMÉ.

Alder and Hancock, from a collection of the Nudibranchiate Mollusca sent to them by Walter Eliot, described several new genera and new species including the present form. Eliot made these collections during 1853 and 1854 from Lawson's Bay in Waltair, near Vizagapatam in

India, and sent them to the authors mentioned above, with a set of exquisite drawings in natural colours made by the Hindoo artists of the locality. A single species of the genus *Kalinga* was described by the authors, and no new forms have since been added. The name of this genus has reference to one of the countries of the ancient Empire of Asoka, where it was first found. Perhaps the specific name *ornata* refers to its beautiful form beset with plumes and processes with variegated colours.

From the descriptions given by these authors of the external features, and from the life-like drawings made by the artists referred to, one can never go wrong in identifying the animal, especially when alive. As far as the internal anatomy is concerned their description is very meagre. They placed the genus *Kalinga* in the family Polyceridae, and regarded it as intermediate between *Euplocamus* and *Plocamopherus*.

Bergh (1890), while studying a collection of Nudibranchs from Amboina in the Molucca Islands, came across a single specimen of this genus preserved in alcohol in the Leiden Museum. The buccal mass was completely everted, and most of the internal parts were very much damaged. He could not study the entire internal anatomy and doubted the identity of the form with *Kalinga ornata*.

In 1905 Farran described one young specimen of *Kalinga* from Professor Herdman's Collection of Opisthobranchiate Mollusca from the Gulf of Manaar. He gave an account of the radular teeth alone, as the radula was not in its normal position, but was found lining the under surface of the everted buccal-organ.

Sir Charles Eliot (1906) examined four very badly preserved specimens in the Hancock Museum in Newcastle-on-Tyne. He also found the same difficulty as the previous authors regarding the buccal parts, and like Bergh, he gave a brief anatomical description of these specimens. In 1908 Bergh again published a short report on two more specimens captured alive in South Africa. Later, Eliot (1913), Baba (1933) from Japan, and Barnard (1927) from South Africa recorded the occurrence of this genus in their respective areas.

From the foregoing account it is evident that only two authors have so far described the anatomy of *Kalinga* from the insufficient and defective material available to them.

OCCURRENCE.

This Nudibranch has previously been recorded from the following places: (i) Lawson's Bay near Vizagapatam and near Madras in the Bay of Bengal—Eliot; (ii) near Amboina, Molucca Islands in the Pacific Ocean—Bergh; (iii) ten miles north of Cheval Paar in the Gulf of Manaar—Farran; (iv) near Amaticulu Conical Hill of South Africa in the Indian Ocean—Bergh; (v) Zululand coast of South Africa—Barnard; and (vi) Tateyama, Misaki, etc., in the Pacific coasts of Japan—Baba.

The material for my work was collected near Madras and at Ennur, ten miles north of Madras. From this it is evident that the animal is widely distributed throughout the Indian and the Pacific Oceans,

EXTERNAL FEATURES.

The animal is Dorid-like in appearance and measures, when full grown, about 10.4 cm. in length, 7.8 cm. in breadth and 3.5 cm. in height. The foot is flat, oval, and pale yellowish-white in colour. The back, which is narrower than the foot, is tinted with shades of light green and pink. It is somewhat arched in front and its semilunar, free anterior margin bears fourteen small, pale-white, plumose tufts (*pa. or.*); the biggest of these lie on either side of the margin, and they become shorter and shorter towards the middle region. This anterior rim or the margin with the plumose tufts is usually spoken of as the 'oral veil'. The posterior end of the body is blunt and rounded. The back has an elevated position above the foot and slopes almost vertically along the sides. Anteriorly between the mantle and the foot just below the middle region of the oral veil is the slit-like mouth (*or. s.*) guarded by two large fleshy outer lips or labial folds (*la.*), each of which bears at its extremity a thin flat process, the oral tentacle. There is a slight constriction at a distance of 3.5 cm. from the oral veil dividing the back into two regions. The anterior of these regions with the buccal mass, the rhinophores, the oral veil, and the labial folds in front, forms the head (Pl. III, figs. 1—4).

At a distance of 2 cm. from the front end are the two dorsal tentacles or rhinophores lodged within their sheaths about 2 cm. apart. The rhinophores (*rh.*) are somewhat conical, perfoliated structures with a stout, short pedicle. The margin of the rhinophore-sheath and the rhinophore stalk are crimson red in colour, while the perfoliated part is dull green with a crimson patch. The free edge of the rhinophore-sheath reveals very small, yellowish, papillated tufts with white tips.

Occupying most of the posterior dorsal region there are five pinnately branched gill-trees or branchiae (*br.*) with interspace between them. In this interbranchial area, almost equidistant from the five branchiae, the fimbriated anal opening (*an.*) is situated on a crimson coloured, raised papilla. Close to it, towards the right side, is the very minute renal opening (*re. ap.*). One of the gill-trees is median and situated in front of the anus at a distance of 1.2 cm. ; the remaining four are placed two on either side of the anal papilla. The right posterior gill-tree is the largest. In the living condition, the gill-trees are greyish-green, bespeckled with crimson; they are extremely contractile and when touched or otherwise irritated measure only about a fourth to fifth of their original length. Unlike *Doris* and other allied genera *Kalinga* has no special peri-anal pockets; but the same amount of protection is afforded to the gills by their being contracted and closely pressed against the back.

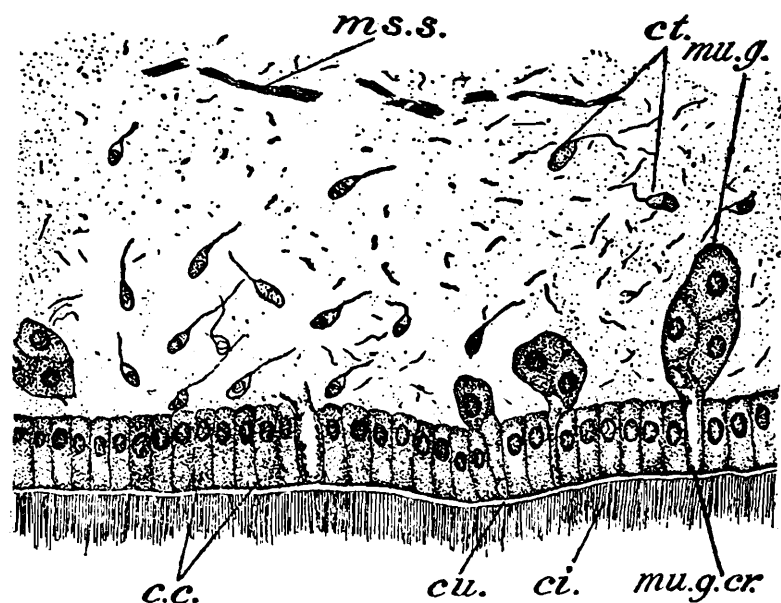
The mantle as well as the sides of the body are beset with small conical processes, very minutely papillated at the base and with a crimson or yellow, contractile tuft in the centre. The conical processes vary in size, almost microscopical to about 4 mm. in diameter. Those along the sides are less prominent, being smaller in size and lighter in colour than those on the back. On either side of the back there are four large conspicuous tufts, (*l. pa.*) each with a conical or a pyramidal stalk bearing on its sides smaller tufts of yellow and white. In between these

four large tufts there are smaller tufts, all of them forming a ridge on either side of the back.

The genital vestibule is situated on the right side of the body between the mantle and the foot at a distance of about 3 cm. from the anterior end.

Foot.

The foot (*ft.*) which is mainly a locomotor organ, is broad, oval, flat and muscular. It helps the animal to creep over and through the crevices of rocks on which it lives or to float freely with the current with its ventral surface upwards. When the animal is left in a spacious aquarium of sea-water, it secretes a copious quantity of mucus and creeps freely on the surface just like any other Gastropod. In such movements no muscular contractions and expansions of the foot are apparent, but the animal seems to glide. In captivity, *Kalinga ornata*, like most other Nudibranchs, has a tendency to float on the surface of the water with the ventral surface upwards.



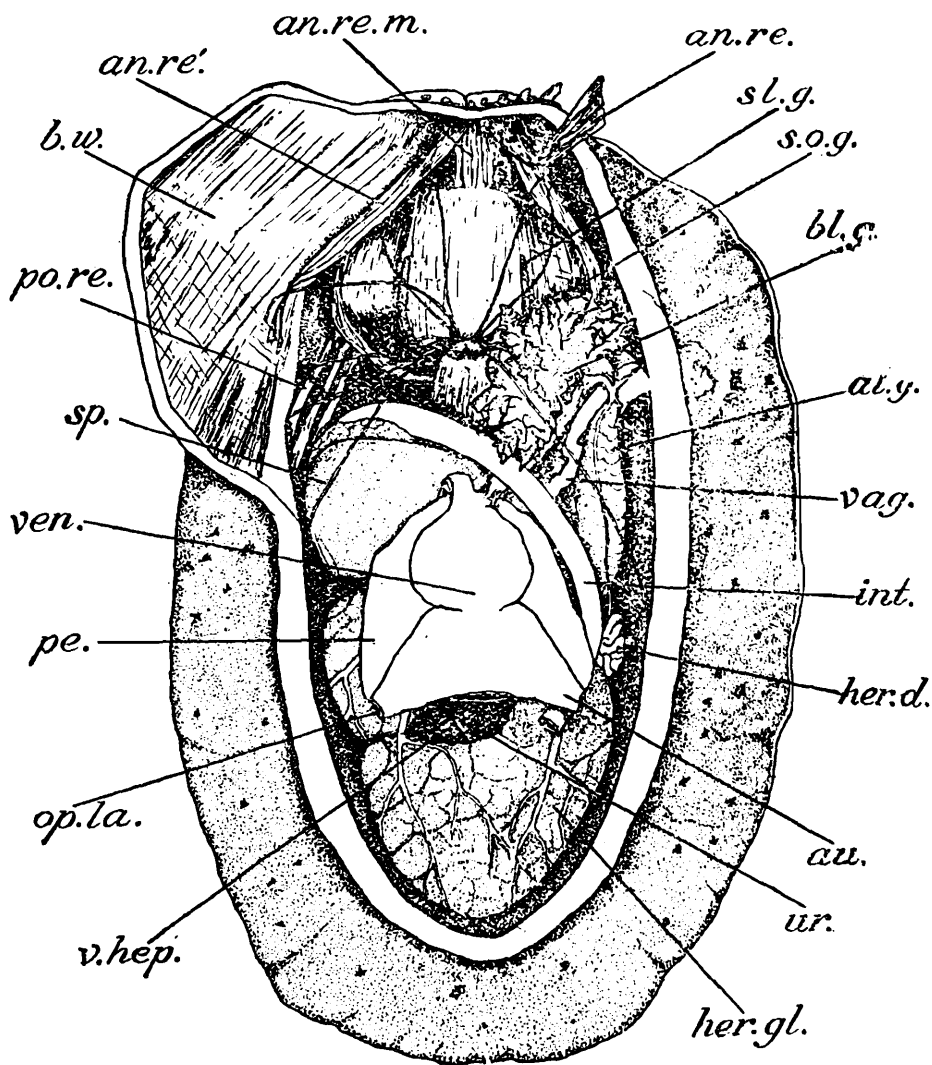
TEXT-FIG. 1.—Transverse section of foot. $\times 600$.

c. c. columnar ciliated cells; *ci.* cilia; *cu.* cuticle; *ct.* connective tissue cells; *ms.* muscle strands; *mu. g.* mucous gland; *mu. g. cr.* crypt of the mucous gland.

A transverse section of the foot (text-fig. 1) reveals an outer epithelial layer of columnar ciliated cells (*c. c.*), the cilia (*ci.*) being nearly as long as the cells themselves. Beneath the ciliary epithelium there are small unicellular and multicellular mucous glands (*mu. g.*), which open to the exterior through minute crypts (*mu. g. cr.*) in the epithelium. The latter are numerous throughout the margin of the foot, and especially towards the extreme anterior and posterior regions, but in the middle region these are few and far between. They are club-shaped, and filled with minute granules which take basic stains very quickly. Separating the columnar cells from the row of cilia there is a thin hyaline cuticle (*cu.*). Underneath the ciliary layer there is the dermal connective tissue (*ct.*) with scattered nerve cells. Small nerve fibres pass from these nerve cells to supply the mucous glands. In the foot there are longitudinal and transverse strands of muscles (*ms. s.*) which are very irregularly arranged to form a network.

BODY-WALL.

The body-wall of the back and the sides of the animal is thick, soft, and flexible. It is devoid of spicules and cilia. A number of plumose contractile and highly sensitive processes of varying dimensions are scattered all over the surface. Anteriorly it bears the two rhinophores and posteriorly the branchiae. It lies somewhat loose over the internal organs except in the region of the rhinophores and the branchiae. In the region of the branchiae the great veins, the intestine and the ureter are connected with it; and in the region of the rhinophores the olfactory nerves pierce the wall of the back and enter the rhinophores. It is somewhat thin anteriorly. Internally, the body-wall has a silvery white appearance due to the close network of muscle strands. The outer

TEXT-FIG. 2.—Viscera *in situ*.

al. g. albumen gland; *an. re.* anterior retractors of the first set; *an. ré.* same of the left side retaining their connection with the body-wall; *an. re. m.* anterior retractors of the second set (median and dorsal); *au.* auricle; *b. w.* body-wall; *bl. g.* blood gland; *her. d.* hermaphrodite duct; *her. gl.* hermaphrodite gland; *int.* intestine; *op. la.* opening of the lateral vein into the auricle; *pe.* pericardium; *po. re.* posterior retractors; *sl. g.* salivary glands; *s. o. g.* supra-oesophageal ganglionic mass; *sp.* spermatheca; *ur.* ureter; *vag.* vagina; *ven.* ventricle; *v. hep.* hepatic vein.

epithelium is glandular, followed by a dermal connective tissue of considerable thickness penetrated by a number of sinuses filled with blood,

which consequently give the body-wall a spongy appearance. The blood passing through these sinuses can be easily aerated, as it is separated from the outside water containing dissolved air only by a thin epithelial layer and the connective tissue. As in the foot, longitudinal and transverse strands of muscles are present in the connective tissue. Some of these strands enter the rhinophores, the contractile processes and the branchiae. The body-wall is partly respiratory and partly sensory. It is also protective as the outer epithelium and the branchiae lodge a number of secreting glands.

On removing the dorsal body-wall the internal organs are seen enveloped in a thin transparent membrane of fibrous material, the peritoneum of Hancock and Embleton (*vide* their description of the anatomy of *Doris*). As this membrane is only the dorsal wall of the haemocoel, the term peritoneum is not applicable; this was subsequently corrected by Hancock himself (1864) and has been accepted by other writers.

DIGESTIVE SYSTEM.

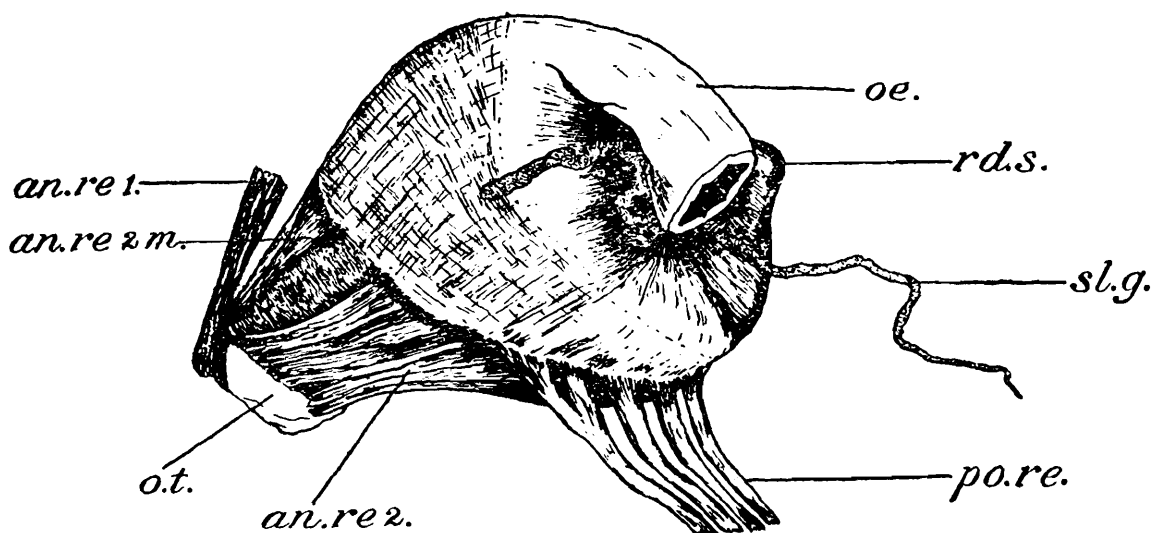
The mouth, which has already been described as a vertical slit between the mantle and the foot, is guarded by the outer lips and leads into a narrow passage, the oral tube (text fig. 3, *o. t.*) lined inside by a thin, fleshy, longitudinally folded inner lip or the second lip. Towards the posterior region of the oral tube there are well developed circular muscles forming a sphincter in front of the entrance to the buccal mass. Immediately following this is the huge bulb-like buccal mass (text-figs. 2, 3), narrow anteriorly and broad posteriorly, occupying the anterior third of the space in the body. The oesophagus (*oe.*) takes its origin from its posterior dorsal region. In the living animal the outer lip is of a pale white colour, while the oral tube is flesh-coloured. The buccal mass is of a rose colour anteriorly—this gradually intensifies posteriorly to bright crimson—but when preserved the whole structure appears pale yellow or white. A ventral view of the buccal mass reveals its bilateral symmetry. The lingual muscles starting from the floor of this organ divide it ventrally into two pad-like structures, while dorsally the buccal mass terminates in a small knob-like projection of the radular sac.

Retractor Muscles of the Buccal Mass.—The buccal mass and the oral tube have three sets of retractor muscles, two forming the anterior retractors and one the posterior (text-figs. 2, 3). The retractor muscles of *Kalinga ornata* do not appear to have been described previously.

Immediately below the body-wall we see a pair of fan-shaped muscles (*an. re 1*), each consisting of about half a dozen radiating strands of muscles, taking their origin dorso-laterally from the anterior end of the oral tube. Proceeding backwards and lying loosely above the buccal mass these muscles have their attachment with the body-wall in the region of the rhinophores, and are in fact a continuation of the longitudinal muscle strands of that region. These form the first set of anterior retractors.

On removing the above-mentioned muscle strands, lying under and in close contact with them we see two more strands of muscles, one on

either side, each consisting of several bundles; these arise ventrolaterally from the middle region of the oral tube and extend to the posterior region of the buccal mass (*an. re 2*). These form the second set of anterior retractors for the shortening of the oral tube. Arising from the oral tube and attached to the anterior end of the roof of the buccal mass there is seen a short strip of a few strands of muscle (*an. re. 2 m*), which lies partly over the oral tube and partly over the labial disc. This probably assists the second set of anterior retractors in their action.



TEXT-FIG. 3.—Side view of buccal mass.

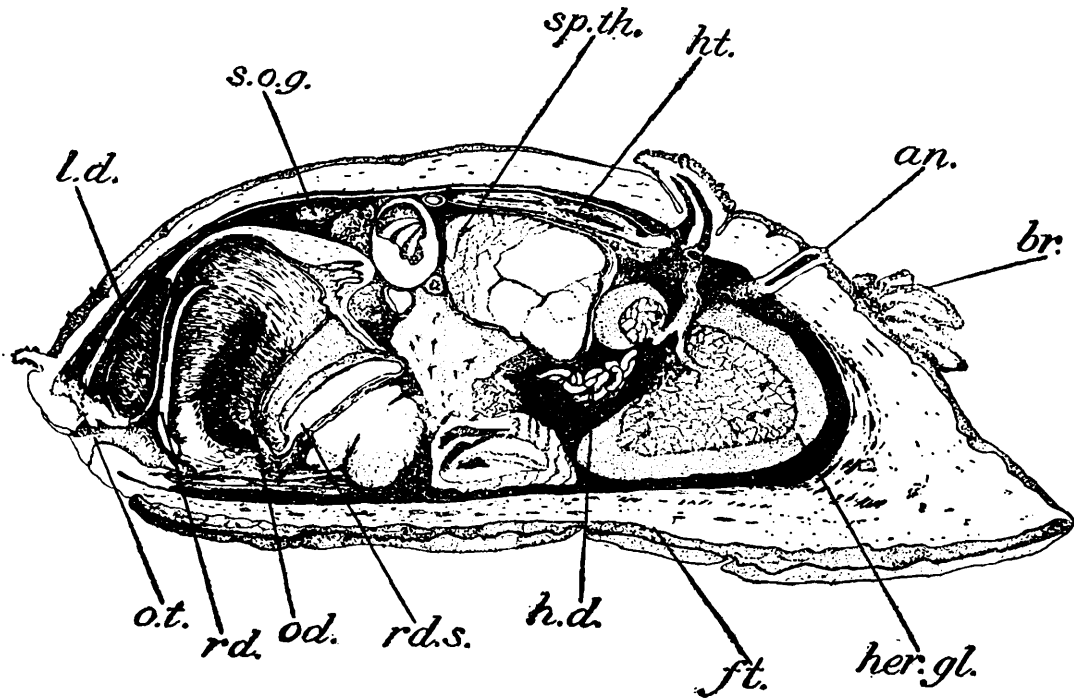
an. re. 1. anterior retractors; *an. re. 2* anterior retractors of the second set (ventro-lateral); *an. re. 2 m.* anterior retractors of the second set (median dorsal); *oe.* oesophagus; *o. t.* oral tube; *po. re.* posterior retractors; *rd. s.* radular sac; *sl. g.* salivary gland.

The posterior retractors (*po. re.*) are two thick powerful strands of muscle, each consisting, like the previous sets, of four to five bundles of muscles which are inserted at the postero-lateral region of the buccal mass, and pass backwards to be fixed to the foot about its middle region. These are responsible for the retraction of the buccal mass as a whole.

Labial Disc.—In front of the buccal mass and guarding the entrance to it, a strong and powerful muscular hoop forms a sort of a collar which is well-developed along its roof and sides though its floor is soft. The corresponding structure in *Doris* has been differently named by different authors as the third lip, the prehensile collar, the buccal lip (Hancock and Embleton 1852), and the labial disc (Sir Charles Eliot 1910). In this paper I have adopted the term labial disc (text-figs. 4, 5, 7, *l. d.*). Like the buccal cavity the labial disc is lined by an epithelium of columnar cells, which secretes a stratified cuticular layer of varying thickness. It is particularly thick in the region of the labial disc which faces the odontophore. The labial disc of *Kalinga ornata* does not bear an armature.

Roof of the Buccal Mass.—Irregularly arranged bundles of muscles, both longitudinal and transverse, form the roof of the buccal mass, which is lined inside by the buccal epithelium of columnar cells, the secretory product forming a cuticle. The spaces between the muscle strands and the lining epithelium are filled by connective tissue. On

either side of the roof, the salivary glands (*sl. g.*) project forwards and open into the buccal cavity.



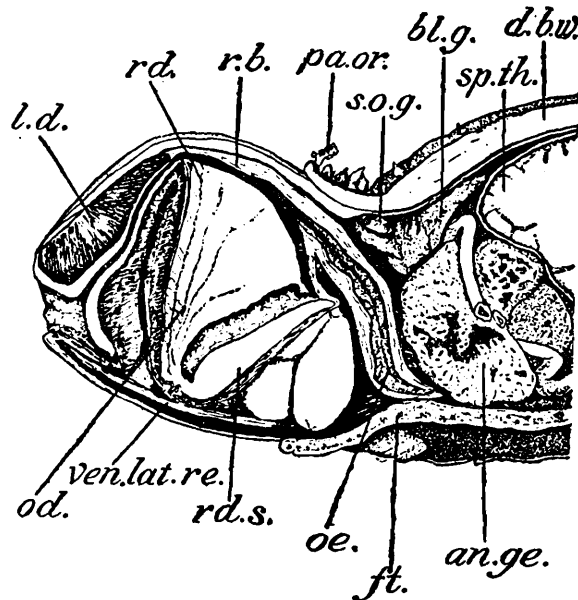
TEXT-FIG. 4.—Median longitudinal section of the entire animal with the buccal mass in position.

an. anus; *br.* branchiae; *ft.* foot; *h. d.* hermaphrodite duct; *her. gl.* hermaphrodite gland; *ht.* heart; *l. d.* labial disc; *od.* odontophore; *o. t.* oral tube; *rd.* radula; *rd. s.* radular sac; *s. o. g.* supra-oesophageal ganglionic mass; *sp. th.* spermatheca.

Odontophore.—The odontophore (text-figs. 4, 5, *od.*) arises on the floor of the buccal mass as a highly muscular conical elevation, surmounted by the dentigerous membrane, the radula (*rd.*). Broadly speaking there are two sets of muscles that take part in the formation of the odontophore. Antero-ventrally where the odontophore faces the roof and the sides of the labial disc, one set of muscles forms a thick compact pad, which does not seem to be very much mobile; while a second set arising posteriorly from the base of the buccal mass consists of loosely arranged powerful muscles (text-fig. 7, *msc. od.*) which run forwards, laterally and upwards to form the muscular elevation. They bring about the movements of the odontophore forwards and backwards, and play an important part in the eversion of the buccal mass. The entire surface of the odontophore is lined by the epithelium and the cuticle, the latter being considerably thick in the anterior region of the odontophore facing the labial disc. Along the median line the odontophore has a deep longitudinal groove.

Radula.—The radula (text-fig. 4, *rd.*) lies closely pressed against the odontophore, and its membrane is almost fused with the cuticle lying underneath. It is also creased down along its middle line fitting into the median groove on the odontophore. Its shape is very much like the hood of a snake, expanded along the sides, narrowed down almost suddenly in front, and posteriorly folded longitudinally from side to side. Its surface is traversed by grooves, faint in front, more pronounced behind, where the radula becomes strongly narrowed downwards. It next takes an upward course to enter the radular sac, (*rd. s.*

where the grooves suddenly disappear. The radular sac is lined by special cells with deeply staining nuclei; and a large number of teeth are being continuously formed here.

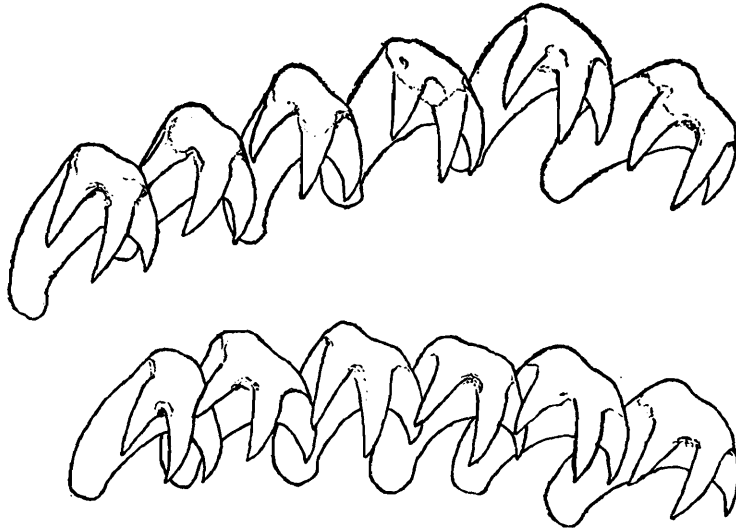


TEXT-FIG. 5.—Median longitudinal section of the anterior region of the animal, in which the buccal mass is pushed out of the body preliminary to eversion.

an. ge. anterior genitalia; bl. g. blood gland; d. b. w. dorsal body-wall ft. foot
l. d. labial disc; od. odontophore; oe. oesophagus; pa. or. papillae of the oral veil;
r. b. roof of the buccal mass; rd. radula; rd. s. radular sac; sp. th. spermatheca; s. o. g.
supra-oesophageal ganglionic mass; ven. lat. re. ventro-lateral retractors.

Numerous tricuspid microscopical teeth of almost the same shape and size are arranged in transverse rows on the radular membrane (text-fig. 6). Each tooth shows a long curved root embedded in the substance of the membrane and a broad exposed crown bearing the three recurved cusps. The top portion of the root is held fast to the dentigerous membrane by a short connective tissue ligament. Along the median line of the radula there is the rachis devoid of teeth, but the transverse rows of either side sometimes come so close together that there appear, in certain areas, spurious rachidial teeth. The anterior-most rows of the teeth of the radula are close together and much worn out by use but the middle expanded portion reveals fairly big teeth in perfect condition. The radular formula given by Farran (1905) was 90. 0. 90. My observations on several specimens show that the number of teeth varies from 85 to 100 in a row on each side. In the young specimen examined by Farran there were about 130 transverse rows of teeth, whereas in a full grown specimen I counted nearly 200 rows in the part of the radula lying outside the radular sac, and a great many more on the posterior part in the radular sac; this agrees more closely with what was found by Bergh (1908). Farran observed that the innermost tooth of each row differed from the rest in having one of its cusps shortened and the first few outermost teeth in having just one or two cusps only. This description of Farran's agrees with the condition observed in some rows, but in many the innermost and the outermost teeth are quite perfect. In conclusion, it may be said that the radular formula of *Kalinga ornata* is 100. 0. 100, this being the maximum number of teeth seen in a row.

A smaller number of teeth may indicate loss due to use. The teeth are all similar, and the subsequent deformity of some of them may be due to accidental breakage of their cusps.

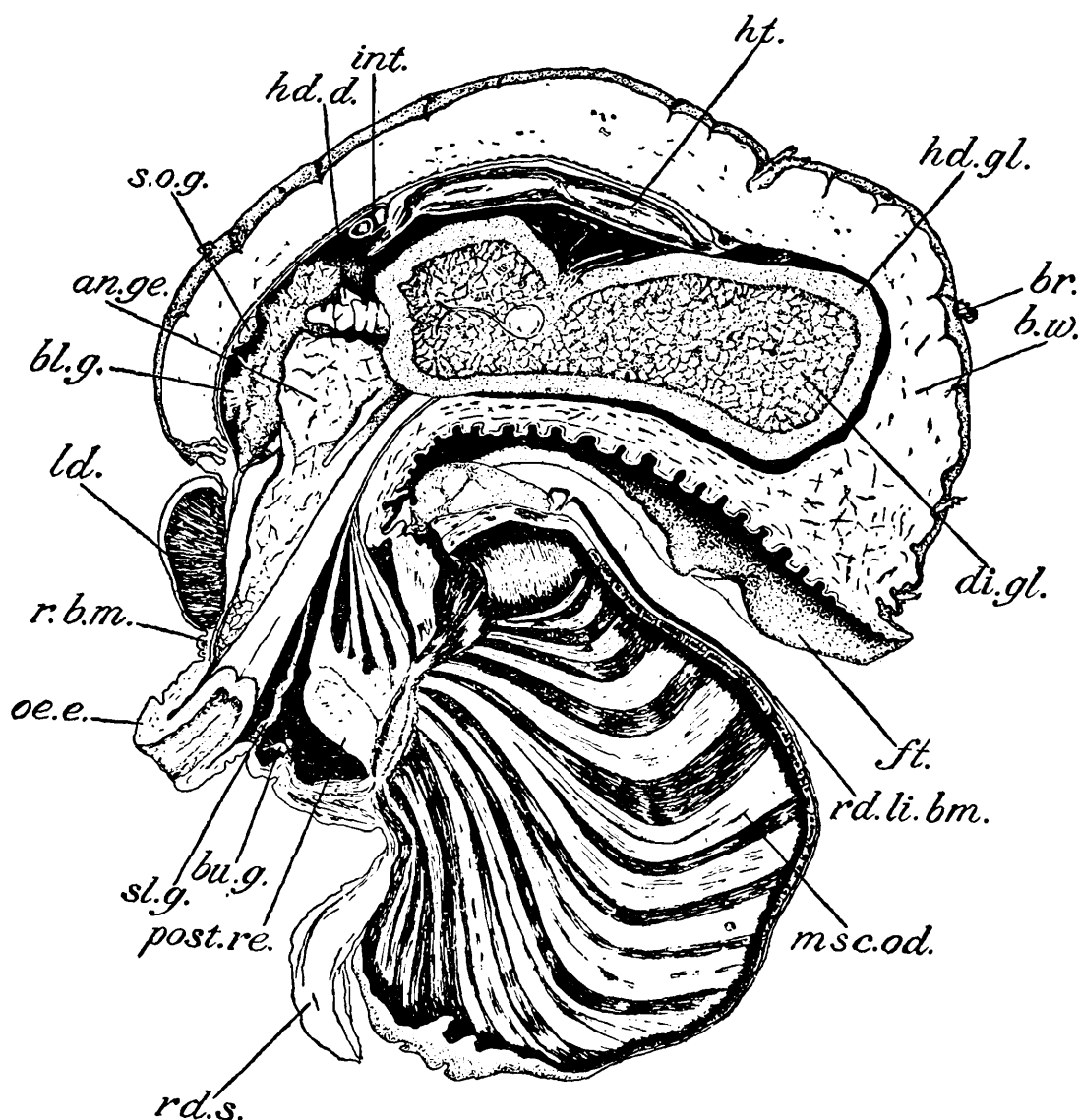


TEXT-FIG. 6.—Teeth of the Radula. $\times 300$.

Eliot (1910) says of *Doris* that “the radula can be drawn backwards and forwards over the odontophore as over a pulley and thus tear to pieces any substance which may be pressed against it” Hancock and Embleton (1852) also expressed the same view as regards *Doris* and *Eolis*. According to Sedgwick (1909), however, it is very common in almost all the Gastropoda that the odontophore itself, with the radula lying upon it, is moved forwards and backwards. I have observed this feature in *Kalinga ornata* when alive. When the odontophore is thus moved with the radula, it rubs against the roof of the labial disc lined by the cuticle and crushes and rasps away any substance that comes between. The radula cannot apparently be moved independently of the odontophore as it is connected intimately with the cuticular layer mentioned already. Judging from the nature of the habitual eversion of the buccal mass to a very great extent, exposing the radula, it is probably right to suppose that it is of immense advantage to the animal to have the radula thus intimately united with the surface upon which it lies.

Condition of the Buccal organ when it is everted.—When the animal is suddenly plunged into a fixative, it undergoes convulsions before it dies, and the whole buccal mass is pushed out of the body as a bag of considerable dimensions, often larger than the individual itself. In such a condition the parts already described assume a peculiar shape and position. The odontophore as a whole, with the radula lying over it is pushed out through what was once the mouth, and the oesophagus remains partly everted as a short tube opening out externally about the middle region of the first half of the buccal mass. The rest of the oesophagus lies concealed and cannot be seen unless a longitudinal section of the animal along with the everted buccal organ is taken. Such a preparation made it possible for me to describe its parts very clearly. As shown in text-fig. 7, the oesophagus is continued into the stomach which is pulled forwards and consequently becomes thinner and longer.

Between the labial disc (*ld.*) which is a continuation of the anterior margin of the mantle, and the mantle itself is a fold which forms the roof of the

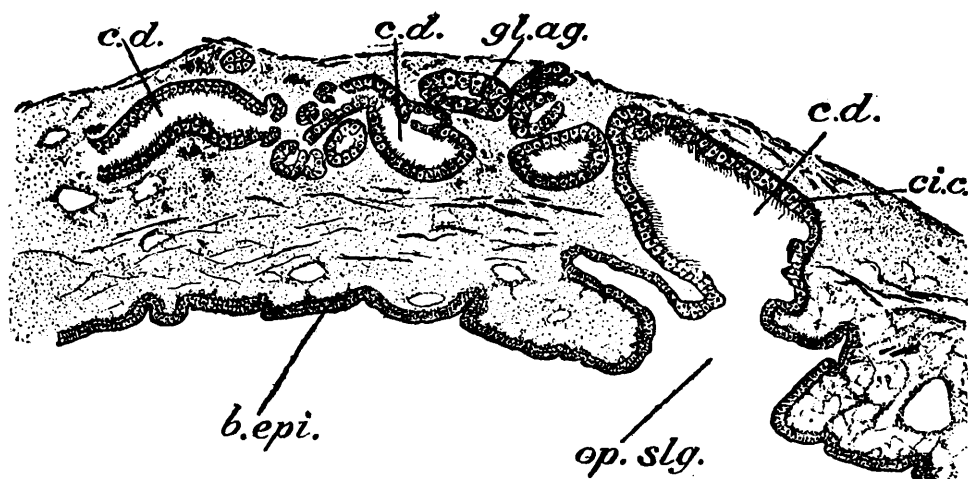


TEXT-FIG. 7.—Longitudinal section of the entire animal with the completely everted buccal mass.

an. ge. anterior genitalia; *bl. g.* blood gland; *br.* branchiae; *bu. g.* buccal ganglia; *b. w.* body-wall; *di. gl.* digestive gland; *ft.* foot; *hd. d.* hermaphrodite duct; *hd. gl.* hermaphrodite gland; *ht.* heart; *int.* intestine; *ld.* labial disc; *msc. od.* muscles of odontophore; *post. re.* posterior retractors; *r. b. m.* roof of buccal mass everted; *oe. e.* part of oesophagus everted; *rd. li. bm.* radula lining the everted buccal mass; *rd. s.* radular sac torn; *sl. g.* salivary gland; *s. o. g.* supra-oesophageal ganglionic mass.

oral tube in its non-everted condition. The anterior end of the labial disc is in continuation of the everted roof of the buccal mass and also of the partly everted oesophagus. Ventrally the labial disc is less prominent. In the everted condition of the buccal mass, the radular sac lies at its free extremity, while the posterior retractors (*post. re.*) are beneath the oesophagus (*oe.e.*) proper attached to the lingual muscles at their origin. The latter proceed forwards and downwards arching along the sides of the buccal mass. The radula lies on the under surface of the everted buccal mass. It is extremely thick near the mouth region becoming gradually thinner towards the radular sac. The buccal ganglia (*bu. g.*) lie beneath the oesophagus in front of the insertion of the

posterior retractors. The salivary glands (*sl. g.*) are now found underneath the oesophagus, opening out to the exterior at the base of the tubular oesophageal projection of the buccal mass.



TEXT-FIG. 8.—Section of the roof of the buccal mass showing the opening of the salivary gland. $\times 30$.

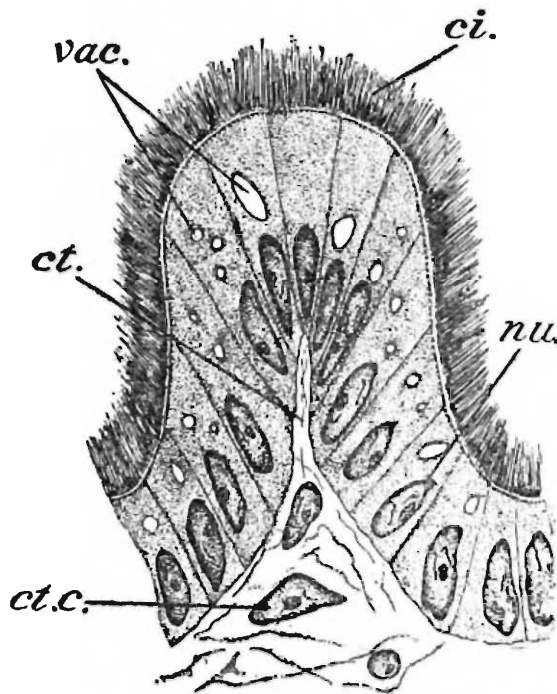
b. epi. buccal epithelium; *c. d.* central conducting duct; *ci. c.* ciliated cells of the conducting passage; *gl. ag.* glandular aggregations; *op. slg.* opening of the salivary duct into the buccal cavity.

Salivary Glands.—The salivary glands (text-fig. 2, 3, *sl. g.*) are two thin flat thread-like structures rather broad anteriorly and narrow posteriorly. They open on the roof of the buccal mass and passing through the circum-oesophageal nerve collar extend up to the liver mass. In sections the salivary gland reveals a central ciliated lumen of the conducting duct (text fig. 8, *c. d.*) into which aggregations of glandular cells (*gl. ag.*) open. A short portion of the duct just before it opens into the buccal mass is devoid of glandular cells.

Oesophagus.—The oesophagus (measuring 15 mm. by 10 mm. in a full grown specimen) takes its origin from the dorsal posterior region of the buccal mass, and bending slightly to the left of the radular sac runs downwards. It has a bright crimson colour and thick walls, with longitudinal plications lined by a thin cuticle. Posteriorly between it and the stomach there is a narrow constriction which, however, is not sharply marked off in large and full grown specimens.

Stomach.—It is a roughly "S" shaped saccular structure. From the point of its origin from the oesophagus it bends slightly to the left and then proceeding backwards in close contact with the inner wall of the foot, enters the mass of the digestive gland on its right side. It then becomes narrow, lies hidden in the furrow of the mass of the digestive gland, takes a crescentic curve there and finally emerges from its left top corner. The rest of the alimentary canal is continued as the intestine with a deep constriction separating the pyloric end of the stomach and the intestine proper. Piercing the curved floor of the stomach, there is a wide opening leading into a stout tubular portion, into which the duct of the supposed gall-bladder from the left side and the hepatic ducts from the anterior and the posterior regions of the digestive gland open.

Digestive Gland.—Occupying nearly the whole of the posterior half of the visceral cavity there is the mass of the digestive gland (text-fig. 7, *di. gl.*) or the hepato-pancreas surrounded by the follicles of the hermaphrodite gland. It is a dull greyish-green conical mass of glandular structure, spongy in appearance due to the blood vessels and the hepatic ducts which ramify in its tissue. Anteriorly, it is broad with a crescentic groove to accommodate the posterior portion of the stomach, which receives the hepatic ducts and the gall-bladder. The hepatic ducts are fairly wide where they open into the stomach, but are extremely narrow where they emerge from the hepatic lobules.



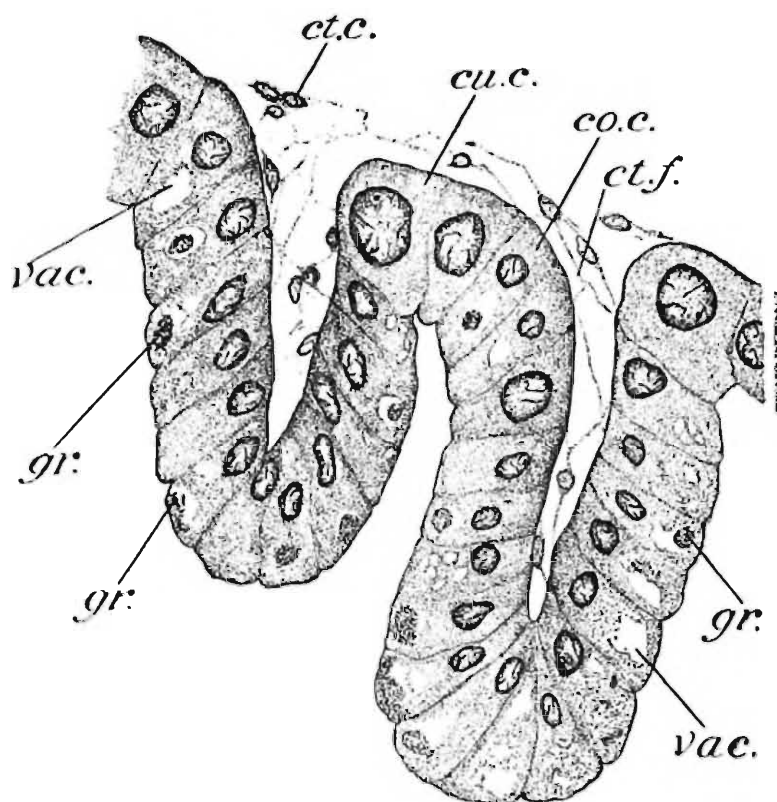
TEXT-FIG. 9.—One of the folds in the broad region of the hepatic ducts. $\times 750$.

ci. cilia; *ct.* connective tissue penetrating into the fold; *ct. c.* connective tissue cells; *nu.* nucleus of the ciliated cells of the lining membrane; *vac.* vacuoles of the ciliated cells.

Similar to the corrugations observed by Agersborg (1923) in the pyloric diverticulum of *Melibe leonina*, I find in *Kalinga ornata* crypts or villi-like projections in the broader regions of the hepatic ducts. These corrugations (text-fig. 9) are formed by the mucous layers being thrown into small folds into which the connective tissue (*ct.*) is continued. In a perfect transverse section of the broad region of the hepatic duct only the floor of the duct displays these corrugations while the roof does not. The latter consists of columnar ciliated cells with fairly large oval nuclei, and without vacuoles in the cytoplasm, while the former consists of cells with oblong nuclei (*nu.*) and vacuolated cytoplasm (*vac.*).

The hepatic lobules are lined by a glandular epithelium of cubical and columnar cells with granular contents (text-fig. 10). The former (*cu. c.*) are larger in size though fewer in number and have bigger nuclei. Some of the columnar cells (*co. c.*) show vacuoles and brown granules (*gr.*) probably of the nature of secretory products. There is one feature common to all these cells; that their cytoplasm is filled with minute

granules which are stained dark with haematoxylin. The epithelium formed of these cells projects in the form of folds into the lumen increasing



TEXT-FIG. 10.—Section of the glandular epithelium of the digestive gland. $\times 600$.

co. c. columnar cells—the difference in the contents of the adjacent cells may be noted; ct. c. connective tissue cells; ct. f. connective tissue penetrating into the folds; cu. c. cubical cells with large nuclei; gr. brown granules in the cytoplasm; vac. vacuoles in the cytoplasm.

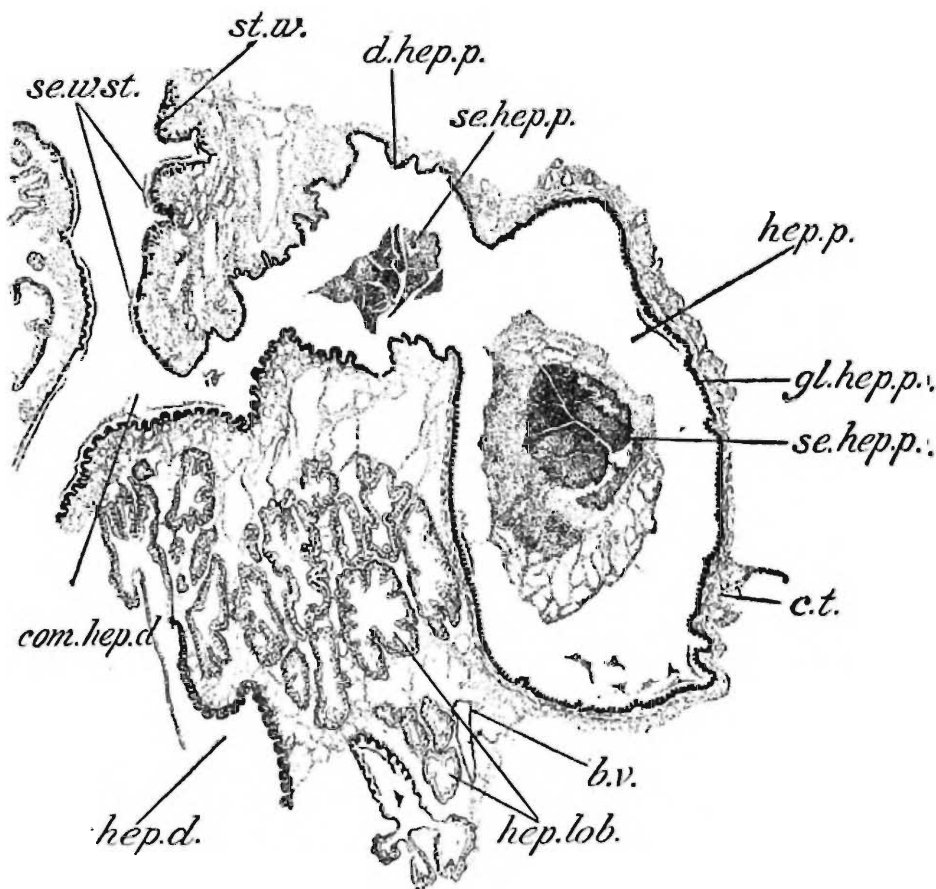
the surface. The connective tissue meshwork (ct. f.) penetrated by blood vessels and the sinuses fills up the interspaces between the various lobules and the ducts, holding them together as a compact gland.

In Gastropoda this digestive gland is, according to Barfurth (1883)*, both secretory and excretory in function. Frenzel (1886) described in *Tethys* three types of cells, the Kornzellen, the Keulenzellen and the Kalkzellen. Hecht* (1895) observed three kinds of definite cells, and a fourth which, according to him, may give rise to cells of any of the three types mentioned above. The three types he described are (i) Cellules vacuolaires excrétrices, (ii) Cellules excrétrices and (iii) Cellules á ferments. The cubical cells without the vacuoles in *Kalinga ornata* agree with the Cellules excrétrices of Hecht and the Kornzellen of Frenzel; while the vacuolated cells of either kind, i.e., those with and without the secretory products agree with the Cellules á ferments and Cellules vacuolaires respectively of Hecht, they are also identical with the Keulenzellen of Frenzel. I have not been able to make out cells which correspond to the Kalkzellen or the chalk cells of Frenzel. Eliot and Evans (1908) describe in *Doridoeides gardineri* certain free cells inside the lumen of the hepatic lobules. They believe that as some of the cells are filled with the excretory products they are detached from the

* For reference to these authors see Agersborg (1923).

walls of the lobules and are dropped into the cavity. No doubt some of them discharge an excretory function ; but I have not noticed any such cells lying free inside the hepatic lobules of *Kalinga ornata*.

Hepatic Pouch.—This is a roundish bag of 3 mm. diameter having thick glandular walls and a short, narrow passage 1 mm. long. It is placed just to the left of the common portion of the hepatic duct into which its cystic duct opens. As a result of the activity of the glandular cells lining the pouch a bluish-black granular secretion is derived. This secretion was considered by Eliot (1910) in *Doris* as forming a thin lining over the soft mucous layer of the stomach, the intestine and the wider portions of the hepatic duct to overcome the irritation caused by the spicules in the food of these Dorids. As a part of this secretion is also mixed with the contents of the alimentary canal, Evans (1914) believed that it acts also as a lubricant for the easy passage of the spiculate excrement down the intestine. As is seen in text-fig. 11, the secretion of the



TEXT-FIG. 11.—Section of hepatic pouch with its cystic duct opening into common hepatic duct. $\times 40$.

b. v. blood vessel ; *c. t.* connective tissue ; *com. hep. d.* common hepatic duct ; *d. hep. p.* duct of the hepatic pouch ; *gl. hep. p.* glandular wall of the hepatic pouch ; *hep. d.* one of the hepatic ducts ; *hep. lob.* hepatic lobules ; *hep. p.* hepatic pouch ; *se. hep. p.* secretion of the hepatic pouch ; *se. w. st.* secretion of the hepatic pouch over the mucosal walls of the stomach ; *st. w.* stomach wall.

hepatic pouch in this animal also forms a thin lining over the inner walls of the gut (*se. w. st.*) and the hepatic ducts ; and, as has been

suggested by previous writers, it probably protects the inner lining of the digestive area.

Intestine.—From the termination of the stomach the alimentary canal is continued as the intestine, about 6.2 cm. in length, with an almost uniform calibre, rather flat and oval in section and with its interior thrown into close longitudinal ridges. From its origin it runs forwards, and turning to the left makes an arch in front of the heart; it is then continued backwards to the anus. The presence of food in varying states of digestion in the intestine, shows that it is the main absorptive region of the gut. The intestinal region nearest the stomach shows only partly digested food not completely absorbed; while the region near the anus reveals undigested calcareous shells and spicules. The intestine consists of an outer fibrous layer and an inner glandular layer with connective tissue between them. The latter layer is formed of columnar ciliated cells with oval nuclei. The outer fibrous layer reveals only a few muscle fibres here and there. The intestine is of an orange colour, when the animal is alive, and is uniformly ciliated throughout its length. There is no typhlosole of the type described in such forms as *Melibe*.

Rectum.—The terminal region of the intestine, which pierces the wall of the back in the interbranchial area and opens out by the anus (text-fig. 4, *an.*) situated to the left of the renal pore, may be reckoned as the rectum though it does not differ to any extent from the rest of the intestine in its histological structure. Near the anus there is a sphincter muscle.

CIRCULATORY SYSTEM.

The circulatory system of *Kalinga ornata* resembles that of other Doridiform Nudibranchiate Molluscs with gills, except for a few variations.

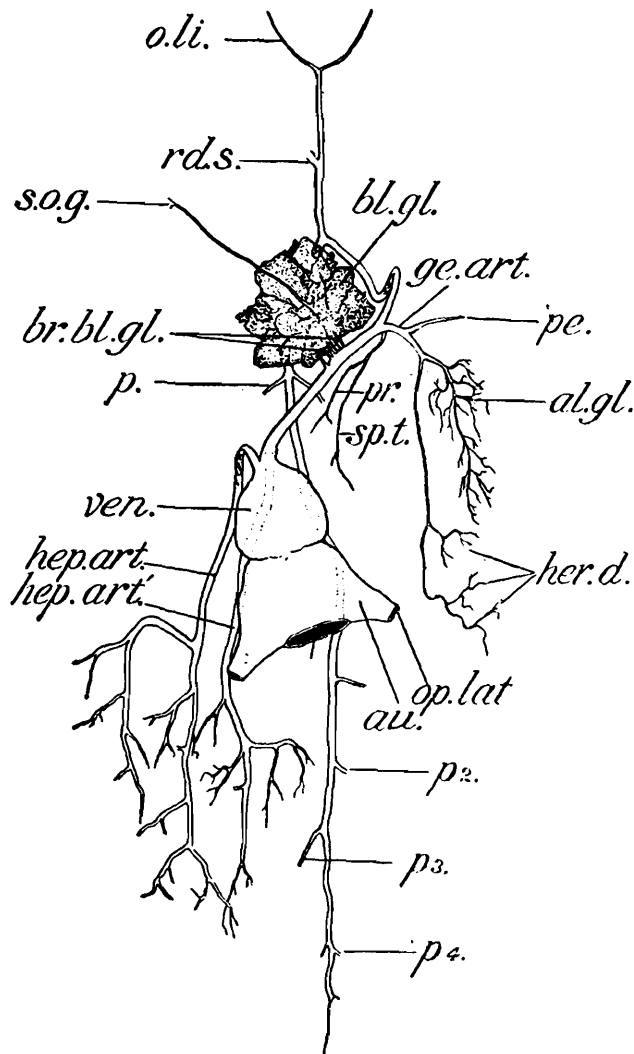
Heart and Pericardium.—The heart lies above the visceral organs just in front of the root of the median gill tree (text-fig. 4, *ht.*). Its pulsations can be seen through the translucent bodywall of the back, and vary from 48 to 50 per minute. It is a broad, muscular, two-chambered organ (text-figs. 2, 12) consisting of a thin-walled roughly triangular auricle (*au.*), and a comparatively thick-walled ventricle (*ven.*), enclosed in a thin transparent membranous pericardium (*pe.*), which is a continuation of the so-called peritoneum on all sides except in the hind region where the great veins communicate with the auricle. The latter, in its expanded condition, fills up a greater part of the lower half of the pericardial chamber, but the ventricle appears somewhat smaller. The walls of the auricle are transparent and formed of delicate strands of muscle and fibrous tissue; whereas those of the ventricle are opaque and highly muscular. As has been noted in *Aplysia* there is no endothelium lining either the auricle or the ventricle, and their muscles are directly bathed in blood. The floor of the pericardium is pierced by the reno-pericardial duct in the right posterior corner and the syrinx renale is suspended freely in the pericardial chamber by fine short strands of

fibrous tissue arising from the auricular wall. I have not observed any communication between the pericardial chamber and the perivisceral cavity. Since the pericardial cavity of Molluscs is coelomic and the perivisceral space is haemocoelic, the statements of some authors regarding the existence of such a communication in certain Dorids are obviously incorrect. The auriculo-ventricular opening, which is a wide transverse slit, is guarded by two semi-circular valves, which appear to be the continuation of the ventricular walls projecting inside. The valves prevent the passage of the blood back into the auricle when the ventricle contracts. This is effected by slender papillated ligaments which connect the auricular wall with the valves. It is probable that when the auricle filled with the blood contracts, the valves rise like a hinge mechanism aided by the pressure of the blood; but when it resumes its original form, the ligaments pull down the valves so that their straight edges meet preventing the blood from going back. At the entrance to the aorta there is another pouch-like valve which consists of a thin transparent membrane attached to the base of the aorta except anteriorly where it is free; the blood from the ventricle flows over the valve into the aorta and its branches, but as soon as it tries to flow backwards, the space between the valve and the lumen of the aorta gets filled and the passage is blocked.

Arterial circulation.—The main aorta arises above the ventricle (text-fig. 12) and divides immediately into three branches. The one lying to the left bends down, passes between the pericardium, and on reaching the mass of the hepatic gland divides into two branches, one ventral to the gland and the other dorsal. The right aortic branch has a similar course, reaching the digestive gland on its right side and giving off branches on the dorsal surface only. All these branches ramify in the hermaphrodite gland over the mass of the digestive gland and the ultimate minute branches enter the substance of this gland. Some of these minute branches are also in intimate connection with the kidney ramifications seen in the mass of the digestive gland.

The median branch or the anterior aorta at a distance of 1.2 cms. from its origin gives off from its left side about half a dozen minor branches which end in bunches of follicles of the blood gland (*bl. gl.*). One of these is considerably stouter than the others, and has some of its branches ending in follicles of this gland; but the main stem is continued forwards to supply the brain with blood. As the anterior aorta proceeds forwards slightly to the right, it gives off a branch (*ge. art.*) to the anterior genitalia. This artery gives off branches (*her. d.*) to the hermaphrodite duct, the albuminous gland (*al. gl.*) and the penis-sheath (*pe.*). The branch to the albumen gland divides further to form a close network over that gland. Before the genital artery is given off there arises from the aorta another small artery which supplies the spermatheca and the prostate gland. Then the anterior aorta turns slightly to the left and bending over the anterior genitalia reaches the ventral side where it divides into two branches. An anterior branch running straight along the median line on the ventral surface of the buccal mass gives off a short branch to the radular sac (*rd. s.*) and proceeds forwards to reach the oral tube, where it bifurcates supplying the outer

lips and the surrounding parts (*o. li.*). The other branch of the anterior aorta proceeds posteriorly supplying the foot with blood.

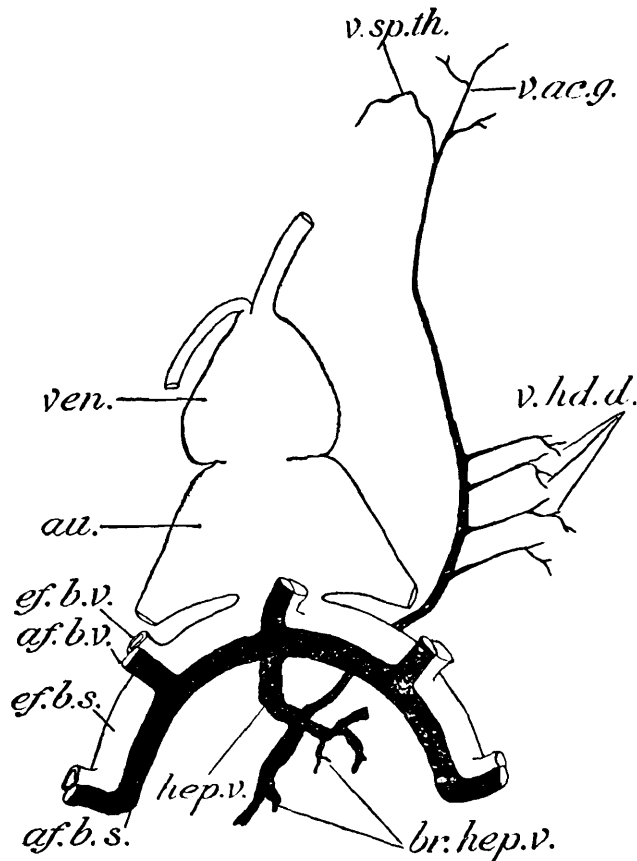


TEXT-FIG. 12.—Arterial system.

al. gl. branches to the albumen gland; *au.* auricle; *bl. gl.* blood gland; *br. bl. gl.* branches to the blood gland; *ge. art.* genital artery; *hep. art.* hepatic artery of the left side; *hep. art.* same of the right side; *her. d.* to the ampulla of the hermaphrodite duct; *o. li.* to the outer lips and the surrounding regions; *op. lat.* opening of the lateral vein into the auricle; *p.*, *p2.*, *p3.* and *p4.* branches of the pedal artery supplying the foot; *pe.* to the penis; *pr.* to the prostate; *rd. s.* to the buccal mass in the region of the radular sac; *s. o. g.* to the supra-oesophageal ganglionic mass; *sp. t.* to the spermatheca; *ven.* ventricle.

Veins and Branchial Circulation.—The arterial blood, after circulation throughout the body tissues, is received into the auricle from two sources : (i) from the skin or the body-wall proper, and (ii) from the branchial system (text-fig. 13). The great hepatic vein (*hep. v.*), which has its ramifications in the mass of the digestive gland, collects the blood from the hermaphrodite gland, the kidney and the digestive gland after they receive their supply from the hepatic arteries. The blood from the ampulla of the hermaphrodite duct (*v. hd. d.*), the spermatheca and the prostate is collected by various minute branches which unite into a small vein to join the great hepatic vein at its origin. This vein from the ampulla of the hermaphrodite duct, the spermatheca and the prostate

is, I believe, described here for the first time. In regard to *Doris*, Hancock and Embleton (1852) say, "In the viscera except in the liver mass and the skin after repeated injections and examination, we have

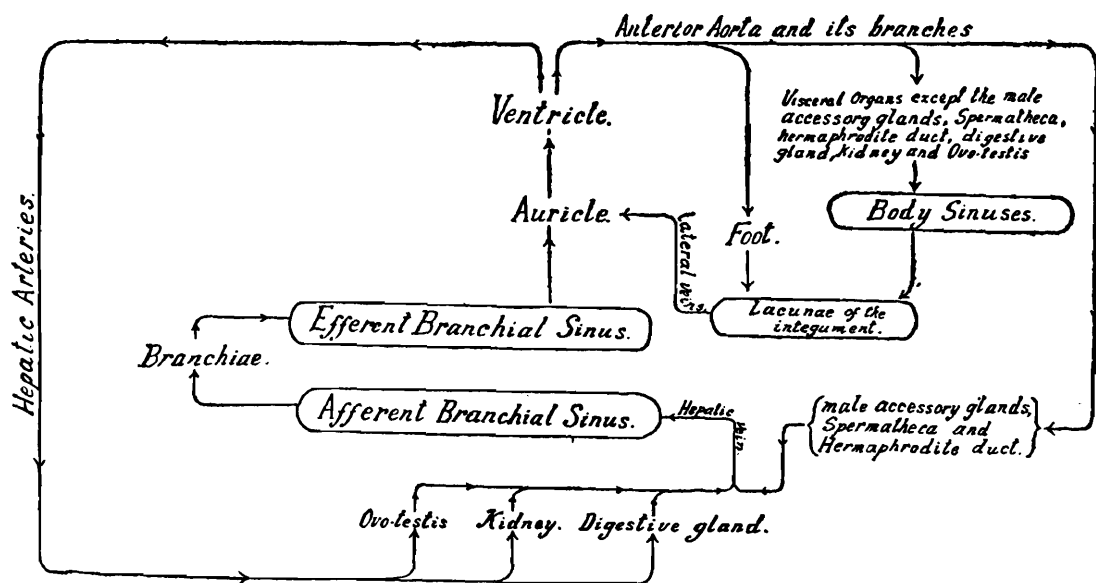


TEXT-FIG. 13.—Venous system.

au. auricle; *af. b. s.* afferent branchial sinus; *af. b. v.* afferent branchial vein; *br. hep. v.* branches of the hepatic vein; *ef. b. s.* efferent branchial sinus; *ef. b. v.* efferent branchial vein; *hep. v.* hepatic vein; *v. ac. g.* vein from the accessory reproductive gland; *ven.* ventricle; *v. hd. d.* veins from the hermaphrodite duct; *v. sp. th.* vein from the spermatheca.

failed to discover veins" Eliot (1910) verifying these results came to the same conclusion. The common hepatic vein after receiving all the branches comes up vertically through the hepatic groove and opens into a semi-circular afferent branchial loop or sinus (*af. b. s.*) lodged in the mantle in the region of the branchiae. In front this loop gives off the afferent branchial veins to the median, right and left anterior gill-trees; and its two ends are continued as the afferent branchial veins into the right and left posterior gill-trees. All these afferent branchial veins (*af. b. v.*) running along the inner side of the branchiae give off branches into the branchial pinnae. The blood passing through these membranous branchiae becomes aerated and is collected by the efferent branchial veins (*ef. b. v.*) lying along the external side of the gills. The efferent vessels of the five gill-trees open into another semi-circular loop or sinus (*ef. b. s.*) lying externally to the one described above. This external sinus communicates directly with the auricle by a median ventral opening; unlike *Doris* there is no efferent vein connecting the auricle and the sinus.

The blood from the anterior genitalia, the hermaphrodite duct, the liver, the kidney and the hermaphrodite gland is thus efficiently aerated in the branchiae and returned to the auricle. In all probability, blood from other regions of the body percolates, as has been suggested by Eliot and others, into a system of inter-visceral blood spaces or sinuses constituting the haemocoel, and passes into the lacunae in the integument, wherefrom it is collected by two lateral veins, one on either side, which open into the auricle posteriorly. Blood thus brought into the auricle through these veins is only partly aerated in the skin.



TEXT-FIG. 14.—Course of Circulation.

Blood Gland.—"It is a spongy glandular-looking organ analogous to some of the vascular ductless glands of the Vertebrata", say Hancock and Embleton in their description of the anatomy of *Doris*. Eliot (1910) says, "The functions of this gland have not been ascertained with precision. There are indications that it provides some of the constituents of the blood, as the colourless circulating fluid may be termed for brevity, and that it produces phagocytic cells which destroy pathogenic microbes" It is present in the Bullids and *Pleurobranchus* among the Tectibranchs, and in all Dorids among the Nudibranchiata; in Cladohepatica, however, it is rarely present. When it occurs, as in *Bathydoris*, in the region of the kidney it is said to be very primitive. In *Kalinga ornata* this gland (text-fig. 2, bl. g.), consisting of bunches of glandular follicles, lies slightly to the right side of the central nervous system, partly hides the anterior genital mass and communicates with the vascular system by the arterial branches arising from the anterior aorta. In Bouin-fixed material, stained with Mayer's haemalum, a number of loose cells with round nuclei are seen inside this gland and similar cells are also present free in the arterial branches. When observed fresh under a high power of the microscope the cells exhibit pseudopodial processes, and probably correspond to the phagocytic cells mentioned above.

The pericardial glands, which are generally present in the Gastropoda and whose function is supposed to be excretory, are absent in this form,

RESPIRATORY SYSTEM.

The chief respiratory organs are the branchiae, but the skin also has an accessory respiratory function. The branchiae are five, pinnately branched and arranged in a semi-circle in the region of the anus. Their colouration, arrangement and blood supply have already been described. In a transverse section (text-fig. 15) the branchiae show a non-ciliated epithelium, underlying which there is the loose connective tissue (*l. ct.*) with the afferent branchial veins (*af. b. v.*) running internally and efferent veins (*ef. b. v.*) externally. The two veins are separated by connective tissue through which, as shown in the figure, the muscle strands (*l.s.m.*) run lengthwise. There are no capillaries, and the blood passing through the fine branches in the minute plumes or pinnules is collected by similar branches of the efferent veins. Internally beneath the epithelium, there are numerous oval multicellular glands (*gl. m.*) with narrow ducts opening externally between the pinnules (*pin.*).



TEXT-FIG. 15.—Transverse section of a branchial plume. $\times$ ca. 35.

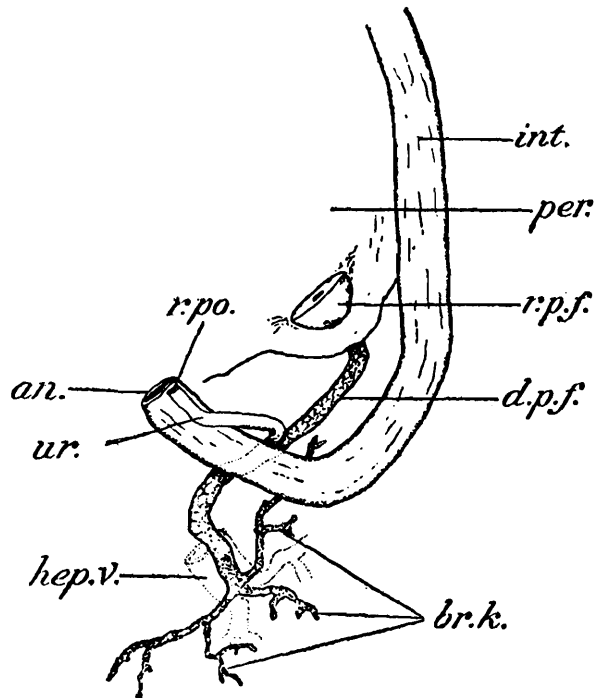
af. b. v. afferent branchial vein; *b. n.* one of the branchial nerves cut in section; *b. pin.* branch of the vein to the pinnules; *br'*, branch to the pinnules of the other side; *ef. b. v.* efferent branchial vein; *gl. m.* multicellular glands; *l. ct.* loose connective tissue; *l. s. m.* longitudinal strands of muscle; *o. epi.* outer epithelium; *pin.* pinnules.

The skin, being soft, free from spicules and beset with a number of papillated tufts, also acts as an accessory organ for the exchange of gases.

RENAL SYSTEM.

The renal system (text-fig. 16) consists of (i) the kidney with its ramifications spread in the mass of the digestive gland, (ii) the ureter (*ur.*) arising from the kidney and opening externally by the side of the anus and (iii) the reno-pericardial funnel (*r. p. f.*) with its duct communicating with the pericardial chamber on the one hand and with the ureter on the other.

Kidney.—The kidney consists of a few ramifications in the connective tissue, which fills up the interspaces between the follicles of the mass of the digestive gland. Its walls are supplied with blood from the branches of the hepatic arteries, and the waste products are extracted by special cells lining the kidney.



TEXT-FIG. 16.—Renal system.

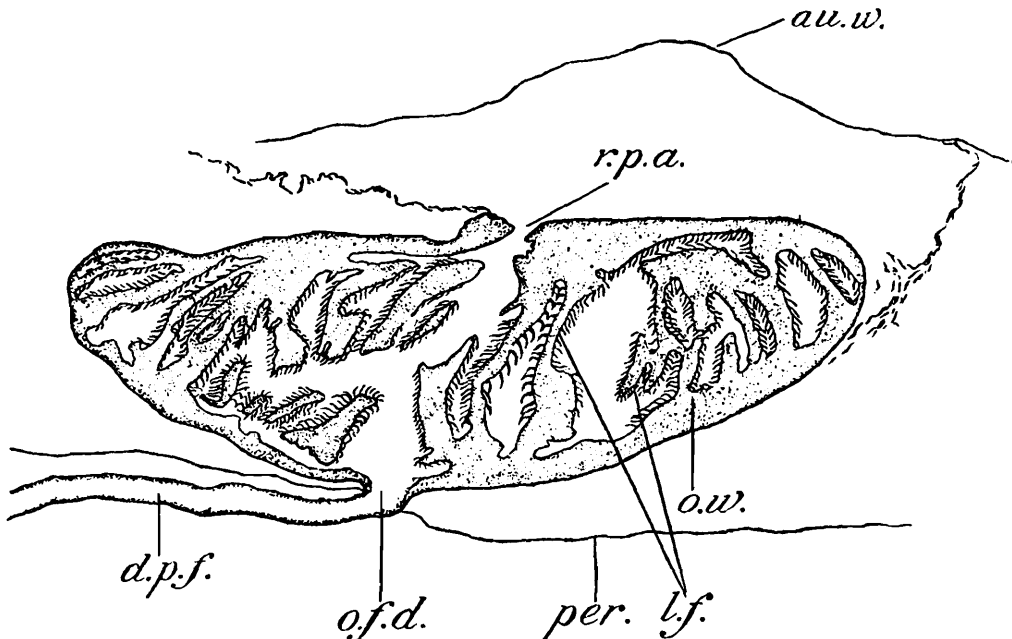
an. anus; *br. k.* ramifications of the kidney; *d. p. f.* duct of the reno-pericardial funnel; *hep. v.* hepatic vein; *int.* intestine; *per.* pericardium; *r. p. f.* reno-pericardial funnel; *r. po.* renal pore; *ur.* ureter.

The kidney in *Plocamophorus ceylonicus*, one of the Polyceridae, as described by Hancock (1864) extends between the anterior and the posterior lobes of the digestive gland in contact with the hepatic vein and terminates in a simple blind caecum; in *Doris tuberculata* it lies externally over the hermaphrodite gland; in *Melibe* the branches more or less follow the ramifications of the hepatic lobules which extend throughout the body-cavity; and in *Kalinga ornata* the ramifications are very few and lie well within the mass of the digestive gland.

Ureter.—The ureter (text-fig. 16, *ur.*) from the kidney is a thin semi-transparent duct about 8 mm. long. It follows the course of the hepatic vein, and piercing the wall of the back opens externally by the single pore (*r. po.*). About half way up it receives the duct of the reno-pericardial funnel. It is lined by an internal syncytial layer and an external thin fibrous layer. Near the cells of the internal layer there appear vacuoles of various sizes which seem to break up into the lumen of the ureter. Similar vacuoles were noticed in the ureter of *Melibe leonina* by Agersborg (1923), who suggested that the excretory product formed near the nuclei appears first in small vacuoles which later unite to form larger vacuoles and discharge their contents into the lumen of the ureter.

Reno-pericardial Funnel.—This structure has received different names such as the pyriform vesicle, the portal heart, the accessory renal or hepatic heart (Hancock and Embleton 1852), pericardial trichter

(Von Jhering), *syrinx renalis* or renal syrinx (Bergh), *nierenspitze*, etc. Some of these names are suggestive of its function, a few of its shape and position, while the others are mere misnomers. The terms, portal heart and accessory heart, applied by Hancock and Embleton introduce, according to Eliot (1910), confusion with regard to its function.

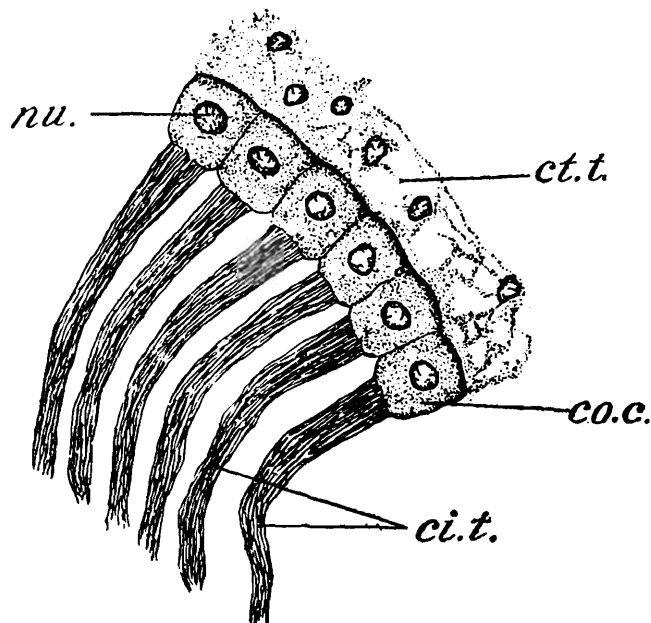


TEXT-FIG. 17.—Longitudinal section through the reno-pericardial funnel.

au. w. auricular wall ; *d. p. f.* duct of the pericardial funnel ; *l. f.* longitudinal folds bearing large tufts of cilia ; *o. f. d.* opening of the funnel into its duct ; *o. w.* outer wall of the funnel ; *per.* pericardium ; *r. p. a.* reno-pericardial aperture.

In *Kalinga ornata* the reno-pericardial funnel (text-fig. 16, *r. p. f.*) is an orange yellow, hollow, cup-shaped organ, 3.5 mm. by 2.5 mm., with its outer edge turned inwards to form a circular orifice. It lies in the right posterior corner of the pericardial chamber almost touching the auricular wall (text-fig. 17) where the right lateral vein enters the auricle and, as has been mentioned elsewhere, is held in position by a few fine fibrous strands arising from the auricular wall. In *Doris* and in *Eolis* figured by Hancock and Embleton (1848 and 1852) the funnel lies in apposition to the wall of the pericardium, and communicates with it, whereas in *Kalinga ornata* it lies within the pericardial chamber. From the narrow end of the funnel arises a thin translucent duct about 3-4 mm. long, and joins the ureter after piercing the pericardial wall. Unlike *Tritonia hombergi* (Hancock 1864) the wall of the funnel does not show any muscles. Internally as in all Nudibranchs, it is longitudinally plicated, the folds projecting into the lumen almost to the centre. The lining membrane over these folds is formed of moderately long columnar cells (text-fig. 18, *co. c.*) with fairly large nuclei (*nu.*) and tufts of cilia (*ci. t.*) several times longer than the cells themselves. The ciliary tufts of the individual cells are separate. The lining membrane of the lower fourth of the funnel does not bear any cilia, and the duct arises from this region. External to the lining membrane, there is a fibrous wall showing rather round nuclei. There is a definite reno-pericardial aperture (text-fig. 17, *r. p. a.*) in *Kalinga ornata* unlike *Melibe*

leonina in which Agersborg (1923) described a syncytial plate, which covers the reno-pericardial opening. In carefully prepared serial sec-



TEXT-FIG. 18.—Ciliated cells lining the folds of the renal funnel. $\times 600$.

ci. t. ciliary tufts; *co. c.* moderately tall columnar cells; *ct. t.* connective tissue of the outer wall of the funnel; *nu.* nuclei.

tions I did not find any such syncytial plate, but only a clear orifice communicating with the pericardial chamber. In this respect it agrees with *Dirona picta* where MacFarland (1912) describes such a communication.

NERVOUS SYSTEM.

The nervous system of *Kalinga ornata* (text-figs. 2 and 19), as in other Dorids, can be divided into two parts (i) the central nervous system with its commissures and peripheral nerves, which can be compared, according to Hancock and Embleton (1852), to the excitomotor or the cerebro-spinal system of Vertebrata, and (ii) the sympathetic system or, as has been suggested by Sir Charles Eliot (1910), the accessory nervous system which forms an extensive network over the viscera where it reveals a number of sympathetic ganglia.

The central nervous system, consisting of a small ganglionic mass (text-figs. 2 and 19, *s. o. g.*) enclosed in a thin translucent capsule of connective tissue, is placed on the roof of the buccal mass, where the oesophagus takes its origin. With its enclosing capsule the dimensions of this supra-oesophageal mass are 3.5-4 mm. from side to side and 2.5-3 mm. from back to front in a full-grown specimen. It is completely surrounded by small capsules or globules of nerve matter the function of which is very little known. The actual ganglionic mass is much smaller. The brain of *Kalinga ornata* shows a very great concentration of ganglia as in *Hexabanchus*, and is extremely small in proportion to the size of the body though in such small forms as *Eolis* and *Scyllaea* the ganglia in the brain can be made out easily with a hand-lens. For this reason, sections of the supra-oesophageal ganglionic mass were made by the

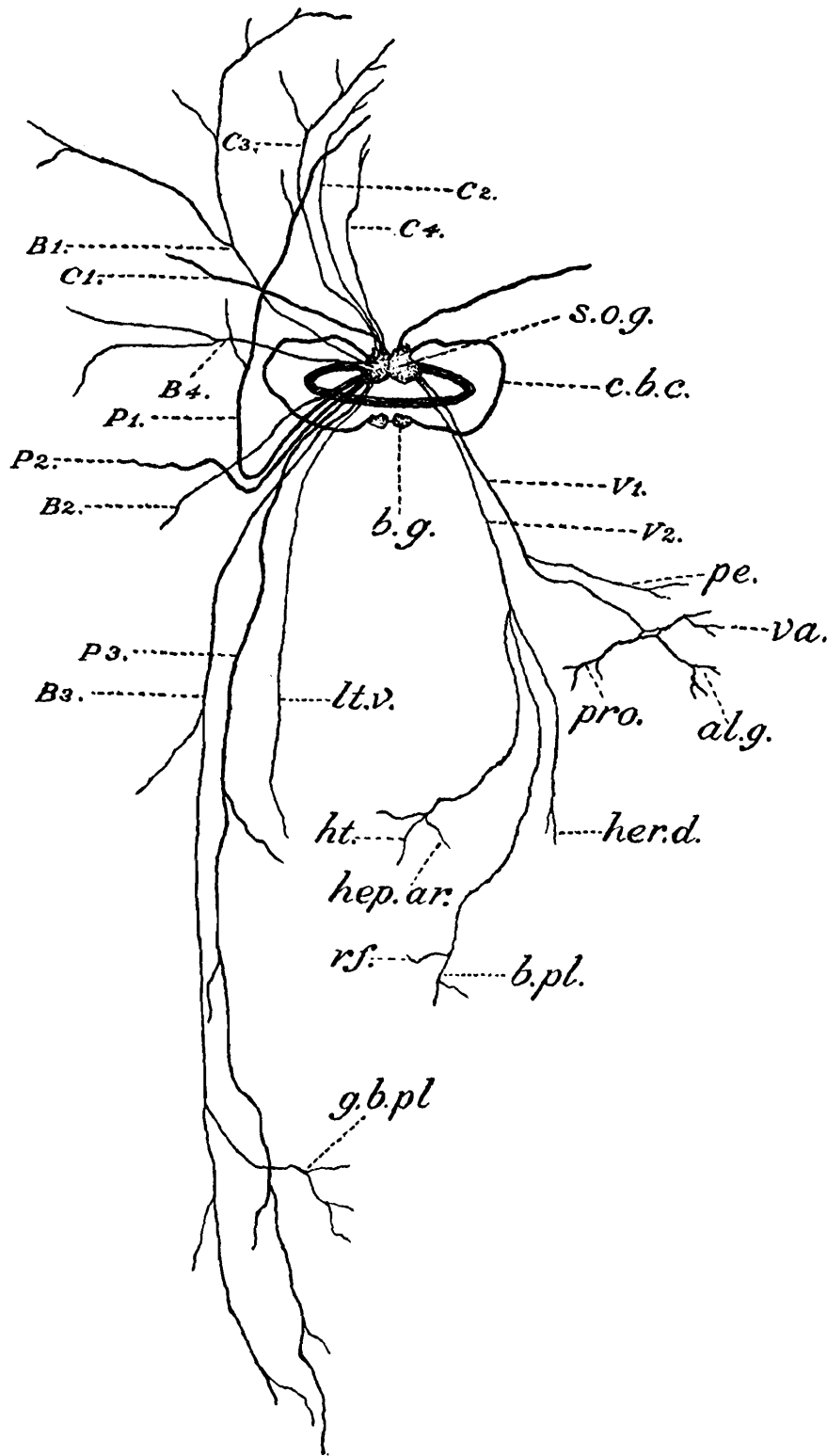
usual double embedding method, and stained with Delafield's Haematoxylin and eosin. The serial sections reveal a pair of small ovoid cerebral ganglia, a pair of branchial or pleural ganglia closely pressed against and almost fused with the cerebrals, and a pair of pedal ganglia. Since the cerebral and pleural ganglia are, as in many Dorids, more or less fused together, they may be called the cerebro-pleural in conformity with the terminology of several authors; its double nature, however, is seen clearly in transverse sections of the mass. The pedal ganglia lie posterior to and beneath the pleural. From the antero-dorsal region of the cerebral portion of the cerebro-pleural ganglion there arises the paired sessile rhinophoral or olfactory ganglion which is several times smaller than the cerebral. Lying beneath the posterior region of the right branchial and pedal ganglia is the unpaired visceral ganglion which is slightly smaller than the rhinophoral ganglion. The cerebrals are united by a very short commissure, while a distinct commissure does not exist between the cerebral and the pleural as they are almost fused; the pedal and the branchial are connected by a short commissure.

From behind the origin of the fourth pair of cerebral nerves, a pair of stout nerve trunks, the cerebro-buccal connectives arise, which passing round the oesophagus join the elliptical buccal ganglia (*b. g.*) to form a complete collar round the oesophagus. Close to this collar is another stouter collar consisting of three cords without ganglia on the inferior side of the oesophagus. Two of these cords connect the pedal ganglia while the third connects the left branchial on the one side and the unpaired visceral on the other. Whether the third collar is present in *Kalinga ornata* as in *Archidoris* is still to be verified.

Nerves from the Cerebral Ganglia.—A pair of stout nerves (*C1*) from the dorso-lateral region of the rhinophoral ganglia supplies the rhinophores. A second pair of cerebral nerves (*C2*) passing along the roof of the buccal mass supplies the anterior retractor muscles with branches. A third pair (*C3*) arising near the outer side of *C2* supplies the oral tube, the oral tentacles and the outer lips. A fourth pair of cerebral nerves (*C4*) running down the buccal mass to near the oral tube supplies the buccal muscles. The nerves *C2*, *C3* and *C4*, described above, all arise from the anterior region of the lower surface of the cerebral ganglion of either side. The next two pairs starting from these ganglia are extremely short and supply the eyes and otocysts.

Nerves from the Branchial Ganglia.—There are four pairs of pallial nerves arising from the branchial or the pleural ganglia. The first pair (*B1*) arises anteriorly from the branchials and passing forwards divides into two branches, which divide again to supply the papillae of the oral veil. The second pair (*B2*), arising from the postero-dorsal region of the branchials, supplies the middle region of the mantle. The third (*B3*), arising from about the same region, passes backwards to supply the mantle. The nerves of this pair in the region of the branchiae communicate with the branchial plexus of the sympathetic system. The fourth pair (*B4*) starts from about the middle region of the lower surface of the branchial and passing between the posterior retractor

muscles of the buccal mass divides into two branches which innervate the mantle region lying just behind the buccal mass. An unpaired



TEXT-FIG. 19.—Nervous system.

C1 Rhinophoral nerve; *C2*, *C3* and *C4*, other cerebral nerves.

B1, *B2*, *B3* and *B4*, branchial nerves to the mantle.

P1, *P2* and *P3*, pedal nerves to the foot.

V1 and *V2*, first and second visceral nerves.

lt. v. left visceral nerve starting from the left branchial ganglion.

al. g. nerve to the albumen gland; *b. g.* buccal ganglia; *b. pl.* branch from the visceral nerve to the branchial plexus; *c. b. c.* cerebro-buccal connective; *g. b. pl.* ganglion of the branchial plexus; *her. d.* to hermaphrodite duct; *hep. ar.* hepatic artery; *ht.* to heart; *pe.* to the penis sheath; *pro.* to the prostate; *rf.* branch to the renal funnel; *s. o. g.* supra-oesophageal ganglionic mass; *va.* to the vagina.

nerve from the left branchial, which is regarded as a visceral nerve, is described below.

Nerves from the Pedal Ganglia.—There are three comparatively stout pairs of pedal nerves (*P1-3*). The first bends under the posterior retractors of the buccal mass and supplies the anterior region of the foot; the second taking a similar course supplies the middle region; while the third passes backwards to innervate the whole of the middle and the posterior regions of the foot.

Nerves from the Visceral centres.—From the unpaired visceral ganglion mentioned above only two nerves were observed to take their origin. The first of these (*V1*) passes to the anterior genitalia and communicates with the sympathetic plexus of the genitalia innervating the vagina (*va.*), the albumen gland (*al. g.*) and the prostate (*pro.*). This nerve sends a small branch about half-way down its course to the base of the penis sheath (*pe.*). The comparatively slender second visceral nerve (*V2*) gives a few branches to the blood gland and proceeds backwards dividing into three branches. One of them divides into branches at the base of the aorta supplying the heart (*ht.*), the pericardium and the hepatic arteries (*hep. ar.*); the second, a slender nerve, supplies the reno-pericardial funnel (*rf.*) and finally joins the branchial plexus (*b. pl.*) of the sympathetic system; while the third innervates the ampulla of the hermaphrodite duct (*her. d.*).

A long slender visceral nerve (*lt. v.*) from the left branchial ganglion proceeds backwards to the hermaphrodite gland. Alder and Hancock (1845) describe a similar nerve in *Polycera quadrilineata*.

Nerves from the Buccal Ganglia.—A pair of buccal or infra-oesophageal or the stomatogastric ganglia (*b. g.*) is placed posteriorly on the buccal mass beneath the oesophagus. They are united by a short commissure and are connected to the cerebral ganglia by the cerebro-buccal connectives (*c. b. c.*). In some Nudibranchs there is a pair of gastro-oesophageal ganglia connected with the buccal ganglia. Alder and Hancock (1866) noted their absence in *Kalinga ornata* when they first described it. Three pairs of nerves arise from the buccal ganglia where the collar nerves join them. The first two pairs arise directly from the ganglia, whereas the third pair takes its origin from the collar. In one of the specimens examined, I found two pairs of nerves arising from the collar. The first pair passes slightly forward and divides into two branches, the posterior which proceeds along the oesophagus and the stomach to communicate with the sympathetic system and the anterior which runs forward on the roof of the buccal mass to supply the salivary glands and the muscles of the roof of the buccal mass. The next nerve arising from the ganglia supplies the roof of the buccal mass. The third pair, arising from the collar, supplies the muscles of the floor of the buccal mass. A pair of minute nerves, arising from the posterior region of the buccal ganglia, supplies the radular sac, and the posterior region of the buccal mass.

Sympathetic Nervous System.—This system in *Kalinga ornata* is neither as conspicuous as in *Doris tuberculata* nor so poorly developed as in *Eolis* and other forms; it is somewhat intermediate between the two types. It consists of various plexuses formed of nerve fibres and

minute ganglia, the latter being orange yellow in *Doris* and pale white in *Kalinga ornata*. One of the plexuses is seen over the anterior genitalia where it is connected with the central nervous system by the genital nerve of the visceral ganglion. A second plexus is seen over the stomach, the liver and the kidney communicating with the central nervous system through the gastro-oesophageal nerves arising from the buccal ganglia. A third is seen near the branchiae in the mantle forming what is known as the branchial plexus, which receives a branch from each of the third pair of branchial nerves. Serial sections of the entire animal reveal minute ganglia of this system all over the visceral organs and in the body-wall.

SENSE ORGANS.

The sense organs of *Kalinga ornata* comprise the eyes, the otocysts, the rhinophores, the labial folds, the lining of the oral tube, the general body-wall, and the papillated processes.

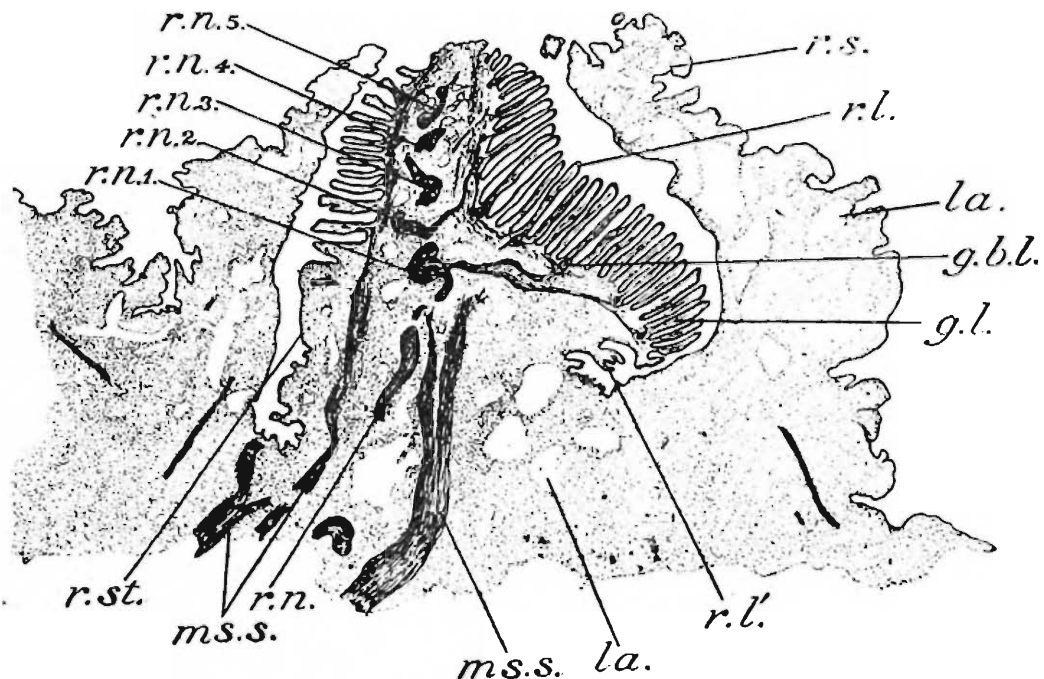
Eyes.—The eyes are present beneath the skin as two very minute black dots in the supra-oesophageal ganglionic mass close to the cerebral ganglia. They appear to be almost sessile on the cerebrals but carefully prepared serial sections reveal a very short nerve arising from the anterior face of these ganglia. Despite its very minute size and restricted function, the eye in *Kalinga ornata* is structurally well developed showing all the parts of a normally functioning Gastropod eye. Enclosed in a thin investing membranous capsule it consists of a cup-shaped pigmented retina accommodating a round globular lens over which lies a non-pigmented layer, the cornea. At the base of the retinal cup the optic nerve ends in a very small ganglion, from which radiate nerve fibres to supply the retinal cells. The skin that covers the eye being somewhat translucent, the animal can probably differentiate darkness from light, though perception of objects is not possible.

Otocysts.—Two tiny sacs placed dorsally on the cerebral ganglia reveal in each about 100 microscopical ovoid bodies, the otoliths or the otoconia, which when stained reveal a central and deeply stained part surrounded by a clear area. Each otocyst consists of a membranous capsule filled with a colourless fluid in which the otoliths float. These organs were for a long time supposed to be auditory in function but later Tschachotin (1908) in Heteropoda, and authors like Ilyn and Delage* on other Molluscs and Invertebrates in general, proved that they "maintain the equilibrium and regulate the exact position of the animal in space" For this reason these structures are appropriately termed statocysts and statoconia. The innervation of these organs as in other Nudibranchiata is from the cerebral ganglia.

Rhinophores.—The rhinophores or the dorsal tentacles are two club-shaped, retractile, lamellated and stalked structures situated on the back in the head region about 2 cm. from the oral veil. A description of their shape, appearance and colouration was included under the head 'External Features' of the animal. Their internal structure is rather complicated as they are traversed by nerve fibres, ganglia and muscle

* As referred to by Prashad, *Pila globosa*, *Mem. Ind. Mus.* VIII, p. 145 (1925).

fibres. Serial sections of this organ reveal a conical lamellated part with a very much abbreviated stalk (text-fig. 20, *r. st.*) lodged in the sheath (*r. s.*). There are thirty-two well-formed lamellae (*r. l.*) and a few minor lobes (*r. l.'*) at the base of the stalk. When the rhinophore is exerted the stalk is conspicuous, and the inner fold of the sheath is pulled out to form a real stalk, while the cavity of the sheath disappears.



TEXT-FIG. 20.—Median longitudinal section of a rhinophore in its sheath drawn from a slide. $\times$ ca. 35.

g. b. l. nerve ganglia at the base of the lamellae; *g. l.* ganglia in the lamellae; *la.* lacunae; *ms. s.* muscle strands; *r. l.* lamellae of the rhinophore; *r. l.'* minor lobes at the base of the rhinophore club; *r. n.*, *r. n1*, *r. n2*, *r. n3*, *r. n4* and *r. n5* rhinophoral nerve cut at various places as it passes in a slightly zigzag way; *r. s.* rhinophore sheath; *r. st.* rhinophore stalk.

The sheath is lined externally by the dermal epithelium which is a continuation of the epithelium of the body-wall. Underneath the epithelium there is loose connective tissue with lacunae (*la.*) filled with blood. The muscle strands (*ms. s.*) of the body-wall pass into the club-shaped head of the rhinophore and their fibres have their attachment near the bases of the lamellae, while a few pass into the lamellae also. Exsertion of the rhinophores is probably caused by the pressure of the blood which fills up the sinuses in the body-wall, and the retraction by the muscle strands described above. The rhinophoral nerve (*r. n.*) with its origin in the dorso-lateral region of the rhinophoral ganglion has a wavy course through the rhinophore to its very tip. A series of minute ganglia situated in and at the bases of the lamellae is connected by nerve fibres from the rhinophoral nerve. The epithelium lining the lamellae of *Kalinga ornata* is not ciliated.

The function of the rhinophores has not been definitely ascertained. Alder, Hancock and Embleton in describing various forms of Nudi-branches termed these structures as dorsal tentacles and attributed to them the sense of smell. Bergh called them 'rhinophores', a name which suggests their function to be olfactory. Eliot (1910) agreeing

with this view believed that the rhinophores enable these creatures to detect the presence of one another or of suitable food at a considerable distance. The reasons advanced by Hancock and Embleton (1852) in support of the view that these organs are olfactory in function are, that these organs are strongly innervated from the anteriormost regions of the cerebral ganglia, that the surface is laminated and that the epithelium bears vibratile cilia. While these facts show beyond doubt that these organs are highly sensitive and react to certain stimuli, it cannot be definitely said that they are discrete organs of smell or taste. Arey* who conducted several experiments on Nudibranchs says that it is safer to avoid such terms as the sense of smell or taste and believes that they respond to a general chemical stimulus, the power to respond to which is present all over the anterior part of the body-wall. Again Arey and Crozier* found that in *Chromodoris* the rhinophores are rheotropic in function, that when these organs are removed the animals lose their power of orientation while moving against the water currents. Agersborg (1922) in *Hermisenda*, however, observed that individuals deprived of these organs moved as easily against the current as the normal ones.

Other Sense Organs.—The labial folds and the lining of the oral tube are supposed to be the seat of sense of taste. The general body surface, especially the papillated processes and the branchiae, also respond to tactile stimulations.

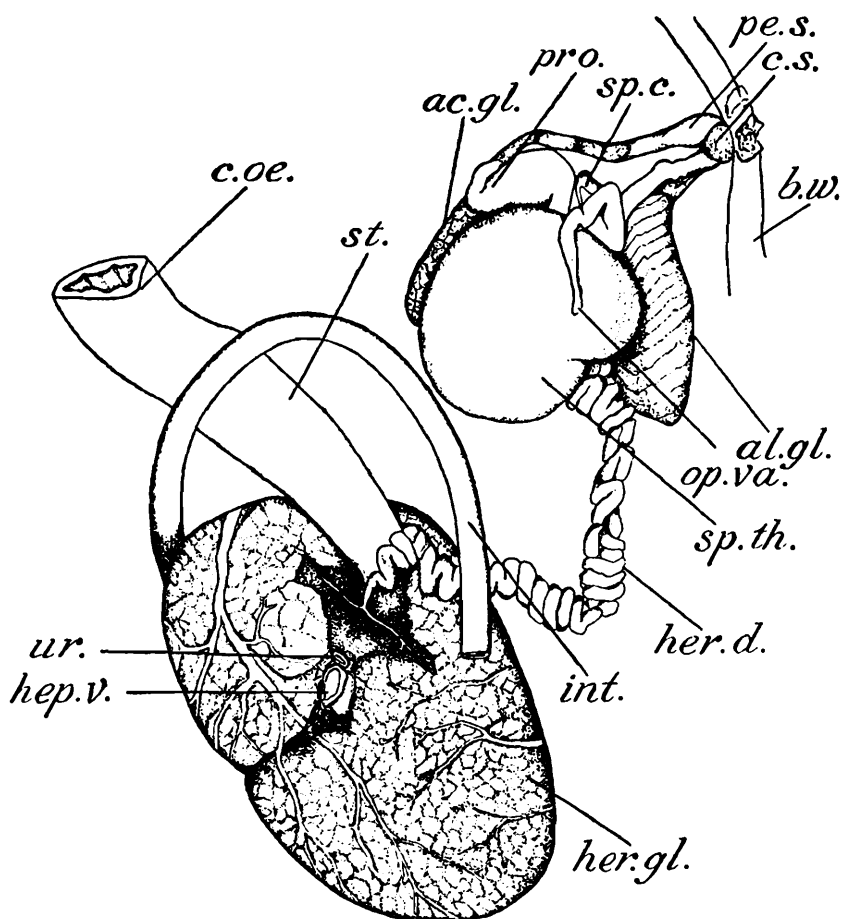
REPRODUCTIVE SYSTEM.

It consists of the hermaphrodite gland (text-fig. 21, *her. gl.*), the hermaphrodite duct (*her. d.*) and the anterior genital mass. All these parts, especially the anterior genitalia, attain considerable dimensions during the breeding season and occupy a very large space in the viscera. In its ducts it shows a typical triaulic condition.

Hermaphrodite Gland.—In a well-developed specimen the hermaphrodite gland (*her. gl.*) completely envelops the mass of the digestive gland excepting the region of the hepatic groove, and is profusely supplied with blood from the branches of the hepatic arteries. In the living animal this gland is externally deep brownish red and internally pale yellow in colour. In dorsal view it appears to be roughly divided into two lobes by the alimentary canal which fits into the hepatic groove, but ventrally it is continuous though compressed laterally to a certain extent between the stomach and the intestine. Sections of this gland fixed in Bouin's fluid, cut 6-7 μ thick, and stained with iron haematoxylin and eosin reveal a number of acini of either sex, all intermingling and communicating at intervals as they run side by side. Such communications exist between the acini of the same sex as also of opposite sexes. Ova and spermatozoa in various stages of development can be recognized in different acini. In the Nudibranchs the real hermaphrodite gland was for a long time considered to be the ovarium and the vas deferens to be the testis, causing a great confusion in identifying the various parts of the reproductive system. According to Pelseneer

* Arey and Crozier as referred to by Agersborg (1923).

(1895), it was Meckel who first showed the presence of the male and the female acini in the supposed ovarium, but he thought that the



TEXT-FIG. 21.—Reproductive system showing the anterior genitalia and the hermaphrodite gland over the digestive gland. The stomach and the intestine are also shown.

ac. gl. accessory male gland; *al. gl.* albumen gland; *b. w.* body-wall; *c. oe.* cut end of the oesophagus; *c. s.* copulatory sac; *hep. v.* hepatic vein; *her. d.* hermaphrodite duct; *her. gl.* hermaphrodite gland; *int.* intestine; *op. va.* origin of the vagina from the spermatheca; *pe. s.* penis sheath; *pro.* prostate; *sp. c.* spermatocyst; *sp. th.* spermatheca; *st.* stomach; *ur.* ureter.

acini did not communicate with one another. Nordman* was the first to notice the intercommunication of the acini, but he supposed that the ovular acini opened into capsules full of spermatozoa. Like his predecessors he supposed the hermaphrodite gland to be the ovarium with capsules of spermatozoa which he called the fecundation pouches. A correct interpretation was, however, given by Leuckart for *Eolis*. He showed that the peripheral ovular acini open into the central acini, producing sperms. This was confirmed by Bergh, Pelseneer (1895) and others. In *Kalinga ornata* the arrangement of the acini is irregular, the male and the female acini running side by side and communicating with one another, but without distinct central and peripheral regions of exclusively sperm-producing and ova-producing acini respectively. A similar arrangement of the acini was also recorded by Eliot (1908) in the hermaphrodite gland of *Doridoeides gardineri*.

* As referred by Pelseneer (1895).

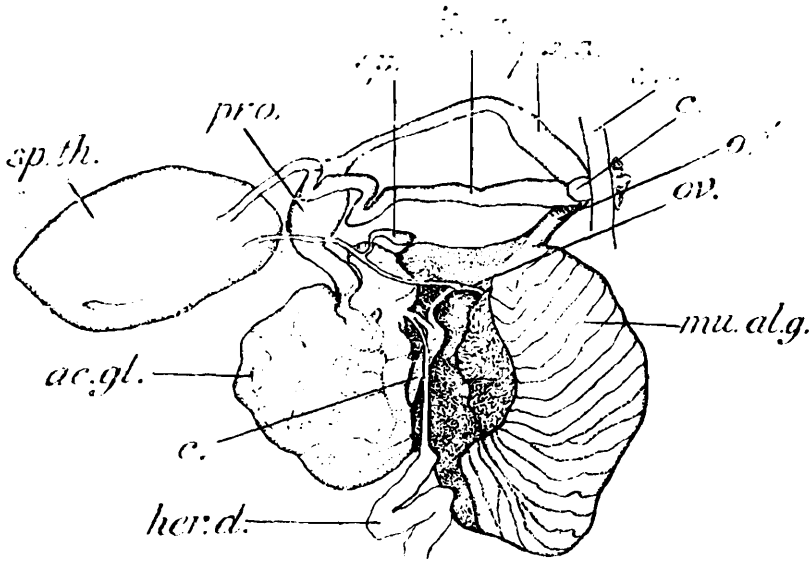
The gland is protandrous. In young specimens with very immature ova, the male acini clearly show well-developed sperms attached by their heads to the walls of the acini. Mature specimens reveal actual sperms as also fairly ripe ova in different acini. Along with these, spermatocytes and vocytes in various stages of growth are always present.

Hermaphrodite Duct.—Towards the anterior region of the hermaphrodite gland from each of its two lobes a minute duct is formed by a ramification of fine branches, which arise from the acini of the gland. These two ducts from the two lobes unite to form the hermaphrodite duct proper, which, very narrow at first, suddenly dilates into a broad duct (text-fig. 21, *her. d.*). It lies coiled to the right of the stomach between the anterior genital mass and the hermaphrodite gland. This dilated part of the hermaphrodite duct, which is called the ampulla, is richly supplied with blood from a branch of the genital artery. In its lumen fairly mature ova and a great number of spermatozoa are seen. A transverse section of the duct reveals an inner cellular layer and an outer fibrous layer. The cellular layer consists of ciliated columnar cells with fairly large oval nuclei. The hermaphrodite duct approaches the anterior genital mass and passes between the accessory male gland and the albuminous gland as a compressed narrow duct. On reaching the top region of these two glands, it suddenly bifurcates giving a very short left branch to the male genitalia and a right branch to the androgynous and the female genitalia.

The Anterior Genitalia.—In the anterior genital mass (text-figs. 21 and 22) which lies just behind the buccal mass and in front of the ampulla of the hermaphrodite duct can be recognised the male, the female and the androgynous organs with their ducts and accessory glands, all greatly pressed and united by connective tissue membranes. A close examination of the genital vestibule reveals the male, the vaginal and the oviducal openings.

The Male Genitalia.—Mention has already been made about the bifurcation of the hermaphrodite duct. Its left branch, which is very short, communicates with a spongy-looking gland (*ac. gl.*) that lies closely pressed against the muco-albuminous gland or the nidamental gland (text-fig. 22, *mu. al. g.*). The spermatozoa, which have been observed lying free in the hermaphrodite duct, are now seen in this accessory gland grouped into round or ovoid clusters forming the spermatophores. From the top corner of this gland a short wide thin-walled duct leads into a large ovate expansion, the prostate (*pro.*). Its walls are thick and glandular. A thin flat duct, about 20 mm. long, starts from the narrow end of the prostate and joins the penis sheath (text-figs. 21 and 22, *pe. s.*) which is 1.2 cms. long. The vas deferens passes through this thin flat duct and is followed by the penis with its basal wall in continuation of the penis sheath. Close to the base of the penis there are two folds of skin. The penis is armed with spines or "hacken bewaffnung" described and figured by Bergh (1890). They vary greatly in size and shape and can be seen lining the inner wall of the penis in its retracted condition. When the penis is everted they come to lie on the outer surface of the penis, and serve to secure firm hold on the vaginal tube of the mate during copulation,

Androgynous and Oviducal Organs.—The second division of the hermaphrodite duct from its point of bifurcation slightly bends down to the



TEXT-FIG. 22.—Anterior genitalia of the reproductive system showing the ducts.

ac. gl. accessory male gland; b. w. body-wall; c. caecum; c. s. copulatory sac; her. d. hermaphrodite duct; mu. al. g. muco-albuminous gland; ov. oviduct entering the muco-albuminous gland; ov¹. oviduct emerging out from the muco-albuminous gland; pe. s. penis sheath; pro. prostate; sp. c. spermatocyst; sp. th. spermatheca; vag. vagina.

right and communicates with a moderately long caecum (c.) 3-3.5 mm. long which lies pressed against the surface of the albuminous gland. Though I have not examined its contents microscopically yet from its shape, and position, and from the analogous structure, "the fertilization chamber", of *Polycera quadrilineata* figured and described by Pohl (1905), I believe that its function is to receive eggs and spermatozoa for fertilization. After communicating with the caecum the branch of the hermaphrodite duct runs slightly forwards and upwards on the surface of the albuminous gland and receives a narrow but tough duct from the spermatheca. It next enters the opaque albuminous gland and is continued into the mucous gland as a fairly wide greatly coiled ciliated tube. Finally it emerges from that gland on its extreme right top corner and opens externally by the oviducal opening for the deposition of the spawn.

The spermatheca or the receptaculum seminis (text-fig. 22, *sp. th.*) is a large roundish bag of reddish brown colour measuring about 15 mm. in diameter when full. Two ducts lead away from it, the vagina (*vag.*) opening to the exterior and the thin narrow passage communicating with the caecum mentioned above. This second duct receives on its way a still narrower duct approximately 2 mm. in length arising from a small pear-shaped body, the spermatocyst (*sp. c.*). The histological structure of the spermatheca is peculiar. Externally there is a thin muscular layer beneath which lies a comparatively thicker layer of loose connective tissue. Internally it is lined by a closely plicated glandular layer of columnar cells with three-fourths of their length free, and united only at their bases. The nuclei of these cells are large and oval; and from their staining reaction appear to be in a very active state. These cells

in *Kalinga ornata* differ from similar cells in *Melibe* described by Agersborg (1923) in that the nuclei in all the cells of the former occupy the distal half whereas in the latter they are basal in the majority of cells. The spermatheca examined by Agersborg contained both spermatozoa and ova and for this reason he designated it as the ovi-spermatheca. In *Kalinga ornata* during the breeding season the contents are only spermatozoa which are either free or packed into clusters. It, therefore, differs from *Melibe* in this respect and agrees with the Dorids in general.

The vagina (*vag.*) arising from the spermatheca (text-fig. 21, *op. va.*) is a fairly long highly muscular duct with an inner lining of glandular layer formed of columnar ciliated cells; this layer forms complex projections into the lumen. At its opening to the exterior, on either side, there is a small ovate saccular organ, which according to Bergh (1890) is the copulatory sac (*c. s.*).

BIOLOGICAL NOTES.

Kalinga ornata inhabits crevices of rocks submerged in shallow waters of the sea. Eliot (1910) remarked that "the Cladohepatica and Polyceridae are much more agile than the Dorids," but *Kalinga ornata* which is undoubtedly a Polycerid is as sluggish as the Dorids on account of the Dorid-like build of its body, as contrasted with the long, tailed forms like *Polycera*, *Plocamopherus*, etc., of this group.

Kalinga ornata is mainly carnivorous. Its food, as revealed by the stomach contents, consists of sponges, young lamellibranchs such as *Pecten* and *Cardium*, small Gastropods, and bits of Holothurians and Echinoids. It is very doubtful whether *Kalinga ornata*, without any organs of offence or defence except for the distasteful secretion of its dermal glands, can tackle any active fair-sized living prey. Probably it feeds on living as well as decaying animal matter available on the substratum on which it lives. From the nature of its radula and oral parts and from observations made on living specimens, the following conclusions are drawn regarding the method of its feeding. The animal applies the mouth to the prey bringing it more ventrally by a contraction of the ventro-lateral strands of the second set of anterior retractor muscles. Further, as a result of the relaxation of the first set of anterior retractors and the sphincter, the oral tube is widened and shortened. Then as a result of the movements of the odontophoral muscles, the odontophore and the radula are set into motion, rubbing against the hard surface of the labial disc. The prey caught between these two hard surfaces is crushed and at the same time rasped; the resultant scrapings are directed towards the oesophagus by the movement of the odontophore.

The eversion of the buccal organ is a very peculiar feature, which has been regularly observed in preserved specimens by all who studied *Kalinga ornata*. Eliot (1906) says "It is therefore clear that the buccal parts are habitually protruded in preserved specimens. But it is impossible to say whether this protrusion is due to convulsive action at the moment of death or whether the living animal can protrude its radula voluntarily. Information as to the feeding habits is much to be desired, ...". I have noticed eversion of the buccal organ both

in living and preserved specimens. When a living specimen of *Kalinga ornata* and a fish were brought together to the Laboratory in a small pot, the Nudibranch, perhaps as a result of the constant annoyance caused by the fish, had partly everted its buccal mass, which measured as much as the animal itself. It was coloured crimson on its upper surface, while its lower surface was of a somewhat lighter hue. I believe that this organ serves to warn or frighten the approaching enemy. Like most Nudibranchs *Kalinga ornata* must be unpalatable to fishes and other animals owing to the presence of large number of mucous glands in the foot, the body-wall and the branchiae; the inedibility of brightly coloured animals is a wide-spread and well-known feature. As in the instance cited above I have observed eversion occurring in a healthy specimen and it may be concluded that it is within the direct control of the animal. The withdrawal of the buccal organ is also under the control of the animal if eversion has been carried only so far as not to cause any injury to the animal. It may be noted here that the eversion of the buccal organ brought about by convulsions before death, though similar, is very violent, and consequently the parts are very much torn. The fact that such an eversion takes place only when the animal is irritated indicates that the explanation suggested above is tenable. Such a display of bright colouration to warn enemies, is not uncommon. A tropical Dorid, *Hexabranhus*, acts similarly. According to Eliot (1910) it spreads out its bright red mantle region at the approach of the enemy as a warning; but when pursued further by the enemy, it hides its bright colouration by folding the mantle, and disappears from view. No mollusc protruding its buccal organ to display a warning colouration of this kind has hitherto been recorded.

Autotomy of the respiratory organs or the cerata in Eolids is very common. Though this phenomenon is unknown among the British Dorids, Eliot (1910) observed that *Discodoris fragilis* and a few others from the tropics having lost the entire mantle margin "remain in apparent good health". In *Kalinga ornata* I have often seen the absence of some of the branchiae, the mantle being scooped out in those places. In a few forms that I have observed some of the branchial trees were very small when compared with the rest. It is probable that they were regenerating branchiae. Strictly speaking, the term autotomy cannot be applied to the phenomenon observed here. In Eolids, where they are shed off voluntarily at the mere sight of the enemy it is undoubted autotomy. In *Kalinga ornata*, I have never observed the branchiae being shed spontaneously, or any structural modification of the branchiae enabling the breakage of the organs to take place along a definite weak zone. It seems to me therefore that what has been observed here is only a case of regeneration following injury caused by enemies, or by accident.

Very few parasites seem to infest this animal. On the back of the animal a pycnogonid, probably *Nymphon parasiticum*, and a few Copepod parasites have been noticed.

The animals are protandrous, and even though mature sperms have been noticed almost throughout the year the eggs ripen during the early summer, i.e., January and February. During these months copulation also takes place as a result of which their spermathecae are full of sperms.

SUMMARY.

1. A study of the complete external and internal morphology of *Kalinga ornata* has been attempted.
2. The structure of the buccal mass is described in detail and drawings of the various parts of the buccal organ under normal and everted conditions are reproduced.
3. The radular formula of *Kalinga ornata* is 100.0.100. The teeth are all similar. The independent movement of the radula over the odontophore is impossible; the former moves with the latter by the action of the odontophoral muscles.
4. The peculiar histological structure of the hepatic ducts is described. The Kalkzellen of the digestive gland are absent. It is suggested that the intestine is the main absorptive region.
5. There is no endothelium lining either the auricle or the ventricle, and the muscles of the heart are directly bathed in blood. The circulatory system is described, and the presence of a vein which brings blood from the spermatheca, the prostate and the hermaphrodite duct is recorded.
6. The kidney ramifications are few in number; they penetrate the connective tissue of the digestive gland. The reno-pericardial funnel lies within the pericardial cavity and communicates with it by a distinct orifice. There are no pericardial glands in this form.
7. The central nervous system shows a very great concentration of the various ganglia.
8. The ovo-testis is protandrous. Ova and spermatozoa are produced in different acini, but there is no definite arrangement of these acini. The genital vestibule shows three openings, viz., the male, the vaginal and the oviducal. In addition to the prostate there is an accessory gland in connection with the male genitalia. A small caecum communicates with the oviduct; and it acts in all probability, as a fertilization chamber.
9. Its habitat, food and the method of feeding are described. The animal protrudes its buccal organ to display a warning colouration. A Pycnogonid and a few Copepod Crustaceans on the back of the animal as external parasites are recorded.

BIBLIOGRAPHY.

1. Agersborg, H. P. K. "Some observations on qualitative chemical and physical stimulations in Nudibranchiate Mollusks with special reference to the rôle of the 'rhizophores'" *Journ. Exper. Zool.*, 1922 : XXXVI : pp. 423-444 : 2 figs.
2. Agersborg, H. P. K. "The Morphology of the Nudibranchiate Mollusc, *Melibe* (syn. *Chioraera*) *leonina* (Gould)." *Quart. Journ. Micr. Sci.*, 1923 : LXVII : pp. 507-592 : pls. xxvii-xxxvii.
3. Alder, J. "Observations on the Genus *Polycera* of Cuvier with Descriptions of two new British species." *Ann. Mag. Nat. Hist.*, 1841 : VI : pp. 337-342.

4. Alder, J. and Hancock, A. "A Monograph of the British Nudibranchiate Mollusca." The Ray Society, London, 1845. Parts 1-7.
5. Alder, J. and Hancock, A. "Notice of a Collection of Nudibranchiate Mollusca made in India by Walter Elliot, Esq., with Descriptions of several New Genera and Species." *Trans. Zool. Soc. London*, 1866 : V : Pt. 3 : pp. 113-147
6. Baba, K. "A noteworthy gill-less Holohepatic Nudibranch, *Okadaia elegans*, Baba, with reference to its internal anatomy." *Annot. Zool. Jap.*, 1931 : XIII : pp. 63-89.
7. Baba, K. "Preliminary note on the Nudibranchia collected in the vicinity of the Amakusa Marine Biological Laboratory." *Ibid.* 1933 : XIV : pp. 165-179.
8. Barnard, K. H. "South African Nudibranch Mollusca, with Descriptions of New Species, and a Note on some Specimens from Tristan d'Acunha." *Ann. S. African Mus.*, 1927 : XXV : pp. 171-215 : pls. xix, xx.
9. Bergh, R. "Report on the Nudibranchiata dredged by H. M. S. Challenger during the years 1873-76." Report of the Scientific results of the Exploring Voyage of H. M. S. Challenger. 1873-1876 : Zool. X : pp. 1-154 : pls. i-iv.
10. Bergh, R. "Malacologische Untersuchungen" in Semper's *Reisen im Archipel der Philippinen*. 1890 : III : Heft 17.
11. Bergh, R. "Opisthobranchiata of South Africa." *Trans. S. African Phil. Soc.*, 1908 : XVII.
12. Brown, Herbert, H. "A study of a Tectibranch Gasteropod Mollusc, *Philine aperta* (L.)." *Trans. Royal Soc. Edin.*, 1934 : LVIII : pp. 179-210.
13. Eales, N. B. "Aplysia." *Liv. Mar. Biol. Comm. Memoir* 24, 1921.
14. Eliot, C. N. E. "On the Nudibranchs of Southern India and Ceylon, with special reference to the Drawings made by Kelart and the Collections belonging to Alder and Hancock preserved in the Hancock Museum at Newcastle-on-Tyne." *Proc. Zool. Soc. London*, 1906 (on *Kalinga*, pp. 670-673 : pl. xlvii, fig. 2).
15. Eliot, C. N. E. "The Nudibranchiata of the Scottish National Antarctic Expedition." *Trans. Royal Soc., Edin.*, 1906 : XLI : pp. 519-532.
16. Eliot, C. N. E. "The Nudibranchiata, with some remarks on the families and genera and description of a new genus, *Doridomorpha*." Stanley Gardiner's *Fauna and Geography of the Maldivé and Laccadive Archipelagoes*, 1906 : pp. 540-573.
17. Eliot, C. N. E. "A Monograph of the British Nudibranchiate Mollusca." 1910. Part 8 (Supplementary). 197 pp., 8 pls.
18. Eliot, C. N. E. "Japanese Nudibranchs." *Journ. Coll. Sci., Imp. Univ., Tokyo*, 1913 : XXXV : pp. 1-47 : pls. i, ii.
19. Eliot, C. N. E. "Fauna of the Chilka Lake : Mollusca Nudibranchiata." *Mem. Ind. Mus.*, 1916 : V : pp. 377-379.

20. Eliot, C. N. E. and Evans, T. J. "Doridoeides gardineri : a Doridi-form Cladohepatic Nudibranch." *Quart. Journ. Micr. Sci.*, 1908 : LII : pp. 279-299 : pls. xv, xvi.
21. Evans, T. J. "The Anatomy of a New Species of Bathydoris, and the affinities of the Genus : Scottish National Antarctic Expedition." *Trans. Royal Soc., Edin.*, 1914 : L : pp. 191-209 : pls. xvii, xviii.
22. Farran, George, P. "Report on the Opisthobranchiate Mollusca collected by Prof. Herdman, at Ceylon, in 1902." *Rep. Pearl Oyster Fish. of the Gulf of Manaar*, 1905 : III : pp. 329-364 : pls. i-vi.
23. Goodrich, Edwin S. "On the Coelom, Genital ducts, and Nephridia." *Quart. Journ. Micr. Sci.*, 1895 : XXXVII : pp. 477-510 : pls. xlv, xlv.
24. Hancock, A. "On the Structure and Homologies of the Renal organ in the Nudibranchiate Mollusca." *Trans. Linn. Soc. London*, 1864 : pp. 477-510 : pls. liv-lix.
25. Hancock, and Embleton, D. "On the Anatomy of *Eolis*, a genus of Mollusks of the order Nudibranchiata." *Ann. Mag. Nat. Hist.*, XV, 1845 : pp. 1-10 ; pp. 77-88 ; (2) i, 1848 : pp. 88-105 ; (2) iii, 1849 : pp. 183-202.
26. Hancock, A. and Embleton, D. "On the anatomy of *Doris*." *Report Brit. Assoc. Adv. Sci.* (1850), p. 124, 1851.
27. Hancock, A. and Embleton, D. "On the anatomy of *Doris*." *Phil. Trans. Royal Soc. London*, 1852 : CXLII : pp. 207-252 : 7 pls.
28. Herdman, W. A. and Clubb, J. A. "On the Innervation of the Cerata of some Nudibranchiata." *Quart. Journ. Micr. Sci.*, 1892 : XXXIII : pp. 541-558 : pls. xxxii-xxxiv.
29. Lang, Arnold. "A Text Book of Comparative Anatomy" translated by Bernard. Pt. II. London.
30. Lankester, E. Ray. "Note on the coelom and vascular system of Mollusca and Arthropoda." *Quart. Journ. Micr. Sci.*, 1893 : XXXIV : pp. 427-434.
31. Lankester, E. Ray. "A Treatise on Zoology." Pt. V Mollusca by Paul Pelseneer. London, 1893.
32. MacFarland, F. M. "The Nudibranch family Dironidae." *Zool. Jahrb. (Suppl. 15 : Festschrift für J. W. Spengel)*, 1912 : Bd. I : pp. 515-533 : pls. xxx-xxxii.
33. Parker, T. J. and Haswell, W. A. "A Text book of Zoology." New York, 1910 : Vol. I : Pt. I.
34. Parona, C. "L'Autotomia e la rigenerazione delle appendici dorsali (Phoenicurus) nella *Tethys leporina*." *Zool. Anz.*, 1891 : XIV : pp. 293-295.
35. Pelseneer, P. "Hermaphroditism in Mollusca." *Quart. Journ. Micr. Sci.*, 1895 : XXXVII : pp. 19-46 : pls. iv-vi.
36. Pohl, P. "Über den feinern Bau des Genital Systems von *Polycera quadrilineata*." *Zool. Jahrb. Anat.*, 1905 : XXI : pp. 427-452.

37. Russel, L. "The Comparative Morphology of the Elysioid and Aeolidioid Types of the Molluscan Nervous System and its Bearing on the Relationships of the Ascoglossan Nudibranchs." *Proc. Zool. Soc. London*, 1929 : pp. 197-233.
38. Sedgwick, Adam. "A Student's Text book of Zoology." Pt. I. 1909.
39. Sewell, R. B. S. and Annandale, N. "Fauna of Chilka Lake : The Hydrography and Invertebrate Fauna of Rhamba Bay in an abnormal year—' *Stiliger pica* Ann. and Prashad." *Mem. Ind. Mus.*, 1922 : V : pp. 700-702.
40. Tschachotin, S. "Die Statocyste der Heteropoden" *Zeit. Wiss. Zool.*, 1908 : XC : pp. 343-422 : pls. xx-xxiv.

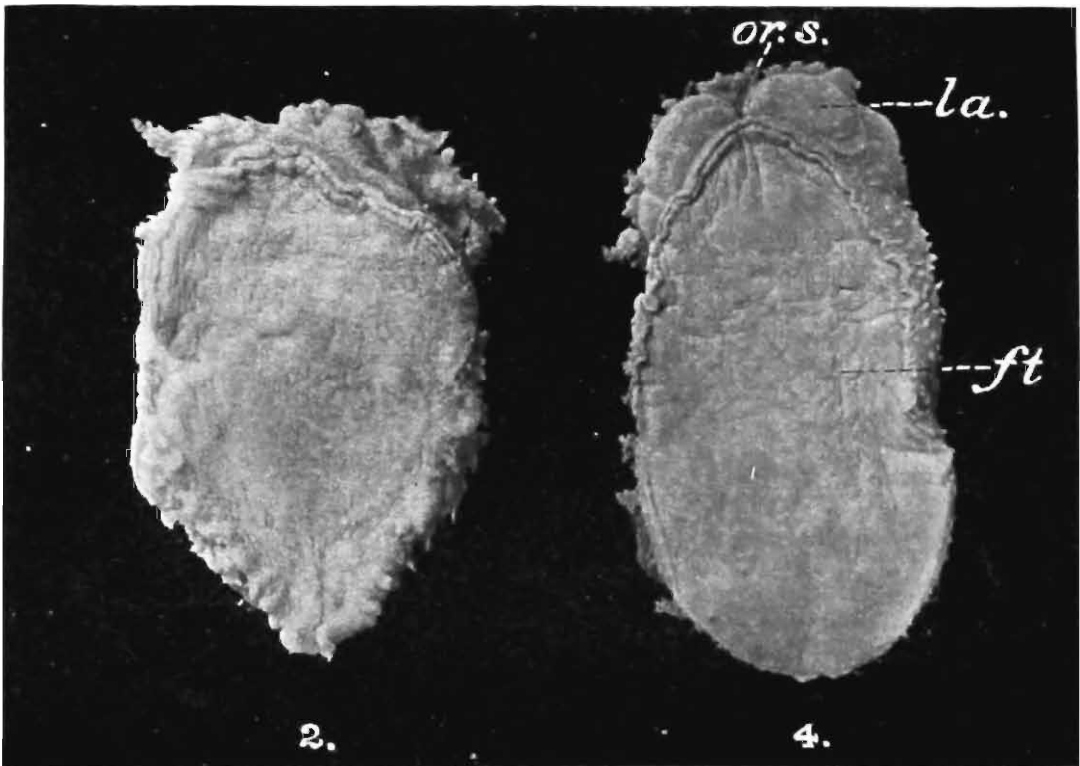
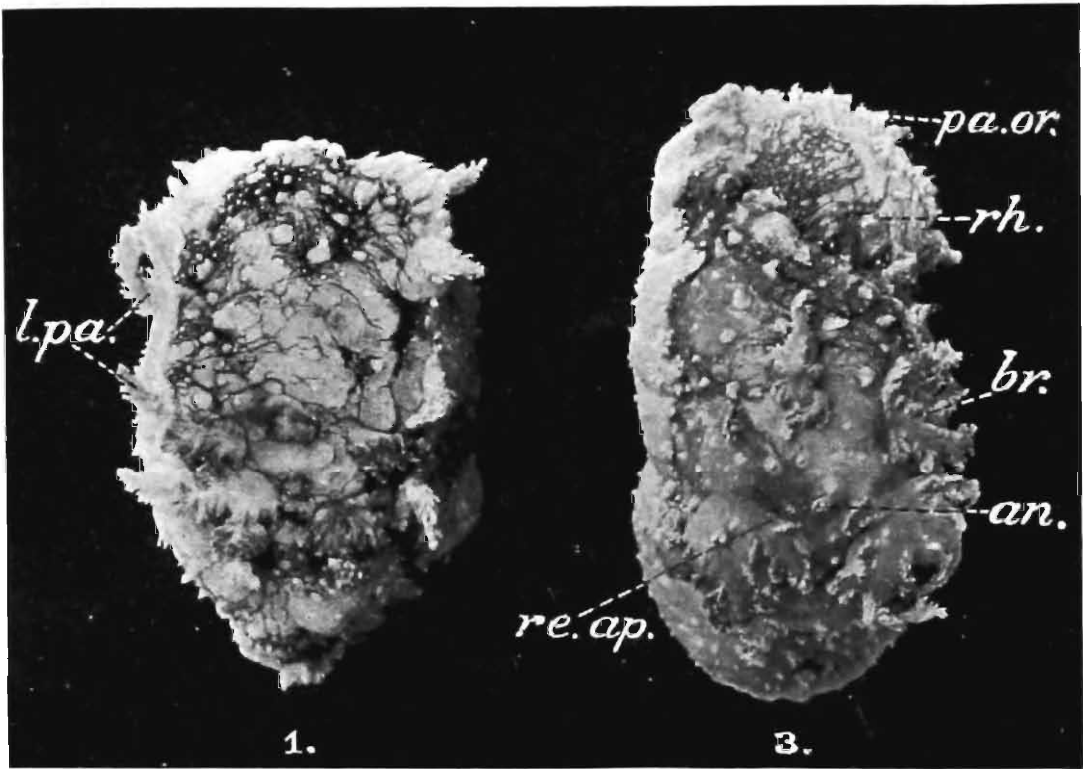
EXPLANATION OF PLATE III.

FIGS. 1 & 3.—Dorsal view of two specimens of *Kalinga ornata* (Alder & Han.) preserved in formalin. (Nat. size.)

The difference in shape between the two specimens is due to fixation. Figure 3 represents a well-narcotised specimen.

FIGS. 2 & 4.—Ventral view of the same.

an. anus; *br.* branchiae; *ft.* foot; *la.* labial folds; *l. pa.* large papillated tufts of the sides; *or. s.* oral slit or mouth; *pa. or.* papillae of the oral veil; *re. ap.* renal aperture; *rh.* rhinophore.



Kalinga ornata (Ald. & Han.).

THE HELMINTHS PARASITIC IN THE FRESH-WATER TURTLES OF RANGOON.

By R. C. CHATTERJI, *Helminthological Institute, University of Rangoon.*

The present account is based on a collection of helminths from the common fresh-water turtles of Rangoon—*Emyda scutata* and *Morenia ocellata*. Two turtles each of the two species were dissected and a large number of intestinal flukes and roundworms were obtained; no blood flukes or other varieties of helminths were found. Of the four species of flukes obtained only one was incompletely described by Bhalerao (1931) from *Batagur baska* of Rangoon, while the other three are new. The roundworms obtained belong to two species of a common genus, one of which is new and a single female specimen of *Camallanus* the specific determination of which remains uncertain. In course of preparation of the present work valuable assistance was rendered by my colleague Mr. B. S. Gogate, to whom I wish to express my sincere thanks. The type-material of the various species is deposited in the Indian Museum, Calcutta.

Class TREMATODA.

Order DIGenea.

Family ALLOCREADIIDAE Stossich 1904.

Subfamily ALLOCREADIINAE Looss 1899.

Kaurma longicirra, gen. et sp. nov.

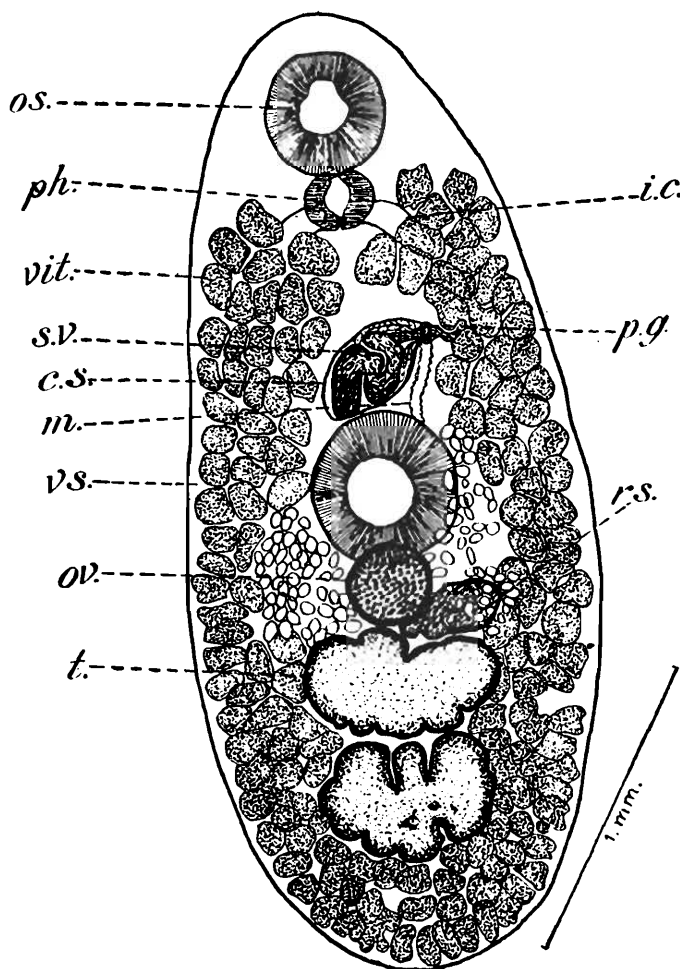
Host :—*Emyda scutata*.

Twenty specimens were obtained from the intestine of one host of which one was very immature showing slight development of the female genitalia. Body oval and elongated with posterior end broader than anterior. Length 2.32—5¹, maximum thickness immediately behind ventral sucker at the region of ovary, 1—2. Spines absent from body but strongly developed on ventral sucker. Suckers present, ventral larger than oral, 0.42—0.72 and 0.36—0.57 in diameter respectively. Oral sucker subventral and well behind anterior margin of body: in some specimens its transverse diameter was found longer than its longitudinal, a case probably due to unequal contraction of body during fixation. Ventral sucker in middle third of body and always spherical. Prepharynx absent. Pharynx muscular, 0.154—0.285 × 0.167—0.342. Oesophagus absent. Intestinal caeca of uniform width, ending a little anterior to posterior end. Genital pore on left side of body, away from intestinal bifurcation and anterior to ventral sucker. Genital atrium small in which side by side lie the male and female genital pores.

Testes median, lobed, situated in posterior third of body except a part. Both the anterior and the posterior testes are longer transversely than antero-posteriorly measuring 0.6—1.14 × 0.23—0.57 and

¹ All measurements are given in millimetres.

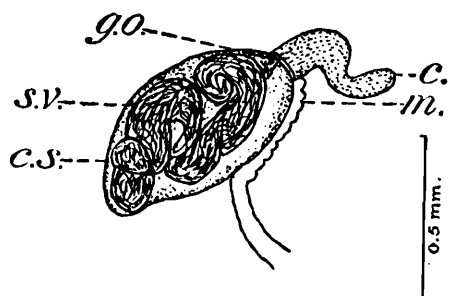
0.58—1.02 $\times$ 0.32—0.67 respectively. Cirrus sac large and oval, 0.28—0.7 long, enclosing a very much coiled vesicula seminalis, scattered prostatic cells, and ductus ejaculatorius, and lying obliquely immediate anterior to ventral sucker and opening into the genital atrium on the left side of the body. Cirrus long, muscular and curved.



TEXT-FIG. 1.—Ventral view of *Kaurma longicirra*, gen. et sp. nov.

c. s., cirrus sac; i. c., intestinal caeca; m., metraterm; os., oral sucker; ov., ovary; p. g., prostatic gland; ph., pharynx; rs., receptaculum seminis; s. v., vesicula seminalis; t., testes; vs., ventral sucker; vit., vitelline glands.

Ovary median, just behind ventral sucker, partly overlapping it dorsally, 0.16—0.35 in diameter: in some specimens it was broader



TEXT-FIG. 2.—Cirrus sac, cirrus and metraterm of *Kaurma longicirra*, gen. et sp. nov.

c., cirrus; c. s., cirrus sac; g. o., genital opening; m., metraterm; s. v., vesicula seminalis.

than long, a condition probably brought about by unequal contraction at the time of fixation. Oviduct arises from the posterior margin of the ovary and running for a short distance joins the receptaculum seminis. Immediately afterwards it receives the common vitelline duct and forms the ootype. Receptaculum seminis sacular, 0.135—0.532 in length, lying almost transversely behind ovary just in front of anterior testis. Vitellaria consists of large follicles lying across the entire length

of the body posterior to pharynx, posterior to testes they meet from both sides and reach posterior end of body. Uterus moderately long and very much coiled, the coils mostly lying on both sides of body in between ventral sucker and anterior testis. Metraterm muscular, joining uterus a little anterior to ventral sucker. Eggs thin-shelled, oval, $0.058-0.072 \times 0.038-0.05$.

The present form resembles the members of the subfamily Allocreadiinae of the family Allocreadiidae in the nature and size of the suckers; the distribution of the vitellaria; the position of the genital pore; the structure and composition of the cirrus sac; the relative position of the testes and ovary; the extent and situation of the uterus; and the condition, size and number of ova. All the genera included in this subfamily have simple ova except *Helicometra*, *Helicometrina*, *Helicometroides*, *Diplobulbus* and *Stenopara* in which they are filamented. In the absence of such filamented ova the present form differs from the above genera and shows resemblance with the rest. The extent of the cirrus sac shows all varying conditions in the different genera of Allocreadiinae, but in most of them it either reaches the centre of the ventral sucker or extends further backwards reaching in some cases as far back as the ovary. In the present form it just touches the anterior border of the ventral sucker and is well separated from the caecal bifurcation, being deflected laterally. A long cirrus is present. The metraterm is very distinct and its wall shows undulations. The genital pore is lateral, intercaecal and much behind the intestinal bifurcation. Oesophagus which is so characteristic of other Allocreadiinae is also absent in the present form. This last difference with the other above mentioned differences makes it necessary to create the new genus *Kaurma* for this parasite with the following diagnosis:—

Allocreadiinae; Body oval and elongated. Integument smooth except on the ventral sucker. Suckers well developed; oral smaller than ventral. Prepharynx and oesophagus absent. Pharynx well developed. Intestinal caeca nearly reaching posterior end of body. Genital pore much behind intestinal bifurcation, on left side of body. Cirrus sac well developed, anterior to ventral sucker, enclosing coiled vesicula seminalis, undifferentiated pars prostatica and a ductus ejaculatorius. Cirrus long and muscular. Testes large and lobed, in posterior half of body. Ovary spherical, anterior to testes and close to ventral sucker. Receptaculum seminis present. Metraterm well developed, muscular. Vitelline glands between pharynx and hinder end of body, marginal anterior to testes but confluent behind them. Post-testicular vitellaria much shorter than lateral. Uterus pre-testicular, moderately long. Ova numerous, oval, with thin shells.

Genotype.—*Kaurma longicira*, sp. nov.

Key to the genera of Allocreadiinae.

Ova filamented	. . .	1
Ova not filamented		5
1. Ova with bipolar filaments	. . .	<i>Diplobulbus</i> Yamaguti 1934.
Ova with unipolar filament	. . .	2
2. With more than two testes		<i>Helicometrina</i> Linton 1910.
With two testes	. . .	3

3. Post-testicular vitellaria absent : testes posterior-most in body	<i>Helicometroides</i> Yamaguti 1934.
Post-testicular vitellaria present	4
4. Cirrus sac reaching up to centre of ventral sucker	<i>Helicometra</i> Odhner 1902.
Cirrus sac extending much beyond ventral sucker	<i>Stenopara</i> Manter 1933.
5. Oesophagus absent	<i>Kaurma</i> , gen. nov.
Oesophagus present	6
6. Yolk glands extending in the neck	7
Yolk glands not extending in the neck	13
7. With more than two testes	<i>Decemtestis</i> Yamaguti 1934.
With two testes	8
8. Testes in the posterior extremity of the body	<i>Caudotestis</i> Yamaguti 1934.
Testes not in the posterior extremity of the body	9
9. Cirrus sac not reaching centre of ventral sucker	10
Cirrus sac extending to centre of ventral sucker or beyond	11
10. Ovary with entire margin	<i>Maculifer</i> Nicoll 1909.
Ovary trilobed	<i>Cainocreadium</i> Nicoll 1909.
Ovary multilobate	<i>Hemacreadium</i> Linton 1910.
11. Oral sucker funnel-shaped	<i>Choanostoma</i> Yamaguti 1934.
Oral sucker not funnel-shaped	12
12. Intestinal caeca not extending behind testes	<i>Eurycreadium</i> Manter 1934.
Intestinal caeca extending behind testes	<i>Lebouria</i> Nicoll 1910.
13. Ventral sucker pedunculated	14
Ventral sucker sessile	15
14. Cirrus petaloid .	<i>Podocotyloides</i> Yamaguti 1934.
Cirrus simple . . .	<i>Pedunculacetabulum</i> Yamaguti 1934.
15. Vitellaria not coalescent posterior to testes	<i>Astacotrema</i> Warren 1903.
Vitellaria coalescent posterior to testes	16
16. Oesophagus short .	<i>Podocotyle</i> Dujardin 1845.
Oesophagus long	17
17. Intestinal caeca broad	<i>Megasolena</i> Linton 1910.
Intestinal caeca narrow	18
18. Cirrus sac well developed	<i>Allocreadium</i> Looss 1900.
Cirrus sac reduced . . .	<i>Cymbephellus</i> Linton 1934.

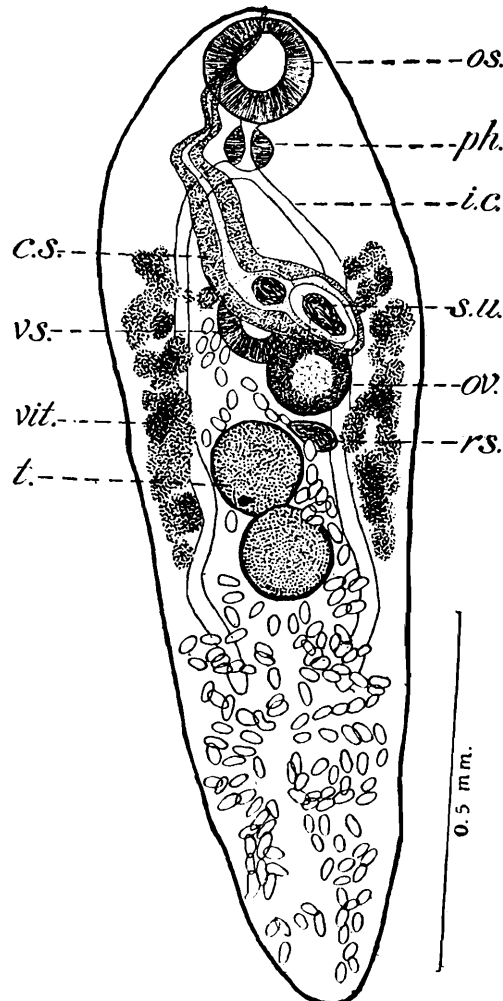
Family CEPHALOGONIMIDAE Nicoll 1915.

Cephalogonimus Poirier 1886.**Cephalogonimus burmanica**, sp. nov.

Host :—*Emyda scutata*.

Over five hundred specimens obtained from the small intestine of one host. Body elongated with anterior end much broader than posterior. Length 0.83—1.52, maximum thickness 0.32—0.42 at the region of oral sucker. Cuticle posteriorly to anterior testis covered with sharp backwardly directed spines, the spines being progressively denser from the posterior to the anterior end. Oral sucker subventral, more powerful than ventral and slightly broader transversely than antero-posteriorly measuring 0.11—0.14 × 0.12—0.154. Ventral sucker

0.1—0.13 in diameter lying a little anterior to middle of body. Prepharynx very small. Pharynx muscular, approximately spherical, 0.042—0.07 in diameter. Oesophagus absent. Intestinal bifurcation away from ventral sucker and closer to oral sucker. Intestinal caeca fairly uniform in width extending behind testes, ending a little anterior to posterior end of body. Genital pore at median anterior tip of body anterior to oral sucker.



TEXT-FIG. 3.—Dorsal view of *Cephalogonimus burmanica*, sp. nov.

c. s., cirrus sac; i. c., intestinal caeca; os., oral sucker; ov., ovary; ph., pharynx; rs., receptaculum seminis; s. u., vesicula seminalis; t., testes; v.s., ventral sucker; vit., vitelline glands.

Testes large, slightly oblique, almost equal, contiguous, approximately 0.09—0.14 in diameter, situated between the caeca a little anterior to their blind ends. Cirrus sac large, 0.32—0.52 long, club-shaped, oblique, extending from near posterior margin of ventral sucker to almost the anterior margin of oral sucker. Near the pharynx it coils on itself and narrows into an elongated region that contains the pars prostatica and the ejaculatory duct. The basal sacular part contains the large convoluted vesicula seminalis, divisible into two portions—a large proximal and a small distal one which, by a narrow constriction, passes into the long pars prostatica.

Ovary on right side of median line, approximately spherical 0.08—0.12 in diameter, anterior to testes and partly overlapped anteriorly

by the ventral sucker. Oviduct arises from the posterior margin and, running obliquely for a short distance, joins the receptaculum seminis. Immediately afterwards it receives the common vitelline duct and forms the ootype. Receptaculum seminis ovoid, 0.038—0.065 in length, on left side of body, between anterior testis and ovary. Vitellaria consists of large follicles, lateral, extra and over caecal, from immediate anterior of ventral sucker to a little behind anterior margin of posterior testis. Uterus arises from the left side of the ootype. Each lateral half of the post-testicular region of the body contains a descending and an ascending loop of the uterus. Beginning on the right side the uterus descends backwards and reaching the posterior end it turns forwards. On approaching near the posterior testis the coils turn to the left and there again it descends and ascends. The ascending uterus passes forwards taking a course parallel and dorsal to the cirrus sac on its way to the genital atrium. Eggs thin shelled, oval, 0.03—0.035 $\times$ 0.015—0.02. Excretory pore at the posterior end. Excretory bladder Y-shaped, occupying a median position and extending as far forward as the posterior testis.

The presence of oblique testes separates the present form from all other species except *C. americanus* Stafford 1902, *C. europaeus* Blazoit 1910, *C. vesicaudus* Nickerson 1912, *C. compactus* Stunkard 1924 and *C. mehri* Pande 1932. The situation of the genital pore at the anterior tip of the body brings the present species closer to the last three of the aforesaid forms. Of these it is closely allied to *C. mehri* Pande 1932 on account of the shape of the body, a higher ratio in size of oral sucker to ventral, absence of oesophagus, left sided position of anterior testis and the median position of posterior testis. It differs from *C. mehri* in the distribution of vitellaria and the position of ovary and testes. The former extend from immediate anterior of the ventral sucker to a little behind anterior margin of posterior testis. Of the latter the ovary is partially overlapped by the ventral sucker and the testes are contiguous with one another. These differences necessitate the creation of a new species for the reception of the present forms.

Family PRONOCEPHALIDAE Looss 1902.

Subfamily NEOPRONOCEPHALINAE Mehra 1932.

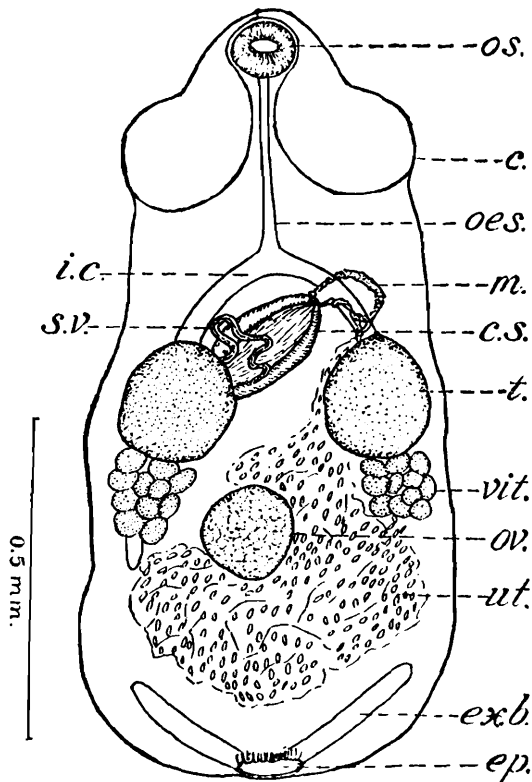
Neopronocephalus Mehra 1932.

Neopronocephalus mehri, sp. nov.

Host :—*Morenia ocellata*.

Both the turtles dissected harboured parasites of this new species numbering 140 and 52 respectively. Body small and thick, with thin cuticle and well developed musculature. Length 1—1.5, maximum thickness just posterior to ovary 0.5—0.6. Cephalic region distinct and is separated from the body by prominent constrictions. It is encircled by the characteristic "collar" which is complete dorsally and

laterally but incomplete ventrally. In the anterior region the body is strongly convex dorsally and deeply concave ventrally, the depth decreasing posteriorly until the body shows an evenly rounded oval structure near the posterior end. Sucker longer transversally than antero-posteriorly, measuring $0.1-0.11 \times 0.11-0.12$. Pharynx absent. Oesophagus narrow, $0.2-0.3$ long. Intestinal bifurcation $0.3-0.38$ from the anterior extremity of the body. Intestinal caeca first curve outwards and then inwards in the region of testes running dorsal to them. Behind testes they again curve a little outward ending a little posterior to the vitelline glands. Genital pores separate, situated on the left side of the median line, intercaecal and close to the intestinal bifurcation.



TEXT-FIG. 4.—Ventral view of *Neopronocephalus mehri*, sp. nov.

c., cirrus; c. s., cirrus sac; ep., excretory pore; ex b., excretory bladder; i. c., intestinal coeca; m., metraterm; oes., oesophagus; os., oral sucker; ov., ovary; s. v., vesicula seminalis; t., testes; ut., uterus; vit., vitelline glands.

Testes oval, almost equal, measuring $0.18-0.3 \times 0.17-0.2$ and lying at the same level almost near the middle of the body. Cirrus sac oval, $0.25-0.27$ long and $0.1-0.12$ in maximum breadth. Vesicula seminalis external lying coiled external to the cirrus sac.

Ovary almost on the median line, nearly spherical, $0.13-0.15$ in diameter. Receptaculum seminis absent. Vitelline glands immediately behind testes, composed of 11–13 closely packed follicles, lying on either side of the body. Metraterm present. Uterus much coiled extending both anterior and posterior to ovary. Ova with thin transparent shells measuring $0.023-0.027 \times 0.0134-0.0154$. Excretory pore very prominent, subterminal, lying on the ventral surface of the body. Excretory bladder V-shaped, the two limbs of which extend

upto a little more than half the distance between ovary and the posterior extremity of the body.

From the two other known species of the genus *Neopronocephalus triangularis* Mehra 1932 and *N. gangeticus* Mehra 1932 the present form is separated owing to great disparity in size, difference in the structure of the cephalic region and the collar, the number of the vitelline glands and the shape and the position of the excretory pore.

The following table gives the chief differences between the present form and those described by Mehra (1932, pp. 236-244).

—	<i>N. triangularis</i> Mehra 1932.	<i>N. gangeticus</i> Mehra 1932.	<i>N. mehri</i> sp. nov.
Length . . .	2.9—4	2—2.4	1—1.5
Cephalic region . . .	Triangular	Not entirely separated.	Triangular and entirely separated.
Int. bifurcation from ant. end	0.6—0.8	0.46—0.5	0.3—0.38
Size of cirrus sac	0.53—0.62 × 0.23—0.3	0.4—0.52 × 0.25—0.28	0.25—0.27 × 0.1—0.12
Follicles in vitelline gland .	11—17	13—15	11—13
Excretory pore . . .	Dorsal, subterminal.	..	Ventral, subterminal.

Family PARAMPHISTOMIDAE Fiscoeder 1901.

Subfamily ZYGOCOTYLINAE Ward 1917.

Stunkardia Bhalerao 1931.

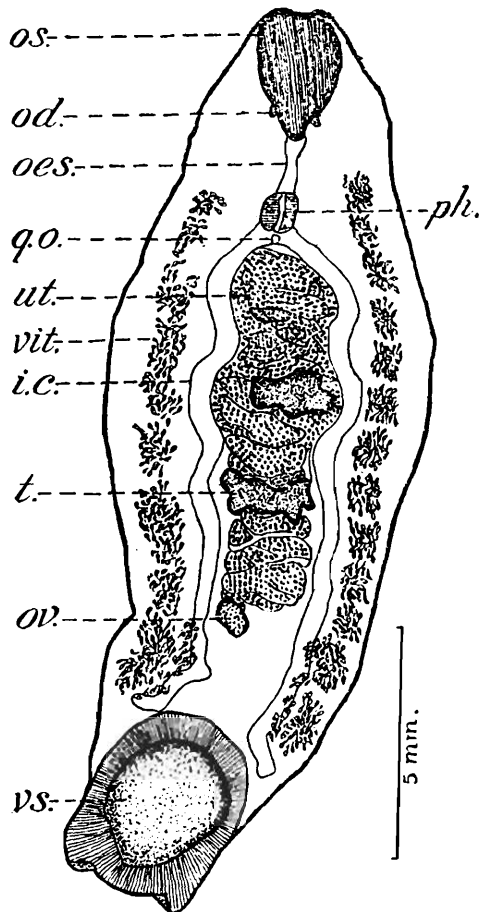
Stunkardia dilymphosa Bhalerao 1931.

Host :—*Morenia ocellata*.

Both the turtles harboured the parasites in the rectum, the numbers being 2 and 3 respectively. Length 13.5—20, maximum breadth 3.8—7. Oral sucker 1.8—2.7 × 1.4—1.8. Ventral sucker 2.5—4.1 × 1.7—3.2. Testes lobed and equal in volume. Ovary lobed. Vitellaria not diffused in the parenchyma, as described by Bhalerao (1931, p. 104), but arranged in distinct follicles along the lateral margin of the body, extending from the level of the oesophageal bulb almost to anterior border of ventral sucker, running mostly alongside intestinal caeca but slightly overlapping them behind ovary. Uterus pre-ovarian, very much convoluted, and filled with a large number of eggs.

The present form is identical with *Stunkardia dilymphosa* Bhalerao 1931, except in the size of the various organs and in the nature of the vitellaria and uterus. The differences of size are all within the limits of individual variation and are of no importance. The comparatively

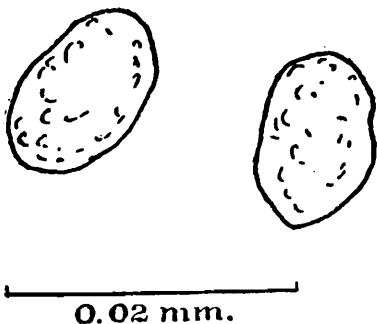
large size of the gonads suggests that the present form is more mature than Bhalerao's specimens and this fact is further supported by his



TEXT-FIG. 5.—Ventral view of *Stunkardia dilymphosa* Bhalerao.

g. o., genital opening; *i. c.*, intestinal coeca; *od.*, oral diverticulum; *oes.*, oesophagus; *os.*, oral sucker; *ov.*, ovary; *ph.*, pharynx; *t.*, testes; *ut.*, uterus; *vs.*, ventral sucker; *vit.*, vitelline glands.

description of vitellaria and uterus. The former are said to be diffused in the parenchyma, but the mature specimens showed distinct lateral follicles which were absent in the partly immature specimen obtained from the same host. The uterus has been described as devoid of eggs



TEXT-FIG. 6.—Ova of *Stunkardia dilymphosa* Bhalerao.

but in the present forms contained a large number. All these variations appear to be due to the different degree of maturity of the specimens, a hypothesis further corroborated by observations of one of my colleagues. It thus appears that the description of Bhalerao is based on immature specimens, and that what were considered as vitellaria may be simply the minute excretory granules that are so well developed and scattered in the parenchyma. In the light of the present work the following amendment in the generic character is necessary—
“Vitellaria follicular, lateral, extending from the level of oesophageal bulb to near posterior sucker”

Class NEMATODA.

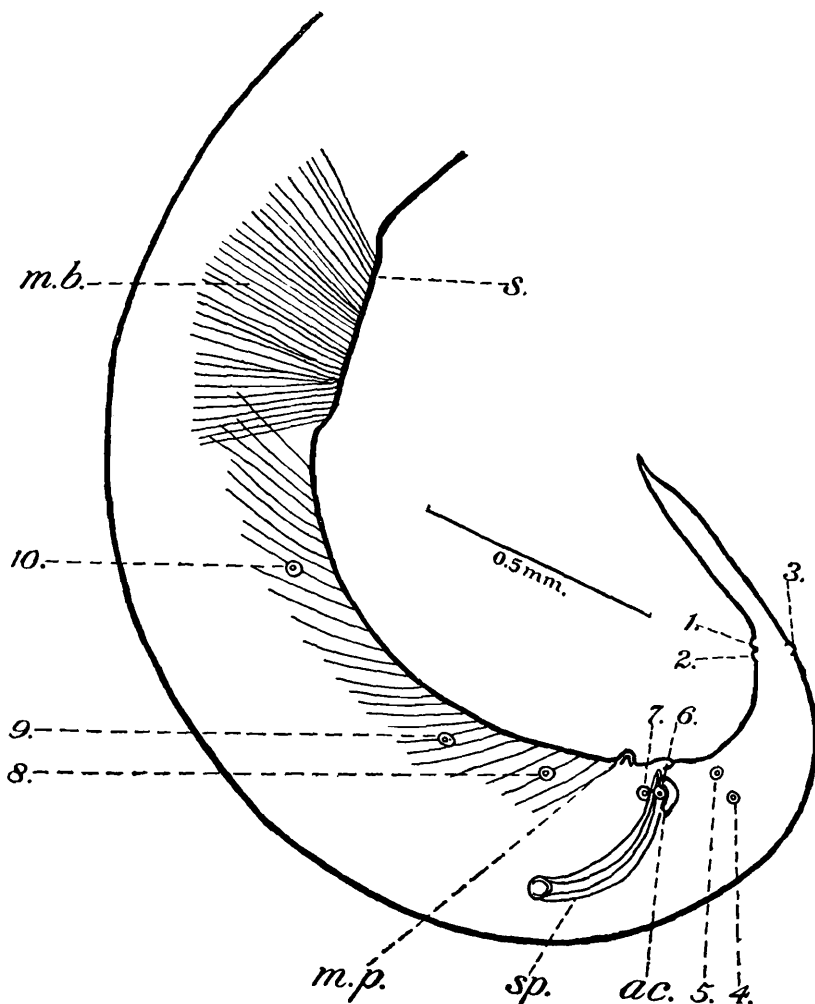
Order ASCAROIDEA.

Family KATHLANIIDAE Travassos 1918.

Subfamily KATHLANIINAE Lane 1914.

Spironoura Leidy 1856.**Spironoura rangoonica**, sp. nov.*Host* :—*Morenia ocellata*.

Approximately 181 parasites obtained from the stomach of one host. Worms of moderate size. Body tapering towards the extremities. Female slightly curved ventrally. Posterior end of male sharply curved ventrally in the form of a hook. The tail in both sexes conical and rapidly tapering in its proximal part; distally it tapers gradually and forms a long stout spike. Head globular and slightly enlarged, separated from the body by a distinct neck. Mouth surrounded by three well developed lips, each being provided with two pairs of papillae

TEXT-FIG. 7.—Posterior end of male *Spironoura rangoonica*, sp. nov.

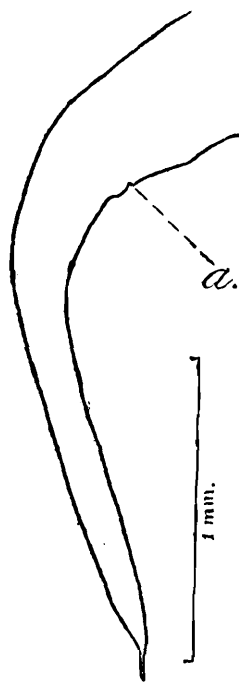
ac., accessory piece; m. b., oblique muscle-bands; m. p., median precloacal papilla; s., sucker-like organ; sp., spicule 1 to 10, ten pairs of caudal papillae.

—one pair small supporting the inner margin of the lip and the other pair lying on its outer margin. Cuticle smooth, with fine transverse striations and less prominent longitudinal striations. Mouth opens

into a buccal cavity, surrounded anteriorly by a ring of thickened cuticle. Oesophagus long and muscular consisting of a short anterior pharynx, a central median shaft, and two oesophageal bulbs, the posterior one of which bears the usual valvular apparatus. Cervical papillae inconspicuous. Nerve ring at a distance of 0.32—0.39 and the excretory pore 1.1—1.34 from the cephalic extremity.

Male:—Length 8.8—10.2, maximum breadth 0.66—0.76. The cylindrical pharynx together with the buccal cavity 0.114—0.115 long. Length of oesophagus from behind pharynx to the end of posterior bulb 1.48—1.65. Oesophageal bulbs broader than long: anterior bulb 0.14—0.16 $\times$ 0.133—0.138, posterior bulb 0.26—0.29 $\times$ 0.23—0.27. Spicules short and curved, 0.35—0.5 long, broadly expanded dorso-ventrally and containing a central median shaft. Accessory piece small 0.06—0.07 long. Sucker-like organ present on the tail. Preanal musculature well developed with bands of muscles running obliquely from the cloacal aperture to the sucker-like organ. The latter provided with radiating bands of muscle fibres. Ten pairs of caudal papillae present. First two pairs lying ventrally near the junction of the caudal spike and the tail; third pair lateral lying almost at the same level with the second pair; fourth and fifth pairs lateral and postanal one lying slightly dorsal to the other; sixth and seventh pairs near the cloaca; eighth, ninth and tenth pairs lying lateral and anterior to cloaca. Length of caudal spike 0.4—0.45.

Female:—Length 9.6—12, maximum breadth 0.7—0.76. Pharynx with the buccal cavity 0.114—0.133 long. Length of oesophagus from behind pharynx to end of posterior bulb 1.56—1.58. Oesophageal bulbs broader than long: anterior bulb 0.17—0.18 $\times$ 0.13—0.17, posterior bulb 0.82—0.31 $\times$ 0.25—0.27. Vulva in posterior half of body dividing the body almost in the ratio of 1.5 : 1. Vagina long with a maximum length of 1.5 in a few specimens, running obliquely anterior to the body across the dorsal side of the body cavity. Length of tail including the spike 1.3—1.62. Eggs oval, with thin shells, measuring 0.114—0.12 $\times$ 0.09—0.095.



TEXT-FIG. 8.—Posterior end of female *Spironoura rangoonica*, sp. nov.

a., anus.

Out of twenty-five species of *Spironoura* described the present form resembles *S. masculum* (Rudolphi 1819), *S. catesbeianae* (Walton 1929) and *S. brevispiculata* Baylis 1935 in the size of the spicules and number and general arrangement of the caudal papillae. The resemblance with *S. catesbeianae* (Walton 1929) is more close on account of the presence of a well developed precloacal sucker-like organ, the condition in the other two cases being quite different. The differences with *S. catesbeianae* (Walton 1929)

are obvious in the presence of a much enlarged body, postequatatorial position of vulva, simple nature of the median precloacal papillae and much longer tail.

Spironoura onama Karve 1927.

Host :—*Morenia ocellata*.

A large number of these parasites were obtained from the rectum of the same turtle which was infected with the former species. The present form agrees with the description given by Karve (1927, pp. 343-349) except in some minor details. The head of the spicule is not enlarged 'like the head of the handle of a hockey stick' but is uniformly thick with the shaft and the extremity of the tail beyond the last pairs of caudal papillæ is slightly longer. These differences are not of sufficient importance to justify the creation of a new species.

Order *SPIRUROIDEA*.

Family CAMALLANIDÆ Railliet and Henry 1915.

Camallanus Railliet and Henry 1915.

Camallanus sp.

Host :—*Morenia ocellata*.

A single immature female, measuring 11.2 in length was found in the intestine. The chitinous buccal valves are broader than long. There were ten longitudinal ridges on each valve. Vulva in front of the middle of the body, provided with an anterior prominent lip. Vagina narrow, running obliquely backward in a straight line. In absence of male specimens and sexually mature females the specific determination remains uncertain.

REFERENCES.

- Baylis, H. A. (1935).—Two new parasitic nematodes from Ceylon. *Ann. Mag. Nat. Hist.* XVI, pp. 190—192.
- Baylis, H. A. and Daubney, R. (1922).—Report on Parasitic Nematodes in the collection of the Zoological Survey of India. *Mem. Ind. Mus.*, VII, pp. 303—310.
- Bhalerao, G. D. (1931).—Two new trematodes from Reptiles: *Paryphostomum indicum* n. sp. and *Stunkardia dilymphosa* n. g., n. sp. *Parasitol.* XXIII, pp. 103—107.
- Harwood, P. D. (1932).—The Helminths parasitic in the Amphibia and Reptilia of Houston, Texas and vicinity. *Proc. U. S. Nat. Mus.* LXXXI, pp. 44—46.
- Hunter III, G. W. and Bangham, R. V. (1932).—Studies on Fish parasites of Lake Erie. 1. Newt rematodes (Allocreadiidae). *Trans. Amer. Micros. Soc.* LI, pp. 137—149.
- Karve, J. N. (1927).—A new nematode from a Burmese tortoise (*Testudo emys*). *Ann. Trop. Med. Parasitol.* XXI, pp. 343—350.
- Linton, E. (1910).—Helminth fauna of the Dry Tortugas. II. Trematodes. *Carnegie Inst. Wash. Pub.*, No. 133, Papers Tortugas Laboratory, IV, pp. 34—38.

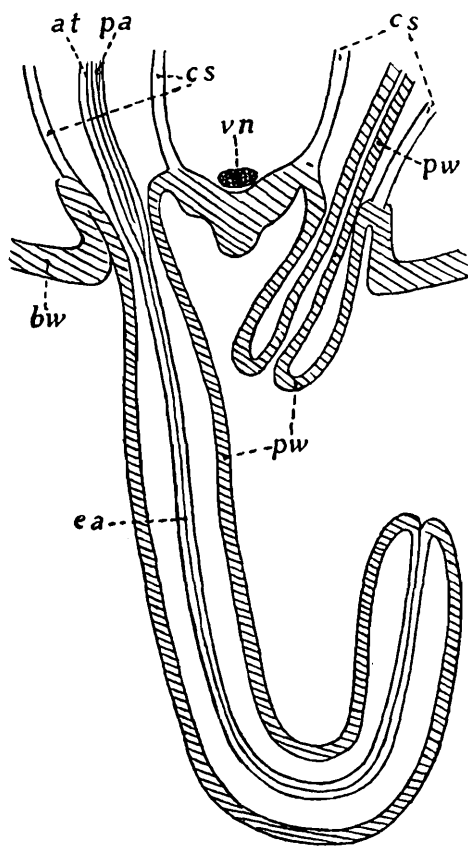
- Manter, H. W. (1933).—The genus *Helicometra* and related trematodes from Tortugas, Florida. *Carnegie Inst. Wash. Pub. No. 435*, Papers Tortugas Laboratory, XI, pp. 167—182.
- Manter, H. W. (1934).—Some Digenetic trematodes from deep-water fish of Tortugas, Florida. *Carnegie Inst. Wash. Pub. No. 435*, Papers Tortugas Laboratory, XVI, pp. 289—304.
- Mehra, H. R. (1932).—Nouveaux monostomes de la famille des Pronocephalidae des tortues d'eau douce de l'Inde. Classification de cette famille. *Ann. Parasitol.* X, pp. 225—247.
- Moghe, M.A. (1930).—A new species of trematode from an Indian tortoise. *Ann. Mag. Nat. Hist.* VI, pp. 677—680.
- Nicoll, W. (1910).—On the entozoa of fishes from the Firth of Clyde. *Parasitol.* III, pp. 336—340.
- Nicoll, W. (1914).—The trematode parasites of fishes from the English Channel. *Jour. Mar. Biol. Assn.* X, pp. 466—505.
- Nicoll, W. (1915).—A list of the trematode parasites of British Marine fishes. *Parasitol.* VII, pp. 339—378.
- Pande, B. P. (1932).—On two new species of the genus *Cephalogonimus* Poirier from water-tortoises of Allahabad with remarks on the family *Cephalogonimidae* Nicoll. *Bull. Acad. Sci. U. P.*, II, pp. 85—100.
- Seurat, L. G. (1918).—Nématodes de la Clemmyde lépreuse. *Bull. Soc. Hist. Nat. Afr. Nord.* IX, p. 20.
- Stafford, J. (1902).—*Cephalogonimus americanus* (new species). *Centralbl. Bakt. Orig.*, XXXII, pp. 719—724.
- Stewart, F. H. (1914).—Studies in Indian Helminthology. No. 1. *Rec. Ind. Mus.*, X, pp. 169, 170.
- Stunkard, H. W. (1924).—On some trematodes from Florida turtles. *Trans. Amer. Micros. Soc.*, XLIII, pp. 106—109.
- Taylor, E. L. (1925).—Notes on some nematodes in the museum of the Liverpool School of Tropical Medicine II. *Ann. Trop. Med. Parasitol.*, XIX, p. 57.
- Thapar, G. S. and Dayal, J. (1934).—The morphology and the systematic position of a new trematode from the intestine of the golden Orfe, *Leuciscus idus*, with a note on the classification of the family *Allocreadiidae*. *Jour. Helminthol.*, XII, pp. 127—136.
- Walton, A. C. (1927).—A revision of the nematodes of the Leidy Collection. *Proc. Acad. Nat. Sci. Philadelphia*, LXXIX, pp. 77, 78.
- Walton, A. C. (1929).—Studies on some nematodes of North American frogs—I. *Jour. Parasitol.*, XV, pp. 235, 236.
- Walton, A. C. (1930).—Studies on some nematodes of North American Amphibia.—II. Cryptobranchidae. *Jour. Parasitol.*, XVII, pp. 20, 21.
- Walton, A. C. (1932).—A redescription of *Leptodera elongata*, Baird 1858 (Nematoda). *Ann. Mag. Nat. Hist.*, IX, pp. 146—150.

- Walton, A. C. (1933).—The Nematoda as parasites of Amphibia. *Jour. Parasitol.*, XX, pp. 1—32.
- Wilkie, J. S. (1930).—Some parasitic nematodes from Japanese Amphibia. *Ann. Mag. Nat. Hist.*, VI, pp. 606—614.
- Woolcock, V (1935).—Digenitic trematodes from some Australian fishes. *Parasitol.*, XXVII, pp. 310—317.
- Yamaguti, S. (1934).—Studies on the Helminth Fauna of Japan. Part 2. Trematodes of Fishes, .I. *Jap. Jour. Zool.*, V, pp. 281—342.

BRANCHIURA SOWERBYI BEDDARD, AND ITS SYNONYMY.

By W. MICHAELSEN (*Hamburg*).

Mr. G. E. Gates sent me for examination some worms collected at Mongyai in the North Shan States by Messrs. B. N. Chopra and H. S. Rao of the Zoological Survey of India. Without hesitation I identified the first examined specimens, which included an almost complete individual, with *Kawamura japonica* Stephenson (1917, *Mem. As. Soc. Bengal*, VI, p. 89, pl. iv, figs. 1-5). Later on examination of a really complete specimen, however, I recognised at its hind end thread-shaped median-ventral and dorsal gills like those characteristic of *Branchiura sowerbyi* Beddard (1892, *Quart. Journ. Microsc. Sci.* (N. S.), XXXIII, p. 325, pl. xix). A closer examination convinced me that the worms indeed are specimens of *B. sowerbyi* already known from the Shan States, and that the *Kawamura japonica* is identical with this branchiate species.



Branchiura sowerbyi Beddard. Transverse section through the ventral part of the 11th segment cutting the penes longitudinally; one of which is almost completely stretched forth whilst the other is only partially everted. *at.* atrium; *bw.* body-wall; *cs.* coelomic sac; *ea.* ectal part of the atrium; *pa.* paratrium; *pw.* wall of the penis; *vn.* ventral nerve-cord.

Branchiura sowerbyi is very fragile as I can state from experience, and as Stephenson noted that the specimens of his supposed new species from Lake Biwa were "nearly all immature and many fragmentary", and further "mostly fragments and immature", I am convinced that

Stephenson did not see any complete specimen. He, therefore, did not recognise the identity of his worms with *Branchiura*.

Some observations about the penis which are rarely seen everted, may be added here. The secondary male pores, distinctly seen only on specimens with drawn-in penes (not to confound with the primary male pores at the tip of the everted penes), are situated not just in the lines of ventral setal bundles, as Beddard and Stephenson noted them, but very slightly dislocated mediad; this area is so narrow that they do not extend beyond the innermost setae of the ventral bundles. This more exact statement corresponds to Beddard's drawing (1892, pl. xix, fig. 8) better than to his description, for in this drawing the male pores are nearer to each other than are the spermathecal pores just behind the ventral setae of that segment. In specimens with everted penes the body-wall of the 11th segment shows ventrally a pair of depressions united with one another in the outer part, separated from one another at the bottom by a more or less high longitudinal wall. The secondary male pores, out of which the penes arise, lie at the lateral slopes of the depressions, *i.e.*, somewhat obliquely, so that the basal parts of the penes converge a little. A penis is pear-shaped, as Stephenson figured it (1917, pl. iv, fig. 2), only when beginning to evert; the nearly completely everted penis, as seen in most of my Shan States specimens, is longish cylindrical, somewhat narrowed at its base and rounded at its tip, which bears the primary male pore—this is a simple, small hole. Such a widely everted penis is about 1 mm. long and in general 0.01 mm. thick, quite straight or more or less bent.