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CONTENTS.

	PAGE.
PARTS 1—4.— <i>Published April, 1948.</i>	
Observations on the Development of <i>Chiloscyllium griseum</i> M. & H., <i>Pristis cuspidatus</i> Lath. and <i>Rhynchobatus djiddensis</i> (Forsk.)	1
Descriptions, Bionomics and Development of <i>Scoliodon sorrakowah</i> (Cuvier)	25
Systematic Position of Three Glyptosternoid Fishes described by Hamilton	55
Systematic Position of Siluroids in Hamilton's Gangetic Fishes ..	63
On the Head-Capsule, Mouth-parts and Related Muscles of the Larva of the Woolly Bear <i>Anthrenus fasciatus</i> Herbst. (Coleoptera : Dermestidae)	73
On a Collection of Mollusca from the Coromandel coast of India	87
Contributions to the Fauna of Manipur State, Assam. Part I. General Introduction .	123
Contributions to the Fauna of Manipur State, Assam. Part II. Birds	127
Revision of Cypraeacea in the Collection of the Zoological Survey of India. Part I. The Families Triviidae, Eratoidae and Pediculariidae .	183

LIST OF PLATES.

	<i>Follow</i>
	<i>Page.</i>
Plate I. Development of Bombay Sharks ..	24
Plate II. Hamilton's Glyptosternoid Fishes	72
Plate III. Mollusca from the Coromandel Coast ..	122
Plate IV Map of Manipur State and the adjacent areas of Assam and Burma	126
Plate V <i>Otus bakkamoena let tia</i> (Hodgson) and <i>Otus bakkamoena</i> <i>manipurensis</i> sub sp. nov.	182

LIST OF AUTHORS.

	<i>Page.</i>
HORA, S. L.	
Systematic Position of Siluroids in Hamilton's Gangetic Fishes	63
HORA, S. L.	
Systematic Position of Three Glyptosternoid Fishes described by Hamilton (<i>in collaboration with Menon, M. A. S.</i>)	55
MENON, M. A. S.	
Systematic Position of Three Glyptosternoid Fishes described by Hamilton (<i>in collaboration with Hora, S. L.</i>)	55
NATH, B.	
Contribution to the Fauna of Manipur State, Assam. Part II. Birds (<i>in collaboration with Roonwal, M. L.</i>)	127
PRADHAN, K. S.	
On the Head-Capsule, Mouth-parts and Related Muscles of the Larva of Woolly Bear <i>Anthrenus fasciatus</i> Herbst. (Coleoptera, Dermestidae)	73
RAY, H. C.	
On the Collection of Mollusca from the Coromandel Coast of India	87
RAY, H. C.	
Revision of Cypraeacea in the Collection of Zoological Survey of India, Part I. The Families Triviidae, Eratoidae, and Pedic- ulariidae	183
ROONWAL, M. L.	
Contributions to the Fauna of Manipur State, Assam. Part I. General Introduction	123
ROONWAL, M. L.	
Contributions to the Fauna of Manipur State, Assam, Part II. Birds (<i>in collaboration with Nath, B.</i>)	127
SARANGDHAR, P. N.	
Observations on the Development of <i>Chiloscyllium griseum</i> M. & H., <i>Pristis cuspidatus</i> Lath. and <i>Rhynchobatus djiddensis</i> (Forsk.) (<i>in collaboration with Setna, S. B.</i>)	1

	<i>Page.</i>
SARANGDHAR, P. N.	
Descriptions, Bionomics and Development of <i>Scoliodon sorrakowah</i> (Cuvier). (<i>in collaboration with Setna, S. B.</i>)	25
SETNA, S. B.	
Observations on the Development of <i>Chiloscyllium griseum</i> M. & H., <i>Pristis cuspidatus</i> Lath. and <i>Rhynchobatus djiddensis</i> (Forsk.) (<i>in collaboration with Sarangdhar, P. N.</i>)	1
SETNA, S. B.	
Descriptions, Bionomics and Development of <i>Scoliodon sorrakowah</i> (Cuvier) (<i>in collaboration with Sarangdhar, P. N.</i>)	25

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.]

A	Page.	A—contd.	Page.
<i>Acanthias vulgaris</i> ..	11	<i>Arca</i> (<i>Acar</i>) <i>profundicola</i> ..	111
<i>Acar</i> ..	111	(<i>Anadara</i>) <i>deyrollei</i> ..	110
<i>Accipetres</i> ..	167	(<i>Barbatia</i>) <i>pteroessa</i> ..	111
<i>Acridotheres albocinctus</i> ..	149	(<i>Bathyarca</i>) <i>profundicola</i> ..	111
<i>grandis</i> ..	149	(<i>Cunearca</i>) <i>rhombea</i> ..	110
<i>siamensis</i> ..	149	<i>deyrollei</i> ..	110
<i>tristis</i> ..	148	<i>indiac orientalis</i> ..	111
<i>tristis tristis</i> ..	148	<i>indica</i> ..	111
<i>Aegypiidae</i> ..	128, 167	<i>obtusoides</i> ..	111
<i>Aethopyga saturata</i> ..	154	<i>profundicola</i> ..	111
<i>saturata saturata</i> ..	154	<i>pteroessa</i> ..	111
<i>Aethiopsar grandis infuscatus</i> ..	149	<i>rhombea</i> ..	110, 111
<i>albocinctus</i> ..	149	(<i>Scapharca</i>) <i>indica</i> ..	111
<i>Agaronia</i> ..	106	<i>Archaeogastropoda</i> ..	88
<i>Ageneiosus mino</i> ..	67	<i>Arcidae</i> ..	110
<i>Agriotes</i> ..	84	<i>Aradaeidae</i> ..	176
<i>Ailia</i> ..	63	<i>Ardeae</i> ..	176
<i>coila</i> ..	65, 67	<i>Ardeola grayii</i> ..	177
<i>Aix galericulata</i> ..	179	<i>Argina</i> ..	111
<i>Akysis</i> ..	63	<i>Argobuccinum</i> (<i>Biplex</i>) <i>perca</i> var. ..	
<i>Alcedinidae</i> ..	157	<i>aculeata</i> ..	100
<i>Alcedo atthis bengalensis</i> ..	157	(<i>Gyrineum</i>) <i>natalor</i> ..	100
<i>bengalensis</i> ..	157	<i>Ariophanta</i> ..	109
<i>fusca</i> ..	158	<i>interrupta</i> ..	109
<i>Alcippe nipalensis</i> ..	131	<i>laevipes</i> ..	110
<i>nipalensis nipalensis</i> ..	131	<i>Ariophantidae</i> ..	109
<i>phayrei</i> ..	131	<i>Ariophantinae</i> ..	109
<i>poioicephala phayrei</i> ..	131	<i>Arius</i> ..	64
<i>Alectoropodes</i> ..	173	<i>jatius</i> ..	68
<i>Amalthea</i> ..	96	<i>nenga</i> ..	69
<i>lissa</i> ..	96, 97	<i>sona</i> ..	69
<i>Amaltheidae</i> ..	96	<i>sp.</i> ..	27
<i>Amblycepididae</i> ..	65	<i>Artemis aspera</i> ..	117
<i>Amblyceps</i> ..	63	<i>Arthropods</i> ..	123
<i>mangois</i> ..	65, 71	<i>Asarocornis scutulata</i> ..	179
<i>Amphiperas</i> ..	184	<i>Asionidae</i> ..	128, 161
<i>Amphiperatidae</i> ..	183, 184, 212, 213	<i>Atrina</i> ..	113
<i>Amphiperatinae</i> ..	184	<i>Aves</i> ..	181
<i>Ampullaria virens</i> ..	94		
<i>Anadara</i> (<i>Argina</i>) <i>indica</i> ..	111		
<i>Anisomyaria</i> ..	112		
<i>Anomalodesmata</i> ..	121		
<i>Anomia</i> ..	113		
<i>achaeus</i> ..	113		
<i>placenta</i> ..	114		
<i>Anomiidae</i> ..	113		
<i>Anthracoceros malabaricus</i> ..	158		
<i>Anthrenus fasciatus</i> 73, 74, 75, 76, 77, 78, ..	80, 82, 83, 84, 85, 86		
<i>Anthus hodgsoni hodgsoni</i> ..	153		
<i>maculatus</i> ..	153		
<i>trivialis hodgsoni</i> ..	153		
<i>Aoria aor</i> ..	72		
<i>Arabica</i> ..	99		
<i>Arboricola atrogularis</i> ..	174		
<i>Arborophila atrogularis</i> ..	174		
<i>Arca</i> ..	110		

B—concl'd.		Page.	C—cont'd.		Page.
Biplex ..	..	100	<i>Ceryle leucomelanura</i> ..	..	157
Bivalvia ..	..	110	<i>rudis</i> ..	..	157
<i>Brachypodius atriceps major</i> ..	..	135	<i>rudis leucomelanura</i> ..	..	157
<i>Brachypteryx cruralis</i> ..	..	135	<i>Chaca chaca</i> ..	..	65, 66
<i>Bregmaceros maclellandi</i> ..	..	27	<i>Chacidae</i> ..	..	65
<i>Botula</i> ..	..	112	<i>Chaimarrhornis leucocephala</i> ..	..	137
<i>Bubulcus coromandus</i> ..	..	176	<i>Charadriidae</i> ..	..	175
<i>ibis coromandus</i> ..	..	176	<i>Charadriiformes</i> ..	..	175
<i>Buccinidae</i> ..	..	105	<i>Charadrius duvauceli</i> ..	..	175
<i>Buccinum rudolphi</i> ..	..	103	<i>Chelyconus</i> ..	..	107
<i>ornatum</i> ..	..	105	<i>Chicoreus</i> ..	..	102
<i>spiratum</i> ..	..	105	<i>Chiloscyllium griseum</i> ..	1, 2, 4, 6, 10, 11, 12, 23, 24,	52
<i>stolatum</i> ..	..	105	<i>indicum</i> ..	..	23
<i>sulcatum</i> ..	..	95	<i>Chiton</i> ..	..	88
<i>undosum</i> ..	..	105	(<i>Chiton</i>) <i>squamosus</i> ..	..	88
<i>Buceros malabaricus</i> ..	..	158	(<i>Chiton</i>) <i>squamosus</i> ..	..	88
<i>Bucerotidae</i> ..	..	158	<i>marmoreus</i> ..	..	88
<i>Buchanga atra</i> ..	..	146	<i>scaber variegatus</i> ..	..	88
<i>pyrrhops</i> ..	..	147	<i>squamosus</i> ..	..	88
<i>Bursa</i> ..	..	100	(<i>Tonicia</i>) <i>marmoreus</i> ..	..	88
<i>†awatii</i> ..	..	100, 102	<i>Chitonida</i> ..	..	88
<i>granularis</i> ..	..	100	<i>Chitonidae</i> ..	..	88
<i>vexillum</i> ..	..	102	<i>Chitoninae</i> ..	..	88
<i>Bursidae</i> ..	..	100	<i>Chloropsis Hardwickii</i> ..	..	132
<i>Butea minos</i> ..	..	125	<i>hardwickii hardwickii</i> ..	..	132
C			<i>Ciconiiformes</i> ..	..	178
<i>Callichrous</i> ..	..	63	<i>Cinnyris saturata</i> ..	..	154
<i>Calliope (?) cruralis</i> ..	..	135	<i>Clarias</i> ..	..	63
<i>Calobates melanope</i> ..	..	153	<i>batrachus</i> ..	64, 65, 66	
<i>Calyptraeidae</i> ..	..	97	<i>Clariidae</i> ..	..	65
<i>Cancroma Coromanda</i> ..	..	176	<i>Clavatula</i> ..	..	108
<i>Cantharidus</i> ..	..	90	<i>javana</i> ..	..	108
<i>kotschy</i> ..	..	90	<i>Clavatulinae</i> ..	..	108
(<i>Thalotia</i>) <i>kotschy</i> ..	..	90	<i>Cleotrivia</i> ..	184, 191, 194	
<i>Cantharus</i> ..	..	105	(<i>Dolichopus</i>) <i>proelucta</i> ..	..	195
(<i>Polia</i>) <i>undosus</i> ..	..	105	<i>globosa</i> ..	..	192
<i>undosus</i> ..	..	105	<i>pilula</i> ..	..	192
<i>Capiluna ruppellii</i> ..	..	89	<i>pisum</i> ..	..	194
<i>Capitonidae</i> ..	..	156	<i>Cleovitreia</i> ..	191, 192	
<i>Caprimulgi</i> ..	..	160	<i>Clupisoma</i> ..	..	63
<i>Caprimulgidae</i> ..	..	160	<i>garua</i> ..	..	65, 67
<i>Caprimulgus albonotus</i> ..	..	160	<i>Coccinella septempunctata</i> ..	..	85
<i>macrourus</i> ..	..	160	<i>Coccinellids</i> ..	..	86
<i>macrourus ? albonotus</i> ..	..	160	<i>Coilia dussumieri</i> ..	..	27
<i>Capulus lissus</i> ..	..	97	<i>Coleoptera</i> ..	73, 75, 77, 79, 81, 83, 84, 85, 86	
<i>Carabus</i> ..	..	84	<i>Collurio tricolor</i> ..	..	144
<i>Cardiidae</i> ..	..	116	<i>Columba agricola</i> ..	..	170
<i>Cardium</i> ..	..	116	<i>risoria</i> var. <i>decaocto</i> ..	..	172
<i>flavum</i> ..	..	118	<i>tigrina</i> ..	..	171
<i>dupuchense</i> ..	..	111	<i>tusatia</i> ..	..	172
(<i>Fragum</i>) <i>simillimum</i> ..	116, 117		<i>Columbae</i> ..	..	170
<i>rugosum</i> ..	..	116	<i>Columbidae</i> ..	128, 170	
<i>simillimum</i> ..	..	117	<i>Conidae</i> ..	..	107
<i>Carpophaga griseicapilla</i> ..	..	170	<i>Conus</i> ..	..	107
<i>Catylisia opima</i> ..	..	118	<i>achatinus</i> ..	..	107
<i>Cellana</i> ..	..	89	<i>achatinus maximus</i> ..	..	107
<i>capensis</i> ..	..	89	<i>monachus</i> ..	..	107
<i>testudinaria</i> ..	..	89	<i>Copsychus saularis</i> ..	..	138
<i>Centrocoecyx intermedius</i> ..	..	156	<i>saularis saularis</i> ..	..	138
<i>Centropus sinensis intermedius</i> ..	..	156	<i>Coracias affinis</i> ..	..	156
<i>Cephalopoda</i> ..	..	121	<i>benghalensis affinis</i> ..	..	156
<i>Gerchneis tinnunculus</i> ..	..	167	<i>puella</i> ..	..	147
<i>tinnunculus interstinctus</i> ..	..	167	<i>Coraciformes</i> ..	..	155
<i>Cerithidea</i> ..	..	95	<i>Coracii</i> ..	..	156
<i>cingulata</i> ..	..	95	<i>Coraciidae</i> ..	..	156
<i>fluvialis</i> ..	..	96	<i>Coraciiformes</i> ..	..	178
<i>Cerithideopsilla</i> ..	..	95	<i>Corbicula</i> ..	..	115
<i>Cerithideopsis</i> ..	..	95	<i>striatella</i> ..	..	115
			<i>Corbiculidae</i> ..	..	115

C—contd.	Page.
Corbioulinae ..	115
Corculum ..	116
simillimum ..	116, 117
<i>Corvus coronoides intermedius</i> ..	129
<i>culminatus</i> ..	128
<i>intermedius</i> ..	128
<i>macrorhynchus</i> ..	128
<i>macrorhynchus intermedius</i> ..	128, 129
<i>splendens</i> ..	129
Corvidae ..	128
Crepidula ..	97
<i>fornicata</i> ..	87, 97
<i>Criniger flaveolus</i> ..	133
<i>gularis flaveolus</i> ..	133
<i>lephrogenys flaveolus</i> ..	133
Crustacea ..	86, 123
Oculi ..	156
Cuneata ..	110
<i>Cyanocinclus cyanus</i> ..	139
<i>Cyanops asiatica</i> ..	156
<i>asiatica asiatica</i> ..	156
Cymaliinae ..	100, 102
Cyphoma gibbosum ..	190
Cypraea ..	183, 186
<i>acutidentata</i> ..	204
<i>arabica</i> ..	203
<i>australis</i> ..	187, 188
<i>brevissima</i> ..	192
<i>childreni</i> ..	201
(<i>Coccinelliformes</i>) <i>oriza</i> ..	199
(<i>Coccinelliformes</i>) <i>tremeza</i> ..	203
<i>corrugata</i> ..	204
<i>edgari</i> ..	197
<i>europaea</i> ..	185
<i>exigua</i> ..	202, 203
<i>formosa</i> ..	188
<i>gemma</i> ..	202, 203
<i>globosa</i> ..	191, 192, 193
<i>hordacea</i> ..	196, 197
<i>intermedia</i> ..	199, 200
<i>insecta</i> ..	196, 197
<i>massauensis</i> ..	203
<i>mauritiana</i> ..	99
<i>nivea</i> ..	199, 201
<i>oryza</i> ..	197, 198, 199, 200, 201
<i>pediculus</i> ..	201
<i>pilula</i> ..	191, 192
<i>pisum</i> ..	193, 194
<i>producta</i> ..	194, 195, 198
<i>quadripunctata</i> ..	189, 190
<i>radians</i> ..	187, 188
<i>rosea</i> ..	189, 190
<i>rotunda</i> ..	197, 198
<i>rubinicolor</i> ..	199, 200, 201
<i>scabriuscula</i> ..	191
<i>sphaerula</i> ..	193
<i>subrostrata var. alba</i> ..	202, 203
<i>tremeza</i> ..	187, 188
(<i>Trivia</i>) <i>australis</i> ..	191
(<i>Trivia</i>) <i>brevissima</i> ..	204
(<i>Trivia</i>) <i>corrugata</i> ..	204
(<i>Trivia</i>) <i>corrugata var. corrugata</i> ..	203
(<i>Trivia</i>) <i>exigua</i> ..	203
(<i>Trivia</i>) <i>gemmae</i> ..	191, 192
(<i>Trivia</i>) <i>globosa</i> ..	196
(<i>Trivia</i>) <i>insecta</i> ..	196
(<i>Trivia</i>) <i>oryza</i> ..	200
(<i>Trivia</i>) <i>pilula</i> ..	192
(<i>Trivia</i>) <i>pisum</i> ..	193, 194
(<i>Trivia</i>) <i>producta</i> ..	195

C—concl'd.	Page.
<i>Cypraea (Trivia) quadripunctata</i> ..	189, 190
(<i>Trivia</i>) <i>rubinicolor</i> ..	198
(<i>Trivia</i>) <i>scabriuscula</i> ..	200
(<i>Trivia</i>) <i>tremeza</i> ..	203
<i>turdus</i> ..	20
Cypraeacea ..	183, 184, 185
Cypraeerata ..	209
Cypraeidae ..	99, 183, 184, 186, 212
Cypricardia ..	120
<i>Cypricardia vellicata</i> ..	116
Cypraeogemma ..	201
<i>Cytherea castanea</i> ..	117

D

Dascillidae ..	73, 86
Decapoda ..	122
<i>Dendrocitta formosae himalayensis</i> ..	130
<i>himalayensis</i> ..	130
<i>sinensis</i> ..	130
<i>sinensis himalayensis</i> ..	130
Dermestes ..	81, 85
<i>vulpinus</i> ..	74, 78, 85
Dermestidae ..	73
Dibranchia ..	121
Dicruridae ..	128, 146
<i>Dicurus leucophaeus hopwoodi</i> ..	147
<i>macrocerus</i> ..	146
<i>macrocerus albirictis</i> ..	146
<i>macrocerus macrocerus</i> ..	128, 146
Diodora ..	88
<i>nigriradiata</i> ..	89
<i>ruppelli</i> ..	88
Diptera ..	80
Dolichopus ..	184, 184, 198
<i>insecta</i> ..	196
<i>producta</i> ..	195
Donacidae ..	120
Donax ..	120
(<i>Hecuba</i>) <i>scortum</i> ..	120
<i>scortum</i> ..	120
Dosinia ..	117
<i>aspera</i> ..	117
<i>excisa</i> ..	117
Dosiniinae ..	117
Drupa ..	104
<i>margariticola</i> ..	104
<i>Ducula badia griseicapilla</i> ..	170
<i>griseicapilla</i> ..	170
Dryobates atratus ..	155
Dryonastes ruficollis ..	130

E

<i>Eburna canaliculata</i> ..	105
<i>Elanus coeruleus</i> ..	169
<i>coeruleus vociferus</i> ..	169
Elasmobranch ..	23, 25, 26, 52, 53
Ellatrivia ..	184, 187, 188
<i>merces</i> ..	188
<i>wirrata</i> ..	188
Emarginulinae ..	88
Enicurus immaculatus ..	137
Enida ..	90
<i>gemma</i> ..	91
<i>japonica</i> ..	91
<i>speciosa</i> ..	91
<i>Ephialtes glabripes</i> ..	164
<i>jerdoni</i> ..	163, 165

	E—concl'd.	Page.
<i>Ephialtes plumipes</i>	..	163
Erato	183, 184, 186, 205, 211	
angistoma	..	209, 210
angulifera	..	210, 211, 212
angyostoma	..	210
angystoma	..	210
callasa	..	205, 206
corrugatum	..	207
corrugatus	..	207
(Erato) angystoma	..	210
(Erato) callosa	..	205
(Erato) sandwicensis	..	209
(Erato) sulcifera	..	207
(Eratopsis) angistoma	..	210
(Eratopsis) callosa	..	205
(Eratopsis) gallinacea	..	211
(Eratopsis) guttula	..	20
(Eratopsis) sandwichensis	..	209
(Eratopsis) sulcifera	..	207
gallinacea	..	211
gallinaceum	..	210
guttata	..	208
guttula	..	206, 208
lachryma	205, 206, 209	
lachryma var. callosa	..	205
nana	..	207
neozelanica	..	205
pellucida	..	209, 210
(Proterato) callosa	..	205
sandwichensis	..	206, 209
schmeltziana	..	207
sulcifera	..	207
sulcifera var. minor	..	212
Eratoidea	183, 184, 186, 205	
Eratoinae	..	184, 186, 209
Erethistes	..	70
conta	..	71
(?) conta	..	65
elongatus	..	71
(?) hara	..	65
<i>Euglyptosternum lineatum</i>	..	60
Eulamellibranchiata	..	115
Eumarcia	..	118
<i>Euplocamus horsfieldi</i>	..	173
Eurylaimidae	..	155
<i>Eurylaimus dalhousiae</i>	..	155
Eutropiichthys	..	63
murius	..	65, 71
vacha	..	65, 71

F

<i>Falco indus</i>	..	168
interstinctus	..	167
vociferus	..	169
Falconidae	..	167
Fasciolariidae	..	106
<i>Fissurella (Capiluna) ruppelli</i>	..	89
ruppelli	..	89
Fissurellidae	..	88
Fossatrivia	..	184
Fragum	..	116
Francolinus chinensis	..	180
Fringillidae	..	150
Fuligula marilla	..	180
Fusinus	..	106
rostratus	..	87, 106
rubrolineatus	..	106
<i>Fusus (Fusus) rostratus</i>	..	106
rostratus	..	106
rubrolineatus	..	106

G

		Page.
Gafrarium	..	118
divaricatum	..	118
Gagata	..	63
cenia	..	65, 69
gagata	..	65, 71
nangra	..	65, 71
viridescens	..	65, 69
Galinae	..	173
<i>Gallophasis horsfieldii</i>	..	173
<i>Garrulax pectoralis</i>	..	130
pectoralis pectoralis	..	130
ruficollis	..	130
Gastropoda	..	88, 185
Gemmula	..	107
Gennaeus horsfieldii	..	173
Gibbula	..	90
(Enida) persica	..	91
†nobomii	..	90, 91
<i>Glaucidium cuculoides</i>	..	166
cuculoides rufescens	..	166
Glyptosternum	..	55
botia	..	56, 57
botium	..	57
telchitta	..	56, 57
Glyptothorax	..	55, 57, 61
botia	..	57
botium	..	58
burmanicus	..	57, 60, 61
cavia	..	56, 57, 60, 61, 65, 70
lineatus	..	56, 60, 61
telchitta	..	55, 57, 58, 65, 70
<i>Gracula saularis</i>	..	138
Gyps himalayensis	..	128, 167
Gyrineum	..	100
(Argobuccinum) tuberculatum	..	100
(Biplex) perca var. aculeata	..	100
natator	..	100
perca	..	100
perca var. aculeata	..	100

H

<i>Halcyon smyrnensis</i>	..	158
smyrnensis fusca	..	158
<i>Haliaetus lineatus</i>	..	169
<i>Haliaster indus</i>	..	168
indus indus	..	168
<i>Harpactes erythrocephalus</i>	..	160
erythrocephalus erythrocephalus	..	160
Harpalus	..	84
Harpodon nehereus	..	27
Haustator	..	94
Hecuba	..	120
<i>Helcioniscus capensis</i>	..	89
testudinarius	..	89
<i>Helix interrupta</i>	..	110
laevipes	..	110
trifasciata	..	110
Helminths	..	123
Hemipimelodus jotius	..	68
Hemitapes	..	118
<i>Hemixus maclellandi maclellandi</i>	..	133
<i>Henicurus immaculatus</i>	..	137
Herodiones	..	176
Heterodonta	..	115
Heteropneustes	..	63
fossilis	..	65, 66
Heteropneustidae	..	65
<i>Heteroxenicus eruralia</i>	..	135

H—concl'd.	Page.	L—concl'd.	Page.
<i>Heteroxenicus cruralis orurælics</i>	135, 181	<i>Lithodomus cumingianus</i>	112
<i>Hexaplex ..</i>	103	<i>Lithophaga ..</i>	112
<i>Hima ..</i>	105	(<i>Botula</i>) <i>cinnamomina</i>	112
<i>Hipponyx (Malluvium) lissu</i>	97	<i>cinnamomea</i>	112
<i>Hirundinidae ..</i>	151	<i>cinnamomina ..</i>	112
<i>Hirundo rustica ..</i>	151	<i>cumingiana ..</i>	112
<i>rustica gutturalis ..</i>	151	<i>Lobivanellus atronuchalis</i>	175
<i>rustica rustica ..</i>	151	<i>indicus atronuchalis ..</i>	175
<i>Hoplopterus duvauceli ..</i>	175	<i>Loricata ..</i>	88
<i>ventralis ..</i>	175	<i>Lunatica brunea ..</i>	93
<i>Hydrocissa albirostris ..</i>	158	<i>Lunella ..</i>	93
<i>malabarica ..</i>	158		
<i>malabarica malabarica ..</i>	158	M	
<i>Hypsipetes gracilis ..</i>	131	<i>Macrones ..</i>	72
<i>macclellandi ..</i>	133	<i>menoda ..</i>	72
I		<i>vittatus ..</i>	70
<i>Ianthocinclia pectoralis ..</i>	130	<i>Macropteropus batrachus</i>	64
<i>Infundibulum ..</i>	90	<i>jagur ..</i>	64, 66
<i>Irena puella ..</i>	147	<i>magur ..</i>	64, 66
<i>puella puella ..</i>	147	<i>Macropygia tusalia ..</i>	172
<i>Irenidae ..</i>	147	<i>unchall tusalia ..</i>	172
<i>Ithagenes cruentus kuseri ..</i>	179	<i>Malapterurus coila ..</i>	67
<i>Ixos maccolellandi ? maccolellandi</i>	133	<i>Malluvium ..</i>	96
<i>maccolellandi tickelli</i>	133	<i>Mammal ..</i>	46, 123, 126
<i>Iyngipicus canicapillus ..</i>	155	<i>Marica (Hemitaper) opima ..</i>	118
J		<i>Margaritinae ..</i>	92
<i>Jennriinae ..</i>	212	<i>Marginella ..</i>	208
K		<i>Marmarostoma ..</i>	93
<i>Katelsysia ..</i>	118	<i>Martesia ..</i>	120
<i>marmorata ..</i>	118	<i>multistriata ..</i>	121
<i>opima ..</i>	118	<i>striata ..</i>	120, 121
L		<i>Martesünæ ..</i>	120
<i>Laevicardium (Trachycardium) fla-</i>		<i>Mauritia ..</i>	99
<i>vum ..</i>	116	<i>arabica dilacerata ..</i>	99
<i>Lanüdae ..</i>	144	<i>histris ..</i>	99
<i>Lanius bouboul ..</i>	138	<i>mauritiana ..</i>	99
<i>cristatus ..</i>	145	<i>Megalema asiatica ..</i>	156
<i>cristatus cristatus ..</i>	145	<i>Megaloptera ..</i>	84
<i>nasutus ..</i>	145	<i>Meretricinae ..</i>	117
<i>nasutus nigriceps ..</i>	145	<i>Meretrix ..</i>	117
<i>nasutus tricolor ..</i>	144, 145, 146	<i>castanea ..</i>	117
<i>nigriceps ..</i>	144	<i>meretrix var. castanea</i>	117
<i>nigriceps nigriceps ..</i>	144	<i>Merula bouboul ..</i>	138
<i>schaich nipalensis ..</i>	145	<i>Mesia argentauris ..</i>	133
<i>tephronotus ..</i>	145	<i>argentauris argentauris</i>	133
<i>Latrunculus spiratus ..</i>	105	<i>Mesogastropoda</i>	94, 185
<i>Leioptila annectans ..</i>	132	<i>Milvus affinis</i>	168
<i>annectans annectans ..</i>	132	<i>govinda ..</i>	168
<i>gracilis ..</i>	131	<i>melanotis ..</i>	169
<i>(sic) annectans ..</i>	132	<i>migrans affinis ..</i>	169
<i>Lepidosteaus ..</i>	52	<i>migrans govinda ..</i>	168
<i>Libitina ..</i>	116	<i>migrans lineatus ..</i>	169
<i>vellicata ..</i>	116	<i>Microtarsus atriceps major ..</i>	135
<i>Libitinidae ..</i>	116	<i>melanocephalus melanocephalus</i>	135
<i>Limicolæ ..</i>	165	<i>Modiola cinnamomea ..</i>	112
<i>Limopsidae ..</i>	112	<i>Mollusca 87, 126, 178, 185, 194, 200, 204</i>	
<i>Limopsis ..</i>	112	<i>Molpastes burmanicus ..</i>	134
<i>indica ..</i>	112	<i>cafer burmanicus ..</i>	134
		<i>haemorrhous burmanicus</i>	134
		<i>Monilea ..</i>	92
		<i>obscura ..</i>	92
		<i>Monticola cyanus ..</i>	139
		<i>cyanus solitaria ..</i>	139
		<i>solitaria affinis ..</i>	128
		<i>solitaria ..</i>	128, 140
		<i>solitaria affinis ..</i>	139, 140, 141
		<i>solitaria cyanus ..</i>	140
		<i>solitaria longirostris</i>	128, 140, 142

M—concl'd.	Page.
<i>Monticola solitaria pandoo</i>	139, 140
<i>solitaria transcaspica</i>	140, 141
<i>solitaria transcaspicus</i>	142
Marula ..	104
Motacilla alba dukhunensis ..	151
alboides ..	152
cinerea caspica	153
<i>dukhunensis</i> ..	151
<i>hodgsoni</i> ..	152
leucopsis ..	152
<i>lugubris alboides</i> ..	152
<i>lugubris leucopsis</i> ..	152
Motacillidae ..	151
Muraenesox tolaboroides ..	27
Murex ..	102
adustus	102, 103
<i>chicoreum</i>	103
chicoreus ..	103
(chicoreus) adustus.	102
<i>cingulata</i> ..	96
<i>endivia</i> ..	103
(Hexaplex) <i>chicoreus</i>	103
<i>javanus</i> ..	108
<i>marganiticola</i> ..	104
(Phyllonotus) <i>endivia</i>	103
<i>rostratus</i>	106
<i>ternispina</i> ..	102
<i>tribulus</i>	102
(Tribulus) <i>ternispina</i> ..	102
Murioidae	102
Muscicapa torquata	136
Muscicapidae ..	144
Myiophoneus temminckii temminckii	143
Myochamidae	121
Myodora	121
quadrata	121
weberi ..	121
Myophonus coeruleus temminckii	143
Mystus ..	72
aor ..	65, 72
oavasius	65, 72
gulio	65, 72
menoda ..	65, 72
vittatus	70, 65
Mytilidae ..	112

N

Nacellinae	89
<i>Nasea stolata</i>	105
Nassariidae	105
Nassarius ..	105
(Phrontis) <i>stolatus</i> ..	105
<i>stolatus</i>	105
Natica ..	98
pellis tigrina ..	98, 99
Naticidae ..	98
Nautilus ..	200
Nectariniidae	154
Nerita	93
plexa	93
Neritidae	93
Neritinae	93
Neuroptera ..	84
Niltava sundara	144
sundara sundara ..	144
Niveria ..	184, 193
brevissima	191
globosa	191
<i>quadripunctata</i>	190

O	Page.
Octopodidae ..	121
Octopodinae ..	121
Octopoda ..	121
Octopus ..	122
cyanea ..	122
<i>marmoratus</i> ..	122
<i>Oliva nebulosa</i> ..	106, 107
(Olivancillaria) <i>nebulosa</i> ..	106
Olivancillaria ..	106
gibbosa ..	107
<i>nebulosa</i> ..	106, 107
Olividae ..	106
Olivinae ..	106
Olyra ..	63
Ompok bimaculatus ..	65, 66, 67
pabo ..	65, 67
Onchidium coriaceum	109
<i>verruculatum</i> ..	109
Oncidiidae ..	108
Oncidium ..	108
peronii ..	109
<i>sewignyii</i>	109
<i>verruculatum</i> ..	109
Oncis ..	109
cariacea ..	109
<i>Stuxbergi</i> ..	109
Oriolidae ..	147
chinensis tenuirostris	147
<i>tenuirostris</i> ..	147
<i>traillii</i> ..	148
<i>traillii traillii</i> ..	148
Ostrea ..	114
arakanensis ..	114
<i>gryphoides var. cuttackensis</i> ..	114
<i>madrasensis</i>	114
<i>nigromarginata</i>	114
Ostreidae ..	114
Otocompsa emeira ..	134
flaviventris flaviventris ..	13
Otus bakkamoena ..	128, 163
bakkamoena bakkamoena	164, 165
bakkamoena deserticolor	164, 165
bakkamoena gangeticus	164, 165
bakkamoena glabripes ..	165
bakkamoena lempiji	164, 165
bakkamoena lettia ..	128, 163, 16
*manipurensis bakkamoena	128, 162
bakkamoena marathae	163, 164, 165
bakkamoena plumipes	164, 165
<i>bakkamoena stewarti</i>	164, 165
<i>indica</i> ..	163, 165
<i>sunia modestus</i>	166
<i>sunia sunia</i> ..	166
Ovula ocularis ..	190
Ovalum ..	211
<i>gallinaceum</i> ..	211

P

Pangasias ..	63
pangasius	65, 68
Paphia ..	119
gallus ..	119
cor ..	119
<i>mialabarica</i>	119
<i>marmorata</i> ..	118
<i>textile</i> ..	119

P—contd.	Page.	P—contd.	Page.
<i>Paradisea tristis</i> ..	148	<i>Pimelodus gagata</i> ..	71
<i>Paratakes</i> ..	119	<i>gagora</i> ..	68
<i>Parreysia</i> ..	115	<i>gilio</i> ..	72
<i>corrugata</i> var. <i>laevirostris</i> ..	115	<i>hara</i> ..	70, 71
<i>Parus caspicus</i> ..	163	<i>jatius</i> ..	68
<i>Passer domesticus</i> ..	160	<i>mangois</i> ..	71
<i>malaccensis</i> ..	150	<i>menoda</i> ..	72
<i>montanus</i> ..	150	<i>murius</i> ..	71
<i>montanus malaccensis</i> ..	150	<i>nangra</i> ..	71
<i>Passeriformes</i> ..	128, 178	<i>nenga</i> ..	69
<i>Pastor traillii</i> ..	148	<i>pangasius</i> ..	68
<i>Patella capensis</i> ..	89	<i>rama</i> ..	69
<i>fornicata</i> ..	97	<i>rita</i> ..	68
<i>testudinaria</i> ..	89	<i>sagor</i> ..	68
<i>Patellidae</i> ..	89	<i>silondia</i> ..	67
<i>Peponotidae</i> ..	133	<i>sona</i> ..	69
<i>Pedicularia</i> ..	184, 212, 213	<i>tengana</i> ..	69
<i>californica</i> ..	212	<i>tengara</i> ..	70
<i>elegantissima</i> ..	213	<i>telchitta</i> ..	55, 56, 57, 70
<i>pacifica</i> ..	213	<i>urua</i> ..	64, 65, 69
(<i>Pediculariella</i>) <i>pacifica</i> ..	213	<i>vacha</i> ..	71
<i>sicula</i> ..	184	<i>viridescens</i> ..	69
<i>Pediulariidae</i> ..	183, 184, 212	<i>Pinna</i> ..	118
<i>Pediulariinae</i> ..	184, 212	<i>nigra</i> ..	113
<i>Pediulariella</i> ..	212, 213	<i>nigrina</i> ..	113
<i>pacifica</i> ..	213	(<i>Atrina</i>) <i>vexillum</i> ..	113
<i>Periplaneta</i> ..	84	<i>vexillum</i> ..	113
<i>americana</i> ..	86	<i>Pinnidae</i> ..	113
<i>Petrocinola affinis</i> ..	142	<i>Placenta</i> ..	114
<i>affinis</i> ..	139	<i>orbicularis</i> ..	114
<i>cyaneus</i> ..	143	<i>placenta</i> ..	115
<i>longirostris</i> ..	143	<i>Planaxidae</i> ..	95
<i>Manillensis</i> ..	142	<i>Planaxinae</i> ..	95
<i>Manillensis</i> (?) ..	139	<i>Planaxis</i> ..	95
<i>pandoo</i> ..	139	<i>breviculus tessellata</i> ..	95
<i>pandoo</i> ..	142	<i>breviculus</i> var. ..	95
<i>Petrocosyphus cyaneus</i> ..	139	<i>sulcatus</i> ..	95
<i>Petrophila cyanus</i> ..	139	<i>Platystacus chaca</i> ..	68
<i>Phasianidae</i> ..	173	<i>Pleurotoma congener</i> ..	107
<i>Phasianus humiae</i> ..	179	(<i>Gemmala</i>) <i>congener</i> ..	107
<i>Phoenicura fuliginosa</i> ..	138	<i>nodifera</i> ..	108
<i>leucocephala</i> ..	137	<i>vagata</i> ..	108
<i>Pholadidae</i> ..	120	<i>Plotosidae</i> ..	65
<i>Pholas</i> (<i>Martesia</i>) <i>striata</i> ..	120	<i>Plotosus canius</i> ..	65, 66
<i>multistriata</i> ..	121	<i>Polia</i> ..	105
<i>striata</i> ..	120	<i>Polyplectron bicalcaratum bakeri</i> ..	173
<i>Phorus pallidulus</i> ..	98	<i>Polyplectrum tibetanum</i> ..	173
<i>Phyllornis hardwickii</i> ..	132	<i>Pomatorhinus erythrogenys mecle-</i>	
<i>Pici</i> ..	155	<i>llandi</i> ..	131
<i>Picidae</i> ..	155	<i>McClellandi</i> ..	131
<i>Picus atratus</i> ..	155	<i>macclellandi</i> ..	131
<i>canicapillus</i> ..	155	<i>Potamides cingulatus</i> ..	96
<i>Pila</i> ..	94	(<i>Telexopium</i>) <i>telescopium</i> ..	96
<i>virens</i> ..	94	<i>Potamidid</i> ..	96
<i>Pilidae</i> ..	94	<i>Potamididae</i> ..	96
<i>Pilinae</i> ..	94	<i>Potamidinae</i> ..	96
<i>Pimelodus angius</i> ..	69	<i>Potomida</i> ..	116
<i>aor</i> ..	72	<i>Pratincola caprata</i> ..	136
<i>arius</i> ..	68	<i>maurus</i> ..	136
<i>atherinoides</i> ..	65	<i>Priotrochus</i> ..	92
<i>bagarius</i> ..	70	<i>obscurus</i> ..	92
<i>batasio</i> ..	69	<i>Pristis cuspidatus</i> 1, 9, 10, 11, 12, 13, 15,	
<i>botius</i> ..	55, 56, 57, 64, 71	16, 18, 20, 23, 24	
<i>carcio</i> ..	70	<i>Proeutropiichthys</i> ..	63
<i>cavauius</i> ..	72	<i>Proparus</i> ..	180
<i>cavia</i> ..	55, 60, 70	<i>Prosobranchia</i> ..	88, 185
<i>conia</i> ..	69	<i>Protapes</i> ..	119
<i>chandramara</i> ..	64, 68	<i>Proterato</i> ..	205, 211
<i>conta</i> ..	71	<i>angistoma angistoma</i> ..	210, 211
<i>ovus</i> ..	56	<i>angistoma angulifera</i> ..	210
		<i>callosa</i> ..	205, 206, 207

P—concl'd.	Page.	S—concl'd.	Page.
<i>Proterato gallinacea</i>	211, 212	<i>Sialis</i> ..	84
<i>panamensis</i> ..	206, 207	<i>Silonia</i> ..	63
<i>sandwichensis</i>	208, 209	<i>silondia</i> ..	65, 67
<i>sulcifera</i>	206, 207	<i>Silonopangasius</i>	63
<i>sulcifera capensis</i> ..	207	<i>Siluridae</i>	65
<i>sulcifera corrugatum</i>	207	<i>Siluroidea</i> ..	64
<i>sulcifera schneideri</i>	207	<i>Siluroids</i>	63, 65
<i>sulcifera smithi</i>	207, 208	<i>Silurus</i> ..	63
<i>sulcifera sulcifera</i>	207, 208	<i>batrachus</i>	64
<i>Pearisomus dalhousiae</i>	155	<i>bimaculatus</i> ..	65
<i>Pseudeutropius</i>	63	<i>boalis</i>	65
<i>atherinoides</i>	65, 69	<i>(Callichrous) pabda</i>	66
<i>Pailorhinus magnirostris</i>	129	<i>(Callichrous) boalis</i>	67
<i>Psittacii</i> ..	178	<i>(Callichrous) canio</i> ..	67
<i>Purpura bufo</i>	104	<i>(Callichrous) chechra</i>	67
<i>bufo callosa</i>	104	<i>(Callichrous) duda</i>	67
<i>callosa</i> ..	104	<i>(Callichrous) garua</i> ..	67
<i>(Microtoma) rudolphi</i>	103	<i>(Callichrous) pabo</i>	67
<i>(Purpura) rudolphi</i>	103	<i>canio</i> ..	64, 65
<i>rudolphi</i>	103	<i>chechra</i> ..	64
<i>(Thalessa) bufo</i>	104	<i>duda</i>	64
<i>Pusula</i> ..	184, 186, 189, 194	<i>fossilis</i>	64
<i>(Ellatrivia) merces</i>	188	<i>pabda</i>	64
<i>(Niveria) quadripunctata</i>	190	<i>singio</i> ..	64, 66
<i>quadripunctata</i> ..	190	<i>Sisor raddophorius</i>	65, 72
<i>Pycnonotus burmanicus</i> ..	134	<i>Sisoridae</i>	65
<i>Pyrotrygon erythrocephalus</i>	160	<i>Sistrum (Morula) fiscellum</i>	104
<i>cephalus</i> ..	160	<i>undatum</i>	104
R		<i>Siva cyanouroptera</i>	132
<i>Raia batis</i>	23	<i>cyanouropter cyanouroptera</i>	132
<i>radiata</i> ..	7	<i>nipalensis</i> ..	131
<i>Rama rama</i> ..	65, 68, 69	<i>Spizixos camiprons</i>	135
<i>Rhinobatus columnae</i>	20	<i>canifrons canifrons</i> ..	135
<i>Rhyacornis fuliginosus</i>	138	<i>Squalus acanthias</i>	53
<i>fuliginosa fuliginosa</i>	138	<i>Stegostoma tigrinum</i> ..	23
<i>Rhynchobatus djiddensis</i>	1, 18, 19, 20, 21, 24	<i>Stenoglossa</i>	102
<i>Ricinula fiscellum</i> ..	104	<i>Stomatella</i>	92
<i>Rita rita</i>	65, 68	<i>elegans</i>	92
<i>Rostellaria curvirostris</i>	98	<i>Stramonita</i> ..	104
<i>Rotella vestiaria</i>	91	<i>Streptopelia chinensis suratensis</i>	171
<i>Rutigula flaviventris</i>	134	<i>chinensis tigrina</i>	171
S		<i>decaocto</i> ..	180
<i>Sarmaticus</i> ..	93	<i>decaocto decaocto</i> ..	128, 172
<i>Saxicola caprata burmanica</i>	136	<i>decaocto xanthocyclus</i>	128, 172
<i>torquata</i>	136, 137	<i>orientalis agricola</i> ..	170, 171
<i>Scapharca deyrollei</i>	110	<i>orientalis meena</i> ..	170
<i>Scarabaeidae</i>	73, 86	<i>Striges</i> ..	161
<i>Schilbeidae</i>	65	<i>Strix indranee newarensis</i>	128, 161
<i>Schizodonta</i> ..	115	<i>javanica</i>	161
<i>Scoliodon sorrakowah</i> ..	25, 26, 27, 28, 29, 31, 33, 34, 38, 39, 41, 42, 44, 46, 47, 48	<i>Lempiji</i> ..	163
<i>Scolopacidae</i>	176	<i>lettioides</i>	163, 165
<i>Scops griseus</i>	163, 165	<i>Strombidae</i> ..	98
<i>lettia</i> ..	163, 165, 166	<i>Surcula</i> ..	108
<i>malaboricus</i>	163, 164	<i>javana</i>	108
<i>modestus</i>	166	<i>Sturnidae</i>	148
<i>pennantus</i>	166	<i>Sturnopaster capensis superciliaris</i>	149
<i>Scyllium</i>	52	<i>contra superciliaris</i>	149
<i>canicula</i>	23	<i>superciliaris</i>	149
<i>Selachoid</i> ..	11	<i>Stylommatophora</i> ..	108
<i>Senectus</i> ..	92, 93	<i>Sylvia palpebrosa</i> ..	154
<i>Sepiella</i> ..	122	<i>Syrnium newarensis</i> ..	161
<i>inermis</i>	122	T	
<i>Sepiidae</i> ..	122	<i>Tachysuridae</i> ..	65
		<i>Tachysurus</i> ..	63
		<i>arius</i>	65, 68
		<i>gagora</i>	65, 68
		<i>jatius</i> ..	65
		<i>nenga</i> ..	65, 69

	T—contd.	Page.
Trachysurus	sagor ..	65, 68
	sona ..	65, 69
Tapes (<i>Hemitapes</i>)	marmorata ..	118
	laterisulca ..	118
	variabilis ..	118
Taxodonta ..	..	110
Telescopium ..	..	96
	telescopium ..	96
Tenebroides	mauritanicus ..	78
	sp. ..	78
Thais ..	..	103
	bufo ..	104
	bufo callosa ..	104
	rudolphi ..	103
	persica ..	103
Thaisidae ..	..	103
Thalotia ..	..	90
Theliosstyla ..	..	93
Tibia ..	..	98
	ourvirostris ..	98
	delicatula ..	98
Timaliidae ..	..	130
Totanus	ochropus ..	176
Trachycardium ..	..	116
Trapezium	sublaevigatum ..	116
Trichophorus	flaveolus ..	133
Tringa	ochropus ..	176
Tritonidea	undosa ..	105
Tritonium	natator ..	100
Trivellona	excelsa ..	188
Trivia ..	183, 184, 185, 186, 189, 191, 194, 199, 201	
	acutisulcata ..	192
	affinis ..	197
	australis ..	187, 188
	avellanoides ..	188
	lipunctata ..	202
	brevissima ..	191, 192, 198
	(Cleotrivia) pilula ..	193
	(Cleotrivia) pisum ..	194
	corrugata ..	204, 205
	(Ellatrivia) merces ..	189
	europaea ..	190, 199
	exigua ..	202, 203, 204
	exigua corrugata ..	203, 204, 205
	exigua exigua ..	202, 203, 204
	globosa ..	191, 192, 193, 202
	hoernesiana ..	192
	hordacea ..	196
	insecta ..	196, 197
	intermedia ..	201
	litiputana ..	201
	merces ..	198
	oryza ..	199, 200, 201, 202
	oryza var. intermedia ..	202
	oryza minor ..	201
	oryza F. minor var. scabriuscula ..	200
	oryza oryza ..	201
	oryza scabriuscula ..	201
	pediculus ..	201
	pellucidula ..	202
	pilula ..	191, 192, 193, 194
	pisum ..	193, 194
	producta ..	195, 196, 198
	(Pusula) quadripunctata ..	190
	quadripunctata ..	189, 190
	rubinicolor ..	191, 197, 198
	sanwicensis ..	201
	sauguinea ..	195, 198
	scabriuscula ..	195, 200, 201, 202
	(semitrivia) merces ..	188

	T—contd.	Page.
(Trivia) sphaerula ..	..	191, 192
(Trivia) Tremza ..	190, 203, 204	
(Trivia) australis ..	..	187, 188
(Trivia) brevissima ..	..	192
(Trivia) corrugata ..	..	204
(Trivia) exigua ..	..	203
(Trivia) insecta ..	..	196
(Trivia) oryza var. intermedia ..	..	200
(Trivia) oryza scabriuscula ..	..	200
(Trivia) pisum ..	..	194
(Trivia) producta ..	..	195
(Trivia) quadripunctata ..	..	190
(Trivia) rubrinicolor ..	..	198
(Trivirostra) corrugata ..	..	204
(Trivirostra) exigua ..	..	203
(Trivirostra) insecta ..	..	196
(Trivirostra) intermedia ..	..	200
(Trivirostra) oryza ..	200, 201	
(Trivirostra) pilula ..	..	192
(Trivirostra) pisum ..	..	194
(Trivirostra) scabriuscula ..	..	200
Triviacea ..	..	186
Triviella ..	..	184, 187
	australis ..	187
	merces ..	187, 188
	(Semitrivia) merces ..	188
Triviidae ..	..	183, 184, 185, 186
Triviinae ..	..	184, 185, 186
Trivirostra ..	..	184, 198, 199
	exigua ..	203
	exigua exigua ..	203
	hordacea ..	196
	insecta ..	196
	oryza ..	200, 201
	oryza oryza ..	201
	oryza scabriuscula ..	201
	scabriuscula ..	200, 201
	tremeza ..	203
Trochidae ..	..	90
Trochinae ..	..	90
Trochus ..	..	90
	(Aphanotrochus) obscurus ..	92
	(Infundibulum) radiatus ..	90
	kotschy ..	90
	obscurus ..	92
	radiatus ..	90
	telescopium ..	90
	nestiarius ..	91
Trogon asiaticus ..	..	156
	erythrocephalus ..	160
Trogones ..	..	160
Trogonidae ..	..	160
Turbinidae ..	..	92
Turbininae ..	..	92
Turbo ..	..	92
	argyrostomus ..	93
	brunneus ..	92, 93
	duplicatus ..	94
	(marmarostoma) bruneus ..	93
	radiatus ..	93
	(Senectus) intercostalis ..	93
Turdidae ..	..	128, 135, 181
Turdus	boulboul ..	138
	dissimilis ..	139
Turricula ..	..	108
Turridae ..	..	107
Turrinae ..	..	107
Turris ..	..	107
	congener ..	107, 108
	vagata ..	108
Turritella ..	..	94

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OBSERVATIONS ON THE DEVELOPMENT OF *CHILOSCYLLIUM GRISEUM* M. & H., *PRISTIS CUSPIDATUS* LATH. AND *RHYNCHOBATUS DJIDDENSIS* (FORSK.).

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[Plate I]

CONTENTS.

	PAGE.
Introduction	1
Egg-cases and breeding season of <i>Chiloscyllium griseum</i> M. & H. ..	1
Egg-cases	1
Mode of formation of egg-case	7
Breeding season	7
Embryonic stages of <i>Pristis cuspidatus</i> Lath.	9
Embryonic 33 mm. stage	9
Embryonic 53 mm. stage	14
Embryonic advanced stages	16
Embryonic stages of <i>Rhynchobatus djiddensis</i> (Forsk.)	18
Embryonic 45 mm. stage	18
Embryonic 150 mm. stage	20
Embryonic advanced stages	22
References to literature	23

INTRODUCTION.

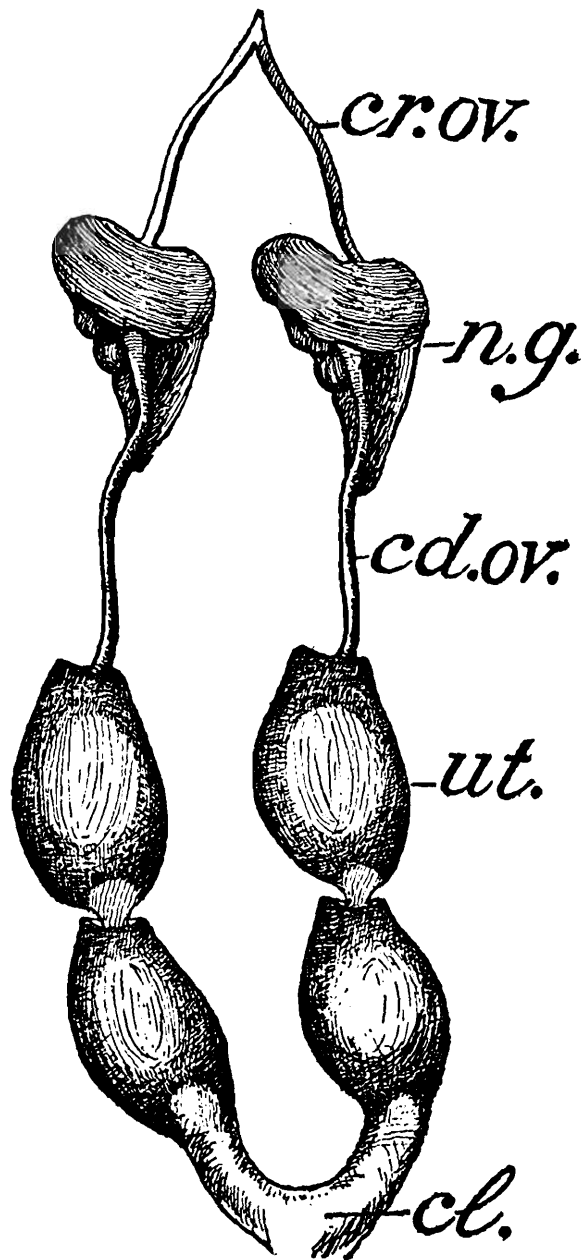
While investigating the breeding habits and life histories of the Bombay elasmobranchs, some striking observations concerning the mode of formation of the egg-cases in the oviparous shark *Chiloscyllium griseum* and the ovo-viviparous forms *Pristis cuspidatus* and *Rhynchobatus djiddensis* were made. The data obtained during these studies, lend support to the part-formation theory of egg-case formation. In the ovo-viviparous forms, the cavities of the egg-capsules were observed to be partitioned by a process of spiral twisting of the inner membrane of the capsules—a process which is probably recorded here for the first time. The embryonic stages of *P. cuspidatus* and *R. djiddensis* described here serve to furnish a more or less complete account of the intra-uterine development in these species. The condition of the parent fishes with successive advancements in pregnancy have also been recorded so as to complete the picture not only from the point of view of the foetus but also that of the mother.

EGG-CASES AND BREEDING SEASON OF *Chiloscyllium griseum* M. & H.

Egg-cases.—Parent ♀: Total length—23 inches; App.wt. 3 lb.; 10th March, 1945.

The abdomen of the fish was large and distended. Dissection revealed the presence of only the right ovary, which was large and

extended along almost the entire length of the abdominal cavity concealing other viscera. It measured 110 mm. $\times$ 50 mm. $\times$ 20 mm. and was studded with 18 large, greenish, yellowish pink, more or less rounded eggs, having diameters ranging from 20 mm. to 25 mm. There were also a number of small, light-coloured ova in various stages of development. A small strap-shaped, greenish-pink epigonal organ was also present, merging anteriorly into the substance of the ovary on its dorsal



TEXT-FIG 1.—*Chiloscylidium griseum* M. & H.

Oviducts, nidamental glands and uteri with four egg-cases 'in utero.' Note the similar disposition of nidamental glands and of egg-cases in both the uteri. *cd. ov.* = caudal oviduct; *cl.* = cloaca; *cr. ov.* = cranial oviduct; *n.g.* = nidamental gland; *ut.* = uterus.

aspect. Each nidamental gland was an asymmetrical, thick, swollen body, having a short dorsal and an elongated ventral groove, the latter being situated medially on the right side and laterally on the left. Both the uteri were thin-walled sacs, each tightly packed with two egg-cases (Text-fig. 1), the quadrangular contours of which were clearly discernible through the thin uterine walls.

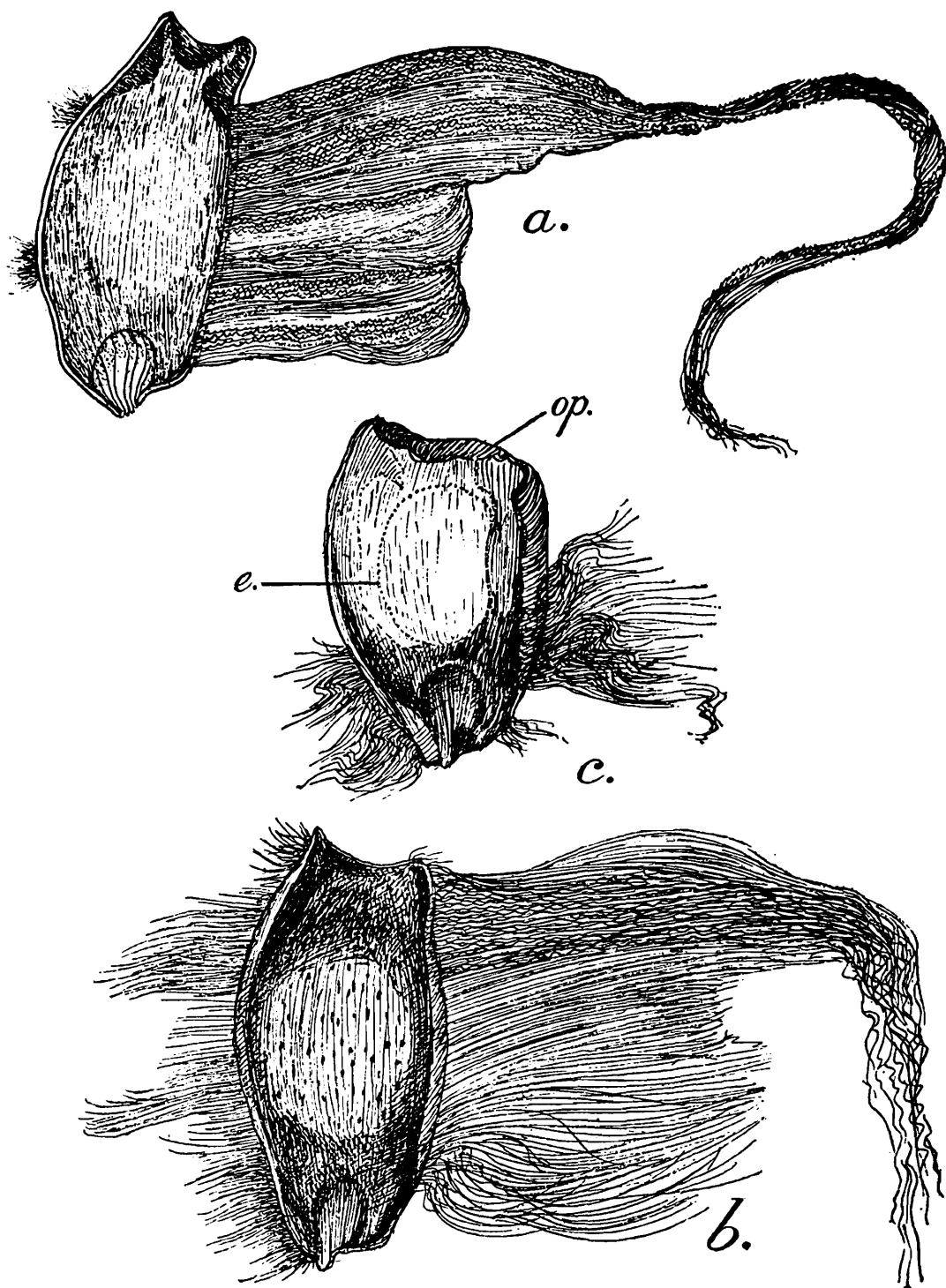
On opening the uterus the two egg-cases were seen to be placed tandem, in a single cavity roughly divided in the middle into two parts by a thick, horizontal fold or ridge of the uterine mucous membrane, showing that the uterus could accommodate only two egg-cases at a time. The silky shell-membrane cord of the proximal egg-case could be traced up lying in the lumen of the caudal oviduct, while that of the distal lay in the proximal compartment. Both pairs of egg-cases in the two uteri were placed exactly opposite each other and not one was yet extruded, even partially through the cloaca. The egg-cases lay flat in the uteri, presenting a slight bulge ventrally. The longer sides of each egg-case lay parallel to the length of the uterus and the broader end was always the anterior end. The shorter and less curved of the two long sides lay medially in the right uterus while the opposite was the position in the left. Thus, while the orientation of the egg-cases in both the uteri was similar, there was no bilateral symmetry in their disposition. This is to be expected in view of the fact that bilateral symmetry is lacking even in the nidamental glands (Text-fig. 1).

The tough, keratinous egg-cases (Text-fig. 2a) are glossy, dark brown in colour, having darker, thickened edges and angles. Their walls are semitransparent and the oval eggs within are visible even from without.

All the four egg-cases are more or less equal in size, having the following range of dimensions (in mm.) :—

Length of the longer and more curved of the two long sides	68-70
Length of the shorter and less curved of the two long sides	60
Width at the anterior end	 20
Width at the posterior end	 11
Width in the centre	 33-35
Maximum thickness	 17
Size of the egg within the egg-case	 20-23 × 25-27
Width of the shell-membrane band	 32
Length of the shell-membrane cord	190

These egg-cases are somewhat smaller than those examined by Aiyar and Nalini (1938), though the description of the cases agrees closely with that given by these authors. Reference may, however, be made to a few points deserving of special mention. Aiyar and Nalini state that the silky fibres composing the broad band gradually twist into a long cord for attachment to sea weeds, etc., and diagrammatically represent them as if they were equally elongated throughout. We find, however, that the silky band is more or less quadrangular in outline and that its fibres are not equally elongated throughout. The fibres along its upper free border are much more elongated than others and it is these only that chiefly go to form the anchoring cord, although a few fibres along the other free margins of the band also merge into it ultimately. Further, if the orientation of the egg-cases within the uterus, described above and apparently the normal orientation, is considered, the corner slits along the larger of the two long edges are ventral in disposition, while those along the other are dorsal. The slits are, however, extremely narrow and elongated and hardly perceptible in a superficial examination.



TEXT-FIG. 2.—*Chiloscyllium griseum* M. & H.

a. egg-case with silky band of anchoring fibres ; *b.* recently formed egg-case removed from uterus. Note superficial longitudinal beaded striations ; *c.* incomplete egg-case removed from nidamental gland. It is nearly two-thirds formed and the egg and albumen have already descended into it.
e. = egg ; *op.* = anterior opening.

The cavity of an egg-case on being opened does not extend beyond the superficial slope at either end and is seen to be filled with a quantity of translucent gelatinous albuminous mass in which is embedded the yellow oval egg. The blastoderms are seen to be scarlet-coloured circular halos about 2 to 2.5 mm. in diameter and situated at one of the poles of the eggs.

The vigorous state of activity of the ovary would make it appear that the female referred to above had just begun its reproductive cycle and that she would produce a number of egg-cases during the oestrous period that she had already entered upon.

Two gravid females, measuring 24" and 25.5" in total length and weighing about 4.5 lbs. apiece, were obtained from Sassoon Dock, Bombay, on 20th January 1944. The reproductive organs of both presented the characteristic features described above, but there were a number of significant differences which are noted below.

Each uterus of the female measuring 24" in length bore a completely formed egg-case having the following as dimensions (in m.m.) :—

Length of the longer side	87
Length of the shorter side	77
Maximum width of the egg-case	38
Size of the fertilized egg within the case	33 × 25

The egg-cases, except for the distinct variation in their size, presented exactly the same features described above.

The left uterus of the other female possessed a completely formed egg-case and there was another incompletely formed egg-case (open at one end) in the nidamental gland of that side. The right nidamental gland also possessed an incompletely formed open egg-case in the process of formation, but the uterus of this side was empty, with flaccid, sagging walls, indicating that its egg-case had just been cast into the sea, while the egg-case on the opposite side was next to be extruded. The completely formed egg-case from the left uterus had the following dimensions (in m.m.) :—

Length of the longer side	83
Length of the shorter side	70
Maximum width of the egg-case	40

This egg-case displayed certain structural peculiarities not noted in those already described. The egg-case was not yet dark or glossy brown in appearance but dull yellow, being coated externally with a dull coloured, rather opaque shelly secretion, which ran into thin, longitudinal streaks that still displayed a beaded appearance (Text-fig. 2*b*). Both the surfaces of this egg-case also possessed small and delicate silky filaments, which were not quite so densely packed as along the edges. On scraping off this superficial coating, the characteristic dark brown wall of the capsule became exposed. The beaded streaks of the shelly substance revealed the characteristic mode of secretion of the shell glands, described at length by Nalini (1940) during her treatment of the structure of the egg-case.

Another significant point arising from these observations was that this egg-case had just descended from the nidamental gland and would be retained for a time in the uterus till its superfluous secretions disappeared, and till it assumed the dark brown, glossy colour at which stage it would be ready to be cast out.

The most interesting features were, however, presented by the incompletely formed egg-cases in both the nidamental glands of the female (Text-fig. 2c ; Pl. I, fig. 2 left). Both of them were equal in development, similar in orientation, which itself was similar to that of the fully formed egg-cases and they were situated exactly opposite each other. It was obvious that nearly two-thirds of their development had been completed, characteristically, from the posterior end forwards and that anteriorly they were open, the openings being fairly wide and irregular in outline. The fertilised eggs, surrounded by dense masses of transparent, gelatinous albumen, had already entered the egg-cases, and more albumen was seen to be still entering through the open ends. The capsular walls were generally clear and transparent in appearance, but tough in consistency except at the edges of the open anterior ends, where they were still rather soft, parchment-like and plastic. Along both the long edges and in the posterior fourth, they were just assuming the yellowish brown tint and here their consistency was more tough. Evidently, the capsular walls were not equally keratinised all over. In the central region they were clearly transparent and not yet marked by the conspicuous longitudinal beaded striations present in other regions. Except this region, the walls turned whitish opaque in formalin. Further, the posterior third of both the long edges, the posterior angles, and the posterior end of either egg-case already possessed bunches of the soft, silky fibres and these were even present, though sparsely, on both the surfaces of the completely formed posterior portion of the egg-case. It was clear that a portion of the big band of the silky anchoring fibres had already been formed. The colour of the fibres was not, however, the characteristic golden yellow, as in the completely formed egg-cases, but was rather dull. Further, both the posterior corners of the egg-case, where development was almost complete, had formed the slits, with their dispositions similar to those in a completely formed egg-case. The dimensions of these incomplete egg-cases were as follows (in m.m.) :—

Length of the longer edge	..	60
Length of the shorter edge	..	50
Width at the open anterior end		30
Width at the posterior end		10

The walls of the egg-case being gently pressed would cause the jelly like albuminous mass engulfing the egg to project through the open end, and the scarlet-coloured blastoderm in the form of a circular halo about 3 mm. in diameter, would come into view.

These observations on the egg-cases in the process of formation facilitate an understanding of the mode of formation of the egg-case in *Chiloseyllium griseum*.

Mode of formation of egg-case.—Beard (1890), Hobson (1930), and Metten (1939) are of the view that the lower half or more of the egg-case is formed before the egg arrives in the nidamental gland and that the closure of the purse is effected only after the entry of the egg in the partially formed egg-case. Widakowich (1906) and Nalini (1940), on the other hand, are of the opinion that the casing material is secreted over the egg only when it actually arrives in the nidamental gland. This process would seem to suggest that the egg-case is secreted as a whole, at one and the same time, that its formation is completed uniformly and simultaneously on all sides, and that there is no preformation of a part of the egg-case before the arrival of the egg in the nidamental gland. Observations on the egg-cases obtained by us point to a lack of uniformity in the composition of the structure of the capsular wall in different regions and clearly suggest a non-synchronous activity of the shell-glands in the different zones of the nidamental glands. These features, together with the very incomplete nature of the egg-cases encountered by us, thus support the former view regarding the formation of egg-cases in oviparous forms. The incomplete egg-cases obtained by us represent obviously a stage slightly later than that of the unique egg-case described by Hobson in the skate *Raja radiata*. Nalini's criticism (*loc. cit.*, p. 209) of Hobson's observations on the half-formed egg-case and of his view about the part-formation of the egg-case is not sound, when it is reasoned that the different ends of the dorsal and ventral walls of the already secreted portion of the egg-case are not subjected to the same pressure throughout and that the different stages in the completion of the egg-case formation (*viz.*, the secretion of the posterior half of the egg-case, the entry into it of the egg surrounded by the albumen and the secretion of the remaining portion of the egg-case) succeed one another so quickly as not to permit of a differential hardening of the uniting regions, such as might lead to the 'suture' and a break in the superficial consistency of the egg-case as imagined by Nalini. Further, our observations regarding the presence already of the silky, anchoring fibres at the posterior ends of the long edges of the incomplete egg-case, and the evident revelation of part-formation of even the anchoring filamentous band, finally dispose of Nalini's view that these filaments are formed, all at the same time and last of all, after the complete formation of the egg-case.

The encountering of such partially formed egg-cases is, indeed, a sheer matter of chance and it is reasonable to believe that a more intensive fishing during the breeding season may reveal the normality of the phenomenon of part-formation of the egg-cases, thus ruling out the possibility of abnormality as implied by Nalini (*op. cit.*), on the grounds that such encounters are only solitary, as at present.

Breeding season.—It will be seen from the following table that though the ova are developed in December, the egg-cases do not appear till January. Females with egg-cases were recorded from January to March and thereafter the ovaries were found to be reduced in size and uteri with flaccid walls. It may, therefore, be surmised that the breeding season lasts from January to March.

Table showing the lengths of parent fishes and the dimensions of their egg-cases from the Bombay, Malabar and Madras areas.

Length of fish.	Date of capture.	Size of the egg-case.		Locality.	Observer.	Remarks.
		Max. length.	Max. width.			
Inches.		mm.	mm.			
23	10-3-43	70	35	Bombay	Authors	4 egg-cases; right ovary full of ripe ova.
23	5-5-43		.	Do.	Do.	No egg-cases ovaries reduced in size; uteri with flaccid walls.
24	5-5-43			Do	Do.	
25	15-12-43			Do.	Do.	
						No egg-cases only the right ovary with round greenish ova, about 5 mm. in diameter.
24	20-1-44	87	38	Do.	Do.	2 egg-cases right ovary in vigorous state of activity.
25.5	20-1-44	83	40	Do.	Do.	1 complete egg-case and 2 incomplete egg-cases in nidamental glands.
[26.5	6-3-44	86	38	Do.	Do.	2 egg-cases.
25	6-3-44			Do.	Do.	No egg-cases; right ovary with small-sized eggs. Only one egg 24 mm. × 20 mm.
[21.5	Dec. '37	60	25	Malabar Coast.	Aiyar and Nalini.	2 egg-cases; ovary very active.
[22.5	Dec. '37	.	.	Do.	Do.	No egg-cases; ovary active.
26.5 (5 Specimens.)	Feb. and Mar. 1937-38.	80	40	Madras	Do.	One, two or three egg-cases in each uterus and ovary in a high state of activity.
29	31-1-38	80	40	Do.	Do.	
	Jan. and Feb. 1913.	78	36	Do.	Sundara Raj	
	Do.	70	32	Do.	Do.	

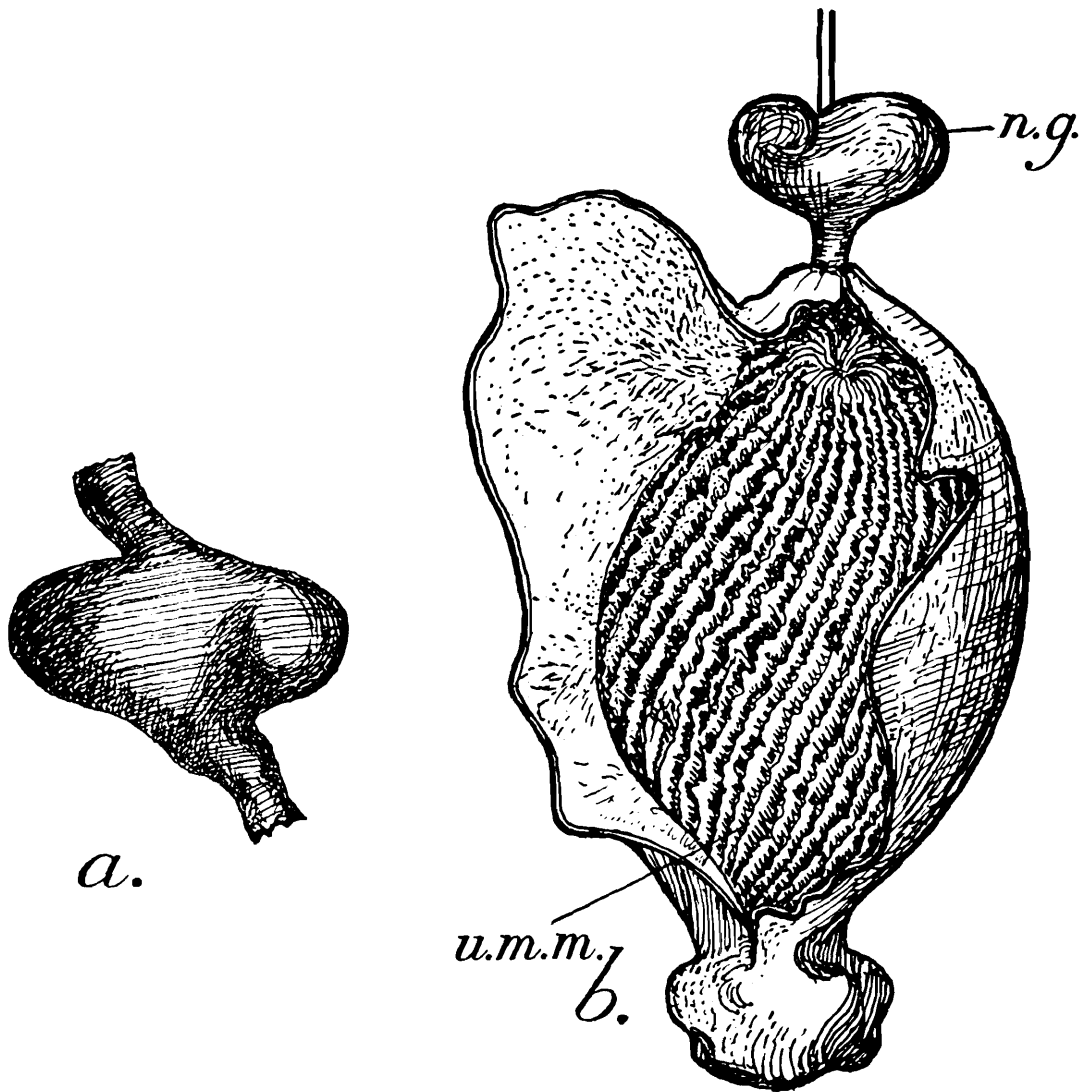
The foregoing table makes it clear that, as on the Madras coast, the species spawns in the Bombay waters from January to March or even April. Further, in view of the fact that the incubation period in this form is about $2\frac{1}{2}$ to 3 months (Aiyar and Nalini, 1938), the latter conclusion is further supported by the fact that free swimming, recently hatched young ones about 12.5 cm. to 17.5 cm. in total lengths (often unbanded) are available in Bombay during April, May, June and even as late as early July.

Another important fact emerging from a scrutiny of the table is that fishes of nearly the same size, namely, 23" to 26.5" in total length, and from the same locality (Bombay) are capable of producing egg-cases of conspicuously different sizes, 70 to 87 mm. long and 35 to 38 mm. broad (Pl. I, fig. 1). This inequality of size of the egg-cases from the same locality does not therefore support Aiyar and Nalini's view that there are definite regional differences in the size of the egg-capsules of this species from the Madras and Malabar coasts, a view which would accord with Clark's (1922) deductions regarding similar differences in the Mediterranean and Plymouth capsules of the same European species of skates. A comparison of the lengths of the parent fishes and of the sizes of their egg-cases from all the three regions would rather suggest that the differences are due to individual variations only and that there are hardly any distinctive differences in the size of the mature fish from the two coastal regions of the same Indian waters, differences such as are suggested by Clark (*op. cit.*) for the same European species in waters so widely separated as the Mediterranean Sea and the English Channel. It may also be noted that the quality and quantity of food available to the mother during the breeding season at a particular locality may have considerable influence on the growth of the intra-uterine phases of the young.

EMBRYONIC STAGES OF *Pristis cuspidatus* LATH.

Embryonic 33 mm. stage (Shark-like Stage).—Parent ♀: Total length including saw—8 feet 2 inches; App. wt.—300 lb.; 15th March, 1943.

Both ovaries were present, each containing a number of round yellow ova about 22 mm. in diameter. Each epigonal organ, about a foot long, was a thick, strap-shaped, greyish, pinkish band merging anteriorly into the substance of the ovary on its dorsal aspect. Each nidamental gland (Text. fig. 3a) was a large, horizontally ovoid body, made up of thick dorsal and ventral bands of tough, greenish grey spongy matter, thickly covered over with connective tissue. These bands overlapped each other laterally and thus caused the rather thickened lateral prominences. Each gland measured 50 mm. × 30 mm. × 10 mm. The uteri occupied the major portion of the abdominal cavity. Each measured 10" × 5" × 1.75" and possessed firm muscular walls. On opening the uterus, its entire cavity was seen to be compactly filled by a completely whole snuff coloured, rather opaque egg-capsule enclosing embryos. On removing the egg-capsule the peculiar character of the uterine mucous membrane became apparent. Except for a short zone at the distal end of the uterus, the entire mucous membrane was raised into a number of prominent, long, close-set plaits or frills running obliquely, each frill



TEXT-FIG. 3.—*Pristis cuspidatus* (Lath.) (33 mm. stage).

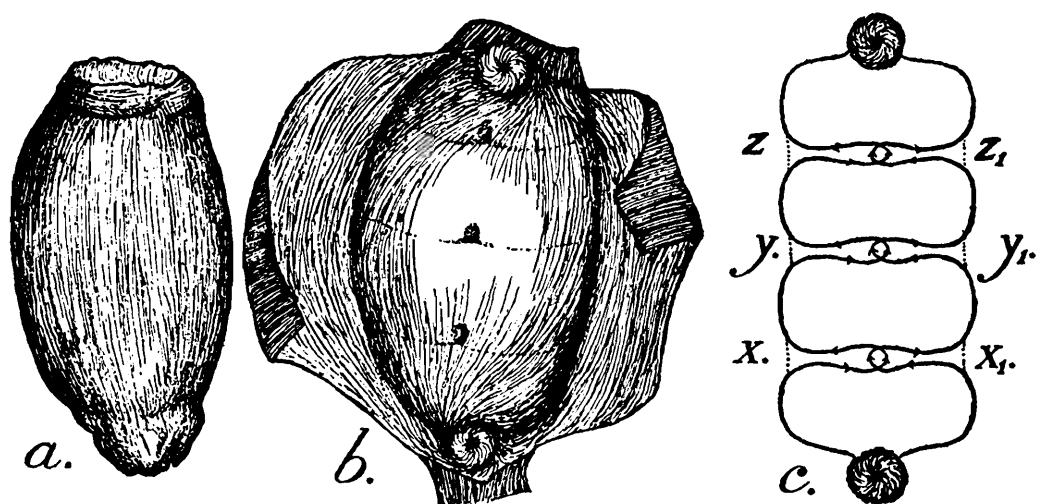
a. nidamental gland ; *b.* uterus opened to show the plaited and frilled character of the uterine mucous membrane.

n.g.=nidamental gland ; *u.m.m.*=uterine mucous membrane.

being about a centimeter broad. The frills were plain and membranous and moderately vascular (Text-fig. 3*b*). Examination of the egg-capsule (Text-fig. 4*a*), which measured as much as the gravid uterus, showed that its outline was quadrangular, and its contour similar to that of the four-cornered egg-case of *Chiloscyllium griseum*. The capsular wall was not, however, tough and horny as in a typical egg-case of an oviparous form, but quite soft and pliant. Slight resilience and firmness and an irregular rugosity were apparent, however, in two band-like areas at either end, where the walls of the sac fused to close the sac. The posterior end of the sac was narrower than, and not as thick as, the anterior. Both these ends were seen to be plugged internally with a profuse quantity of transparent, gelatinous albuminous mass. Except for the two thick, rather resilient bands mentioned above, the wall of the egg-capsule was generally thin, soft and fragile. Its appearance externally was bright and glossy, and internally dull and whitish yellow. Examination of the structure of the capsular wall revealed an extremely thin and delicate brown membrane, reinforced internally by a uniform deposition of dull-coloured shelly secretion that imparted thickness to the wall.

The secretion formed a uniform coating on the internal surface of the capsular wall. It was not, however, hyaline in appearance, but displayed a conspicuous longitudinally fibrose configuration, suggesting that it was formed as the result of coalescence of the thin, narrow, longitudinally running streaks of shelly secretions, whose plasticity in the fresh condition helped in the formation of an entire sheet. Such a mode of secretion of the shelly matter in this form conforms with that in the oviparous form *Chiloscyllium griseum*, although, however, it may be stated that the longitudinal striations in the present case did not, at this stage, display a beaded appearance as in the latter.

Striking peculiarities were noted in the internal structure of the egg-capsule. The wall of the egg-capsule was seen to be lined internally, throughout, by a very thin, delicate membrane which was colourless, transparent and gelatinous in consistency. It closely adhered to the capsular wall on its internal surface, but there was no organic connection between the two and the former could easily be peeled off from the latter without any rupture of the tissues. This internal membranous layer greatly resembled the delicate and hyaline shell membrane of a typical viviparous selachoid, except for the yellow colour and iridescence of the latter. Its disposition in the egg-capsule under consideration could well be compared with that of the thin and soft shell membrane on the inside of the shell of a hen's egg. A further striking peculiarity was, that the cavity of this internal membranous pouch was not whole, but was divided into compartments placed transversely one behind the other and each lodging a tiny embryo with its huge, massive, yolk-sac (Text-fig. 4b). There were four compartments and four embryos in each of the egg-cases of the specimen under consideration. Ed Graeffe has recorded the presence of such compartments in the egg-cases of the ovo-viviparous selachoid *Acanthias vulgaris* B. P.



TEXT-FIG. 4.—*Pristis cuspidatus* (Lath.) (33 mm. stage).

- a. egg-case; b. egg-case opened to show arrangement of compartments within the egg-case; c. schematic representation of compartment-formation in a typical ovo-viviparous egg-case. Note that complete fusion of layers at xx, yy, zz, except in the region of the central twists results in the formation of bilaminated inter-compartmental partitions producing the effect shown in b.

The mode of formation of these compartments was unique (Text-fig. 4b, c), being not observed by us in any other elasmobranch so far studied and is, we believe, recorded here for the first time. Both at the anterior and posterior end of each compartment, a sharp spiral twist was noticeable in the compartmental walls, the twists at the extreme anterior and posterior ends being traced into rounded, spirally formed rather opaque discs of the gelatinous membranous walls. Careful examination of these spiral twists and the partitions intervening between the compartments revealed the mode of formation of the latter. The soft membranous walls of each compartment crossed each other, centrally towards the anterior end of the compartment, where they whirled spirally so as to effect a closure of that compartment and then extended untwisted but crossed so as to form the walls of the next compartment. At the anterior end of that compartment, they would again cross each other, twist spirally and so close it and proceed further to form the walls of the next compartment; and so on till the end. The intervening partitions were thus formed as the result of fusion of the crossing layers and extended throughout the width of the egg-case. Evidently, the partitions had double layers while in other regions, the wall of this internal pouch consisted of one layer only (Text-fig. 4c). In this mode of formation of the compartments, it may be imagined that, if the spiral twists were uncoiled, the compartments would disappear and the entire cavity of the pouch be turned into one spacious compartment.

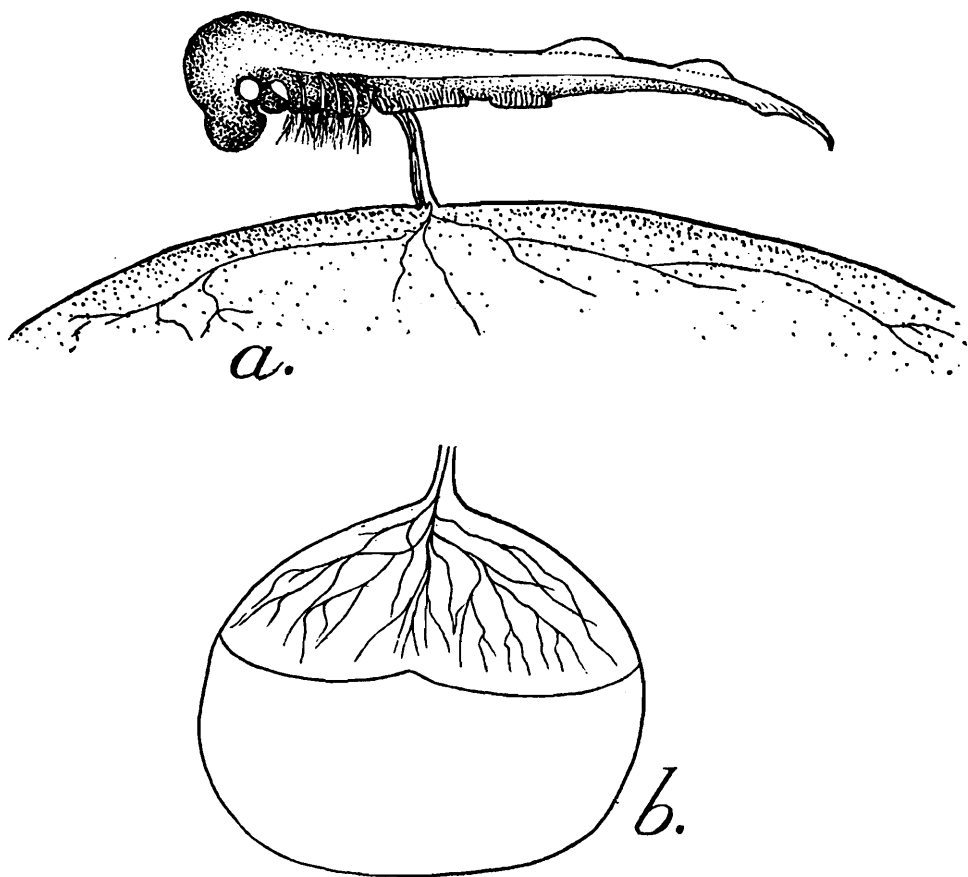
The outsize of the egg-case (which is very nearly that of the uterus itself) containing, as it did, four large eggs, in comparison with that of the nidamental gland, leads us to the view that the egg-case is formed in parts and is not secreted as a whole, as is believed by Nalini (1940) in the oviparous form *C. griseum*. It would appear that in a typical ovo-viviparous form such as *P. cuspidatus*, the posterior portion of the egg-case and a major portion of the hindmost compartment are formed first (complete formation so far as the detailed structural composition is concerned), the latter receives the fertilized egg wrapped in albumen and then closes by the spiral-twisting process described above. This portion of the egg-case would slip down into the uterus, while simultaneously, the second compartment and a corresponding portion of the egg-case would be secreted in continuity with that of the previous one. The second compartment, on receiving the second zygote would close and the partially formed egg-case slip further down. The process would continue till finally the last zygote would enter the last compartment (the foremost), to be closed finally and sealed with a profuse quantity of gelatinous albumen. Such a mode of formation of the egg-case would naturally imply its formation from the posterior end forwards, so that the zygote near the cloacal end of the egg-case would be the first to be received and the zygote at the other extremity, the last to enter the shelly capsule.

This view about the part-formation of the egg-capsule in the species under consideration appears to be the only plausible one in view of the marked disparity in the sizes of the whole egg-capsule and the nidamental gland and is strikingly similar to the theory of part-formation of the egg-case in the oviparous form *C. griseum*.

The following are the dimensions of an embryo (in mm.) :—

Total length	..	32-34
Length of umbilical cord		15
Diameter of yolk-sac		125

The embryos (Text-fig. 5a) are typically shark-like at this stage and there is not even a trace of the characteristic 'sawfish'-like rostrum. The snout is, at this stage, only a soft and blunt downward extension of the soft and swollen head region. On the ventral aspect of this snout, the nostrillar pits show themselves as mere notches on the lateral borders, immediately in front of the mouth. The eyes are prominent, with round, opaque lenses and the ocular pigment has not yet appeared. Immediately behind the eyes and in front of the first gill-opening, is the diamond-shaped spiracle, which is devoid of spiracular filaments. The visceral region is still in a premature condition of development.



TEXT-FIG. 5.—*Pristis cuspidatus* (Lath.) (33 mm. stage).

- a. 33 mm. embryo with yolk-sac only partly depicted. Note the rudimentary gill region; b. reduced view of the yolk-sac showing vascularisation only half-way down its walls.

It is not yet compact nor incorporated completely in the embryonic body. The visceral arches are free, still unlined by the lateral and ventral body walls. They extend as separate more or less vertically disposed dorso-ventral loops, from the angles of which, bunches of

external branchial filaments issue forth. Short and rudimentary internal gill-filaments have just made their appearance as slight projections of the posterior mucous lining of each of the visceral arches. All the fins have made their appearance in their respective adult positions, but are in a rudimentary state of development, being merely soft, curved flaps supported internally by delicate fin rays. The pectoral fin originates slightly behind the last gill-arch. It is an elongated, curved flap with a broad base and no free anterior portion. Nor is it yet brought into relation with the gill-region. Slightly behind the posterior termination of the pectoral fin originates the pelvic fin. It is about half to two-thirds the size of the pectorals. The first dorsal fin arises above the posterior third of the pelvic base and is nearly equal in size to the second dorsal which is located behind the former at a distance of about the basal length of either. The vertical fin membrane has not yet vanished completely. The caudal fin is typically lanceolate and the sub-caudal lobe is not yet clearly marked out. It is seen to terminate in a small and delicate curved piece. The sexes of the embryos are not yet distinguished externally. Nor has the process of general pigmentation started and the embryos are generally cream-coloured, being crimson only in regions of high vascular activity.

The yolk-sac is a huge, massive bag full of pasty, yellow yolk, connected with the embryo by a short thick umbilical cord. Its walls, which are extremely thin, are, at this stage, vascularised only half way down their extent, the lower half being still without blood-capillaries (Text-fig. 5b). A vascular ring, formed by the union of the curved extensions of the umbilical vessels, runs round the sac equatorially, bisecting as it were the globe. The blood-capillaries of the vascular regions are wavy in outline. The umbilical cord consists, as in *Selachoids*, of an artery, a vein and a very fine capillary like yolk-duct, all enclosed in a thick, gelatinous sheath of connective tissue, reflected from the upper pole of the sac. The latter does not, however, possess any appendicula nor any superficial markings.

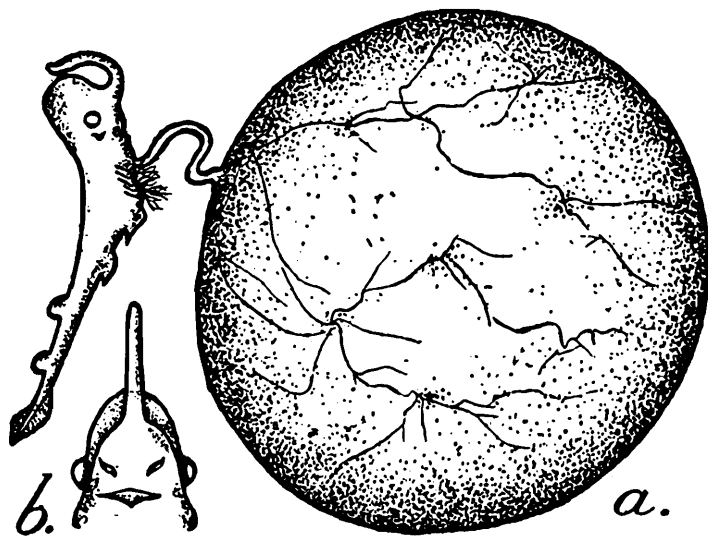
Embryonic 53 mm. stage (Proboscoid stage):—Parent ♀: Total length including saw—9 feet, 3 inches; App. wt.—400 lb.; 4th February, 1944.

Each ovary of the above female was 6" × 2.2" × 0.5" in size, studded with small, yellowish pink ova, the largest being about the size of a grape. (12 mm.). The other reproductive organs presented features more or less similar to those described before. Each uterus in the present case measured 9" × 4.5" × 2.3". Both the uteri contained completely whole, brown egg-capsules enclosing embryos with large massive yolk-sacs. Superficially, these egg-capsules resembled, in toto, the ones described in the earlier stage, and the characteristic internal compartmental arrangement was found to persist even at this stage of pregnancy. The disposition of the embryos in the compartments was, however, slightly oblique now and the inter-compartmental partitions were partially hidden from view. There were three compartments and three embryos in each egg-case. The uterine mucous membrane was besmeared with a sticky cream-coloured fluid secreted by the uterine glands. Either

all the six embryos were female or their sexes had not yet been differentiated externally. They were all of nearly the same dimensions namely—

Total length from tip of head to tip of caudal fin	53 mm.
Length of caudal fin	7 "
Length of rostral prolongation from its root	13 "
Width of rostral prolongation at base	3 "
" " " further up	2 "
Length of umbilical cord	80 "
Diameter of yolk-sac	100-105 "
Length of branchial filament	15 "

The embryo (Text-fig. 6*a, b*) is soft, ivory-coloured, devoid of any pigment and scales. The presence of a prominent rostral prolongation or proboscis has already imparted to it the "sawfish" character, but unlike as in the adult, the rostrum is still soft and without the "lateral teeth." Even rudiments of these have not appeared at this stage. The rostrum is rather wide at the base and in view of the still downward extension of the snout region (not anterior such as would be as the result of dorso-ventral flattening of the head and snout region) it has a curved and dorsiflexed disposition, and not antero-posterior as in the adult condition. The head region is swollen and rounded and not flattened dorso-ventrally. The eyes are small, resembling studs and are directed antero-laterally:



TEXT-FIG. 6.—*Pristis cuspidatus* (Lath.) (53 mm. stage).

a. 53 mm. embryo with umbilical cord and yolk-sac. Note that its vascularisation is total at this stage; *b.* ventral view of rostral and head regions.

The lens has a ring of pigment all round. The spiracle, directed postero-laterally and now in the form of an oblique slit, is situated behind the eye at a distance of half the orbital diameter. It has a thick anterior valve, but there are no spiracular filaments. Ventrally, the depressions of the nostrils, with characteristic valves, are distinguishable just in front of the fairly wide mouth opening. The visceral region is now well incorporated in the body. The gill-openings are V-shaped and extend latero-ventrally, not having yet assumed a complete ventral

disposition. Through each issues out a bunch of crowded, crimson-coloured, blunt-tipped branchial filaments. *Fins*.—In accordance with the still lateral disposition of the gill slits, the pectoral fins too are not yet completely fused with the lateral body-wall to complete the 'disc'. They are ventro-lateral in their disposition and nearly the anterior third of each is by now free and in the form of a narrow constricted knob. In the recess between this free anterior part of the pectoral fin and the sides of the body are located the last two or three gill-slits. The foremost point of the pectoral fin reaches as far as the second gill slit. Both the dorsal fins are equal in size and similar in shape. The first originates slightly ahead of the posterior end of the pelvic base. The pelvic fins are located almost in the middle of the body excluding the rostrum. The caudal fin is lanceolate in shape and has already the characteristic lateral keels. The subcaudal lobe is not distinguishable even at this stage.

The yolk in the yolk-sac is still viscous and has not been liquified to any great extent. The vascularisation of the yolk-sac walls is, however, total at this stage. The arrangement of the blood capillaries on its basal wall is peculiar. Here, they are arranged radially and converge towards the centre to form a central, circular vascular ring of a fairly big size. From this ring start two prominent vessels, an artery and a vein which rise up the walls of the sac to ultimately enter the umbilical cord. The upper pole of the yolk-sac tapers gradually to form the yolk-duct which, too, passes up into the umbilical cord. But for its greater length, the latter is exactly similar to the cord described in the previous stage. The connections of the umbilical vessels within the embryonic body are characteristic of the elasmobranchs in general, while the yolk-duct joins the upper end of the colon on its dorsal aspect without the intervention of an internal yolk-sac.

The reproductive conditions of a female measuring 8' 1" in total length and landed on 2nd March, 1944 corresponded exactly with those noted for the stages previously described. As in the 53 mm. stage, each egg-case in the present instance also bore three compartments and three embryos. The latter measured 43 mm. in total length and represented obviously a stage of embryonic development, intermediate between the 33 mm. and 53 mm. stages. As in the 53 mm. stage, a definite rostrum has been formed, but it is only 3 mm. long, hardly extending beyond the head region. Also, like the 53 mm. stage, two strips of ocular pigment are present even at this stage. The gill region of the embryos is, however, similar to that of the 33 mm. stage, not being yet incorporated within the body and bounded by ventral and lateral body walls. The foremost point of the pectoral fin reaches at this stage, as far as the fourth visceral arch. The vascularisation of the yolk-sac has progressed only two-thirds down its vertical walls and even in this respect the condition is intermediate between the 33 mm. and the 53 mm. stages.

Advanced stages.—Southwell (1910) has described the gravid condition of a female sawfish (*P. cuspidatus*), 15·5' in length, captured off the Ceylonese Coast. He and later Hussakof (1912) have described the 14" embryonic stage obtained from the above mentioned female. The

internal anatomy of these embryos has been described by Southwell and Baini Prashad (1919). Obviously, these embryos had, at this stage, reached a fairly advanced stage of development and resembled a fully-grown sawfish except for the fact that they still possessed yolk-sacs and umbilical cords and that the 'teeth' on their saws had not yet cut through the membrane enveloping them. The fact that their yolk-sacs measured 2.75" in diameter and evidently still contained some yolk suggests, however, that they would have to remain some more time in the wombs before birth.

The stage described by us below represents a much more advanced condition which could be regarded as only slightly prior to the condition of parturition.

Parent ♀: Total length including saw—8 feet 11 inches; App. wt.—400 lb.; 6th March, 1944.

The ovaries of this female were small and contained small ova, the biggest about a centimeter in diameter and containing yellow yolk. The left uterus was empty and contained a few fragmentary pieces of the shell membrane (egg-case), while the right contained three foetuses, besides a small quantity of the disintegrating shelly substance. Two of the foetuses were male and one female. The embryos of the left uterus had probably been discharged into the sea.

The foetuses had the following dimensions, in inches (Pl. I, fig. 3):—

Total length including saw	..	..	21.5
Length of saw		..	6.6
Toothed portion of the saw		..	5.4
Maximum width of the saw		..	1.2
Width of the saw at lower tooth-less portion			0.75
Width across pectoral expansion	..	..	6.5
Yolk-sac	..	..	1.2 × 0.6
Yolk-stalk	..	..	2.5
Biggest lateral tooth on saw	..	..	8 mm. × 2.5 mm. at base.

But for the presence of short yolk-stalks and reduced yolk-sacs and the fact that the rostral teeth (quite hard and sharp) have not even yet cut through the thick and tough membrane enveloping them, the foetuses closely resemble the adult fish. The characteristic dorsal pigmentation is now present, but the body is not yet covered over uniformly or extensively with the dermal denticles. These latter have developed only in certain regions such as both the surfaces of the toothed portion of the saw, the anterior borders of the pectorals, pelvics and the dorsals, the upper border of the caudal and the anterior border of the subcaudal lobe. The yolk-sac contains very little yolk and its blood capillaries have nearly atrophied. Nor is there any blood vessel in the yolk-stalk. There is, however, a fairly big internal yolk-sac containing a quantity of thin and liquified yellow yolk and it appears that the foetus would be borne in the uterus for yet some time before expulsion.

Our observations on the dimensions of the newly born young ones of this species (with very much reduced, stublike, yolk-stalks and sacs hardly half a centimeter long) reveal that the foetuses are born when from 17"—24" in total length. It would appear that the rostral teeth are cut through the membrane only when the foetuses are free, as otherwise, parturition would indeed be a difficult process for the parent because of the sharp and hard teeth in even the prenatal stages.

EMBRYONIC STAGES OF *Rhynchobatus djiddensis* (FORSK.).

Embryonic 45 mm. stage (Shark-like stage).—Parent ♀: Total length 9 feet 9 inches; App. wt.—400 lb.; August, 1943.

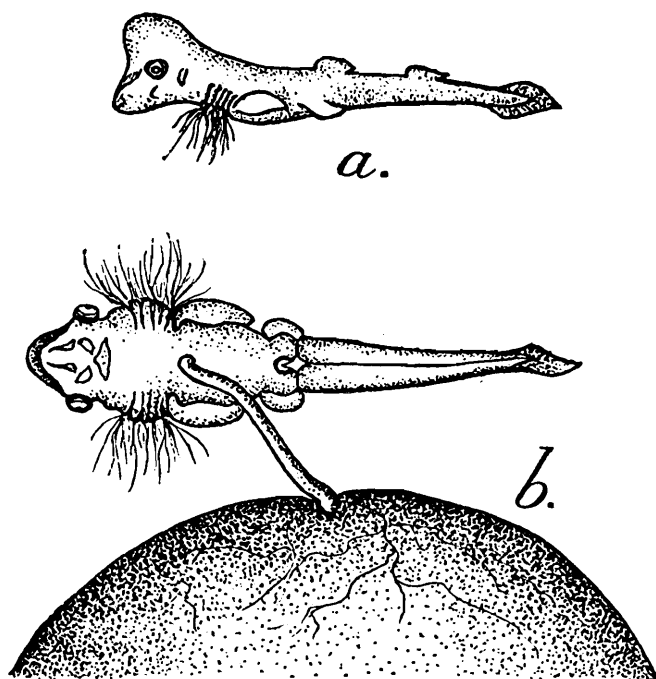
Both ovaries of the female were in a vigorous state of activity being packed with variously sized, round eggs, measuring from 1.5 cm. to 3.75 cm. in diameter. The smaller eggs were yellowish, cherry red in colour, while the bigger ones were yellow, with an extremely delicate network of blood capillaries spread on their membranes. The nidamental glands presented features exactly similar to those of *P. cuspidatus*. Both uteri were gravid, each measuring 9"×5.4"×2.5" The walls of the uteri were firm and elastic. Each uterus on being cut open was seen to be compactly filled with a turgid, completely whole shell-membrane sac exactly similar to the egg-capsules of *P. cuspidatus*. Its cavity too, when slit open, was seen to be partitioned in a manner similar to that in the 33 mm. stage of *P. cuspidatus*. There were three compartments and three embryos in the egg-case of the right uterus and four in the left. Either all the embryos were female or the sexes were not yet distinguished externally.

On removing the embryos and the shelly egg-cases, the uterine mucous membrane was seen to bear all over its face longitudinally directed plaits and folds very similar to those in *P. cuspidatus*.

The following are the dimensions of embryos (in mm.) :—

Total length	..	44-48
Length of caudal fin		7
Length of umbilical cord		38
Diameter of yolk-sac		125
Length of branchial filaments	..	17-18
Length of snout projection beyond the head region		3
Interorbital distance		8.9

The head region of the embryo (Text-fig. 7a, b) is soft and swollen, oval in outline and bears two big and round studlike eyes laterally. Anteriorly, it descends almost vertically downwards to merge into a short, bluntly triangular soft snout. The latter bears ventrally two prominent nostrils immediately in front of the widely open, triangular mouth. The anterior and posterior nasal valves of the adult condition are present even at this stage, though in a rudimentary condition. The ovoid spiracles, with thick anterior valves are situated immediately behind the eyes, but on a lower level. They are without any spiracular filaments. The gill region is still in a primitive state of development and very similar to that of the 33 mm. stage of *Pristis cuspidatus*. It

TEXT-FIG. 7.—*Rhynchobatus djiddensis* (Forsk.).

a. profile of 45 mm. embryo ; *b.* ventral view of the same with umbilical cord and yolk-sac (depicted partially).

is not yet compacted and incorporated within the body and not yet bounded by ventral and lateral body walls. The visceral arches are free and bunches of branchial filaments issue out from their angles. All the fins are developed in their respective adult positions, though differing considerably from their respective adult shapes. The dorsals are nearly semi-circular, the caudal is lanceolate and the pelvics are reniform. The condition of the pectorals at this stage deserves special mention. They are elongated antero-posteriorly, have broad basal attachments and their narrow anterior prolongations are free and not yet fused with the sides of the body to give rise to the 'disc'. In the recesses between these and the sides of the body lie the hindmost gill-slits with their bunches of branchial filaments. It is only with subsequent growth and a total ventral movement of the gill-slits that these ends of the pectorals would coalesce with the sides of the body to form the disc typical of the Batoids. The embryo, is at this stage, ivory yellow in colour, suffused with crimson in regions of high vascular activity. The process of pigmentation has not yet begun, nor have scales appeared and the embryo is quite soft. The trunk is crossed ventrally by a single blood vessel in the median line.

The yolk-sac is a huge, rounded, massive structure full of viscous yellow yolk. The walls of the yolk-sac are very thin and highly vascular, the blood capillaries mounting up its walls in a zigzag manner and running more or less parallel to each other. Basally, however, they run radially to join a thick vascular ring placed centrally. The yolk-sac capillaries ultimately join to form the umbilical vessels, which pass up into the umbilical cord. The latter also contains, besides the vessels, the yolk-duct. The cord has a gelatinous, connective tissue sheath, which is seen to be reflected from the apical walls of the yolk-sac. The

connections of the umbilical vessels within the body of the embryo are typical and the yolk-duct joins the colon without the intervention of a yolk-sac at this stage of development.

The embryonic stage described above corresponds in many respects with the 36 mm. stage of *Rhinobatus columnae* described by Southwell and Prashad (1919) and is also similar to the 43 mm. stage of *Pristis cuspidatus* dealt with by us before.

However, a few points of contrast between the 45 mm. stage of *R. djiddensis* and the 43 mm. stage of *P. cuspidatus* invite comment.

The bodies of the 45 mm. embryos of *R. djiddensis* are stouter and more thickest than those of the 43 mm. embryos of *P. cuspidatus*. Also, while in the embryos of *P. cuspidatus* a definite rostral prolongation is present, already imparting to it the typical "Pristis" character, the snout region in *R. djiddensis* has hardly flattened dorso-ventrally so as to assume its specific shovel-shaped character. Further, while at this stage in *R. djiddensis*, the vascularisation of the yolk-sac is complete, that in the yolk-sac of *P. cuspidatus* has progressed only two-thirds down its vertical walls, it being total at only the 53 mm. stage.

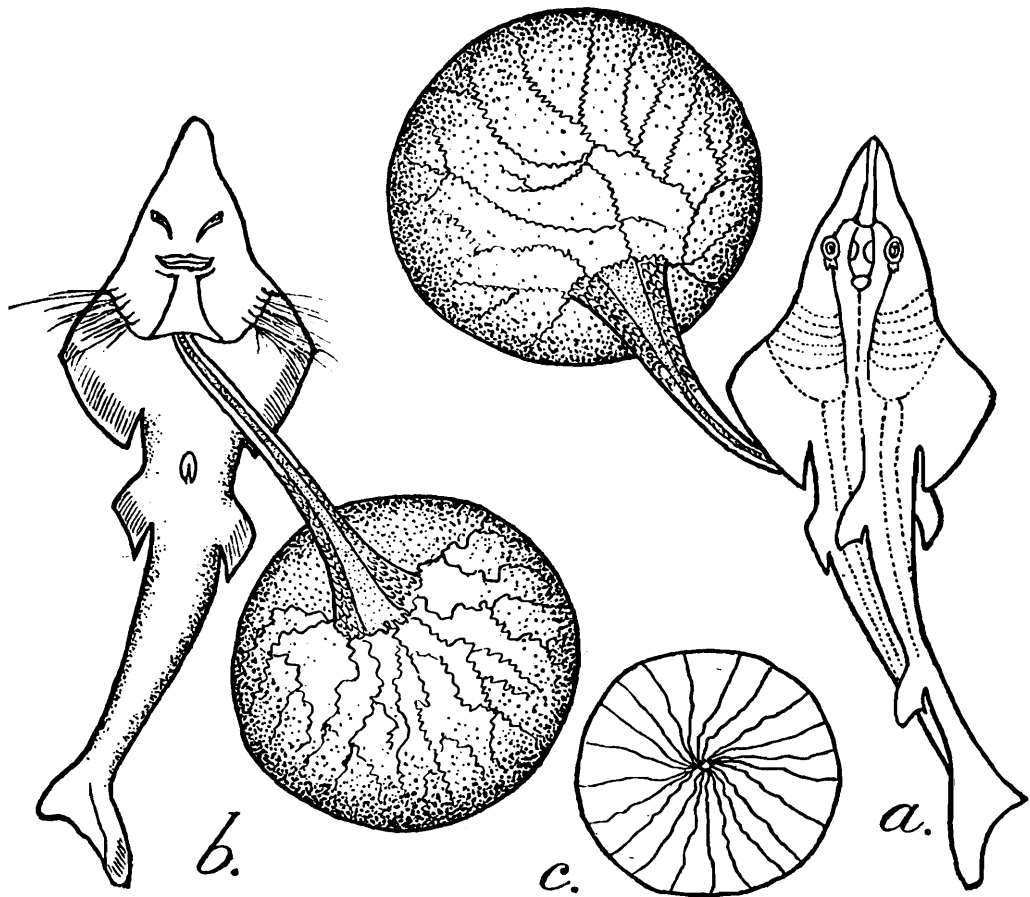
The primitive, lateral disposition of the visceral region and the incompleteness of the 'disc' in the 45 mm. stage of *R. djiddensis* and in the 33 mm., 43 mm. and 53 mm. stages of *P. cuspidatus* impart to these stages a typical 'shark-like' character and definitely reveal their shark-like ancestry and the assumption of the Batoid condition as purely of a secondary nature.

Embryonic 150 mm. stage—Parent ♀: Total length—8 feet 8 inches ; App! wt.-200 lb. ; 18th March, 1942.

The reproductive organs of this female presented features quite similar to the ones described previously except for the fact that the ovarian eggs in the present case ranged from 2.5 cm. to 6.25 cm. in diameter. Also the embryos in each of the uteri were no longer enclosed in the shelly egg-capsules referred to in the previous stage but lay naked in its cavity, there being five embryos in either uterus. Disintegrating fragments of the capsule could, however, be discerned in the uterine cavity and the uterine mucosa was besmeared all over with a pinkish creamy liquid not noted in the earlier stage described before. Three of the embryos in the right uterus were male and two female while in the left one was male and four female. One of these had the following dimensions (in mm.):—

Total length	150
Maximum width across the pectoral expansions	.. 55
Length of snout in front of interorbital line	.. 30
Interorbital distance	11
Length of the umbilical cord	.. 62.5
Diameter of yolk-sac	.. 106
Length of branchial filaments	 1.8 to 2.5
Length of clasper	 4

The embryo (Text-fig. 8 ; Pl. I, fig. 4, *upper right corner*) has by now assumed the characteristic ray-like appearance and in external morphology resembles the adult in most respects. The following differences may, however, be noted. The embryo is still ivory yellow in colour and the process of pigmentation has not yet commenced. The dorsal surface of the trunk is, however, marked by four dark crimson lines running parallel to each other. The skin is soft and there is no scale or tubercle formation yet. The gill region is slightly inflated and bunches of long, thread-like filaments still issue out of the gill slits. The spiracles, too, are very narrow and not yet fully opened out.



TEXT-FIG. 8.—*Rhynchobatus djiddensis* (Forsk.) (150 mm. stage).

a. dorsal view of embryo with umbilical cord and yolk-sac ; b. ventral view of the same ; c. radial arrangement of blood capillaries on the basal wall of the yolk-sac.

It may be pointed out here that very small yellow fragments of the disintegrating shelly capsule were seen attached to some of the branchial filaments and these could be traced right inside the gill slits also. It is probable that they served some nutritive function and as such were being injected by the embryo.

The yolk-sac and umbilical cord at this stage are essentially similar to those described in the earlier stage except for the fact that the gelatinous investing sheath of the umbilical cord displays, at this stage, scale-like markings which are seen to extend from the commencement of the cord right up to its mid-length. The large quantity of yolk in the yolk-sac even at this stage of development suggests that the embryo would grow yet considerably before being born.

Examination of several gravid females at various stages of pregnancy landed at Sassoon Dock, Bombay, from July to October revealed, during the course of embryonic development, the following interesting features.

Embryos ranging from 95 mm. to 157 mm. in total length are alike in development and exactly similar to the 150 mm. stage described above. These stages may well be designated as 'intermediate' stages of development.

Advanced Stages.—From the 200 mm. stage onwards the embryos may be said to have entered upon advanced stages of development. The progressive characterisation in different stages is described below.

In an embryo at the 200 mm. stage, the branchial filaments are no longer present. The process of pigmentation has started already and the black pectoral spot has appeared. There are no other pigment spots, however, nor has the general grey pigmentation developed. The mid-dorsal and, to a very slight extent, the dorso-pectoral spinous rudiments are apparent at this stage.

At the 235 mm. stage the dorsal surface is slightly tinged with grey and four diffused round or oval white spots are discernible around the black pectoral spot. Faint black pigment spots have also appeared in the orbital regions. The rudimentary markings of the mid-dorsal and dorso-pectoral spines are quite conspicuous now (Pl. I, fig. 4, *middle*).

At the 287 mm. stage, the process of pigmentation has advanced considerably and the dorsal surface tends to become more and more grey. The diffused dark spot and band in the orbital region are very conspicuous now and, in addition to the pectoral spots, round or oblong white spots are also present on the pectoral roots and sides of the body, extending below the first dorsal fin. Further, in addition to the mid-dorsal and dorso-pectoral spinous rows, the orbital row has also appeared. The spiny rudiments at this stage are elongate, slender, yellowish streaks not projecting above the general body surface.

At the 437 mm. stage, the foetuses are more or less perfect replicas of the parent, except for the fact that they still possess umbilical cords and yolk-sacs which are definitely reduced in size. All the dorsal spinelets, too, are grey and slender and just project above the general body surface. There is a huge internal yolk-sac present at this stage (Pl. I, fig. 4, *left*).

A characteristic worthy of note is that every successive advancement in the various stages of development described above is accompanied "pari passu" with a progressive reduction in the size of the yolk-sac, the diameter of the yolk-sac in an embryo of 45 mm. being 125 mm. and that in the yolk-sac of an embryo measuring 437 mm. being 50 mm. only.

The presence of some amount of yolk in the yolk-sac of a foetus 437 mm. in total length and the attainment of a total length of 450 mm. by the smallest free-swimming young one of this species examined by us justify the assumption that the young ones of this species, at birth, measure from 18" to at the most 24" in total length.

REFERENCES TO LITERATURE.

- AIYAR, R. G. AND NALINI, K. P., 1938.—Observations on the reproductive system, egg-case, embryos and breeding habits of *Chiloscyllium griseum* M. & H. *Proc. Indian Acad. Sci. (B)*, VII, pp. 252-269.
- AIYAR, R. G. AND MAHADEVAN, G., 1938.—On a collection of elasmobranch embryos obtained from the Madras Coast. *Proc. 26th Indian Sci. Congr. (Lahore)*. Pt. 3, Abstracts, p. 134.
- AIYAR, R. G., 1942.—Observations on the protective envelope of some viviparous elasmobranch fishes of the Madras Coast. *Proc. 29th Indian Sci. Congr. (Baroda)*. Pt. 3, Abstracts, p. 157.
- * BEARD, J., 1890.—On the development of the Common Skate *Raja batis*. 8th Ann. Report Fisheries, Scotland, P. III.
- CLARK, R. S., 1922.—Rays and Skates. *J. Mar. biol. Ass. U.K.*, XII (4), pp. 577-643.
- DERANIYAGALA, P. E. P., 1933-34.—The embryo of the dogfish. *Chiloscyllium indicum*. *Spol. Zeyl.*, XVIII, pp. 249-252.
- ED. GRAEFFE, 1888.—Übersicht Seethierfauna des Golfes von Triest. *Arbeit. Zool. Instit. Univ. Wien. Zool. Stat.*, VII, pp. 3-4.
- HOBSON, A. D., 1930.—A note on the formation of the egg-case of the Skate. *J. Mar. biol. Ass. U. K.*, XVI (2), pp. 577-581.
- HUSSAKOF, L., 1912.—Notes on the embryo of *Pristis cuspidatus*. *Bull. Amer. Mus. nat. Hist.*, XXXI, pp. 327-330.
- METTEN, H., 1939.—Studies on the reproduction of dog-fish. *Philos. Trans. Roy. Soc. London*, CCXXX, pp. 217-238.
- NALINI, K. P., 1940.—Structure and function of the nidamental gland of *Chiloscyllium griseum* (M. & H.) *Proc. Indian Acad. Sci. (B)*, XII, (5), pp. 189-214.
- PRASAD, R. R., 1942.—Preliminary observations on the nidamental glands of some elasmobranch fishes of the Madras Coast. *Proc. 29th Indian Sci. Congr. (Baroda)*, Pt. 3, Abstracts, p. 157.
- SMEDLEY, N., 1926.—On a stage in the development of the tiger-shark, *Stegostoma tigrinum*. *Jour. Malayan Br. Roy. Asiat. Soc.*, IV, p. 166.
- SOUTHWELL, T., 1910.—A descriptive note on the capture of a large saw-fish *Pristis cuspidatus* containing intra-uterine embryos. *Spol. Zeyl.*, VI, pp. 137-139.
- SOUTHWELL, T. AND PRASHAD, B., 1919.—Embryological and developmental studies of Indian fishes. *Rec. Ind. Mus.*, XVI, pp. 215-240.
- SUNDERA RAJ. B., 1914.—Note on the breeding of *Chiloscyllium griseum*, M. & H. *Rec. Ind. Mus.*, X, pp. 317-319.
- WHITLEY, G. P., 1940.—The Fishes of Australia Part I. *Roy. Zool. Soc.*, New South Wales.
- *WIDAKOWICH, V., 1906.—Über Bau und Function des nidamentalorgans von *Scyllium canicula*. *Zeit. fur. Wiss. Zool.*, LXX, Bd. I, pp. 1-21.

* These references were not consulted in original but are quoted from Nalini, 1940,

EXPLANATION OF PLATE I.

Development of Bombay Sharks.

Chiloscyllium griseum M. & H.

FIG. 1.—Egg-case of two types, larger (left) and smaller (right).

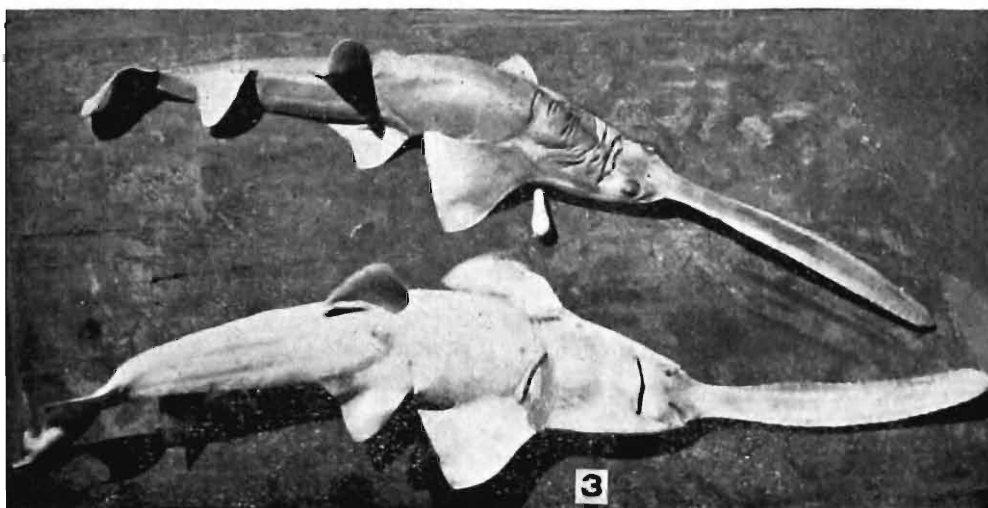
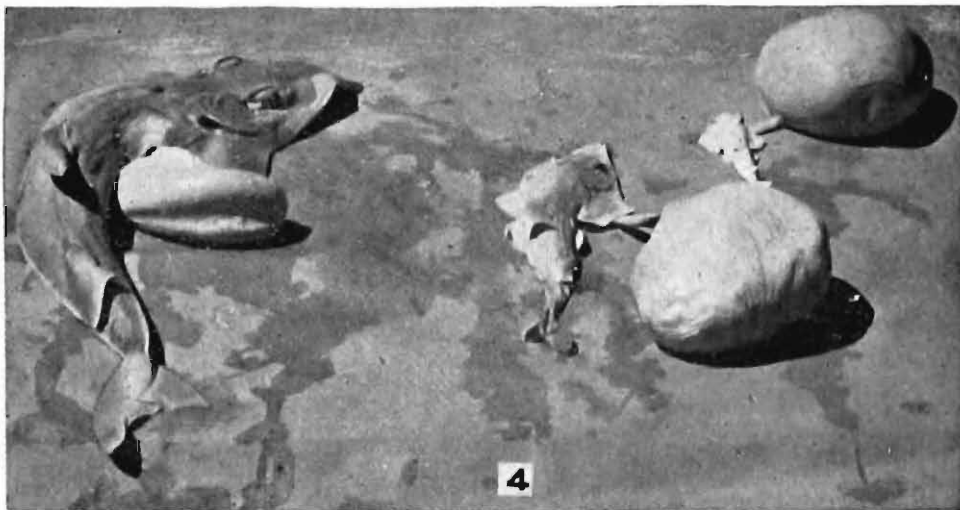
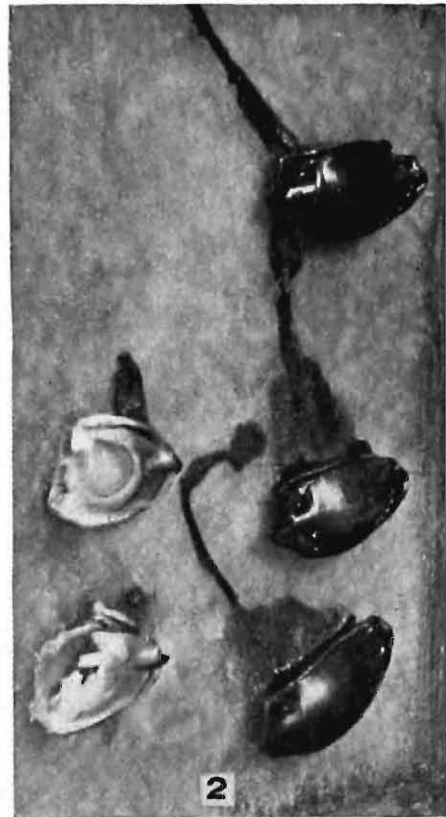
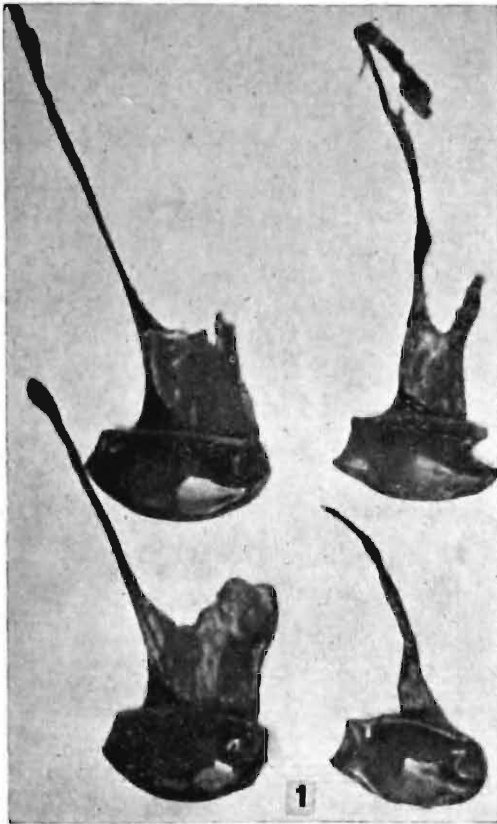
FIG. 2.—Photograph showing egg-cases, complete (right) and incomplete (left).

Pristis cuspidatus (Lath.).

FIG. 3.—Dorsal (upper) and ventral (lower) aspects of advanced embryos. Note the atrophied yolk-sac.

Rhynchobatus djiddensis (Forsk.).

FIG. 4.—157 mm. embryo (right upper) ; 235 mm. embryo (right lower) and 437 mm. embryo (left).



DEVELOPMENT OF BOMBAY SHARKS.

DESCRIPTION, BIONOMICS AND DEVELOPMENT OF *SCOLIODON SORRAKOWAH* (CUVIER).

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CONTENTS.

	PAGE.
Introduction	25
Description	26
Bionomics	27
Development	27
Early pregnancy	27
Intra-capsular eggs	27
Embryonic 0.8 mm. stage	29
Embryonic 1.0 mm. stage	30
Embryonic 3.4 mm. stage	32
Embryonic 15.0 mm. stage	34
Embryonic 20.0 mm. stage	37
Intermediate stages of pregnancy	39
Advanced stages of pregnancy	41
Histology of the yolk-sac placenta	43
Embryonic history of yolk-sac placenta, with remarks on its probable mode of function	46
List of adult females in pregnant and post-pregnant stages collected from Bombay from April 1942 to May 1944	48
Summary	51
Bibliography	52

INTRODUCTION.

As a result of serious food shortages during the war and stoppages of imports from abroad, fishery of the Sharks and Rays became very popular, principally for the production of rich vitamin bearing liver oils but also as a valuable source of protein food. In consequence, the catches of these fishes increased manyfold and even immature specimens are not spared. The fishery officers began to realise that such an indiscriminate fishing and injudicious exploitation, particularly of gravid females and immature forms, may, in course of time, lead to a depletion of the Selachian fauna and the need for working out the life-histories of commercially important species became evident, for at any stage it may become necessary to control the fishery by legislative measures. The present communication is the result of investigations conducted in Bombay waters over a period of three years since 1942.

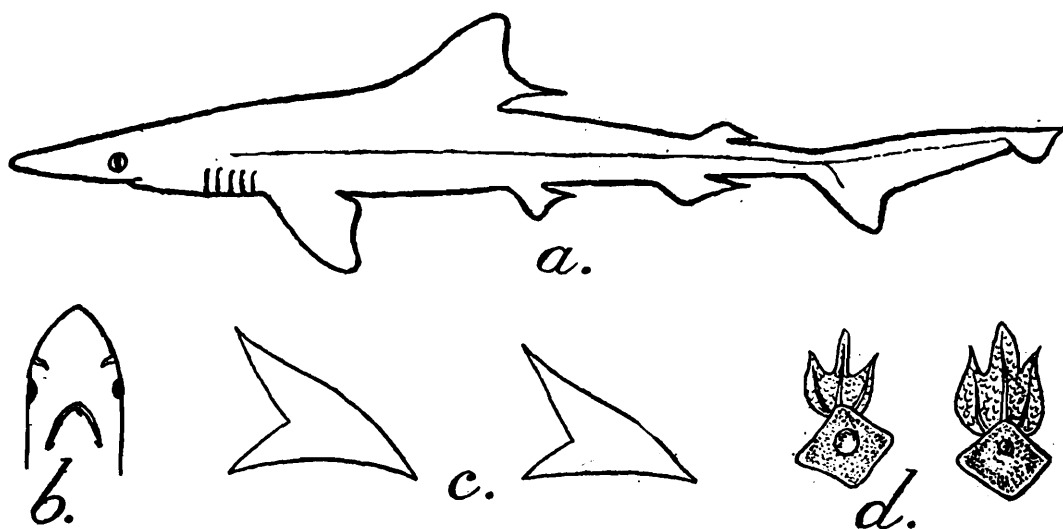
The Shark *Scoliodon sorrakowah*, locally known as "Son Mushi", is in great demand with a section of the Bombay Public as a table delicacy. The species is found in Bombay waters throughout the year in fair abundance and is perhaps the smallest among the present-day viviparous Elasmobranchs. Some of its placental features were described by Mahadevan (1940) and next year Choodamani (1941) described its eggs.

As will be shown below, this shark is remarkable for its mode of foetal nurture and the adaptive structural modifications it has undergone for this purpose. The histology of the placental features described here is perhaps unique among Elasmobranchs, in so far as it approaches the highly evolved placentation among the mammals.

A set of specimens representing various phases in the development of the species is deposited in the collections of the Zoological Survey of India for convenience of reference in future.

DESCRIPTION.

The snout (Text-fig. 1a) is rather thin, elongated and pointed; its sides are not quite straight. The length of its preoral portion (Text-fig. 1b) exceeds the width of the mouth by one-fourth and is slightly more than the distance between the eye and the first gill-opening. The groove at the angle of the mouth extends a short distance along the lower jaw but not along the upper. The nostrils, with triangular flaps, are nearer the mouth than the end of the snout. The teeth (15.1.15/14-15.0.14-15) are thin and flat, with deep external notches and without swollen bases (Text-fig. 1c); their borders are entire. The teeth on both jaws are obliquely situated, but more so near the symphysis, where they are arranged in a close-set bunch. Scales (Text-fig. 1d) are small in size and thickly set all over the body. The basal plate is quadrangular in outline with rounded angles. The spines are trident with three keels and each spine is about twice as long as abroad. The central cusp is the highest. Fins; The pectoral fin originates below the last gill slit and does not extend to below the first dorsal. Its posterior border



TEXT-FIG. 1.—*S. sorrakowah* (Cuvier)

a. Lateral view; b. Under surface of head; c. Teeth; d. Dermal denticle.

is nearly straight. The first dorsal fin is situated almost in the middle of the trunk and its posterior tip extends above the pelvic fins. The latter are about one-third the size of the pectorals. The second dorsal fin originates above the posterior fourth of the base of the anal and is much smaller than it. The anal fin is an unnotched, triangular, flap-like structure about three to four times as long as low. Its basal

length exceeds twice that of the second dorsal. The caudal fin is contained four times in the total length. It is a broad blade-like structure with a deep notch posteriorly. The sub-caudal lobe is not sharply marked off from the caudal blade and extends but slightly below the caudal fin. The colour is pale greyish bronze above, dull white at sides and beneath. The maximum length of this species in Bombay waters is 26', while that from Madras observed by Mahadevan (1940) is 29". Females attain maturity when about 17" long and the smallest male possessing long and well-developed fusiform claspers measured 18" in length, indicating that maturity in both sexes is attained when they are of about the same size.

BIONOMICS.

The species is generally an inhabitant of the rocky regions close to the shore and is obtainable in Bombay waters within a radius of two to three miles off the coast. Its seclusion in a rocky abode makes its catching with nets difficult, and thus hooks and lines are commonly employed for its capture. The presence of some specimens in fishermen's nets is probably due to their having strayed away from their habitat to prey on fish already trapped in the nets.

The fish generally swim in shoals in quest of food. The individuals are either all males or all females. This characteristic may be noted at the landing sites where the fish caught will be found to be exclusively males or females.

The species feeds voraciously on prawns, shrimps, cuttlefishes, etc., and such small shoaling fish as 'Mandela' (*Coilia dussumieri*), 'Kaleti' (*Trypauchen vagina*), 'Khada' (*Bregmaceros maclellandi*) 'Bombil' (*Harpodon nehereus*), etc. These varieties figure regularly among their stomach contents.

Fishermen assert that the flesh and entrails of *S. sorrakowah* make excellent bait for 'Shingala' (*Arius* sp), 'Wam' (*Muraenesox tala-bonoides*) and larger sharks, probably because of a peculiar strong odour that emanates from them even in the fresh condition.

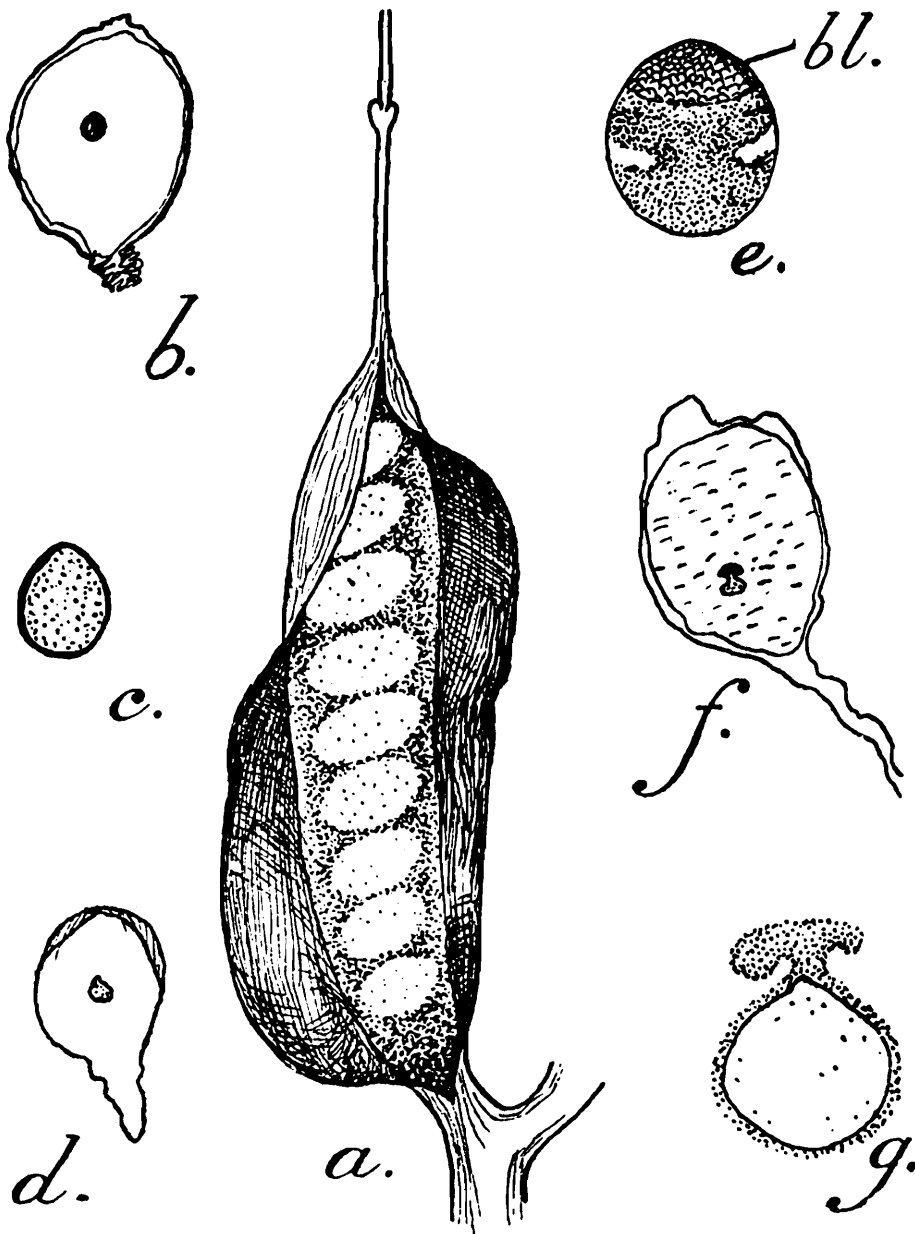
DEVELOPMENT.

Early Pregnancy.—Under this heading are included those stages of pregnancy which display the growth and subsequent full-fledged morphological structure of trophonemata.

Intra-capsular eggs.

Examination of the reproductive organs of a female measuring 23" in total length and landed on 5th January, 1943 showed that both the ovaries were present and contained small, rounded, whitish opaque ova about the size of pin heads, and sometimes even smaller, the largest measuring a millimetre in diameter. There was no trace of yellow yolk in them, Epigonal organs were present as long, thin strips of pinkish crimson hue, merging anteriorly in the substance of the ovaries. Both the uteri were equal in development, each being 5.2 cms. long and a centimetre broad and did not appear to be gravid. Dissection showed,

however, that each uterus was divided into nine obliquely transverse compartments (Text-fig. 2*a*), each containing an egg enclosed in a very thin, colourless and transparent sac of the shell-membrane. The entire egg-case looked like a pear-shaped or ovoid, turgid ball, having at its



TEXT-FIG. 2.—*S. sorrakowah* (Cuvier)

a. Uterus in very early stages of pregnancy opened to show more or less horizontal disposition of compartments ; *b.* Egg-case with zygote embedded in albuminous mass. Note the end with folded tuft ; *c.* Magnified view of the egg within the egg-case ; *d.* Egg-case with tufted end extended (naturally) as embryonic growth proceeds ; *e.* Egg with blastodermic cap above & partially consumed yolk below ; *f.* Egg-case with nutritive liquid in which the embryo floats, *g.* 0.8 mm. embryos with yolk-stalk & yolk-sac *bl.*, blastoderm.

narrower pole a somewhat elongated, folded tuft of the shell-membrane. There was no such tuft at the other pole, though an irregular and rather inconspicuous folding of the shell-membrane was discernible. In the present case, the end with the tuft was always directed posteriorly in the compartment. Later examination of a number of other females bearing intrauterine eggs showed, that this end would be directed even anteriorly. The egg-cases (Text-fig. 2*b*) were from 5-6 mm. long and from 2-2.5 mm. in width. The entire case stretched to about 8-9 mm. when its tufted end was gradually pulled.

Dissection and microscopic examination of an egg-case showed that the extremely thin and delicate but elastic shell-membrane formed within it an avoid sac enclosing a small quantity of clear, transparent liquid¹, with the whitish opaque, oval egg suspended in it (Text-fig. 2c). The eggs measured on an average 1 mm. $\times$ 0.75 mm. They did not, however, reveal any embryonic differentiation at this stage, though the white yolk appeared to have been already used up slightly.

A female 25" in total length and landed on 1st February, 1944 revealed a further stage in the developmental condition of the egg-cases and the eggs contained in them. There was no longer a folded tuft at the end of the egg-case, which had now stretched so much that it looked like the elongated tubular end of the major, bulbous sac (Text-fig. 2d). The egg-cases measured, on an average, 12 mm. in total length. Their bulbs contained even now a quantity of clear, transparent albuminous liquid noted previously and the eggs remained suspended in them.

The eggs revealed, at this stage, conspicuous embryonic development. (Text-fig. 2e). Each was typically oval in outline, with opaque masses of granular yolk contents. At the narrower end, there was a white cap of blastodermic cells in contact with a narrow band of yolk. A little lower down, there was another big band of yolk, the two bands being connected by a narrow junctional zone. The yolk had evidently been consumed partially. The blastodermic area did not yet occupy a third of the egg, but in certain cases it already appeared to be separating from the yolk mass beneath.

Choodamani in his description of "The smallest (ξ) elasmobranch egg" (1941) refers to that of *Scoliodon sorrakowah*, but does not mention the presence of an albuminous mass or liquid surrounding the eggs in the egg-cases. Prasad (1942) states that both the mucous and albumen secreting tubules in the nidamental glands of this form have disappeared, implying that mucous and albumen are not secreted by them at all. Our observations on the presence of the albuminous liquid in the shell-sacs do not thus conform with the view of the aforesaid authors regarding the total functional activity of the nidamental glands in this form. This disparity may perhaps be explained by the possibility that some cells at least in the glands, scattered among the shell-secreting tubules, have retained the albumen (and/or mucous) secreting activity. Thus alone can the presence of the albuminous liquid in the shell-sacs be accounted for. The nidamental glands in *S. sorrakowah* appear to be functionally quite similar to those of the allied viviparous species though, as pointed out by Prasad, they may have undergone a certain amount of structural midification.

Embryonic 0.8 mm. Stage.

Parent ♀ : Total length—23" ; App. wt.—1.5 lb. ; 6th January 1944.

Each uterus of this female was divided into six oval compartments, each of which contained an intact shell-membrane sac enclosing a rudimentary embryo. The uterine compartments lay one below the other

¹Other cases, however, had a small quantity of a rather firm opaque albuminous mass surrounding the egg, instead of the clear transparent liquid.

at this stage and each contained a quantity of rather sticky, cream-coloured, nutritive secretion with which the shell-membrane sac was besmeared. The mucous membrane of each compartment was moderately vascular, quite plain and smooth at this stage and there was not the slightest indication of a trophonema formation.

Each shell membrane sac is, at this stage, an irregularly ovoid or oblong pouch of the extremely thin, colourless, transparent shell membrane, having its narrower end well stretched out (Text-fig. 2f). Obviously, this latter represents the folded elastic tufts in the egg-cases described previously. The sac itself measures, on an average, 7 mm. $\times$ 4 mm. and the extended portion about 5 mm. It is now filled with a quantity of yellowish opaque, nutritive liquid in which the contained embryo is bathed freely. The secretions in the compartment referred to above have, in all probability, diffused through the shell-membrane sac and serve as a source of nourishment to the developing embryo.

From a microscopic examination of the embryonic mass, it is at once apparent that the rudimentary embryo has definitely lifted itself above the general surface of the yolk-sac, with which it remains connected by a short, thick umbilical stalk (Text-fig. 2g). The embryo measures hardly 0.8 millimetre in length and under low power magnification appears to be a rather elongated and flattened structure with a broad head end and a narrower, rounded tail end. Beyond this, not a trace of external morphological differentiation is yet noticeable. The umbilical stalk, which is nothing but the short upper pole of the yolk-sac, joins the embryo at a point near its mid-length ventrally. The yolk-sac itself measures about 1.1 mm. $\times$ 1 mm. and its walls are seen to be coated externally with a thick layer of blastoderm, which is continuous, round the umbilical stalk and the umbilicus with the ventral body wall. The umbilical stalk is devoid of appendicula at this stage.

Embryonic 1 mm. stage.

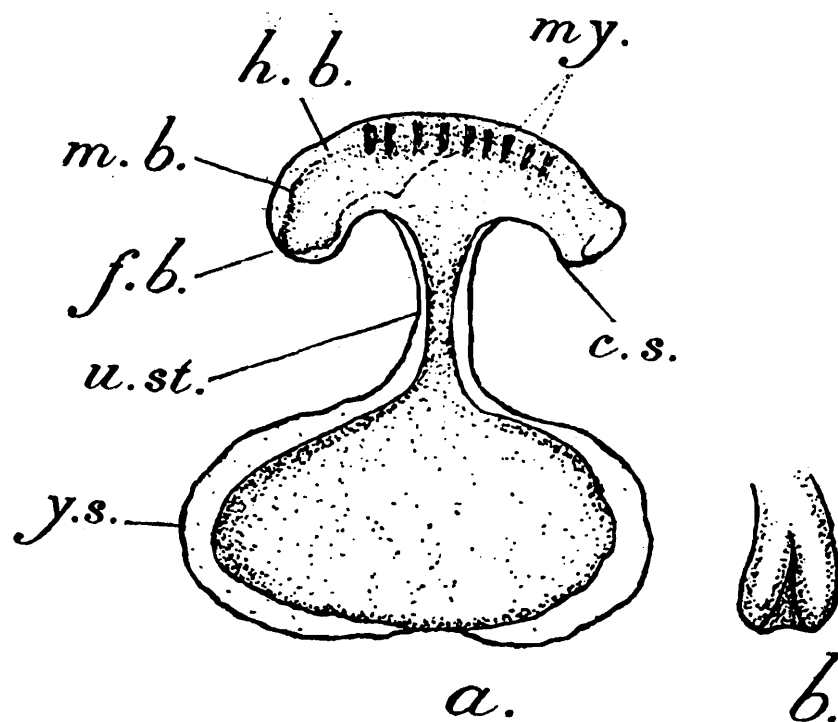
Parent ♀ : Total length—17.5" ; App. wt.—1.5 lb. ; 18th May, 1944. Each uterus was divided into six obliquely transverse compartments, each lodging a tiny embryo. Except for one embryo lying in the most anterior compartment of the right uterus, all the other embryos lay naked in the compartments, unenclosed in any shell-membrane sacs of the previous stage. Neither was there any trace of the disintegrated shell-membrane sacs in these compartments. The exceptional embryo was, however, enclosed in an outstretched shell membrane sac similar to that of the previous stage. The sac contained a quantity of translucent liquid in which the embryo was bathed. It was evident that the development of this embryo had not progressed to the same extent as that of the others and its egg was, thus, obviously the last to be fertilised and received into the uterus. The other embryos were smeared with a quantity of cream-coloured, pasty secretion of the uterine mucous membrane and the compartments were not yet filled with the thin and opaque nutritive liquid characteristic of later stages. The mucous membrane of each compartment was fairly vascular, but particularly so over a small patch lying in the postero-lateral corner where the future trophonema would arise.

It was evident that just at this stage of embryonic development the shell-membrane sacs disintegrated, liberating the embryos in the compartments.

The following are the measurements of the embryo at this stage :—

Total length	1 mm.
Length of umbilical stalk	0.6 mm.
Thickness of umbilical stalk	0.2 mm.
Yolk-sac (widest diameter)	1.2 mm.

The embryo (Text-fig. 3a) is an arched, laterally compressed structure, white in colour. Both its cephalic and caudal flexures are pronounced, its cranial end being a little more swollen than the caudal. A certain amount of organic differentiation is apparent at this stage. The three primary divisions of the brain, *viz.*, forebrain, mid-brain and hind-brain, are distinguishable. About eight to nine pairs of mesoblastic somites can be counted in the middle third of the embryonic body and there is an unsegmented mass on either side of the tail. A peculiarity



TEXT-FIG. 3.—*S. sorrakowah* (Cuvier), 1 mm. stage ($\times 36$).

a. Embryo with yolk-sac and umbilical stalk; b. Dorsal view of the ununited caudal region.

c.s., caudal swelling; f.b., forebrain; h.b., hind brain; m.b., mid brain; my., myotomes; u.st., umbilical stalk; y.s., yolk-sac.

of the stage is that near the posterior tip of the caudal region the lateral body walls have not yet fused with one another, there being an open space, between two thickened lips—the caudal swellings (Text-figs. 3b). A portion of the notochordal tissue is visible through the aforesaid space. The embryonic vascular structures are not easily distinguishable.

The umbilical stalk is a fairly elongated structure, opening with a wide, funnel-like opening in the mid-ventral region of the embryo. The stalk conveys the yolk-duct which is the prolongation of the upper

pole of the yolk-sac. Appendicula have not yet developed. The yolk-sac is an ivory-coloured, horizontally ovoid sac of a firm consistency. Its external surface is quite smooth at this stage and it is, in all likelihood, filled with the cream-coloured secretion of the uterine mucosa, which replaces the meagre quantity of the initial yolk. There is no trace yet of the formation of spongy, vascular tissue in the sac.

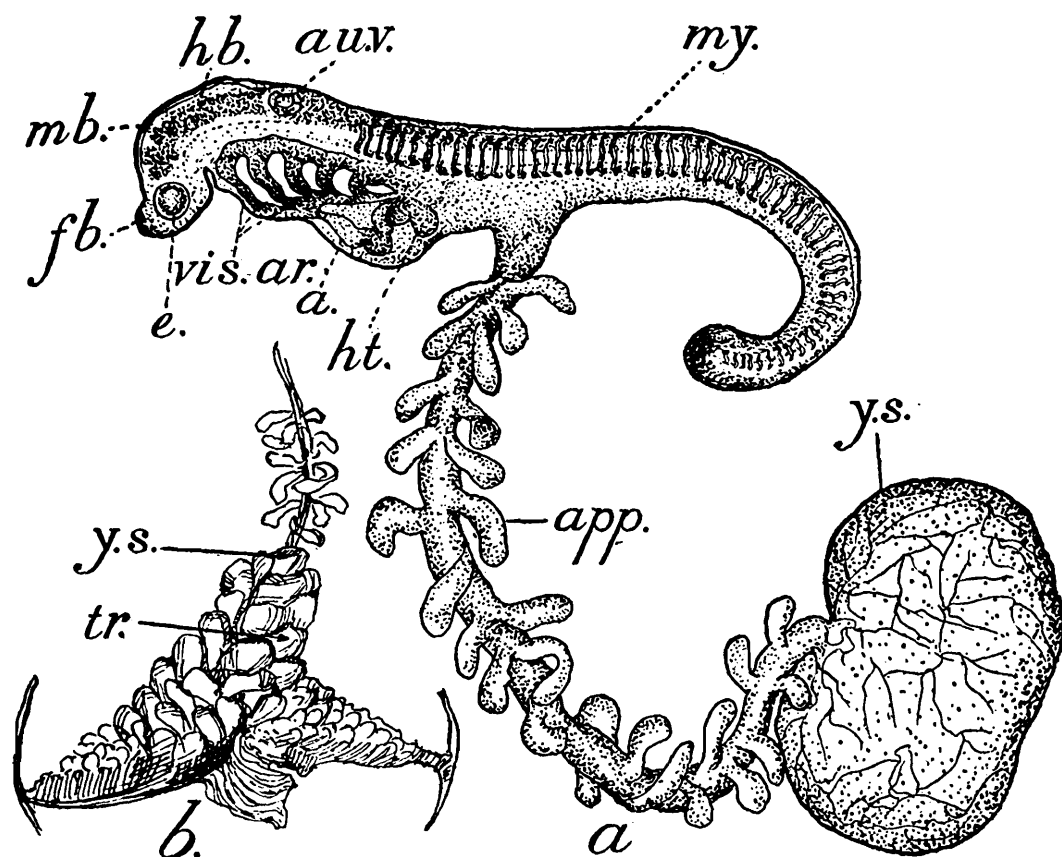
Embryonic 3-4 mm. stage.

Parent ♀ : Total length—19" ; App. wt.—1.5 lb ; 20th January, 1944. Each uterus of the above female measured 55 mm. $\times$ 10 mm. and was divided into five obliquely longitudinal compartments containing very tiny embryos. Each compartment was filled with a quantity of yellowish opaque liquid under which the embryo, with its appended structures lay completely submerged. The embryos which were 3 mm. to 4.5 mm. in total length were no longer enclosed in shell-membrane sacs (egg-cases) and their tiny yolk-sacs were already connected with the uterine trophonemata to form rudimentary placental connections. Their extremely delicate placental cords already possessed very minute appendicula. The uterine mucous membrane on the dorsal face of each compartment was highly vascular and very finely folded to form a pinnate, central ridge, which, at the posterior end of the compartment, was involuted, together with a portion of the underlying sub-mucous tissue, to form a small rudimentary trophonema. The latter was in the form of an extremely wrinkled, more or less solid, conical bulge, the top of which afforded a deep seat for the tiny yolk-sac (Text-fig. 4b). The structures referred to later on as 'trophonematous cord' and 'trophonematous bulb' as the various morphological components of a full-fledged trophonema were not clearly distinguished at this stage of pregnancy. This shows that, even after the formation of a rudimentary placental connection, the uterine trophonema continues to grow and develop till its various components are distinctly differentiated morphologically. The earliest stage recorded at which these were discernible, was the 10-12 mm. stage referred to later.

The following are the measurements of the embryo at this stage :—

Total length	.	.	.	.	.	.	3.4 mm.
Length of umbilical cord	.	.	.	.	.	.	4.5 mm.
Yolk-sac	.	.	.	.	.	.	1 mm. $\times$ 0.75 mm.
Length of trophonema	.	.	.	.	.	.	1.5 mm.

The embryo (Text-fig. 4a) is perfectly white in colour and its tissues are fairly transparent. In the fresh condition the heart and the capillary-like blood vessels are easily distinguishable by the red blood conveyed through them. The cephalic flexure is well marked, the long axis of the front part of the head making, at this stage, almost a right angle with the long axis of the body. The brain consists of the usual three divisions, the fore, mid and hind brain, the midbrain region constituting the anterior termination of the long axis of the embryo. Optic vesicles are clearly visible in the forebrain region, and a round, translucent lens appears in each vesicle. In the region of the hind-brain the auditory vesicles are seen as prominent but shallow, cup-shaped structures in the external skin. The mouth is discernible as a median longitudinal



TEXT-FIG. 4.—*S. sorrakowah* (Cuvier), 3 mm. stage ($\times 27$).

a. Embryo with appendiculated placental cord & yolk-sac ; b. Yolk-sac placenta ($\times 9$) a., conus arteriosus ; app., appendicula ; au v., auditory vesicle ; e., eye ; fb., fore-brain ; hb., hind brain ; ht., heart ; mb., mid brain ; my., myotomes ; tr., trophonema ; vis. ar., visceral arches ; y.s., yolk-sac.

pit, the hind borders of which are constituted by the first pair of viscecal arches, the mandibular. Behind the oral region, four pairs of branchial clefts and five pairs of visceral arches are easily made out though the fifth pair of the latter is yet rudimentary. The heart is quite prominent, but still an elongated and twisted, tubular organ not yet possessing the characteristic compacted form of the adult condition. The elongated ventral aorta runs beneath the visceral region, and very fine capillary like vessels, emerging dorsally from the arches are seen to join into a single dorsal aorta which extends posteriorly only up to a point corresponding to the entrance of the placental cord in the body of the embryo. The liver bud is not yet formed, nor is the position of the anus yet indicated. There is no fin differentiation yet. About 40 pairs of mesoblastic somites can easily be counted and they extend right up to the tail end of the embryo. The tail end is rather swollen and like the cranial end, it too, is flexed ventrally and not in a line with the long axis of the trunk.

The placental cord joins the embryonic intestine nearly midway between its total length. It already bears very tiny, blunt-tipped appendicula some of which are forked near their tips. The cord contains, at this stage, only a single blood-vessel, in all probability an artery which is a branch of the dorsal aorta. It sends off delicate off shoots to the appendicula. There is no definite yolk duct, nor is there a trace of a second blood-vessel.

The yolk-sac is an extremely small, pale coloured more or less rounded sac with hardly any traces of yolk, but already possessing a small quantity of spongy vascular tissue. Its basal, as also its side walls, are fairly vascular. As already pointed out, the trophonema is an excessively wrinkled but highly glandular conical mass of the uterine mucosa which is not yet vascularised externally. Its apex affords a deep seat for the tiny yolk-sac which is more or less completely embedded there, thus completing the rudimentary placental arrangement (Text-fig. 4b).

Embryonic 15 mm. stage.

Parent ♀ ; Total length—22" ; App. wt.—1 lb. ; 20th December, 1943.

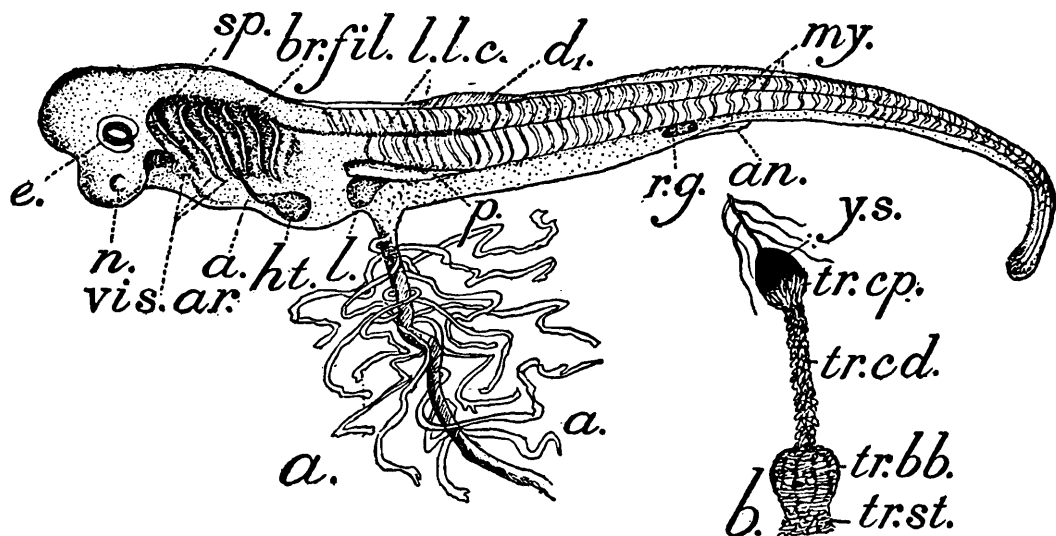
The right uterus of this female contained seven compartments and seven embryos and the left six, the yellow liquid in the compartments referred to in the previous stage being present in this case also. The uterine mucous membrane of each compartment had, at this stage, given rise to a full-fledged trophonema consisting of four distinct morphological components and the trophonema occupied at this stage a major portion of the compartment cavity.

The sexes of the embryos could not be distinguished externally.

The following are the measurements of the embryo at this stage :—

Total length	14-15 mm.
Length of placental cord	15-17 mm.
Diameter of yolk-sac	3 mm.
Length of the entire trophonema	11-13 mm.
Thickness of the trophonematous cord	2 mm.
Length of an appendiculum	6-7 mm.

The embryo (Text-fig. 5a) is still in a rudimentary stage of development and the various external morphological features, especially most of the fins, have not yet made their appearance. It has semi-transparent body walls through which the various internal organs such as the heart, the liver, the intestine, the rectal gland, the lateral line canals, the myotomes, etc., are easily discernible. In profile, the head region resembles a soft, rounded, swollen bulge anteriorly and a slight flattening antero-dorsally. The head merges below, at an angle,



TEXT-FIG. 5.—*S. sorrakowah* (Cuvier), 15 mm. stage ($\times 16$).

a. Embryo; b. Yolk-sac placenta. na., anus; br. fil., branchial filaments; d^1 , rudiment of first dorsal fin; l., liver bud; l.l.c., lateral line canal; n., nostril; p. pectoral fin; r.g., rectal gland; sp., spiracle; tr. cp., trophonematous cup; tr. cd., trophonematous cord; tr. bb., trophonematous bulb; tr. st., trophonematous stalk.

into the snout, which, too, is thick, soft and broadly rounded at this stage. Ventrally two very prominent nostrils are conspicuous on the margins of the snout. The eyes are prominent, rounded in outline, with ovoid lenses, but no ocular pigment has yet appeared. Also the orbital rims have not yet closed completely. Behind the wide buccal opening the inflated pharyngeal region is perforated laterally by prominent gill clefts, the first three of which are markedly oblique and much larger than the last two, which are also much smaller than the former. Rudiments of branchial filaments in the form of soft, knob-like papillae are visible on the front wall of each one of them. Above the mouth and only slightly ahead of the first gill opening but at an angle with it, is situated the spiracular cleft which, too, shows very faint (hardly distinguishable superficially) rudiments of spiracular filaments. The spiracular clefts are about half the size of the first gill openings. Beneath the gill region, the pinkish bulb-like heart and the conus arteriosus are easily discernible, the latter giving off epibranchial vessels to the gills. Behind the snout, ventrally, the mouth extends as a wide, more or less diamond-shaped opening not yet definitely bounded by jaws. The various flaps of the oral mucous membrane have, however, distinctly developed.

Only the pectoral fins are definitely formed at this stage, while some others are indicated only faintly. These former are situated on the ventro-lateral body walls, some distance behind the hindmost gill openings and this situation of theirs in relation to the gill region is in marked contrast with the adult condition, in which the pectorals move further forwards and eventually lie below the hindmost gill slits. The pectorals are mere crescent-shaped flaps at this stage, with wide bases and very small free posterior projections. The dorsal and the ventral median fin membranes are nothing but mere demarcations, in corresponding situations, of the general epidermal sheath of the embryonic body. The dorsal is distinguished at a point slightly posterior to the second gill cleft and the ventral behind the cloacal aperture, both being continuous round the tail end. The position of the first dorsal fin may roughly be said to be indicated by the elevation of the dorsal skin fold, a short distance behind the pectorals. The positions of the other median fins are not, however, even faintly marked out at this stage. Ventrally, the cloacal aperture is located at a point corresponding to a dorsal point situated slightly behind the posterior termination of the first dorsal rudiment, and two slight epidermal bulges, one on either side of the cloaca probably indicate the positions of the pelvic rudiments. The tubular intestine is seen to terminate into the cloaca posteriorly. The pinkish rectal gland is situated on the dorsal aspect of the intestine, slightly anterior to the cloacal aperture, and is easily distinguished superficially in profile. A number of V-shaped myotomes extend posteriorly from behind the gill region, but in the caudal region, they have lost their V-shaped character and become more or less vertical.

The placental cord is seen to pierce the ventral body wall midway between the pectoral fins and one of its vessels, the vein is easily seen to enter the whitish opaque liver, which is located internally in a position somewhat anterior to the origin of the pectorals and

immediately behind the bulb-like heart. Finally, also distinguished superficially, in profile, is the tubular lateral line sensory canal located beneath the epidermal sheath. It begins immediately above the orbit and extends, at this stage, posteriorly along the dorso-lateral surface of the body, to a point midway between the posterior end of the pectoral fin and the rectal gland.

Yolk-sac placenta.—Both the foetal and the maternal tissues enter into the formation of the yolk-sac placenta (Text-fig. 5*b*). The foetal placenta is contributed by the original yolk-sac (y.s.) which is by now a soft rounded structure, full of spongy vascular tissue. Its basal wall does not present a smooth and entire surface, but appears to be rather rough, fissured or perforated, the perforations leading inside the sac. The yolk-sac is received into a flask-shaped structure of the uterine trophonema, the maternal portion of the placenta, thus forming a composite placental arrangement. The trophonema itself presents a peculiar macroscopic structure. As seen in text-fig. 5*b*, each trophonema, is seen to consist, from the maternal to the foetal end, of the following four distinct morphological components, *viz.*, (1) trophonematous stalk (*tr. st.*), a short, thick, pillar-like structure formed as a result of the toughened involutions of the uterine mucous membrane and the underlying submucous part of the compartmental wall, (2) trophonematous bulb (*tr. bb.*), the trophonematous stalk dilates at its foetal end to form a prominent, almost rounded, more or less solid bulge, which bears a striking resemblance to a bit of cauliflower, and (3) and (4) trophonematous cord and trophonematous cup (*tr. cd.* & *tr. cp.*), from the summit of the trophonematous bulb, there rises an elongated cord filled with a certain amount of spongy vascular tissue and free maternal blood; at its foetal end the cord dilates into a thin walled, shallow cup which receives the basal portion of the yolk-sac. The attachment between the two is in the nature of apposition and there is no firm interdigitating arrangement as between folds and villi. In slightly advanced stages of pregnancy, the cup is not quite entire, but disintegrated into a crown of processes which then hold the yolk-sac in a manner akin to that in which gems are gripped in rings.

The outer walls of the structures described above are not plain and smooth, but present an extremely wrinkled and uneven surface, which presents under the low power of the microscope, scaly and rugose appearance. The trophonema as a whole is not loose and lax, but is firm, with a definite tone. On gently detaching the yolk-sac from the cup, free maternal blood oozes from the distal end of the trophonematous cord.

The placental cord consists of a small artery and a fairly prominent vein enclosed in a connective tissue sheath there being no trace of a yolk-duct even at this stage. It is quite possible that the yolk-duct might have atrophied much earlier. The cord bears numerous, long appendicula almost throughout its length. They are rather flat, strap-shaped structures, some of them being forked near their distal extremities. Each possesses, even at this stage, a very fine arterial and a venous capillary running marginally and a vascular loop at its tip. At its

distal end the cord is attached to the yolk-sac which connects with the trophonema to form the placenta.

The 10-12 mm. stage, examined on the 28th February, 1944 almost completely resembled the one described above, except in two respects. Firstly, there was not the slightest indication of any fin differentiation but for the formation of rudimentary pectoral fins. Secondly, the lateral line canal extended at this stage only up to the roots of the pectoral fins. A full-fledged placenta was, however, formed and resembled 'in toto' that of the 15 mm. stage.

Embryonic 20 mm. stage.

Parent ♀ : Total length—23·5" ; App. wt.—2 lb. ; 20th October, 1943.

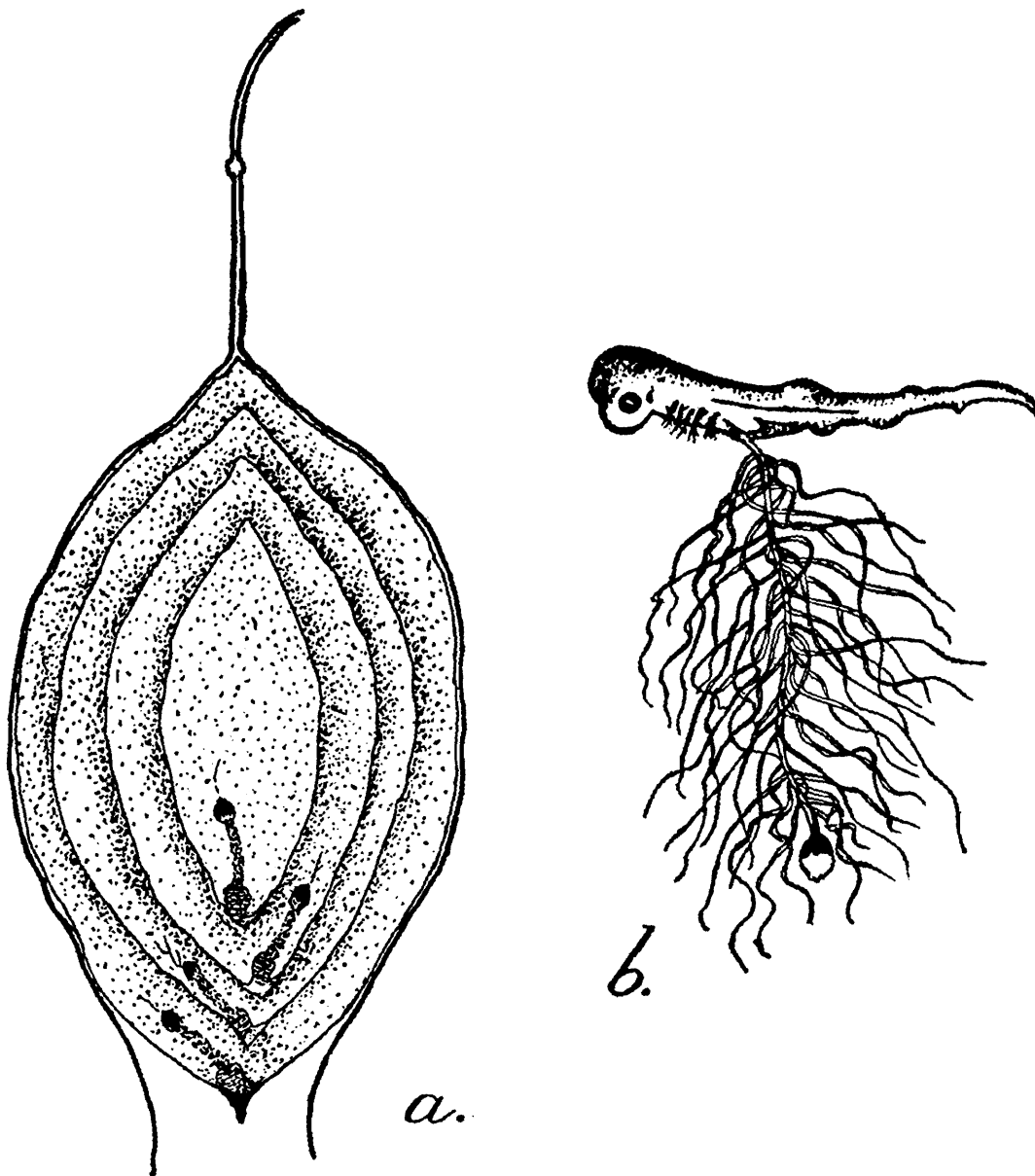
The compartments in the uteri of the above female, were disposed antero-posteriorly (Text-fig. 6a), there being five in the right uterus and four in the left. There were, however, only two embryos in the former and three in the latter, and the trophenemata of only these were well-developed, those of the abortive compartments being comparatively much reduced in size, though definitely formed on a similar plan. All the embryos, except one in the left uterus, lay with the heads directed towards the cranial end of the mother, while the exceptional embryo lay with its head towards her caudal end. Sexes were not yet differentiated externally.

The following are the measurements of one of the embryos at this stage :—

Total length	20 mm.
Length of caudal fin	5 mm.
Length of placental cord	32-35 mm.
Diameter of the yolk-sac and that of the trophonematous cup	2·8 mm. and 3 mm. resp.
Total length of the entire trophonema	14 mm.
Thickness of trophonematous cord	2 mm.
Maximum length of an appendiculum	23 mm.

The embryo (Text-fig. 6a,b) is completely formed externally at this stage and almost reddish crimson in colour, the process of general pigmentation not having yet started. The head region is a soft and swollen bulge, merging below, at an angle, into the beak-like snout, which too, is short and bluntly rounded and not flattened dorso-ventrally. The head and the snout regions thus contrast markedly with the adult condition of these regions. The eyes are prominent, and rather oval in outline with a round whitish opaque lens. The iris is represented at this stage by two narrow strips of dark pigment, an anterior and a posterior, which just overlap small segments of the lens in front and behind. Some distance behind the orbit and immediately above the angle of the mouth, the spiracular slit is discernible as a distinctly reduced crescent-shaped, oblique slit with short papillae-like spiracular filaments. The gill region

is very conspicuous on account of the presence of bunches of crowded and vascular branchial filaments which are now in the form of very short, club-shaped threads slightly protruding out of the gill-slits. The fins, excepting the pectorals, have all appeared in their respective adult positions. The pectorals, are, however, located well behind the last gill-slit and in this respect; the condition is still primitive. Nor have any of the fins yet assumed their respective characteristic adult forms, most of them being mere curved flaps, supported internally by delicate fin rays. The subcaudal lobe, too, is not yet clearly marked out and thus the heterocercal character of the selachian tail is indistinguishable at this stage.



TEXT-FIG. 6.—*S. sorrakowah* (Cuvier), 20 mm. stage

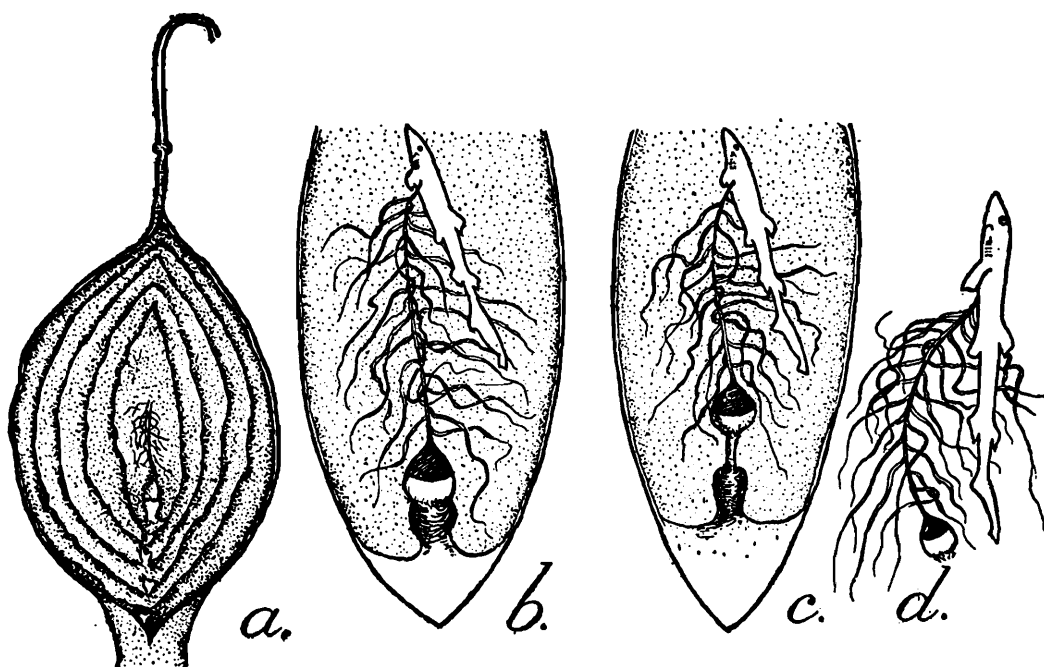
- a.* Dissection of uterus showing arrangement of compartments and trophonomata;
b. Embryo with appendiculated placental cord and foetal placenta.

The placental cord pierces the abdominal wall of the embryo at a point midway between the pectoral fins. It presents the same anatomical features as described in the previous stage and is similarly attached to the rounded yolk-sac which forms a placenta in conjunction with the full-fledged maternal trophonema of its own compartment.

Except for the actual number of young ones borne by the uteri, exactly identical conditions of pregnancy and embryonic development were encountered in 25 mm. to 33 mm. stages.

Intermediate stages of pregnancy:—Under this heading are described such stages of pregnancy in which trophonemata display structural degeneration in varying degrees.

Each uterus of a female 17.5 inches in length (App. wt. 1.5 lb. ; Aug. 29, 1942) was divided into five compartments, each containing an embryo and a trophonema. The embryos now resembled the adult in every respect (Text-fig. 7*d*), though the general dorsal pigmentation had not yet advanced to any appreciable degree. The rudiments of



TEXT-FIG. 7.—*S. sorrakowah* (Cuvier), (Intermediate stages of pregnancy).

a. Dissection of uterus showing compartments and trophonemata ; *b.* A portion of compartment magnified showing embryo with its placenta 'in situ.' Note the complete reduction of trophonematous cord ; *c.* Placental condition in which trophonematous cord is still present though definitely reduced in length ; *d.* Embryo with appendiculated placental cord & yolk-sac.

branchial filaments could also be seen projecting through gill-silts though they were definitely undergoing degeneration. Sexes were distinguishable at this stage, three of the five embryos in each uterus being male

and two female. The embryos presented the following range of dimensions :—

Total length		56-61 mm.
Yolk-sac		6 mm. × 4 mm.
Length of placental cord		78-81 mm.
Maximum length of an appendiculum		55 mm.
Length of trophonematous cord (where present)		5 mm.
Length of barrel-shaped trophonema		5-6 mm.
Diameter of summit of trophonema		3-4 mm.

The existence of two different conditions in the anatomical character of the maternal placentae was striking. In three of the five compartments of the right uterus each trophonema was seen to consist of the four distinct components described in the 15 mm. stage and the basal portion of the yolk-sac was still attached to the crown of processes, (remnants of the original trophonematous cup) at the foetal end of the cord. The latter, however, showed a conspicuous reduction in its length, suggesting structural degeneration (Text-fig. 7c). In the remaining two compartments of the right uterus and in all compartments of the left, the trophonematous cords were, however, entirely absent and the foetal yolk-sacs rested directly on the summits of the barrel-shaped or pillar-like trophonemata which now consisted of the modified trophonematous bulbs and stalks only. The trophonemata were no longer tough and solid as their components were before, but were rather lax and hollow and filled with loose, spongy tissue having blood capillaries entering them basally. Their apices afforded seats for the yolk-sacs which were slenderly held in position by strands of tissue arising from the rims of the trophonemata and representing the remnants of the original trophonematous cups (Text-fig. 7b). The outer surface of the trophonemata was now smooth and not wrinkled as before and was highly vascular. Mere touch dislodged the yolk-sac from their seats, and maternal blood was noted exuding freely through the apices of the hollow trophonemata.

Such trophonemata which show a partial reduction of their constituent components with the synchronic growth of the embryos represent a case of gradual structural and functional degeneration of the specially developed structures, when the conditions that necessitate their growth gradually alter on the negative side.

Parent ♀ : Total length—25" : App. wt.—3 lb., October 1, 1942.

The right uterus of this fish was divided into seven compartments^s containing seven embryos, out of which two were males and five females. The left uterus contained, however, eight compartments and eight embryos, all of which were females. The embryos presented the following range of dimensions :—

Total length		55-64 mm.
Yolk-sac		6 mm. × 5 mm.
Length of placental cord		60-74 mm.
Length of trophonema		3 mm.
Diameter of trophonematous cup		5-7 mm.

The trophonemata in this particular instance presented a slight variation from the condition recorded in the latter instance of the

preceding case. As in that condition the trophonematous cords were entirely absent, but unlike it, the residual trophonemata still bore on their summits entire trophonematous cups which had not yet disintegrated into crowns of processes, in spite of a more or less equal advancement in pregnancy. On the other hand, the cups showed a slight increase in size in keeping with the larger size of the yolk-sacs and it could easily be discerned that this increase was at the cost of the foetal ends of the trophonematous cords, which had themselves undergone complete morphological reduction. Further, the trophonemata still retained the highly wrinkled superficial consistency noted in the earlier stages of pregnancy though not possessing the same firm tone as before. A gentle pull dislodged the yolk-sac from the cup and as before, free maternal blood oozed from the apex of the more or less hollow trophonema.

The comparative observations described above clearly show that gravid females in similar conditions of pregnancy (complete morphological reduction of the trophonematous cords and bearing nearly equal-sized embryos) do not necessarily exhibit the same degenerative changes in the trophonemata and this appears to be in keeping with the fact that all gravid females do not necessarily bring forth young ones of identical sizes.

Advanced Pregnancy.—Under this heading are recorded the stages in which the trophonemata have undergone a more or less complete degeneration and are reduced to mere scars.

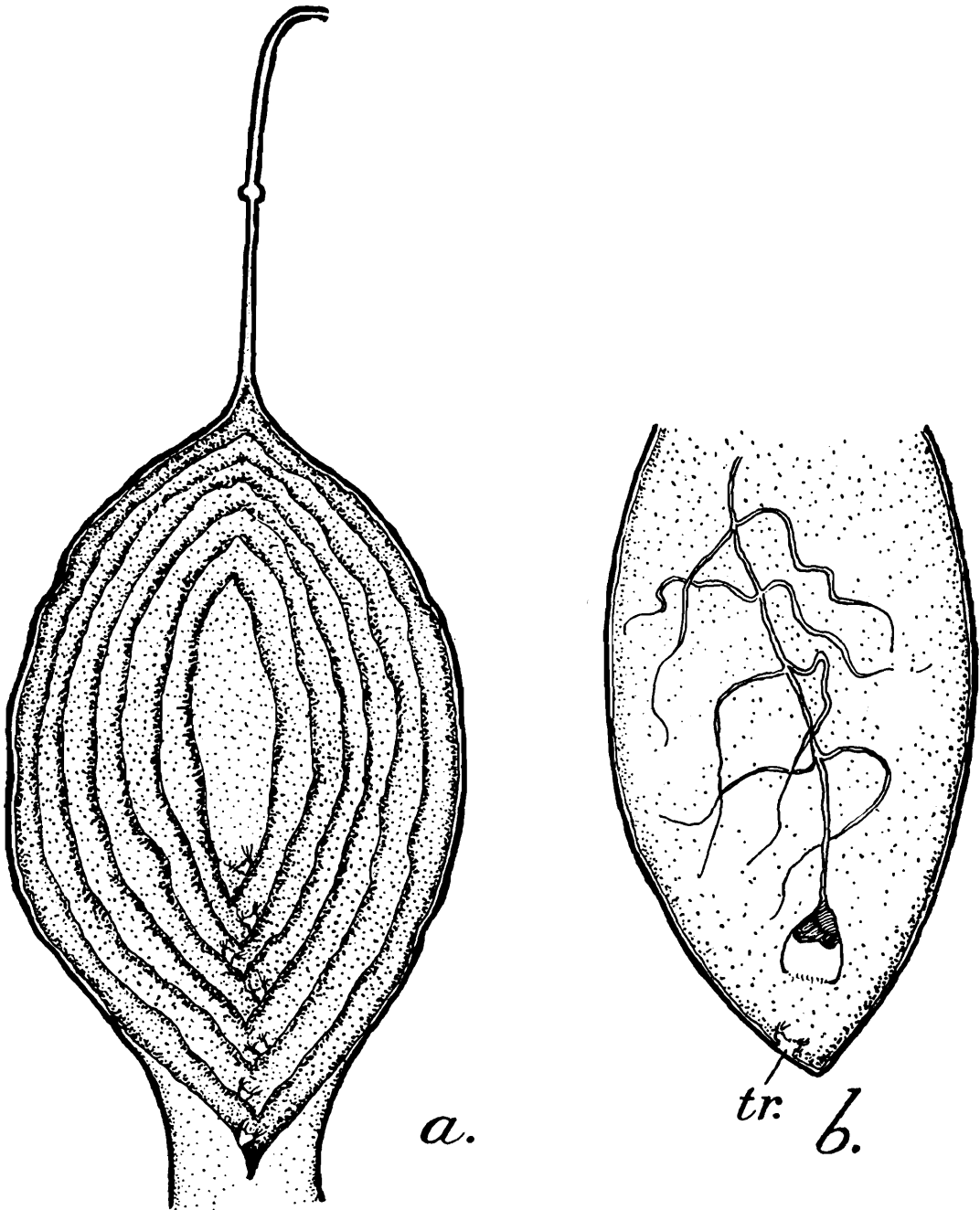
Parent ♀ : Total length-20.5" ; App. wt.-2 lb. ; May 22, 1942.

Examination of the above female showed that her right uterus contained seven embryos, of which five were males and two females, while the left uterus contained six embryos, of which three were male and three female. A slight difference was noticeable in the size of the male and female embryos at this stage, the females being bigger than males. The embryos of the two sexes presented the following dimensions :—

Total length	117 mm.	125 mm.
Length of placental cord	125 mm.	105 mm.
Maximum length of an appendiculum	80 mm.	79 mm.
Yolk-sac	7.5 mm. × 7.5 mm. 10 mm. × 10 mm.	
Length of trophonema	3 mm.	2 mm.

The advanced embryos of *S. sorrakowah* measuring 135 mm. in total length have been described by Southwell and Prashad (1919) and the descriptive features of the embryos referred to by us above closely resemble those of the embryos examined by the aforesaid authors. The embryos are, at these advanced stages of development, perfect replicas of the parent fish. Their placentae are described below :

The trophonemata, at this stage, are extremely reduced in size and appear as mere hollow, vascular stubs or thick elevations in the posterior parts of the uterine compartments (Text-fig. 8a-b). Their rims still bear remnants of the disintegrated cups and some of the yolk-sacs are still held in contact with the reduced trophonemata. The contact is however, slight and a mere touch dislodges the sac from the trophonema. It is at once apparent that the structural degeneration of the trophonema noted in the intermediate stages of pregnancy has by now progressed considerably and a corresponding increase in the size of the embryos indicates that the parent female is fast nearing the delivery period



TEXT-FIG. 8.—*S. sorrakowah* (Cuvier) (Advanced pregnancy).

a. Dissection of uterus showing arrangement of compartments with reduced trophonemata ; *b.* A single compartment magnified to show structural degeneration undergone by trophonema (tr.).

Histology of the yolk-sac placenta.

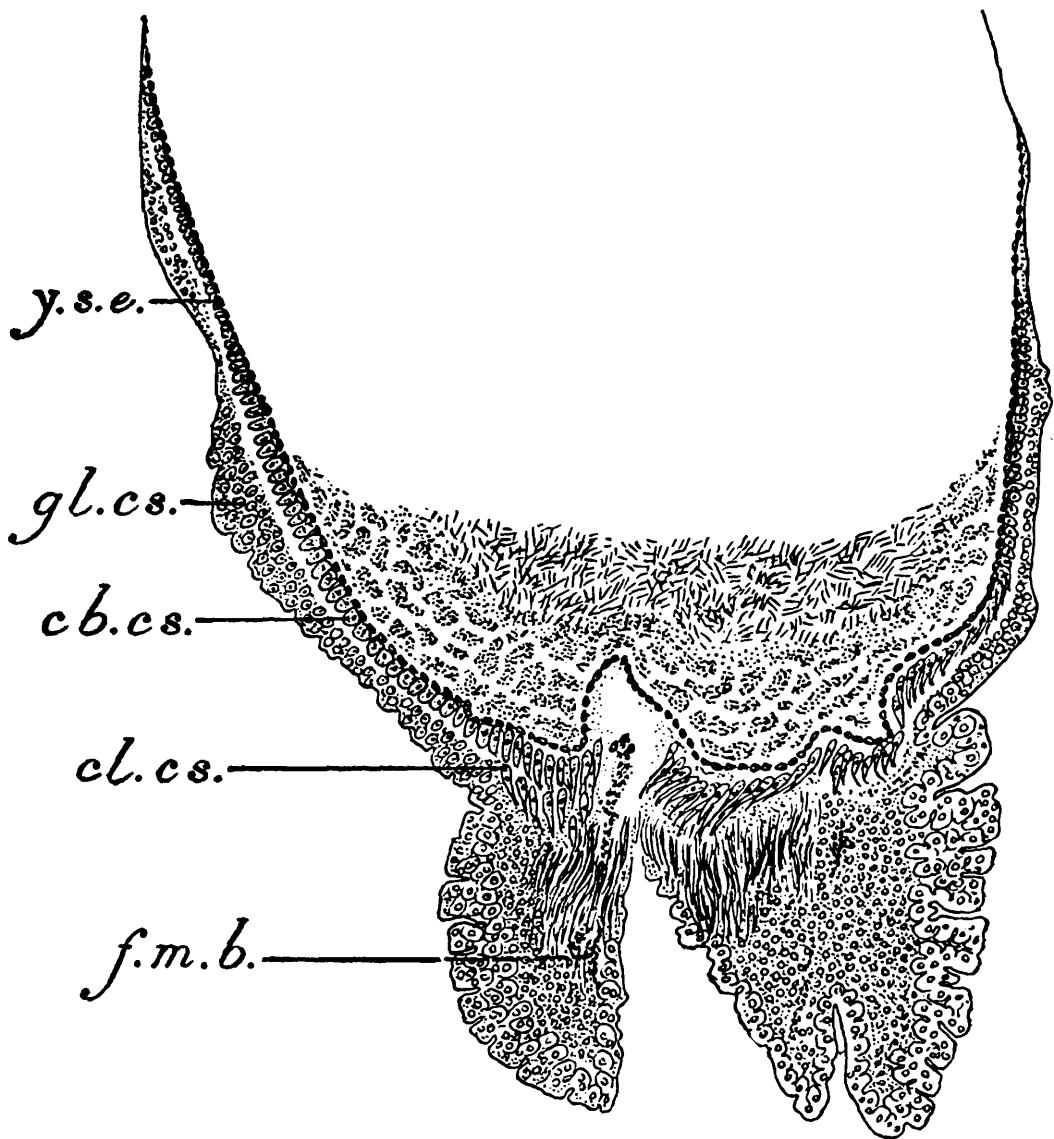
In order to be able to understand the structure of the placenta and the mode of transference of nourishment from the mother to the foetus the yolk-sac placentae in various stages of gestation, viz., 10 mm. stage, 15 mm.—stage, 25 mm.—stage, 6 cm.—stage and 12 cm.—stage were cut into longitudinal sections. In the first three stages, the sections clearly display the four morphological constituents already described, and the doublewalled trophonematous cup is seen to embrace the tiny yolk-sac almost completely. In the 6 cm.-stage, the trophonematous cord is no longer present and the yolk-sac rests on the cup, which now comes to lie over the residual, pillar-like trophonema. Due to an increase in the size of the yolk-sac the grip of the cup over the sac has slackened considerably, and the sac is now only half way embraced by

the cup. In the most advanced stages the greatly reduced trophonema and its cup display an extremely disintegrating structure and the yolk-sac which is then comparatively several times larger, is barely in contact with the trophonema.

The different sections, while revealing a histological structure which, for the most part, substantiates Mahadevan's (1940) observations on the structure of the trophonematous cup and the mode of transference of nourishment suggested by her bring out a few additional very striking facts which are of special interest both histologically and physiologically.

The trophonematous cup is seen to be composed, throughout, of two distinct walls, an inner one formed as observed by Mahadevan as the result of invagination of the outer. The outer wall of the cup, as also the walls of the entire trophonema (including all its components), is seen to be made up of glandular epithelium (Text-fig. 9), mostly grouped together in the form of glands but simply layered occasionally. Except for the region of the cup, the glandular walls of the trophonema are seen to be arranged in the form of broad villi or papillae that impart to the trophonema, the uneven and rugose superficial consistency. The gland cells are more or less rounded or oval in outline with prominent central nuclei and granular protoplasm. This glandular tissue is also seen to extent within the lumen of the trophonema. In fact in the earlier stages of pregnancy the trophonematous cord is more or less solid, being made up of glandular tissue, with a sparse quantity of connective tissue interspersed between it. The glands of the trophonema must undoubtedly be secreting, in part at least, the nutritive liquid noted in the compartments and their secretions must also be thrown within the trophonema whence they must subsequently be transferred to the embryo.

The inner wall of the trophonematous cup is seen to be one cell thick, though occasionally it gives the effect of being pseudo-stratified. The cells of this layer present a peculiarity with respect to their histological nature in different regions and at different stages of pregnancy. In the very early stages the cells are more or less cuboidal throughout, tending to elongate and become columnar in the basal region of the cup, where the wall of the yolk-sac presents an undulating contour (Text-fig. 9, *cl. cs.*). By their basal ends these cells are in firm and intimate contact with the yolk-sac ectoderm, following it even through the undulations, while their narrow and tapering ends meet the glandular tissue of the outer wall of the cup and that of the core of the trophonematous cord, thus keeping themselves actively engaged in absorbing their nutritive secretions. As however, pregnancy advances, the cells in the basal and basilateral regions get detached from the glandular core of the trophonematous cord, elongate and become distinctly columnar. They then possess highly granular protoplasm and prominent, oval, binucleolated nuclei which appear to be in a high state of activity. The remaining cells of the invaginated layer continue, however, to retain their original cuboidal character. In these latter regions, the contact with the glandular tissue persists, with the result that their cells do not get an opportunity of changing their form and becoming



TEXT-FIG. 9.—*S. sorrakowah* (Cuvier).

Longitudinal section of placenta in intermediate stages of pregnancy.

cb. cs., Cuboid cells of inner layer of trophonematous cup; *cl. cs.*, columnar cells of the same; *f. m. b.*, free maternal blood; *gl. cs.*, gland cells of outer layer of trophonematous cup *f. m. b.*; *y. s. e.*—yolk-sac ectoderm.

columnar. Occasionally the columnar character of the cells may be defective and the original cuboidal persistent in certain sections of even the basal region of the invaginated layer, where the cells generally become columnar. As before, this defect may be traced to the persistence of attachment of the defective regions with the glandular tissue, with the result that the development of the cells is missed. Contact with the yolk-sac ectoderm is maintained throughout, however, despite advancement in pregnancy and it is only in very highly advanced stages that this contact is lost as a result of the general disintegration which sets in then.

With the assumption of the columnar character by the cells of the inner invaginated layer of the cup and their subsequent detachment from the glandular tissue of the cord, a new additional mode of absorption of nutriment becomes apparent. The columnar cells are then

profusely bathed with free maternal blood (Text-fig. 9) rising up through the trophonematous cord. The latter is no longer a solid glandular cord, but develops a core of loose, spongy connective tissue engulfing free maternal blood. At the base of the trophonema the involuted blood-capillaries of the uterine mucosa may show definite capillary walls, but the capillaries as such are not extended throughout the cord. Free maternal blood is seen to pour forth through the involuted capillaries near the base of the cord, whence it is carried up its reticulated and spongy core either in regular channels or through irregular spaces. (Free blood rising up through the longitudinally running grooves and furrows, which are formed internally as a result of the excessive superficial folding and furrowing of the walls of the trophonematous cord, may produce the effect of capillary formation, but this is only an illusion and there are no true blood-capillaries in the cord). Two streaks of involuntary muscle fibres running through the entire length of the cord immediately inside the outer glandular walls appear to propel this channelled or engulfed blood towards the columnar cell layer of the cup, which is thus continuously bathed by free maternal blood. It is not clear how a disintegration of the blood-capillaries of the uterine mucosa occurs but the fact remains that they emit free blood within the trophonema. Since trophonema constitutes the maternal portion of the placenta a specialized organ of foetal nutrition-emission of free maternal blood for the more direct supply of nutriment to the developing embryo is not quite an inconceivable phenomenon.

The general histology of the yolk-sac conforms with the description of it given by Mahadevan (1940). The firm contact between the single-layered granulated cells of the yolk-sac ectoderm and the columnar cells of the invaginated layer of the trophonematous cup is, indeed, highly suggestive of a mutual exchange of food material and excretory products between the maternal and foetal tissues.

The development of prominent columnar cells in only the basal and basilateral regions of the cup and a nearly synchronous development of a new mode of food-supply, *viz.*, free blood bathing the columnar cells so as to supply them nourishment, point to two distinct possibilities *viz.*, (i) that these cells are, with the advancement in pregnancy, called upon to perform a function more complex than mere absorption of nutrition and its transference to the yolk-sac ectoderm and (ii) that the basal region of the yolk-sac which presents a deeply fissured and undulating surface is particularly absorptive in nature. With the advancement in pregnancy, two kinds of nutritive materials appear to be made available to the embryo through the trophonema. As in earlier stages, the ready-made, nutritive secretions elaborated by the glandular tissue of the trophonema and thrown into its lumen, whence they are, we might say, diffused, in all probability, unaltered through the invaginated layer and passed on to the embryo and secondly the nutritive materials in the free maternal blood which must exist chiefly in an elementary (digested and simplified) condition. It is highly probable that these undergo suitable elaboration and conversion within the then specially developed columnar cells before passing to the foetus. It is also possible

that some of the disintegrating gland cells (Histotrophe of ungulate mammals) and maternal blood corpuscles undergo nutritive degeneration and are absorbed by the trophic columnar cells. Such dynamic action of the columnar cells would well be regarded as an active trophoblastic action, and the layer a trophoblast in the true sense of the term, analogous to the 'true trophoblast' of birds and mammals. A significant point of difference between the two trophoblasts would be that; whereas the latter is a foetal tissue, the former is a purely maternal one, representing a phenomenon of reversion of functions—a phenomenon that is only in keeping with the fact that the foetal tissue in such primary group of vertebrates as fishes is not endowed with the higher physiological faculties (*viz.*, phagocytosis, elaboration and synthesis, controlled supply of food materials etc.) of a true avian and mammalian trophoblast, thus rendering the intervention of an analogous maternal tissue a crucial necessity.

Embryonic history of the yolk-sac placenta, with remarks on its probable mode of function.

(Text-figs. 4, 6, 7, 8 & 9.)

The placenta in *Scoliodon sorrakowah* presents very unique structural peculiarities and is the only one of its kind amongst the placental elasmobranchs studied. The foetal placenta is constituted throughout by the almost yolkless yolk-sac of the embryo while the maternal portion consists of the trophonema, an organ formed from the specially modified uterine mucous membrane in the posterior part of the uterine compartment. The earliest placenta noted by us in this species is that formed at the 3 mm.-stage of embryonic development. At that stage the trophonema is very small, just a bit of the highly wrinkled, glandular tissue of the uterine mucosa. Nevertheless, it already enguifs the yolk-sac, thus completing the placentol arrangement. As growth proceeds both the yolk-sac and the trophonema grow in size and length till the latter develops the four distinct morphological components described by us, at the earliest, at the 10-12 mm. stage. These components are, from the foetal to the maternal end, (i) & (ii) the trophonematous cup and cord (iii) the trophonematous bulb and (iv) the trophonematous stalk. The foetal yolk-sac is simply fitted on the double-walled trophonematous cup there being no invasion of the maternal tissue by the foetal tissue and no firm interdigitating arrangement a between folds and villi. Such a condition persists for some time and then structural and functional degeneration of the trophonema sets in. The foetal yolk-sac is continuously increasing in size and the cup gradually loses its hold on the sac, becoming shallower and shallower. The trophonematous cord also goes on diminishing in length and finally disappears (55-60 mm.). The disappearance of the trophonematous cord marks, in our opinion, the commencement of the intermediate stages of pregnancy. The trophonematous bulb and stalk which were hitherto more or less tough and solid now become hollow and modified so as to form a barrel-shaped or pillar-like structure, the apex of which affords a seat for the yolk-sac. Remnants of the original trophonematous cup are even yet noticeable holding the yolk-sac in contact with the trophonema.

The trophenema is quite vascular at this stage. With further growth of the embryo, even this residual trophonema goes on diminishing in size, till finally, any trace of the original complex structure is completely lost and a mere stub-like vascular elevation is left behind, with the yolk-sac very nearly losing contact with it (110-130 mm.). It is apparent that simultaneously with the growth of the embryo structural and functional degeneration of the specialized maternal structure—the trophonema proceeds downwards from its foetal to the maternal end, till it finally disappears completely after the birth of the embryos (120-140 mm.).

As observed by Mahadevan (1940), the mature egg in this species is very small (1 mm. in diameter) and contains very little yolk which lasts the embryo a very short while indeed. The mother is, therefore, driven to the necessity of making a very early provision of nutriment for the developing embryo, and we find the uterine compartments containing nutritive secretions even as early as in the 0.8 mm. stage of embryonic development, when the embryo still lies enclosed in the egg-case. An actual placental connection is formed as early as 3-4 mm. stage. Judged from the histological structure of the placenta in very early stages, the alimentary condition of the embryo then appears to be principally histotrophic. The cuboidal cells of the inner invaginated layer of the cup lying in actual contact with the outer gland cells actively absorb their secretions and transfer them to the cells of the yolk-sac ectoderm with which they are in firm contact by their basal ends. With subsequent advance in pregnancy (as observed by us in 10 mm. stage and onwards), the placental condition becomes distinctly haemotrophic also. In addition to the former source of nutrition, nutriment from free maternal blood is then made available to the embryo *via* the trophoblastic columnar cells of the invaginated layer of the cup, which may thus be rightly described as a 'maternal trophoblast' as distinguished from the foetal trophoblast of birds and mammals. The placental layers from the maternal to the foetal end are then seen to be (i) free maternal blood, (ii) 'maternal trophoblast', & (iii) yolk-sac ectoderm. Using Grosser's terminology describing tissue relationship in the placentae of mammals, the above placenta in *S. sorrakowah* could be described as of Haemo-epithelio-chorialis variety, an altogether new category not met with in any of the placental forms studied so far.

In highly advanced stages of development, the placental structure is seen to be totally disorganised and very little nutrition, if at all, reaches the embryo through that organ. The embryonic development is almost completed by that time and the nutritive secretions in the compartments which continue to be secreted to the last, serve as nourishment to the foetus till the time of its birth.

In view of the fact that profuse quantities of uterine secretions are made available to the embryo almost throughout its intrauterine life, it appears that the alimentary conditions during the foetal life of *S. sorrakowah* are far more histotrophic than haemotrophic and that comparatively a very small quantity of nutrition is derived directly from the maternal blood vascular system. Further, the efficiency of the

maternal trophoblast, which is not inherently a 'true trophoblast', is bound to be of a limited nature and in view of this, as also the poor contact relations between the foetal and maternal tissues, we are inclined to believe that the placenta in *S. sorrakowah* is of a primitive nature, in spite of the fact that it is highly specialised structurally.

List of adult females in pregnant and post-pregnant stages collected from Bombay from April '42 to May '44.

Date of capture.	Length of parent female.	Total No. of embryos.	Average length of embryos.	Remarks.
28.4.1942	21"	7+7=14	10.6 cm.	Advanced pregnancy.
18.5.1942	17.5"	5+5=10	5.6 "	Intermediate pregnancy.
22.5.1942	20.5"	7+6=13	12.1 "	Advanced pregnancy.
14.8.1942	18"	4+4=8	3.2 "	Early pregnancy.
18.8.1942	21"	7+7=14	9.2 "	Advanced pregnancy.
29.8.1942	17.5"	5+5=10	5.8 "	Intermediate pregnancy.
8.9.1942	18"	3+3=6	4.7 "	Intermediate pregnancy.
29.9.1942	22"	7+7=14	11.5 "	Advanced pregnancy.
30.9.1941	21.5"	7+6=13	13 "	Parturition stage.
1.10.1942	23"	5+5=10	4.8 "	Intermediate pregnancy.
1.10.1942	25"	7+8=15	5.9 "	Intermediate pregnancy.
1.10.1942	22"	..	..	Post-pregnant condition.
14.11.1942	22"	6+5=11	13.75 cm.	Parturition stage.
15.11.1942	18"			Post-pregnant condition.
5.2.1943	23"	9+9=18	Intrauterine eggs.	Very early pregnancy.
9.3.1943	18"	7+7=14	0.5 cm.	Very early pregnancy.
11.4.1943	21"	7+7=14	5 "	Intermediate pregnancy.
12.5.1943	22"	6+5=11	4 "	Early pregnancy (Sexes differentiated externally).
17.5.1943	24"	5+5=10	Intrauterine eggs.	Very early pregnancy.
17.5.1943	23.5"	7+7=14	5.5 cm.	Intermediate pregnancy.
6.7.1943	23"	6+5=11	9.3 "	Advanced pregnancy.
11, 12, 13, 14.7.1943.				Young ones 6"-7" in fishermen's baskets.
26.8.1943	22"	7+5=12	12.7 cm.	Advanced pregnancy.
26.8.1943	22.5"			Post-pregnant condition.

List of adult females in pregnant and post-pregnant stages collected from Bombay from April '42 to May '44—contd.

Date of capture.	Length of parent female.	Total No. of embryos.	Average length of embryos.	Remarks.
26-8-1943	21"	6+6=12	14 cm.	Parturition stage.
27-8-1943	22"	7+7=14	4.5 "	Intermediate pregnancy.
24-9-1943	20.5"			Post-pregnant condition.
28-9-1943	22"	6+6=12	12 cm.	Advanced pregnancy.
9-10-1943	20.5"	4+3=7	13 "	Parturition stage.
20-10-1943	23.5"	2+3=5	2 "	Early pregnancy. There were five compartments in each uterus but some were abortive and without embryos. Their trophonemata were present but in a very rudimentary condition.
21-10-1943	22.5"			Post-pregnant condition.
25-10-1943	21"	4+4=8	6 cm.	Intermediate pregnancy.
25-10-1943	23"	4+3=7	12 "	Advanced pregnancy.
26-10-1943	21.5"	4+4=8	8.1 "	Intermediate pregnancy.
26-10-1943	22"	4+4=8	2.5 "	Early pregnancy.
15-12-1943	25.5"	4+4=8	13.5 "	Parturition stage.
15-12-1943	24"	6+2=8	9.3 "	Advanced pregnancy. - The abortive compartments of the left uterus were infected with a species of flat-worms.
20-12-1943	18"			Pre-pregnant condition. Ovaries full of ripe ova.
20-12-1943	22.5"	7+7=14	9.6 cm.	Advanced pregnancy.
20-12-1943	22"	7+6=13	1.5 "	Very early pregnancy.
30-12-1943	26"	6+3=9	13.5 "	Parturition stage. Three compartments in the left uterus were abortive though showing a complete tropho-nema formation.
31-12-1943	20"			Post-pregnant condition.
1-1-1944	25.75"	6+6=12	11.8 cm.	Advanced pregnancy.
6-1-1944	23.5"			Post-pregnant condition.
6-1-1944	21.5"	6+2=8	Intrauterine eggs.	Very early pregnancy.
6-1-1944	23"	6+6=12	0.08 cm.	Very early pregnancy.

List of adult females in pregnant and post-pregnant stages collected from Bombay from April '42 to May '44—contd.

Date of capture.	Length of parent female.	Total No. of embryos.	Average length of embryos.	Remarks.
20-1-1944	21.5"	6+6=12	2.5 cm.	Early pregnancy. The right uterus had seven compartments but one of them was abortive. It contained, however, a complete trophomenema.
20-1-1944	20"	4+4=8	2.3 ,	Early pregnancy.
20-1-1944	22"	6+6=12	Intrauterine eggs.	Very early pregnancy.
20-1-1944	19"	5+5=10	0.4 cm.	Very early pregnancy.
27-1-1944	22.5"			Post-pregnant condition.
28-1-1944	19"			Post-pregnant condition.
1-2-1944	25"			Post-pregnant condition.
1-2-1944	25"	6+6=12	Intrauterine eggs.	Very early pregnancy.
1-2-1944	25.5"	5+4=9	14 cm.	Parturition stage.
28-2-1944	22"			Post-pregnant condition.
28-2-1944	23"	7+7=14	Intrauterine eggs	Very early pregnancy.
28-2-1944	25"	6+6=12	1.1 cm.	Very early pregnancy.
28-2-1944	23"	7+7=14	Intrauterine eggs.	Very early pregnancy.
28-2-1944	22"	8+8=16	,,	Very early pregnancy.
28-2-1944	25"	0+5=5	2.5 cm.	Early pregnancy. The right uterus was in an unhealthy state. It nevertheless contained five compartments three of which contained empty shell-sacs and two abortive ova.
29-2-1944	25"			Post-pregnant condition.
1-3-1944	21"			Post-pregnant condition.
2-3-1944	22"	2+3=5	2.8 cm.	Early pregnancy.
2-3-1944	19"	7+7=14	Intrauterine eggs.	Very early pregnancy.
2-3-1944	21"	1+1=2	17.5 cm.	Advanced pregnancy. Abnormally big fetuses.
6-3-1944	22.5"	7+7=14	Intrauterine eggs.	Very early pregnancy.
6-3-1944	22"	4+4=8	6.1 cm.	Intermediate pregnancy.
6-3-1944	23"	6+6=12	2.8 ,,	Early pregnancy.
11-4-1944	21"	4+4=8	7.5 ,,	Intermediate pregnancy.

List of adult females in pregnant and post-pregnant stages collected from Bombay from April '42 to May '44—concl'd.

Date of capture.	Length of parent female.	Total No. of embryos.	Average length of embryos.	Remarks.
11-4-1944	23.5"	8+8=16	9 cm.	Advanced pregnancy.
13-4-1944	25"	9+9=18	12 "	Advanced pregnancy.
13-4-1944	19"	8+8=16	5.1 "	Intermediate pregnancy.
13-4-1944	23"	12+10=22	4 "	Early pregnancy.
11-5-1944	21.5"	5+0=5	16 "	Parturition stage. The left uterus was empty and had been evacuated sometime back. The placental cords of the young ones in the right uterus were shed in the compartments and the umbilical scars were fresh.
15-5-1944	20.5"	5+5=10	12 cm.	Advanced pregnancy.
17-5-1944	21.5"	6+0=6	Intrauterine eggs.	Very early pregnancy.
17-5-1944	23"	6+6=12	"	Very early pregnancy.
17-5-1944	22.5"			Post-pregnant condition.
18-5-1944	17.5"	6+6=12	0.1 cm.	Very early pregnancy. It is just at this stage that the shell membrane sacs are disintegrated and embryos lie naked in the uterine compartments. There is no formation of a trophonema yet.
18-5-1944	19"	4+4=8	4.8 cm.	Intermediate pregnancy.

SUMMARY.

A scrutiny of the foregoing account and table brings out the following points about the breeding season and breeding habits of the species :—

- (i) The species breeds throughout the year. The peak period of parturition appears, however, to be in November, December and January, for, in the early months of the year, females are in early stages of pregnancy,
- (ii) Females mature when they are about 17" long. The maximum length of the species in the Bombay waters appears to be about 26".
- (iii) Both the ovaries are present and functional. The mature egg is extremely small in size, about a millimetre in diameter and contains very little, colourless, granular yolk.
- (iv) Fertilized eggs descend into the uterus enclosed in delicate shell-membrane sacs. These sacs disintegrate at a very early stage of embryonic development (1 mm-stage) and for the most part of the existence, the embryos lie naked in the compartments, but profusely covered with nutritive uterine secretions.

- (v) As a rule the number of embryos born is 14, 7 from each uterus. The maximum number of embryos borne by a single uterus is twelve. The sexes are distinguished externally when the embryos are about 40 mm. long.
- (vi) The young ones measure from 130 mm. to 150 mm. in total length at birth. Their placental cords are shed shortly before birth.
- (vii) All the compartments of a uterus do not necessarily contain developing embryos, some of them being found to contain abortive trophonemata only. It is possible that either the embryos of these compartments have undergone very early abortive degeneration or that the actual presence of embryos is not necessary for the formation of trophonemata, the pregnancy (fertilization) stimulus being enough to cause their formation even in the maiden compartments (hormonic action ?)
- (viii) The conditions of embryonic alimentation are highly histotrophic and only slightly haemotrophic. The placenta formed is of the *Haemio-epithelio-chorial* variety.

BIBLIOGRAPHY.

- AIYAR, R. G. & NALINI, K. P., 1938.—Observations on the reproductive system, egg-case, embryos and breeding habits of *Chiloscyllium griseum*, Muller & Henle. *Proc. Indian Acad. Sci. (B)*, VII, pp. 252-269.
- BALFOUR, F. M., 1885.—*A Treatise on Comparative Embryology* II, 2nd Ed., Macmillan & Co.
- BEARD, J., 1896.—The Yolk-sac, yolk and merocytes in Scyllium and Lepidosteus, *Anat. Ans. Bd.* 12.
- BRINKMANN, M. C. A., 1903.—Histologie, Histogenese Und Bedeutung der mucosa uteri einiger-viviparer Haie und Rochen. *Mitt. Zool. Stat. Neapel*. Vol. XVI.
- *CHOODAMANI, N. V., 1941.—On the smallest (?) Elasmobranch egg. *Proc. 28th Indian Sci. Congr.*, Benares.
- FORD, E., 1921.—A contribution to our knowledge of the life-histories of the dog fishes landed at Plymouth. *J. Mar. biol. Ass. U. K.*, XII, pp. 468-506.
- GOODRICH, E. S., 1930.—*Studies on the Structure and Development of Vertebrates*. Macmillan & Co., Ltd., London.
- HOWELL, W. H., 1933.—*A Text Book of Physiology*. W. B. Saunders Company, Philadelphia and London.
- KERR, J. G., 1919.—*Text-book of Embryology*, Vol. II, Macmillan and Company, Ltd., London.
- *MAHADEVAN, G., 1940.—Preliminary observations on the structure of the uterus and the placenta of a few Indian elasmobranchs. *Proc. Indian Acad. Sci.* XI, pp. 1-44.
- MARSHALL, F. H. A., 1922.—*Physiology of Reproduction*. 2nd Ed. Longman's Green & Co.
- NALINI, K. P., 1940.—Structure and function of the nidamental gland of *Chiloscyllium griseum* (M. and H.). *Proc. Indian Acad. Sci.* 12, pp. 189-214.
- NEEDHAM, J., 1931.—*Chemical Embryology*. Vol. 3, Cambridge.
- NORMAN, J. R., 1931.—*History of Fishes*, London.

1948.] SETNA & SARANGDHAR : *Shark Scoliodon Sorrakowah (Cuvier)*. 53

PRASAD, R. R., 1942.—Preliminary observations on the nidamental glands of some elasmobranch fishes of the Madras Coast. *Proc. 29th Indian Sci. Congr.* Baroda.

RAU, S. A., 1941.—Some aspects of Mammalian Placenta. *Proc. 28th Indian Sci. Congr.*, Banaras.

ROGERS, C. G., 1938.—*Text book of Comparative Physiology*. 2nd Edition McGraw, Hill Book Co.

*SEDGWICK, A., 1892.—Notes on Elasmobranch development. *Quart. J. micr. Sci.* XXXIII.

*SOUTHWELL, T. & PRASHAD B., 1919.—Embryological and developmental studies of Indian fishes. *Rec. Ind. Mus.* XVI, pp. 216-240.

WHITLEY, G. P., 1940.—*The fishes of Australia, Part I*. Roy. Zool. Soc., New S. Wales.

WIDAKOWICH, V., 1907.—Über den Uterus von *Squalus acanthias*. *Z. wiss. Zool.*, LXXXVIII, pp. 403-544.

* These references have been quoted in the text.

SYSTEMATIC POSITION OF THREE GLYPTOSTERNOID FISHES DESCRIBED BY HAMILTON.

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(Plate II)

Of the 49 species of Catfishes described by Hamilton¹ in his "Gangetic Fishes", three have doubtfully been assigned by later workers to *Glyptothorax* Blyth, viz., *Pimelodus telchitta* from Bengal and Bihar (p. 185), *P. botius* from Northern Bengal (p. 192) and *P. cavia* from Northern Bengal (p. 188). It is most surprising that Hamilton, very keen observer as he was, did not notice the well-marked, plaited, adhesive apparatus on the chest region of these species. His descriptions were published without any figures and he did not preserve any specimens. In view of these handicaps, the specific limits of these species have not been well defined and it is the object of this note to elucidate their taxonomic position.

Pimelodus telchitta was doubtfully referred by Günther² to *Glyptosternum* in a foot-note with the remark that "The unpublished drawing shows 11 rays, and all the barbels shorter than the head." This M. drawing was reproduced by one of us³ in 1929 but without any comments on the systematic position of the species. In 1871, Day⁴ redescribed this species but did not mention the locality of his specimens. Later in 1877, Day⁵ gave a description of the species with figure and noted its distribution as "Punjab, N. W. Provinces, Bengal and Bihar". The same description was repeated by him in his volume on Fishes in the *Fauna of British India* series (Vol. I, p. 199; 1889). In 1923, one of us⁶ recognised *G. telchitta* in the sense in which Day had applied it and for lack of sufficient material he did not make any further comments on the taxonomy of the species. Fortunately, a considerable amount of fresh material has now become available in the collection of the Zoological Survey of India from North-east Bengal, Bihar and U. P. and it is, therefore, possible to define this species with a fair degree of accuracy.

A careful analysis of Hamilton's description of *Pimelodus botius* and its comparison with that of *P. telchitta* shows that the two species do not differ from each other in any fundamental character. The following table gives the characteristic features of the two species as described by Hamilton :—

Pimelodus telchitta.

Pimelodus botius.

- | | |
|--|--|
| 1. Caudal fin divided into two nearly equal lobes. | Caudal fin divided into two equal lobes. |
| 2. Opaque, rough reddish body, having on each side one faint stripe. | Opaque, brownish, scabrous body. |

¹ Hamilton, F., *An Account of the Fishes found in the River Ganges and its branches* (Edinburgh: 1822).

² Günther, A., *Cat. Fish. Brit. Mus.* V, p. 185 (1864).

³ Hora, S. L., *Mem. Ind. Mus.* pl. xxi, fig. 3 (1929).

⁴ Day, F., *Proc. Zool. Soc. London*, p. 288 (1871).

⁵ Day, F., *Fish. India*, p. 498, pl. cxvi, fig. 2 (1877).

⁶ Hora, S. L., *Rec. Ind. Mus.* XXV, p. 28 (1923).

Pimelodus telchitta.*Pimelodus botius*.

- | | |
|---|--|
| 3. A. 13 ; D. 8. | A. 11 ; D. 6. |
| 4. Long in <i>proportion</i> to its breadth, tapers gradually to the tail, and is scarcely compressed at the sides. | Long in <i>proportion</i> to its breadth, sharp at both ends, and scarcely compressed. |
| 5. Head small, oval and sharpish ; covered with bony plates. | Head small, oval, rather blunt ; covered with a very rough thick skin. |
| 6. All tendrils shorter than head. | All tendrils shorter than head. |
| 7. Mouth placed under and behind extremity of nose. | Mouth below and behind the extremity of nose. |
| 8. Lips fleshy ; teeth not visible. | Lips fleshy ; no teeth. |
| 9. Nostrils nearer the jaw than eye. | Nostrils nearer the jaw than eye. |
| 10. There is no slit under the throat. | There is no slit under the throat. |
| 11. Vent rather behind the middle. | Vent near middle of body. |
| 12. Dorsal spine smooth and pectoral indented behind. | Dorsal spine smooth and pectoral indented behind. |

Day, who regarded the two species as valid, recognised them on the following characters :

Glyptosternum botia, A. 11-12. Pupil of eyes transversely oval. Maxillary barbels reach to below the hind edge of the eye. Skin roughened with small spinate tuberosities. Jumna and rivers of Northern Bengal.

Glyptosternum telchitta, A. 11. Pupil of eyes circular. Maxillary barbels reach to below the hind edge of eyes. Skin looks as if it had scales embedded in it. Punjab, N. W. Provinces, Bengal and Behar.

We have examined Day's originals of his figures in the *Fishes of India* and feel that they cannot be separated specifically. The texture of the skin depends on preservation and the form of the pupil is not a dependable character, especially as the eyes are subcutaneous and greatly reduced. In 1923, Hora (*loc. cit.*, p. 27) was able to recognise this species only in the sense in which Day had used the name. An examination of fresh material from various parts of the overlapping ranges of the two species shows that they are conspecific.

Considerable uncertainty has, however, prevailed with regard to Hamilton's *Pimelodus cavia*, for even Day only gave quotations from Hamilton's description in his *Fishes of India* and the "Fauna" volume. Hamilton discovered this species "in the northern rivers of Bengal" and remarked on its affinity to *Pimelodus cous* Lacépède. With these two clues, we hunted for this species among the records of fishes known from Northern Bengal and fixed up *Glyptothorax lineatus* Day) as the likely species. Day had found this species in the river Jumna (? Bengal) and at Suddya in Upper Assam. Shaw and Shebb are¹ found it in "Small rivers of the Terai (Sivoke River) and Duars (Ghish and Chel Rivers)" When the specimens were compared with Hamilton's description, there seemed no doubt that Day's *G. lineatus* must be regarded as identical with Hamilton's *G. cavia*. The form of the head and mouth are very characteristic of this species.

¹ Shaw, G. E. & Shebbeare, E. O., *Journ. Roy. As. Soc. Bengal. Science*, III, p. 102, 1937 (1938).

An examination of the entire material of *Glyptothorax* has further shown that *G. cavia* also embraces *G. burmanicus* Prashad & Mukerji¹ from the Myitkyina District in Burma. It will thus be seen that Hamilton's *G. cavia* is not only found in Northern Bengal (type locality), but in Assam and Burma as well. We propose to give below full descriptions of *G. telchitta* and *G. cavia* in the light of the above discussion.

***Glyptothorax telchitta* (Hamilton).**

(Plate II, figs. 1-3.)

- 1822 *Pimelodus telchitta*, Hamilton, *Gangetic Fishes*, pp. 185, 378.
- 1822. *Pimelodus botius*, Hamilton, *Ibid.*, pp. 192, 378.
- 1871. *Glyptosternum telchitta*, Day, *Proc. Zool. Soc. London*, p. 228.
- 1877. *Glyptosternum telchitta*, Day, *Fish. India*, p. 498, pl. cxvi, fig. 2.
- 1877. *Glyptosternum botia*, Day, *Ibid.*, p. 497, pl. cxii, fig. 4.
- 1889. *Glyptosternum telchitta*, Day, *Faun. Brit. India*, Fish. I, p. 199.
- 1889. *Glyptosternum botium*, Day, *Ibid.*, p. 198.
- 1923. *Glyptothorax botia*, Hora, *Rec. Ind. Mus.* XXV, p. 27.
- 1923. *Glyptothorax telchitta*, Hora, *Ibid.*, p. 28.
- 1929. *Pimelodus telchitta*, Hora, *Mem. Ind. Mus.* IX, pl. xxi, fig. 3 (Hamilton's drawing published).
- 1939. *Glyptothorax botia*, Das, *Rec. Ind. Mus.* XLI, p. 448.

D. 1/6-7; A. 9-12; P. 1/7-9; V. 6, C. 16-18+.

Glyptothorax telchitta is a more or less spindle-shaped fish, being deepest at the region of the rayed dorsal fin. The dorsal profile rises gently from the tip of the snout to the base of the dorsal, thereafter sloping gradually to the base of the caudal fin. The ventral profile is less arched and gently convex as far as the origin of the pelvic fins and thereafter gradually rises to the base of the caudal fin. Both the head and the body are subcylindrical and stream-lined. The head is bluntly pointed anteriorly; its length is contained from 4.1 to 4.6 times in the standard length; its height at the occiput is contained from 1.3 to 1.6 times and its width 1.2 to 1.4 times in its length. The eyes are small and dorso-lateral in position; their diameter is contained from 10.0 to 11.7 times in the length of the head. The snout is almost equal to half the length of the head. The interorbital width is contained from 3.2 to 3.7 times in the width of the head. The mouth is inferior and horizontal; the width of its gape is almost equal to half the length of the snout; the lips are papillated and reflected round the corner. The teeth in the jaws are villiform; those in the upper jaw form a narrow, continuous band while in the lower jaw the band is interrupted in the middle. The nasal openings are close to the tip of the snout, and separated from it by a distance equal to the diameter of the eye. The nasal barbels are nearly as long as the distance between their bases; the maxillaries extend only upto the eyes; the outer mandibulars are almost half as long as the snout while the inner mandibulars are as long as the gape of the mouth. The gill-openings form spout-like, channelled structures on the ventral surface in front of the bases of the pectoral fins. The gill-membrane is flap-like near the upper angle of the opening.

¹Prashad, B. & Mukerji, D. D., *Rec. Ind. Mus.* XXXI, p. 184, fig. 5, pl. vii, fig. 3 (1929).

The depth of the body is contained from 5.5 to 6.9 times in the standard length. The caudal peduncle is 3.0 to 3.8 times as long as high. The dorsal fin commences midway between the tip of the snout and the adipose dorsal, its height is almost equal to the length of the snout. When the skin is removed from the spine, it is found to be smooth along both the edges. The pectoral spine is strong and broad; it is denticulated internally. The pectoral fin extends nearly to the middle of the base of the dorsal fin and is about equal to the head behind the base of the nasal barbels; it is separated from the pelvic by a considerable distance. The pelvic fins are usually longer than the dorsal spine and extend only up to the vent. There is a small anal papilla. The anal fin is situated opposite the adipose dorsal. The caudal fin is deeply forked and the lobes are more or less equal.

The adhesive apparatus on the chest is spindle-shaped without any central pit.

The colour in the preserved specimens is darkish brown on the dorsal, and lateral regions, being dirty-yellow below. The head and sides and the fins are mottled with dark spots. The anal, dorsal, caudal and paired fins are marked with spotted bands. The skin is rough with horny tubercles.

Glyptothorax telchitta is represented in the collection of the zoological Survey of India from the following localities :—

Register No.	Locality.	Donor or Collector.
F 81/2	Rihand Dam Site, Mirzapur Dt., U. P.	Drs. H. A. Hafiz & K. S. Misra.
F 10268/1	Jharahi R., Siripur, Saran Dt., Bihar.	Mr. M. Mackenzie.
F 10274/1	Siripur, Saran Dt., Bihar.	Do.
F 5374/1	Do.	Do.
F 13326/1	Damodar R. near Ramgarh town, Hazaribagh Dt., Bihar.	Dr. H. S. Rao.
F 6887/1	Mawai, Bara Banki, U. P.	Mr. M. M. Khan.
F 9735/1 } (Cat. 580) }	Birbhum, Bengal.	Museum Collector (A. S. B.).
F 11377/1	Rivers of Terai and Duars, N. Messrs. G. E. Shaw & E. O. Shebbeare. Bengal.	
1314	No locality.	Purchased from Dr. F. Day; Original of Day's pl. cxvi, fig. 2 (<i>G.</i> <i>telchitta</i>).
1488	"Jumna".	Purchased from Dr. F. Day; Original of Day's pl. cxiii, fig. 4 (<i>G.</i> <i>botium</i>).

Distribution.—United Provinces (Vindhyan Mountains), Bihar and Northern Bengal. Its record from the Punjab needs confirmation.

Measurements in millimetres

	F 81/2					F 10268/1	F 10274/1	F 5374/1	F 13326/1				F 6887/1	F 9735/1			F 11377/1		1314	1468
Standard length	85.5	63.2	68.5	69.0	49.5	64.5	61.3	61.2	44.3	34.0	42.5	37.0	45.2	60.0	52.8	36.0	63.0	67.5	68.0	76.4
Length of head	20.8	15.0	16.0	16.0	11.5	14.0	14.8	14.3	10.3	8.0	9.5	9.0	11.0	13.5	12.0	8.5	14.3	16.0	15.0	17.2
Height of head at occiput	13.5	10.0	11.0	11.0	7.8	10.7	9.8	9.9	6.5	5.0	6.2	5.4	7.0	9.0	8.0	5.4	9.5	9.8	11.0	10.4
Width of head	15.0	11.0	12.0	11.9	8.5	11.2	10.6	10.9	7.7	5.8	7.5	6.4	8.0	10.2	9.2	6.3	10.9	11.6	11.8	13.0
Length of snout	10.0	7.5	7.2	7.7	5.5	7.0	7.3	7.0	4.8	4.0	4.4	4.0	5.0	6.0	5.7	3.5	7.0	7.5	7.0	8.4
Diameter of eye	1.9	1.5	1.5	1.5	1.0	1.3	1.4	1.3	1.0	0.8	0.8	0.8	1.0	1.2	1.2	0.8	1.3	1.5	1.5	1.5
Interorbital width	4.0	3.2	3.2	3.2	2.6	3.3	3.0	3.3	2.3	1.6	2.2	2.0	2.3	3.0	2.8	1.8	3.3	3.2	3.0	4.0
Depth of body	14.5	11.0	12.8	12.2	8.0	11.6	10.0	10.2	7.2	5.0	6.8	5.3	7.2	9.0	8.0	5.2	10.8	11.0	10.0	12.0
Length of caudal peduncle	18.3	13.0	14.0	14.5	11.0	15.0	13.5	13.2	10.2	7.2	9.0	7.6	9.4	13.5	10.0	6.0	15.0	15.0	15.0	17.3
Least height of caudal peduncle.	5.0	3.8	4.0	4.0	2.8	4.5	4.2	4.0	3.0	2.2	3.0	2.5	3.0	4.0	3.0	2.0	3.2	3.2	3.4	4.0
Longest ray of dorsal	13.8	11.0	11.5	12.0	9.5	11.8	10.5	9.3	8.9	7.0	8.2	7.0	8.2	12.0	10.0	8.0	10.5	11.4	D	15.0
Length of dorsal spine	10.3	8.0	8.9	9.0	7.0	8.8	8.0	6.3	6.2	5.0	6.7	5.0	6.8	9.0	8.0	5.0	7.0	8.4	8.3	10.8
Length of pectoral	15.0	12.0	12.0	13.0	9.0	12.0	10.5	10.2	8.4	7.7	9.0	7.3	9.0	12.0	10.0	8.2	11.3	11.7	12.5	15.8
Length of pectoral spine	12.5	10.8	10.8	11.5	8.0	9.6	8.8	7.0	6.5	5.5	6.4	5.2	6.5	9.5	9.0	5.2	9.0	9.0	11.0	12.3
Length of pelvic	11.0	9.0	9.0	10.0	7.0	8.5	9.4	8.3	6.5	5.2	6.0	6.0	6.6	8.5	8.0	6.0	8.3	8.7	10.0	10.8
Longest ray of anal	13.3	11.4	11.5	12.0	9.0	11.5	11.4	10.0	9.0	7.3	8.3	7.0	10.0	11.8	11.0	7.5	11.0	11.2	D	14.9
Length of base of anal	13.5	11.0	11.8	11.5	8.7	9.7	9.6	9.8	8.0	6.0	6.3	6.0	8.8	11.0	8.5	6.2	11.0	10.8	10.5	12.0
Length of base of adipose dorsal.	10.0	6.8	7.0	8.0	5.5	6.8	5.8	7.0	5.2	4.2	5.0	4.6	7.0	6.5	6.5	5.0	7.0	8.6	6.5	8.2

Glyptothorax cavia (Hamilton).

(Plate II, figs. 4, 5.)

1322. *Pimelodus cavia*, Hamilton, *Gangetic Fishes*, pp. 188, 378.
 1877. *Euglyptosternum lineatum*, Day, *Fish. India*, p. 500, pl. cxvi, fig. 7.
 1889. *Euglyptosternum lineatum*, Day, *Faun. Brit. India*, Fish. I, p. 202, fig. 73.
 1923. *Glyptothorax lineatus*, Hora, *Rec. Ind. Mus.* XXV, pp. 9, 10, fig. 1a.
 1929. *Glyptothorax burmanicus*, Prashad & Mukerji, *Rec. Ind. Mus.* XXXI p. 184, fig. 5, pl. vii, fig. 3.

D. 1/6 ; A. 12 ; P. 1/9 ; V. 6 ; C. 18+.

In *Glyptothorax cavia*, the dorsal profile rises gently from the tip of the snout to the base of the dorsal fin and thereafter it slopes down gradually to the base of the caudal fin. The ventral profile is straight and horizontal as far as the anal fin and thereafter it rises gradually to the base of the caudal fin. Both the head and the body are broad and flattened. The head is broadly rounded anteriorly ; its length is contained from 3.5 to 3.6 times in the standard length ; its height at the occiput is contained nearly 2 times and its width 1.3 times in its length. The eyes are small and dorso-lateral in position ; their diameter is contained from 10.0 to 12.0 times in the length of the head. The snout is almost equal to half the length of the head. The interorbital width is contained from 3.2 to 3.7 times in the width of the head. The mouth is inferior, broad and horizontal ; the width of its gape is almost equal to the length of the snout ; the lips are papillated and reflected round the corner. The teeth in the jaws are villiform ; those in the upper jaw form a broad, continuous band while in the lower jaw the band is interrupted in the middle. The nasal openings are close to the tip of the snout, separated from it by a distance equal to the diameter of the eye. The nasal barbels are almost as long as the distance between their bases ; the maxillaries extend slightly beyond the base of the pectoral spine the outer mandibulars are as long as the postorbital part of the head while the inner mandibulars are as long as the nasals. The gill-openings form spout-like structures on the ventral surface in front of the bases of the pectoral fin. The gill-membrane is flap-like near the upper angle of the opening.

The depth of body is contained from 5.9 to 6.6 times in the standard length. The caudal peduncle is nearly two and a half times as long as high.

The dorsal fin commences midway between the tip of the snout and the adipose dorsal. In the two Indian specimens, its height is greater than the depth of body below it whereas in the Burmese example it is somewhat shorter. The dorsal spine is strong and almost equal to the head excluding the snout. When the skin is removed, it is found to be roughened along both edges. The pectoral spine is broad and strong ; it is denticulated internally. The pectoral fin almost extends to the end of the base of the dorsal fin and is equal to the head behind the base of the nasal barbel ; it is separated from the pelvic by a considerable distance. The pelvic fins are longer than the dorsal spine and extend beyond the vent but not as far as the base of the anal fin. There is a small anal papilla. The anal fin is situated opposite the adipose dorsal. The caudal fin is deeply forked with the lower lobe slightly the longer.

The adhesive apparatus on the chest is very characteristic ; it is incomplete posteriorly but surrounds a deep central pit which is probably capable of suctional action. The adhesive ridges show that the structure is very closely applied to the rocks and stones in rapid waters.

The colour in the preserved specimens is brown olivaceous above and dirty yellowish below. The sides and the dorsal surface are mottled with deep coloured spots and the bases of the fins are provided with dark bands. There are indications of spotted bands on the pectoral, pelvic, anal and caudal fins.

Glyptothorax cavia is represented in the collection of the Zoological Survey of India from the following localities :—

Register No.	Locality.	Donor or Collector.	Remarks.
1312	Jumna (? Bengal).	Purchased from Dr. F. Day.	Type of <i>G. lineatus</i> : Original of Day's pl. cxvi. fig. 7.
F 10877/1	Sankha R., Myitkyina Dt., U. Burma.	Dr. B. N. Chopra.	Type of <i>G. burmanicus</i> .
F 11375/1	Rivers below Darjeeling, Bengal.	Messrs. G. E. Shaw & E. O. Shebbeare.	

In discussing the relationships of *Glyptothorax burmanicus*, Prashad and Mukerji¹ referred to Hora's work on the revision of the genus *Glyptothorax*² but overlooked the fact that Day's *G. lineatus* had not been included in the key to the species on account of its characteristic band of teeth in the upper jaw.

Distribution.—Northern Bengal, Assam and Burma.

Measurements in millimetres.

	1312	F 10877/1	F 11375/1
Standard length	122.2	106.0	165.5
Length of head	33.9	29.5	46.5
Height of head at occiput	16.8	15.2	24.0
Width of head	26.0	22.5	37.5
Length of snout	17.6	14.5	23.0
Diameter of eye	2.8	2.5	4.5
Interorbital width	8.7	6.0	10.0
Depth of body	18.8	19.0	28.0
Length of caudal peduncle	7.8	7.5	11.5
Longest ray of dorsal	21.2	17.8	30.5
Length of dorsal spine	17.3	13.5	23.5
Length of pectoral	25.1	21.0	38.0
Length of pectoral spine	24.0	16.0	30.5
Length of pelvic	19.1	14.5	25.5
Longest ray of anal	20.1	19.5	32.5
Length of base of anal	14.7	13.2	23.0
Length of base of adipose dorsal	13.8	14.5	24.0

¹ Prashad, B. & Mukerji, D. D., *Rec. Ind. Mus.* XXXI, p. 185 (1929).

² Hora, S. L., *Rec. Ind. Mus.* XXV, pp. 8-30 (1923).

SYSTEMATIC POSITION OF SILUROIDS IN HAMILTON'S "GANGETIC FISHES."

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Since 1933, I have been engaged in a revision of the Siluroid fishes of India, Burma and Ceylon and have so far published notes on the genera *Amblyceps* Blyth,¹ *Akysis* Bleeker,² *Olyra* McClelland,³ *Wallago* Bleeker,⁴ *Heteropneustes* Müller,⁵ *Clarias* Gronovius,⁶ *Silurus* Linnaeus,⁷ *Callichrous* Hamilton,⁸ *Gagata* Bleeker,⁹ *Batasio* Blyth,¹⁰ *Silonopangasius* Hora,¹¹ *Pseudeutropius* Bleeker,¹² *Proeutropichthys* Hora,¹³ and *Ailia* Gray.¹⁴ In a series of articles on the 'Game Fishes of India', detailed revisions are given of the genera *Eutropichthys* Bleeker,¹⁵ *Clupisoma* Swainson¹⁶ *Silonia* Swainson,¹⁷ *Pangasias* Cuvier and Valenciennes,¹⁸ *Bagarius* Bleeker¹⁹ and *Wallagonia* Myers.²⁰

These studies were interrupted owing to my deputation for a period of 5 years to Bengal in May 1942 to organise a fisheries department there, but the earlier work had shown that great difficulty was experienced in elucidating the precise systematic position of some of the Siluroid fishes described by Hamilton²¹ in his monumental work "Gangetic Fishes." The circumstances under which this work was published could not but lead to insufficient characterization of a number of species which resulted in great confusion in later taxonomic works on Indian freshwater fishes. An aid to the study of

¹Hora, S. L., *Rec. Ind. Mus.* XXXV, pp. 607-621 (1933).

²Hora, S. L., *ibid.* XXXVIII, pp. 199-202 (1936).

³Hora, S. L., *ibid.* XXXVIII, pp. 202-207 (1936).

⁴Hora, S. L., *ibid.* XXXVIII, pp. 207-208 (1936).

⁵Hora, S. L., *ibid.* XXXVIII, pp. 208-209 (1936).

⁶Hora, S. L., *ibid.* XXXVII, pp. 347-351 (1936); XLIII, pp. 112-114 (1941).

⁷Hora, S. L., *ibid.* XXXVIII, pp. 351-356 (1936).

⁸Hora, S. L., *ibid.* XXXVIII, pp. 256-361 (1936).

⁹Hora, S. L., *ibid.* XLIII, pp. 9-27 (1941).

¹⁰Hora, S. L., *ibid.* XLIII, pp. 28-42 (1941).

¹¹Hora, S. L., *ibid.* XLIII, pp. 97-100 (1941).

¹²Hora, S. L., *ibid.* XLIII, pp. 100-105 (1941).

¹³Hora, S. L., *ibid.* XLIII, pp. 105-110 (1941).

¹⁴Hora, S. L., *ibid.* XLIII, pp. 110-112 (1941).

¹⁵Hora, S. L., *Journ. Bombay Nat. Hist. Soc.* XXXIX, pp. 431-446 (1937).

¹⁶Hora, S. L., *ibid.* XXXIX, pp. 659-678 (1937).

¹⁷Hora, S. L., *ibid.* XL, pp. 197-147 (1938).

¹⁸Hora, S. L., *ibid.* XL, pp. 355-366 (1938).

¹⁹Hora, S. L., *ibid.* XL, pp. 583-593 (1939).

²⁰Hora, S. L., *ibid.* XLI, pp. 64-71 (1939).

²¹Hamilton, F., *An Account of the Fishes found in the River Ganges and its branches* (Edinburgh: 1822).

Hamilton's "Gangetic Fishes" was published¹ to bring together all scattered data concerning this work in one place but no attempt was made to elucidate the systematic position of the various species described therein. The object of this note is to define the specific limits of the Siluroids in Hamilton's "Gangetic Fishes" and to give up-to-date references to literature in support of the views expressed herein. Indian species of some of the genera, such as *Arius* Cuvier & Valenciennes (= *Tachysurus* Lacépède), have not yet been revised but there appears to have been little or no confusion regarding their systematic position or specific limits.

I wish to record here my thanks to Dr. K. S. Misra in looking up records of distribution of various species and for putting up relevant literature connected therewith.

Of the 49 species of Cat-fishes (Siluroidea) described by Hamilton, 41 are found to be valid according to modern standards. The remaining eight were either based on deformities, such as *Macropteronotus jagur*, or on variations in colour, fin rays, etc., such as *Silurus pabda*, *S. canio*, *S. duda*, *S. chechra*, *Pimelodus chandramara*, *P. botius*, *P. urua*, etc. Of the 41 valid species, six have been relegated to the synonymy of earlier species, but it is worthy of note that Hamilton himself had pointed out the affinities of his species to earlier known forms. For example, in describing *Macropteronotus magur* (= *Clarias batrachus*), he observed :—

"This species, if it be distinct, has the utmost affinity to the *Macropteronotus batrachus* of La Cepede, (*Hist. des Poissons*, Tome V, page 84), or the *Silurus batrachus* of Bloch, (*Ichth.* Tome XI, page 34, Pl. CCCLXX, fig. 1). The fish, indeed, described by these authors differs from ours in the number of rays supporting its fins, but, owing to the thickness of the skin, no great reliance can be placed on the accuracy of this mark; and besides, these authors describe their fish as of an uniform brown colour, and state, that the prickles of each pectoral fin is strongly indented behind."

It will thus be seen that number of rays in the fins, colouration and nature of pectoral spines influenced Hamilton in separating his species from *Clarias batrachus*. I² have already shown the great variability of certain taxonomic characters in this species and it is no wonder that Hamilton attached some importance to them in those early days.

In the case of his *Silurus singio*, he observed :—

"This fish, if really different, is most nearly allied to the *Silurus fossilis* of Bloch, (*Ichth.* Tome XI, p. 36, Pl. CCCLX, fig. 2), and La Cepede, (*Hist. des Poissons*, Tome V, p. 74). Their fish is of a chocolate colour, its lateral lines ascend towards the shoulder; and the number of rays in its fins is somewhat different from that of the fish in Bengal. The most marked differences, however, to judge from the figure of Bloch, are, that he represents the prickles of the pectoral fins as slender, and without barbs."

¹Hora, S. L., *Mem. Ind. Mus.* IX, pp. 169-192 (1929).

²Hora, S. L., *Rec. Ind. Mus.* XXXVIII, pp. 347-351 (1936).

This shows how incomplete description and bad delineations of earlier species influenced him to propose new species.

Similarly he pointed out very strong resemblance of his *Silurus canio* to *S. bimaculatus* of Bloch ; of *S. boalis* to *Wallago* of Dr. Russell and of *Pimelodus urua* to *P. atherinoides* of Lacépède. All this shows that he was a very careful worker on the systematics of fishes.

According to our present-day knowledge, Hamilton's Siluroids can be arranged in the following systematic order :—

Classification of Siluroids in Hamilton's " Gangetic Fishes."

Family CLARIIDÆ.

1. *Clarias batrachus* (Linn.).

Family HETEROPNEUSTIDÆ.

2. *Heteropneustes fossilis* (Bl.).

Family SILURIDÆ.

3. *Ompok bimaculatus* (Bl.).

4. *Ompok pabo* (Ham.).

5. *Wallagonia attu* (Bl.).

Family CHACIDÆ.

6. *Chaca chaca* (Ham.).

Family PLOTOSIDÆ.

7. *Plotosus canius* (Ham.)

Family SCHILBEIDÆ.

8. *Ailia coila* (Ham.).

9. *Clupisoma garua* (Ham.).

10. *Eutropiichthys vacha* (Ham.).

11. *Eutropiichthys murius* (Ham.).

12. *Pseudeutropius atherinoides* (Bl.).

13. *Silonia silondia* (Ham.).

14. *Pangasius pangasius* (Ham.).

Family BAGRIDÆ.

15. *Batasio batasio* (Ham.).

16. *Batasio tengana* (Ham.).

17. *Mystus vittatus* (Ham.).

18. *Mystus gulio* (Ham.).

19. *Mystus menoda* (Ham.).

20. *Mystus cavasius* (Ham.).

21. *Mystus aor* (Ham.).

22. *Rama rama* (Ham.).

23. *Rita rita* (Ham.).

Family AMBLYCEPITIDÆ.

24. *Amblyceps mangois* (Ham.).

Family SISORIDÆ.

25. *Bagarius bagarius* (Ham)

26. *Gagata cenia* ((Ham.).

27. *Gagat gagata* (Ham.).

28. *Gagata viridescens* (Ham.).

29. *Gagata nangra* (Ham.).

30. *Glyptothorax telchitta* (Ham.).

31. *Glyptothorax caria* (Ham.).

32. *Erethistes* (?) *hara* (Ham.).

33. *Erethistes* (?) *conta* (Ham.).

34. *Sisor raddophorus* (Ham.)

Family TACHYSURIDÆ.

35. *Batrachcephalus mino* (Ham.)

36. *Tachysurus arius* (Ham.).

37. *Tachysurus gagora* (Ham.).

38. *Tachysurus jatius* (Ham.).

39. *Tachysurus nenga* (Ham.).

40. *Tachysurus sagor* (Ham.).

41. *Tachysurus sona* (Ham.).

Table showing Systematic Position of Siluroids in Hamilton's "Gangetic Fishes."

No.	Name and Reference in "Gangetic Fishes."	Locality and Local Name in "Gangetic Fishes."	Locality and Local Names in Original Notes.	Current Scientific Name and Reference.	Distribution.
1	<i>Platystacus chaca</i> , p. 140, pl. xxviii, fig. 43.	North-East Bengal; <i>Chaca</i> .	Fluviis et stagnis Bengala; <i>Chayka</i> .	<i>Chaca chaca</i> (Hamilton); Weber & de Beaufort, <i>Fish. Indo-Austral.</i> II, p. 246, fig. 99 (1913).	India, Burma, Malacca, Malay Peninsula, Banka, Borneo and Sumatra.
2	<i>Plotosus canius</i> , p. 142, pl. xv, fig. 44.	Southern Bengal; <i>Kani magur</i> .	Fluviis Bengala inferioris; <i>Kaanee Maagoor</i> .	<i>Plotosus canius</i> Hamilton; Weber & de Beaufort, <i>ibid.</i> II, p. 227.	Ceylon, India, Burma-Siam, Malaya and Indo-Australian Archipelago, Canton (China).
3	<i>Macropteronotus jagur</i> , p. 145.		Stagnis Bengala inferioris; <i>Jagur</i> Lukipura.	<i>Clarias batrachus</i> (Linnaeus); Hora, <i>Rec. Ind. Mus.</i> XXXVIII, p. 348 (1936).	Ceylon, India, Burma, Malaya, Dutch East Indies, Philippines, French Indo-China and Hongkong.
4	<i>Macropteronotus magur</i> , p. 146, pl. xxvi, fig. 45.	<i>Magur</i>	Stagnis et fopis Bengala inferioris in luto Post.	Ditto.	Ditto.
5	<i>Silurus singio</i> , p. 147, pl. xxvii, fig. 46.	<i>Singgi</i> ..	Stagnorum et fossarum luto; <i>Kamacha singgi</i> .	<i>Heteropneustes fossilis</i> (Bloch); Hora, <i>Rec. Ind. Mus.</i> XXXVIII, p. 208 (1936).	Ceylon, India, Burma, Siam and Indo-China.
6	<i>Silurus</i> (<i>Callichrous</i>) <i>pabda</i> , p. 150, pl. xxv, fig. 47.	Bengal; <i>Pabda</i> .	Fluviis et stagnis Bengala inferioris; <i>Paebdaa</i>	<i>Ompok bimaculatus</i> (Bloch); Hora, <i>Rec. Ind. Mus.</i> XXXVIII, pp. 356-361 (1936). Smith (<i>U. S. Nat. Mus. Bull.</i> CLXXXVIII, p. 337, 1945) has given valid reasons for replacing <i>Callichrous</i> by <i>Ompok</i> Lacépède.	Ceylon, India, Burma, Siam, Malaya, Java, Borneo, Sumatra, Chusan, Yunnan and the Yangtse-Kiang.

- | | | | | | |
|----|--|--|---|---|--|
| 7 | <i>Silurus</i> (<i>Callichrous</i>)
<i>canio</i> , p. 151. | North-east Bengal; <i>Kani</i>
<i>pabda</i> . | Goalpara; stagnis Ben-
gala orientalis. | Ditto. | Ditto. |
| 8 | <i>Silurus</i> (<i>Callichrous</i>)
<i>duda</i> , p. 152. | Kusi River; <i>Dudha</i>
<i>pabda</i> . | .. | Ditto. | Ditto. |
| 9 | <i>Silurus</i> (<i>Callichrous</i>)
<i>chechra</i> , p. 152. | Kusi River. | Mainayi. | <i>Ompok bimaculatus</i> (Bloch) | Oriental Region. |
| 10 | <i>Silurus</i> (<i>Callichrous</i>)
<i>pabo</i> , p. 153, pl. xxii,
fig. 48. | Brahmaputra River. | Goalpara. | <i>Ompok pabo</i> (Hamilton);
Hora, <i>Rec. Ind. Mus.</i>
XXXVIII, p. 361 (1936). | North-eastern India and
Burma. |
| 11 | <i>Silurus</i> (<i>Callichrous</i>)
<i>boalis</i> , p. 154, pl. xxix,
fig. 49. | India; <i>Boalis</i> . | Fluviis et stagnis Ben-
gala inferioris; <i>Boyal</i>
<i>Patanitala</i> , <i>Keyali</i>
and <i>Boaglee</i> . | <i>Wallagonia attu</i> (Bloch);
Hora, <i>Rec. Ind. Mus.</i>
XXXVIII, p. 361 (1936).
Myers (<i>Copeia</i> , p. 98, 1938)
proposed the generic name
<i>Wallagonia</i> for <i>W. leerii</i>
and its allies. | Ceylon, India, Burma,
Siam, Indo-China, Java,
Sumatra and Western
Yunnan. |
| 12 | <i>Silurus</i> (<i>Callichrous</i>)
<i>garua</i> , p. 156, pl. xxi,
fig. 50. | Gangetic Provinces;
<i>Garua</i> . | Fluviis Bengala; <i>Kocha</i>
(Tista). | <i>Clupiscma garu</i> (Hamilton);
Hora, <i>Journ. Bombay Nat.</i>
<i>Hist. Soc.</i> XXXIX,
p. 661 (1937). | Northern India. |
| 13 | <i>Malapterurus coila</i> , p.
158. | Bengal. | Fluviis aqua dulcis;
<i>Koila</i> , <i>Kajoli</i> <i>Kazali</i> . | <i>Ailia coila</i> (Hamilton); Hora,
<i>Rec. Ind. Mus.</i> XLIII,
pp. 110-112 (1941). | Northern India. |
| 14 | <i>Ageneiosus mino</i> , p. 159. | Upper part of estuaries . | Sundarbon; <i>Min</i> . | <i>Batrachoccephalus mino</i> (Hamil-
ton); Smith, <i>U. S. Nat.</i>
<i>Mus. Bull.</i> CLXXXVIII, p.
404, fig. 90 (1945). | India, Burma, Siam,
Java, Borneo, Sumatra
and Canton. |
| 15 | <i>Pimelodus silondia</i> , p.
160, pl. vii, fig. 50. | Gangetic Estuaries. | Goyalpara Lukeपुरा;
<i>Selon</i> , <i>Silondya vacha</i> . | <i>Silonia silondia</i> (Hamilton);
Hora, <i>Journ. Bombay</i>
<i>Nat. Hist. Soc.</i> XL, pp. 137-
147 (1938). | Northern India and
Burma, according to
Day. |

Table showing Systematic Position of Siluroids in Hamilton's "Gangetic Fishes"—contd.

No.	Name and Reference in "Gangetic Fishes."	Locality and Local Name in "Gangetic Fishes."	Locality and Local Names in Original Notes.	Current Scientific Name and Reference.	Distribution.
16	<i>Pimelodus chandramara</i> , p. 162.	Atreyi River.	Fluvis Attrei; <i>Chang-daramara</i> .	<i>Ramarama</i> (Hamilton); Hora & Law, <i>Rec. Ind. Mus.</i> XLIII, pp. 31, 32 (1941).	Northern Bihar and Assam.
17	<i>Pimelodus pangasius</i> , p. 163, pl. xxxiii, fig. 52.	Estuaries of Bengal.	Fluvisis Bengala inferioris; <i>Pangass</i> .	<i>Pangasius pangasius</i> (Hamilton); Hora, <i>Journ. Bombay Nat. Hist. Soc.</i> XL, pp. 355-366 (1938).	India, Burma, Siam, Malaya Peninsula and Java.
18	<i>Pimelodus rita</i> , p. 165, pl. xxiv, fig. 53.	Estuaries of Bengal.	Fluviis Bengala inferioris; <i>Reeta</i> .	<i>Rita rita</i> (Hamilton); Day, <i>Fish. India</i> , p. 454 (1877).	Northern India and Burma.
19	<i>Pimelodus gagora</i> , p. 167, pl. x, fig. 54.	Estuaries of Bengal.	Ostiis Gangeticus; <i>Gaag-ora</i> , <i>Locra</i> .	<i>Tachysurus</i> ¹ <i>gagora</i> (Hamilton); Smith, <i>U. S. Nat. Mus. Bull.</i> CLXXXVIII, p. 409 (1945).	Orissa, Bengal, Burma and Siam.
20	<i>Pimelodus sagor</i> , p. 169	Estuaries of Bengal.	Ostiis Gangeticus; <i>Sagor</i> .	<i>Tachysurus sagor</i> (Hamilton); Smith, <i>ibid.</i> p. 413 (1945).	India, Burma, Malaya, Malay Archipelgo and Siam.
21	<i>Pimelodus arius</i> , p. 170.	Estuaries of Bengal. <i>Ari gagora</i> .	Ostiis Gangeticus; <i>Aree Gagora</i> .	<i>Tachysurus arius</i> (Hamilton); Day, <i>Fish. India</i> , p. 463 (1877). Described as <i>Arius jatus</i> (Hamilton).	Bengal and Burma, according to Day.
22	<i>Pimelodus jatus</i> , p. 171.	Estuaries of Bengal; <i>Jat gagora</i> .	Ostiis Gangeticus.	<i>Hemipimelodus jatus</i> (Hamilton); Day, <i>ibid.</i> p. 466 (1877). Described as <i>Arius jatus</i> (Hamilton).	Orissa, Bengal and Burma.

23	<i>Pimelodus nenga</i> , p. 171.	Estuaries of Bengal; <i>Nenga gagora</i> .	Ostiis Gangeticus.	<i>Tachysurus nenga</i> (Hamilton); Day, <i>ibid.</i> p. 358 (1877). Described as <i>Arius nenga</i> (Hamilton).	Bengal.
24	<i>Pimelodus sona</i> , p. 172.	Estuaries of Bengal.	Ostiis Gangeticus; <i>Sona gagora</i> .	<i>Tachysurus sona</i> (Hamilton); Day, <i>ibid.</i> p. 462 (1877). Described as <i>Arius sona</i> (Hamilton).	Bengal.
25	<i>Pimelodus viridescens</i> , p. 173, pl. xi, fig. 56.	Northern Bengal.	Fluviis Kamrupa borealis; <i>Kenya-tenggara</i> .	<i>Gagata viridescens</i> (Hamilton); Hora & Law, <i>Rec. Ind. Mus.</i> XLIII, p. 24 (1941).	Santal Parganas, Northern Bengal and Assam.
26	<i>Pimelodus cenia</i> , p. 174, pl. xxxi, fig. 56.	Northern Bengal.	Fluviis Bengala borealis; <i>Ram Tayngra, Kengga, Kaia; Keingya</i> .	<i>Gagata cenia</i> (Hamilton); Hora & Law, <i>ibid.</i> p. 21 (1941).	Northern India from Punjab to Assam.
27	<i>Pimelodus rama</i> , p. 176, pl. iii, fig. 55.	Brahmaputra River.		<i>Rama rama</i> (Hamilton); Hora & Law, <i>ibid.</i> pp. 31, 32 (1941). No. 16 of this list is a synonym of this species.	Northern Bihar and Assam.
28	<i>Pimelodus tengana</i> , p. 176, pl. xxxix, fig. 58.	Brahmaputra River.	Gualpara; <i>Tenggara</i> .	<i>Batasio tengana</i> (Hamilton); Hora & Law, <i>ibid.</i> p. 36 (1941).	Bengal, Assam, Tenasserim, Mergui and Perak.
29	<i>Pimelodus urua</i> , p. 177.	Northern Bengal.	Dinajpura, Gualpora; <i>Uruya, Badadaha</i> .	<i>Pseudeutropius atherinoides</i> (Bloch); Hora, <i>Rec. Ind. Mus.</i> XLIII, p. 103 (1941).	Throughout India, excluding Western Coast.
30	<i>Pimelodus batasio</i> , p. 179, pl. xxiii, fig. 60.	Tista River.	Jalpegory; <i>Batasi tenggora</i> .	<i>Batasio batasio</i> (Hamilton); Hora & Law, <i>Rec. Ind. Mus.</i> XLIII, p. 33 (1941).	Tista River System, Northern Bengal.
31	<i>Pimelodus angius</i> , p. 180, pl. xxix, fig. 59.	Bengal.	Fluviis orientallibus Bengala; <i>Angii, Doya, Bangs-patari</i> .	<i>Pseudeutropius atherinoides</i> (Bloch); Hora, <i>Rec. Ind. Mus.</i> XLIII, p. 130 (1941).	Throughout India, excluding Western Coast.

' No up-to-date revision of the Indian species of the genus *Tachysurus* is available, so the species are here given as recognised by Day.

Table showing Systematic Position of Siluroids in Hamilton's "Gangetic Fishes"—contd.

No.	Name and Reference in "Gangetic Fishes."	Locality and Local Name in "Gangetic Fishes."	Locality and Local Names in Original Notes.	Current Scientific Name and Reference.	Distribution.
32	<i>Pimelodus carcio</i> , p. 181, p. xxiii, fig. 60.	Northern Bengal.	Stagnis Bengala Borealis, <i>Kurki Tayngra</i> .	<i>Mystus vittatus</i> (Bloch); Day, <i>Fish. India</i> , p. 448 (1877). Described as <i>Macrones vittatus</i> (Bloch).	Ceylon, India, Burma and Siam.
33	<i>Pimelodustengara</i> , p. 183, pl. iii, fig. 61.	India.	Stagnis Bengala inferioris; <i>Tenggara, Mosa</i> .	Ditto.	Ditto.
34	<i>Pimelodustelchitta</i> , p. 185.	Bengal and Behar.	Jungipur, Nathpur; <i>Telchitta</i> .	<i>Glyptothorax telchitta</i> (Hamilton). Hora & Menon, <i>Rec. Ind. Mus.</i> XLVI, p. 57 (1948).	Hills of the U. P., Bihar and Bengal.
35	<i>Pimelodus bagarius</i> , p. 186, pl. vii, fig. 62.	Vaghari.	Fluviis Calcutta; <i>Bagari</i> .	<i>Bagarius bagarius</i> (Hamilton); Hora, <i>Journ. Bombay Nat. Hist. Soc.</i> XL, p. 853-593 (1939).	India, Burma, Siam, Malay Archipelago and Tonkin, China.
36	<i>Pimelodus cavia</i> , p. 188.	Northern Bengal.	Patgong; <i>Kavyateng-gara</i> .	<i>Glyptothorax cavia</i> (Hamilton) Hora & Menon, <i>Rec. Ind. Mus.</i> XLVI, p. 60 (1948).	North-eastern Bengal and Assam.
37	<i>Pimelodus hara</i> , p. 190.	River Kosi.	Nathpur.	This and the following species have been referred by various authors to the genus <i>Erethistes</i> Müll. & Trosch., which appears to be a composite genus. A revision of these and allied fishes will be published later.	Ditto.

- 38 *Pimelodus conta*, p. 191. Mahananda River. Sanashygotta; *Khongta*. Though the precise generic position of this species cannot be given here in view of what is stated above under No. 37, there seems no doubt that Day's *Erethistes elongatus* represents this species and his *E. conta* is probably Hamilton's *P. hara*.
- 39 *Pimelodus botius*, p. 192 Northern Bengal Pargong, fluviis Kamrupa borealis; *Bhot magur*. *Glythorax telchitta* (Hamilton). Hora & Menon, *Rec. Ind. Mus.* XLVI, p. 57 (1948). Same as No. 34 above.
- 40 *Pimelodus nangra*, p. 193, Kosi River. Nathpur. *Gagata nangra* (Hamilton); Hora & Law, *Rec. Ind. Mus.* XLIII, p. 27 (1941). Hill rivers of northern India.
- 41 *Pimelodus marius*, p. 195. Mahananda River; *Muri vacha*. Bolahat; *Muri bacha*. *Eutropiichthys marius* (Hamilton); Hora, *Journ. Bombay Nat. Hist. Soc.* XXXIX, p. 435 (1937). Rivers of northern India.
- 42 *Pimelodus vacha*, p. 196, Gangetic Provinces. pl. xix, fig. 64. Fluviis Bengala; *Vacha Kaa, Ungun*. *Eutropiichthys vacha* (Hamilton); Northern India, Burma and Siam. The Burmese and Siamese forms may be different. Hora, *Journ. Bombay Nat. Hist. Soc.* XXXIX, pp. 431-446 (1937).
- 43 *Pimelodus gagata*, p. 196 Rivers. and estuaries of Bengal. Chaampagaree; *Go-ungraa, Gagata*. *Gagata gagata* (Hamilton); Ganges, Brahmaputra and Irrawadi river systems. Hora & Law, *Rec. Ind. Mus.* XLIII, p. 15 (1941).
- 44 *Pimelodus mangois*, p. 199. Northern Benar; *Mang-goi*. Nathpur. *Amblyceps mangois* (Hamilton); Hora, *Rec. Ind. Mus.* XXXV, p. 617 (1933). Himalayas, Assam Hills, Satpurās, Burma, Malay Peninsula and Siam.

Table showing Systematic Position of Siluroids in Hamilton's "Gangetic Fishes"—contd.

No.	Name and Reference in "Gangetic Fishes"	Locality and Local Name in "Gangetic Fishes."	Locality and Local Names in Original Notes.	Current Scientific Name and Reference.	Distribution.
45	<i>Pimelodus gilio</i> , p. 201, pl. xxiii, fig. 66.	Gangetic Guli.	estuaries; Goolee, Noona Tyangra.	<i>Mystus</i> ¹ <i>gilio</i> (Hamilton; Smith, <i>U. S. Nat. Mus. Bull.</i> CLXXXVIII, p. 384 (1945).	Ceylon, India, Burma, Siam, Malay Peninsula, Mudoera, Java, Borneo and Sumatra.
46	<i>Pimelodus menoda</i> , p. 203, pl. i, fig. 72.	Northern Bengal.	Bihar and Bolahat; Menod, Gagor.	<i>Mystus menoda</i> (Hamilton); Chaudhuri, <i>Rec. Ind. Mus.</i> VII, p. 210 (1912). Described as <i>Macrones menoda</i> .	Orissa, Bihar, Bengal and Assam.]
47	<i>Pimelodus cavasius</i> , p. 203, pl. xi, fig. 67.	Gangetic tenggara.	Provinces; Fluvio Attarei, Kavasi Tenggora.	<i>Mystus carasius</i> (Hamilton); Smith, <i>U. S. Nat. Mus. Bull.</i> CLXXXVIII, p. 389 (1945).	India, Burma, Siam, Malaya, Java, Borneo, Sumatra, Chusan, Yunnan and the Yangtse-Kiang.
48	<i>Pimelodus aor</i> , p. 205, pl. xx, fig. 68.	Rivers of Bengal and upper parts of Gangetic estuaries, Aor.		<i>Mystus aor</i> (Hamilton); Prashad and Mukerji, <i>Rec. Ind. Mus.</i> XXXI, 178 (1929), Described as <i>Aoria aor</i> .	Sind, U.P., Bihar., C.P., Bengal, Mahanadi river, (Orissa), Coorg State, Indawpgi Lake, U. Burma.
49	<i>Sisor rabdophorus</i> p. 208.	Northern rivers of Bengal and Behar.		<i>Sisor rabdophorus</i> Hamilton, Shaw and Shebbeare, <i>Journ. Roy. As. Soc. Bengal. Sci.</i> III., p. 107 (1937).	Indus, Ganges and Jumna in Northern India, Bengal and Bihar, according to Day. Mukerji obtained a specimen form near Siliguri.

¹ No up-to-date revision of the Indian species of the genus *Mystus* is available, so the species are here given as recognised by Day under the genus *Macrones*.

EXPLANATION OF PLATE II.

Hamilton's Glyptosternoid Fishes.

Glyptothorax telchitta (Hamilton).

FIG. 1.—Lateral view $\times 1\frac{2}{3}$.

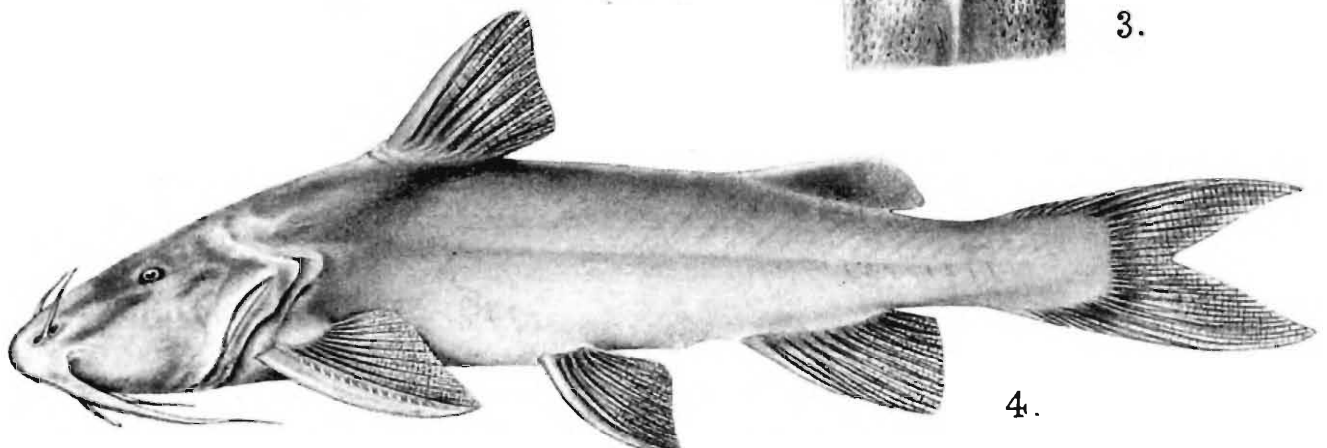
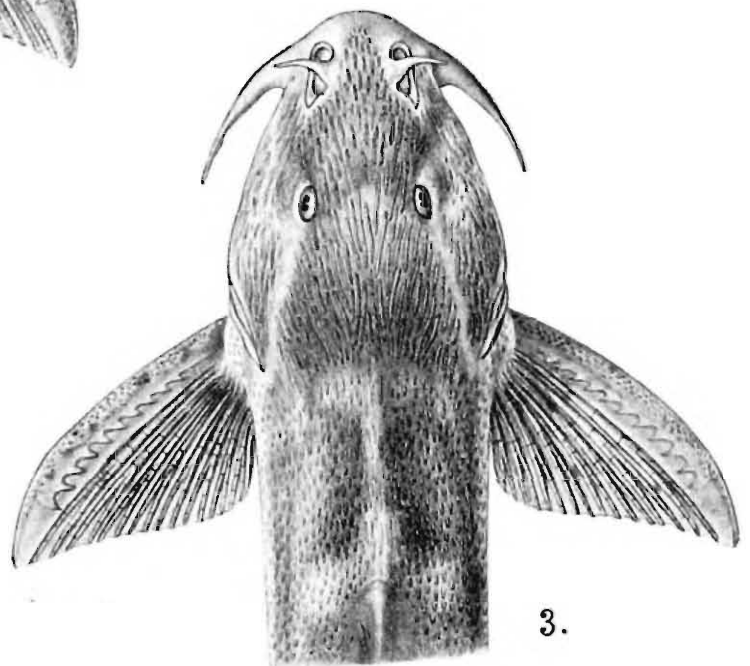
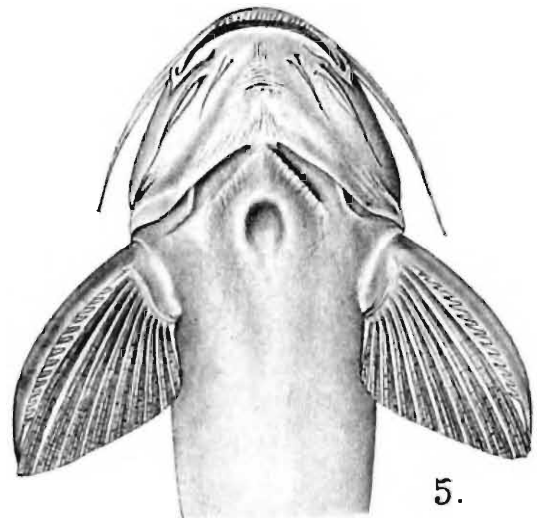
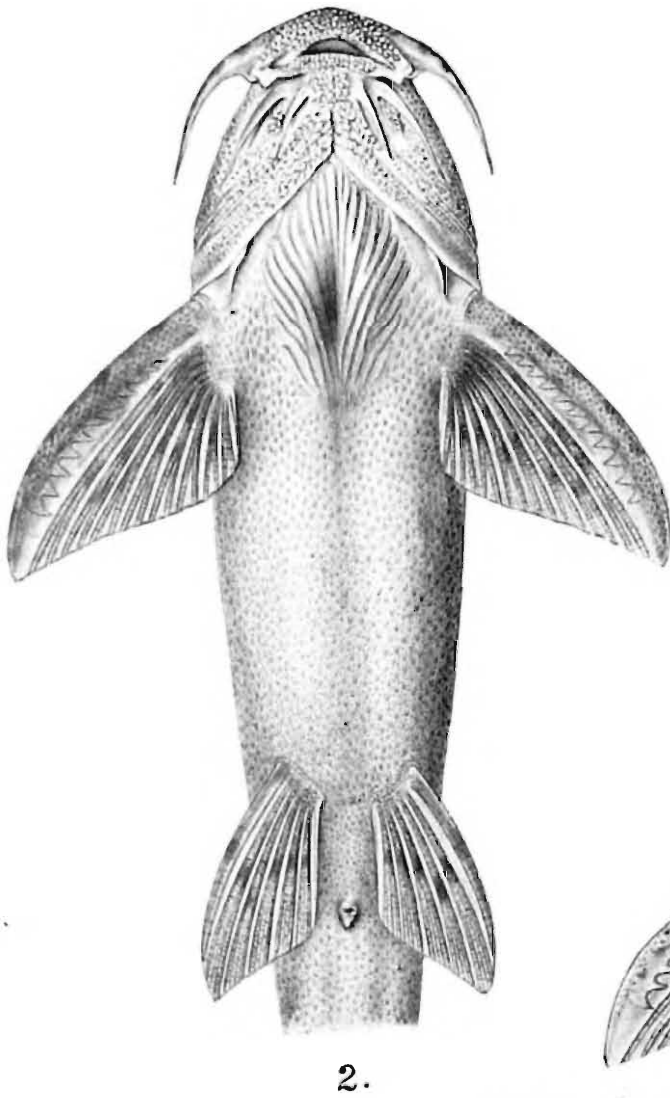
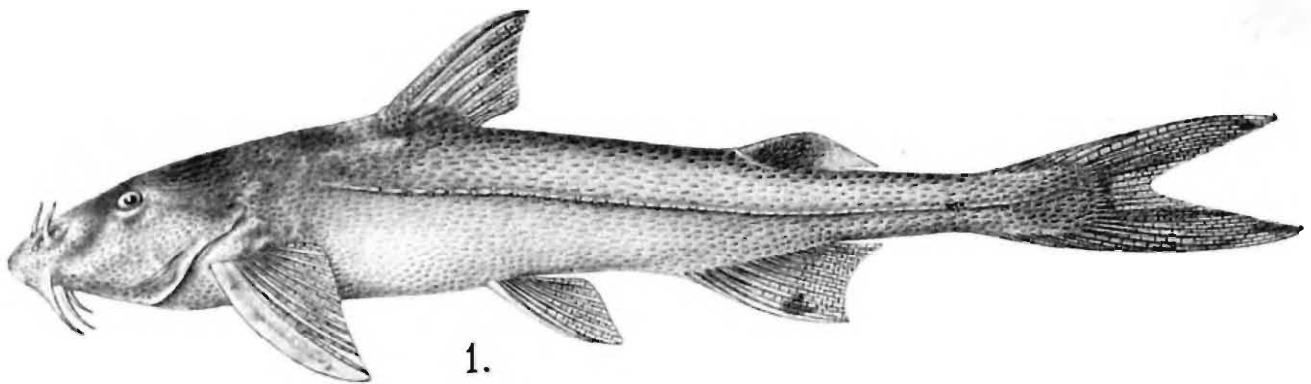
FIG. 2.—Ventral surface of head and body. $\times 2\frac{2}{3}$.

FIG. 3.—Dorsal surface of head and anterior part of body. $\times 3\frac{2}{3}$.

Glyptothorax cavia (Hamilton).

FIG. 4.—Lateral view $\times \frac{2}{3}$.

FIG. 5.—Ventral surface of head and anterior part of body $\times \frac{2}{3}$.



HAMILTON'S GLYPTOSTERNOID FISHES

ON THE HEAD CAPSULE, MOUTH-PARTS AND RELATED MUSCLES OF THE LARVA OF THE WOOLLY BEAR, *ANTHRENU S FASCIATUS* HERBST (COLEOPTERA, DERMESTIDAE).

By K. S. PRADHAN, M.Sc., Zoological Survey of India, Calcutta.

CONTENTS.

	PAGE.
Introduction	73
Material and Methods	74
Head capsule	74
Mouth-parts	76
Labrum-epipharynx	77
Mandibles	79
Maxillae	79
Labium	81
Hypopharynx	81
Musculature of the mouth-parts	82
Labral muscles	82
Mandibular muscles	83
Maxillary muscles	83
Labial muscles	84
Hypopharyngeal muscles	85
Summary	86
Acknowledgments	86
References	86

INTRODUCTION.

The investigation on the mouth parts of the larva of *Anthrenus fasciatus* Herbst. was taken up with a view to studying in detail the structure of these appendages and the glands, if any, associated with them that help in softening the food which is composed of highly resistant skeletal proteins (wool). Carpenter and Mac Dowell (1912) described the mouth-parts of some beetle larvae belonging to the families Dascillidae and Scarabaeidae. Anderson (1936) gave a comparative account of the labium of Coleopterous larvae and came to the conclusion that the prementum is very often subdivided into a first and a second prementum.

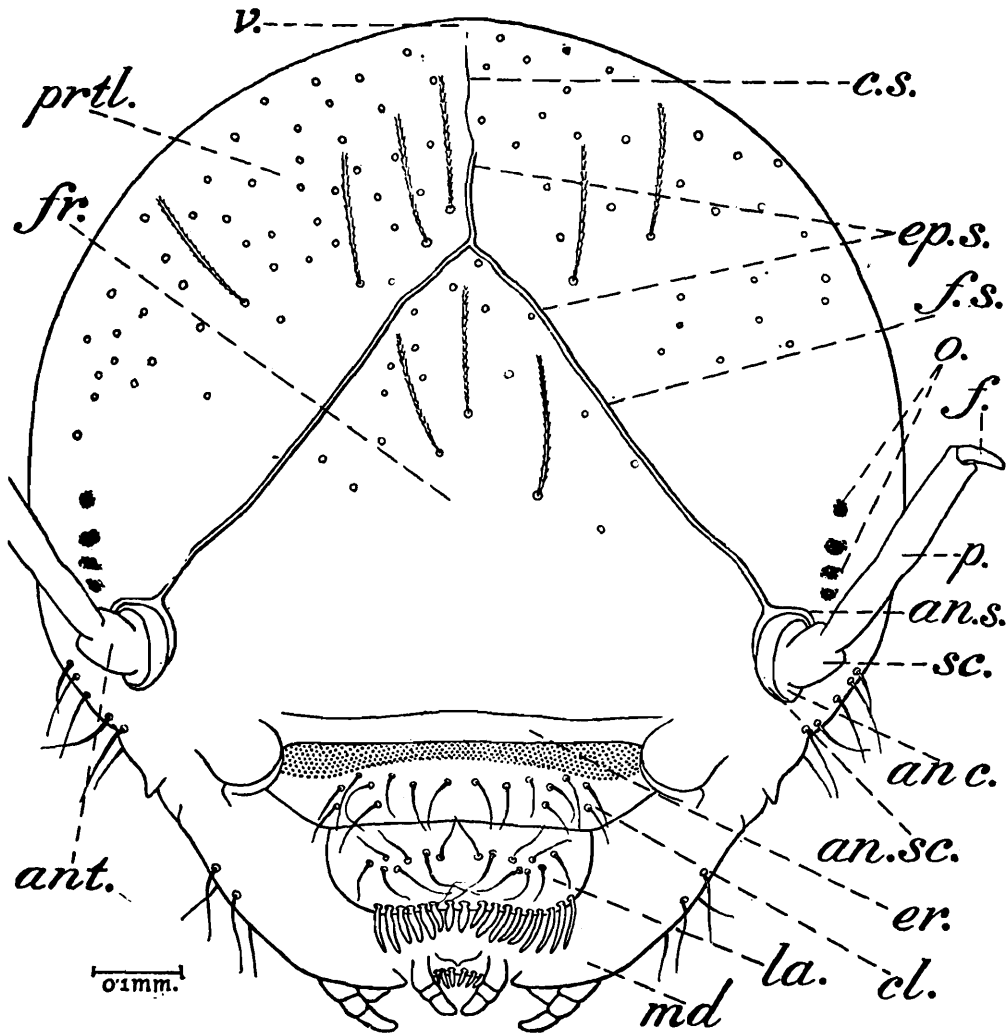
Das (1938) described the musculature of the mouth-parts of insect larvae belonging to various orders including Coleoptera and did not support the view advanced by Anderon. Although a number of papers have been published on the morphology of the mouth-parts of adult and larval insects there still exists difference of opinion in the interpretation of the sclerites of mouth-parts, especially of labium. Dorsey (1943) dealt with a comparative study of the musculature of the labrum, labium, and hypopharyngeal region of adult and immature Coleoptera. The present study on the larva of *Anthrenus fasciatus* has revealed that the prementum is a single, undivided plate and that there exist differences in the structure of mentum and the arrangement of labial muscles in the larvae of *A. fasciatus* and *Dermestes vulpinus*, the insects belonging to the same family Dermestidae.

MATERIAL AND METHODS.

The size of the larvae in different stages of growth varies from 0.7 to 4.5 mm. in length. For the present study nearly fully grown larvae, about 3.5 to 4 mm. were employed. For the study of the mouth-parts, the specimens were treated with 10 per cent. KOH overnight, then thoroughly washed in distilled water and finally stained with basic carbol fuchsin. For the study of musculature, material preserved in 90 per cent alcohol after a thoracic incision was found to be better than the fresh one. The head of the preserved larva was severed from the rest of the body and treated with acetone for a few days to dissolve the superfluous fat. Although the entire fat was not thus removed, the treatment proved useful and facilitated dissection to a considerable extent. After treating with acetone, the head was softened in distilled water for two days. Dissections were then made in 50 per cent. alcohol under a binocular microscope. The dissected mouth-parts along with the muscles were stained with a weak solution of eosin in 90 per cent. alcohol, cleared in Xylol and mounted in balsam. Some stained preparations were also made in glycerine. Microtome sections, 8-10 μ thick, of the head of the larva were cut in a vertical-longitudinal plane and were stained with iron haematoxylin and Orange G. The larvae employed for cutting sections were fixed in alcoholic Bouin's fluid immediately after they had cast off their skin, and preserved in 80 per cent. alcohol.

HEAD CAPSULE.

The head capsule of the larva of *Anthrenus fasciatus* (text-fig. 1) is of hypognathous type. The mid-dorsal region of the head, the epicranium, carries an inverted Y-shaped suture, the epicranial suture (*ep. s.*). The stem of the Y or the coronal suture (*c. s.*), also known as the metopic suture, extends medially on the top of the head. The two arms of the Y which diverge from the anterior end of the coronal suture and run anteriorly upto the antennal suture are called the frontal sutures (*f.s.*). The area bounded by the frontal sutures is the frons (*fr.*). The lateral areas of the cranium enclosed between the coronal and the frontal sutures are the parietals (*prtl.*). The dorsal surfaces of the two parietals forming the top of the head constitute the vertex (*v.*).



TEXT-FIG. 1.

Dorsal view of the head capsule of the larva of *Anthrenus fasciatus* Herbst.

an. s., antennal suture; *an. sc.*, antennal sclerite; *anc.*, antacorium; *ant.*, antenna; *c.s.*, coronal suture; *er.*, epistomal ridge; *ep. s.*, epicranial suture; *f.*, flagellum; *fr.*, frons; *f.s.*, frontal suture; *la.*, labrum; *md.*, mandible; *o.*, ocelli; *p.*, pedicel; *prtl.*, parietal; *sc.*, scape; *v.*, vertex.

The frons is a well defined sclerite, limited dorsally and laterally by the frontal sutures (*f.s.*), and ventrally by the epistomal or fronto-clypeal suture. The epistomal suture is a deep inflection producing internally a strong chitinous ridge (*er.*) known as the epistomal ridge and this forms a brace in the region between the anterior mandibular articulations. The anterior arms of the tentorium (text-fig. 2b, *a. tent. a.*) arise from the epistomal ridge. The subgenal margins (text-fig. 2a, *sg. m.*) are connected in front with the epistomal suture running across the face and behind with the marginal rim of the epicranium called the peristome (fig. 2a, *pm.*) which is well developed.

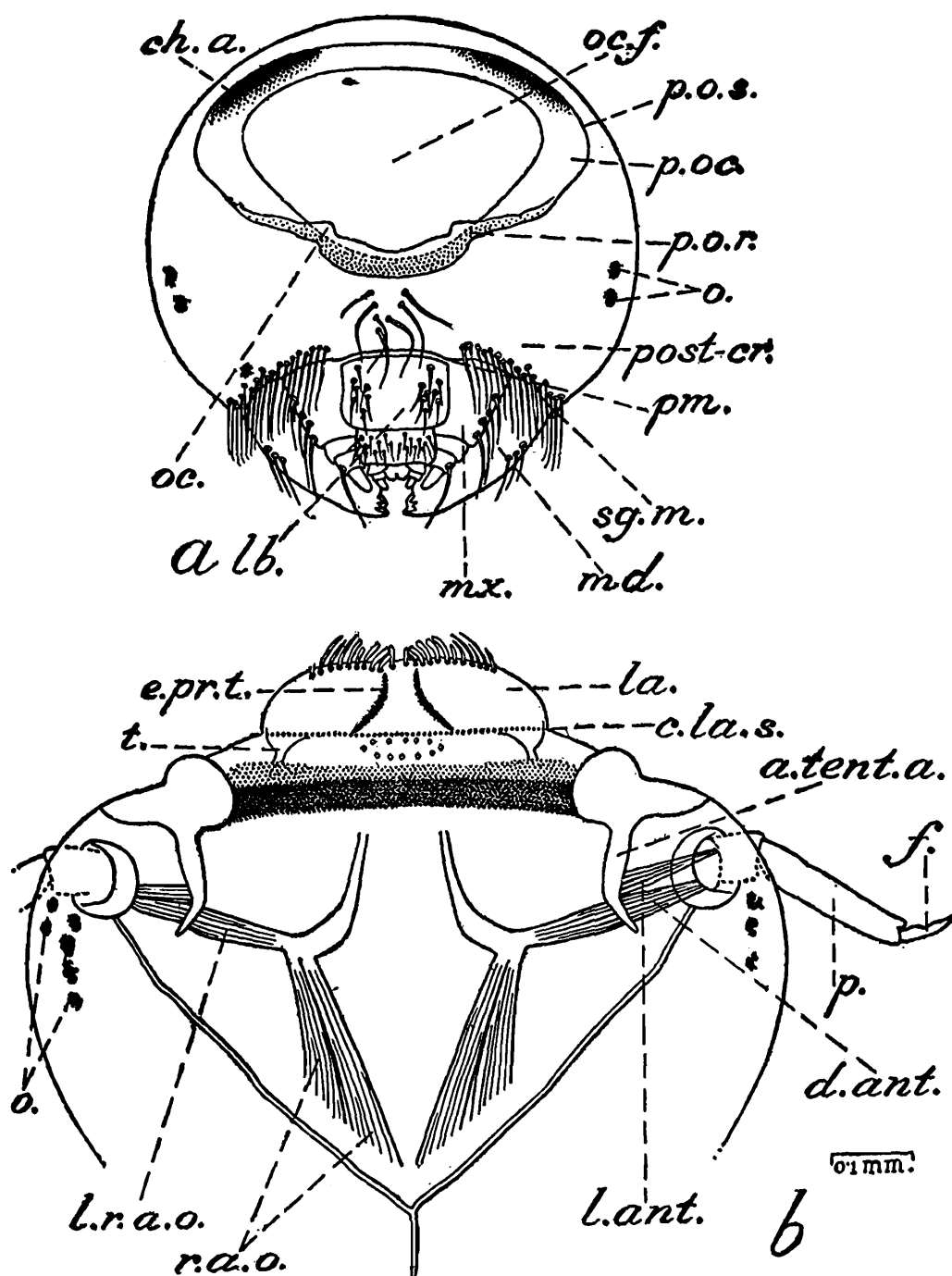
The antennae are situated laterally near the bases of the mandibles. The antennal sutures (text-fig. 1, *an. s.*) are closely approximated to the frontal sutures. Each antenna is lodged in a circular, lightly pigmented membranous area, the antacorium (*anc.*), and is surrounded by a deeply chitinised ring, the antennal sclerite (*an. sc.*). The antenna is composed of three segments, the scape (*sc.*), the pedicel (*p.*), and a short flagellum

(f.). The second segment is the longest and almost invariably presents a slight constriction a little before the middle of its length. The third segment is the smallest, and carries a small, conical sensory papilla at its tip. Each antenna is moved by two extrinsic muscles, one levator (text-fig. 2b, *l. ant.*) and the other depressor (*d. ant.*). The area of the cranium just below and behind the antenna is marked by six black dots or ocelli (text-figs. 1 & 2, *o*). These are located in two groups or rows. The anterior or dorsal row contains four ocelli, while the row posterior and ventral to the former contains only two. The two rows do not run parallel to each other but more or less converge anteriorly. The ocelli of the posterior row are clearly visible from the lateral or ventral side, but the view of the anterior row is obstructed by a number of hairs present between the two rows. The ocelli of both the rows are situated on a pale, lightly pigmented area. The facial region of the cranium is covered with a large number of hairs which are irregularly distributed and the exact boundaries of the various sutures can be clearly seen after removing them. The dorsal surfaces of the two parietals forming the top of the head are devoid of hairs. The posterior region of the head is not very hairy. There are a few hair on the ventral or posterior surface of the gnathal appendages and also near the subgenal and the peristomal margin.

The occipital suture is absent. The area of the cranium limited anteriorly by the frontal sutures, ventrally by the subgenal margins (text-fig. 2a, *sg. m.*) and peristome, and posteriorly by the post-occipital suture (*p.o.s.*) is the posterior region of the cranium (*post-cr.*) The post-occiput (*p. oc.*), which forms the margin of the occipital foramen (*oc. f.*), is a narrow band of the epicranium separated from the posterior region of the cranium by the post-occipital suture and to this is attached the neck membrane. The dorso-lateral region of the post-occiput bears a pair of somewhat deeply chitinised areas (*ch. a.*). Internally and ventrally the post-occipital suture forms a strongly chitinised post-occipital ridge (*p.o.r.*). At the base of the posterior tentorial arms, which arise from the post-occipital ridge, are situated narrow pits which lead into them. The posterior margin of the post-occiput bears ventro-laterally a pair of small processes, which by their position may be called the occipital condyle (text-fig. 2a, *oc.*).

MOUTH-PARTS.

The mouth-parts of the larva of *Anthrenus fasciatus* consist of : (1) an unpaired *labrum-epipharynx*, (2) a pair of *mandibles*, (3) a pair of *maxillae*, (4) an unpaired *labium*, and (5) an unpaired *hypopharynx*. The space enclosed by these appendages is the pre-oral or extra-oral cavity and it ends proximally at the opening of the mouth aperture. The roof of the pre-oral cavity is formed by the inner membranous region of the clypeo-labrum, while its floor is formed by the membranous tongue-like *hypopharynx*, which is continuous with the labium. Its lateral walls are formed by the inner sides of the mandibles and maxillae.



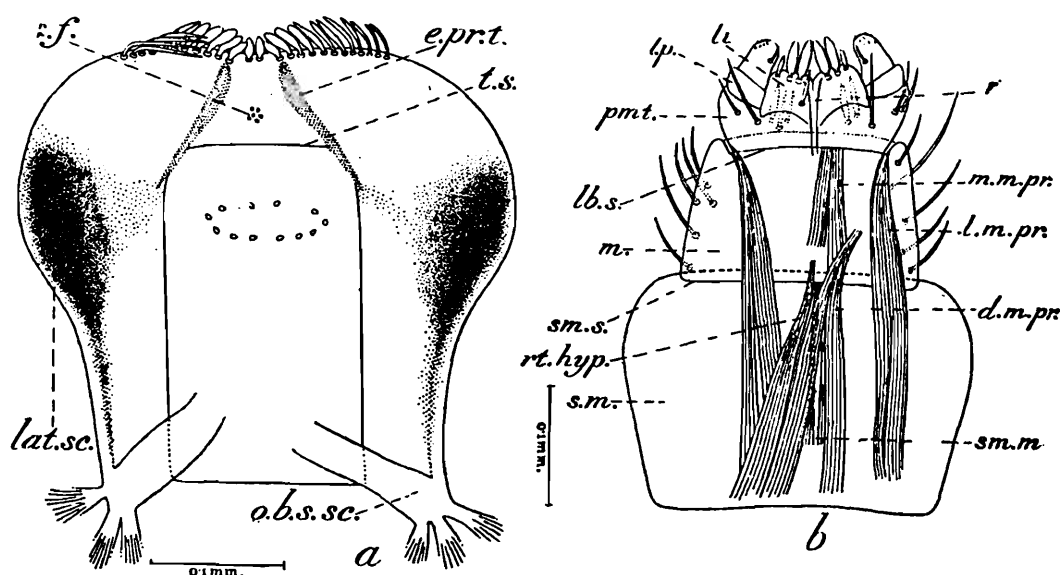
TEXT-FIG. 2.

Anthrenus fasciatus Herbst.—a. Ventral view of the head capsule. b. ventral view of a portion of the dorsal wall of the head capsule.

a. tent. a., anterior tentorial arm; c. la. s., clypeolabral suture; ch. a., chitinised area; d. ant., depressor muscle of antenna; e. pr. t., strong rod-like sclerite; la., labrum; lb., labium; md., mandible; mx., maxilla; o., ocelli; oc., occipital condyle; oc. f., occipital foramen; pm., peristome; p. oc., post occiput; p. o. r., post occipital ridge; p. o. s., post occipital suture; post-cr., posterior region of the cranium; r. a. o., retractor muscle of the mouth angle; sg. m., subgenal margin; t., torma.

Labrum-epipharynx (text-figs. 2b & 3a).—The labrum-epipharynx is a broad transversely elongate plate. It overlies the mandibles and, when cleared in 5 per cent. KOH solution, looks like a hollow bag. Its anterior or dorsal surface, which forms the labrum proper, is slightly convex and deeply chitinised, and is connected proximally to the lower margin of the clypeus by the

clypeo-labral suture (text-fig. 2b, c. la. s.). From the dorso-lateral corners of the labrum, close to the clypeo-labral suture are given off a pair of strongly chitinised short curved rods known as tormae. Each torma (t.) bends inwards and downwards, and then fuses with the lateral sclerite (text-fig. 3a, lat. sc.) situated on the epipharyngeal surface of the labrum close to its lateral margin. The fusion of tormae with the lateral sclerites evidently gives greater rigidity and support to the labrum but it has led to the suppression of lateral labral muscles or ventral (posterior) muscles of the labrum, which have been stated by Das (1938) and Dorsey (1943) to be inserted on the torma in the larvae of other Coleopterous insects e.g. *Dermestes vulpinus* F., *Tenebroides mauritanicus* L. and *Tenebriodes* sp. The posterior wall of labium is thin and membranous and forms the epipharynx. It bears a pair of somewhat rod-like sclerites (e. pr. t.), which are inclined towards each other at the distal end. Between the two rod-like sclerites, runs a transverse suture (text-fig. 3a, t.s.), which separates the epipharyngeal surface of the labrum from the membranous inner surface of the clypeus; and the two together form the epipharyngeal wall of the pre-oral cavity.



TEXT-FIG 3.

Anthrenus fasciatus Hebst.—a. Epipharyngeal surface of the labrum and clypeus as seen from below. b. Dorsal view of labium showing various muscles.

a., part of the apodeme; d. m. pr., dorsal muscles of prementum; e. pr. t., strong rod-like sclerite; l. m. pr., lateral muscles of prementum; l. p., labial palp; lat. sc., lateral sclerite; lb. s., labial suture; li., ligulia; m., mentum; m. m. pr., median muscles of prementum; o. b. s. sc., a portion of the oral branch of suspensorial sclerite; pmt., prementum; rt. hyp., retractor muscles of hypopharynx; s.f., sensory papillae; s. m., submentum; sm. m., submentomental muscles; sm. s., submentomental suture.

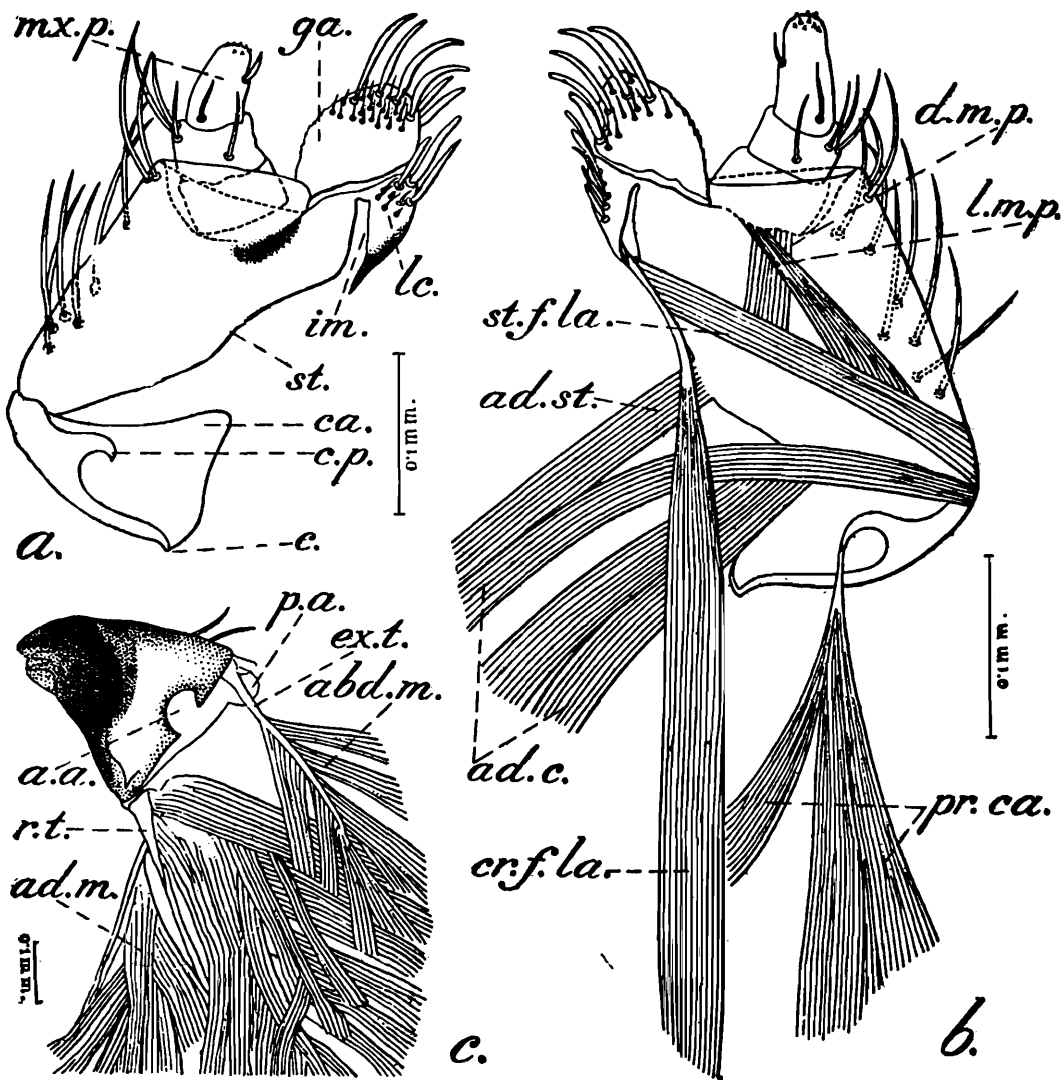
The dorsal surface of the labrum is covered with a large number of irregularly distributed hairs. In preparing a permanent mount of the labrum after treatment with KOH, most of these hairs fall off and the labrum presents a deeply fenestrated appearance. The epipharyngeal surface of the labrum (text-fig. 3a.) bears thick, short stumpy setae which are regularly arranged in a single row along its distal margin. It also bears a group of six extremely minute, conical sensory papillae (s. f.) which are located in front of and slightly away from the transverse

suture. The membranous surface of the clypeus also bears a number of sensory papillae arranged in an elliptical, ring-like pattern. They are, however, bigger in size than those borne by the epipharyngeal surface of the labrum.

Mandibles (text-fig. 4c.).—The mandibles are the strongest of the mouth-parts and are situated laterally, immediately below and behind the labrum and clypeus. The outer surface of each mandible is convex and the basal portion roughly triangular. It is attached to the *pleurostomal*¹ margin of the cranium by the outer edge of the triangular base. Of the three angles at the basal portion of the mandible one points inwards and projects into the intergnathal pre-oral cavity, while the other two are directed outwards. The proximal region of the mandible is hollow while the brownish-black distal region is very hard and compact. The mesial surface of the distal region of the mandible is deeply notched ; it may be called the incisor area since it bears chitinous ridges or teeth, which are, however, not clearly seen in all preparations. In suitable mounts one can see three tooth-like ridges separated by two grooves. Each mandible is hinged to the head capsule by an anterior and a posterior articulation. The anterior or dorsal articulatory point (*a.a.*) consists of a notch or socket in the proximal or dorsal margin of the mandible into which fits a convex knob-like structure situated in the dorsal margin of the head capsule, close to the base of the anterior tentorial arms. The posterior or ventral articulatory point (*p.a.*) consists of a strongly developed condyle which fits into a socket in the ventral margin of the posterior region of the cranium. A pair of apodemes or tendons are associated with the mandibles for the attachment of muscles. Of these, the inner or mesial one—the recto-tendon (*r. t.*)—arises proximally from the inner angle of the basal portion, while the outer one or extenso-tendon (*ex. t.*) arises between the anterior and posterior articulatory surfaces and is situated slightly anterior to the posterior articulation. The proximal region of the mandible on its outer or convex surface is covered with a few hairs.

Maxillae (text-fig. 4a.).—The two maxillae are situated posterior to the mandibles one on either side of the medially placed labium. Each maxilla consists of a small proximal sclerite, the cardo (*ca.*) and a long distal sclerite the stipes (*st.*). The stipes bears a short palpus (*mx. p.*) and two lobes, the galea (*ga.*) and the lacinia (*lc.*). A distinct suture between the cardo and the stipes permits considerable flexibility to both. The cardo is attached to the head by the pleural membrane and articulated to the hypostomal margin of the cranium by a small basal condyle (*c.*), which fits into a groove in the ventral margin or the hypostomal margin. The outer surface of the cardo is somewhat convex and presents a cup-shaped structure when seen from inside, i.e., antero-dorsally. The proximal rim of the cardo at its outer angle on the inner side is inflected to form a stout, slightly curved, tooth-like process (*c.p.*) known as the cardo process, to which is attached the promotor muscle of the cardo. Distally the cardo articulates with the stipes forming an angle with the latter. The membranous area bounded by the margins

¹ For descriptive purposes the part of the subgenal suture lying above the mandible is sometimes distinguished as the pleurostomal suture.



TEXT-FIG. 4.

Anthrenus fasciatus Herbst.—a. Left maxilla. b. Right maxilla with muscles. c. Right mandible with muscles.

a. a., anterior articulatory point; abd. m., abductor muscle; ad. c., adductor of cardo; ad. m., adductor muscle; ad. st., adductor of stipes; c., condyle; c. p., cardo process; ca., cardo; cr. f. la., cranial flexor of lacinia; d. m. p., depressor muscle of palp; ex. t., extenso-tendon; ga., galea; i. m., membranous area; l. m. p. levator muscle of palp; lc., lacinia; mx. p., maxillary palp; p. a., posterior articulatory point; pr. ca., promotor of cardo; r. t., recto-tendon; st., stipes; st. f. la., stipital flexor of lacinia.

of the stipes, cardo, and labium is the basimaxillary membrane. It is devoid of any sclerites. The stipes is narrow proximally and wider distally. At its proximal end it is articulated with the cardo at two points. Das (1938) also states that except in the larval Diptera such a condition exists in most larval insects. From the distal end of the stipes arises the three segmented maxillary palpus (mx. p.). The two proximal segments of the palp are broader than long, while the third one is longer than broad and unlike the other segments carries a number of minute sensory papillae at its rounded tip. The galea (ga.) has the form of a flattened lobe narrow at the base and broad distally. Its outer margin is slightly convex and serrated. The distal half of the galea, which carries a large number of thick setae, is less chitinised than the proximal half which stains deeply with fuchsin. The lacinia (lc.) is situated

behind the galea and has the form of a triangular lobe. A small membranous area (*i.m.*) intervenes between the main portion of the stipes and the lacinia. The inner angle of lacinia is sharply inflected and directed backwards forming a strong apodeme for the attachment of the cranial flexor of lacinia. The posterior or the ventral surface of the maxilla is covered with a number of bristles or hairs.

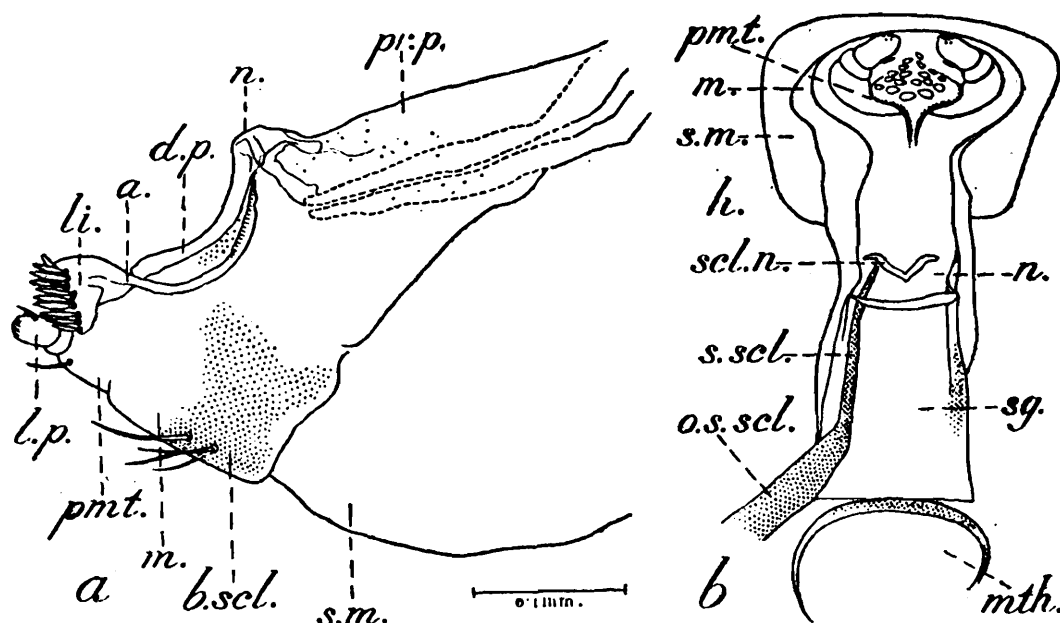
Labium (text-fig. 3b).—The labium is attached to the ventral margin of the head and consists of two main segments, the distal one being the prelabium or prementum (*pmt.*) and the proximal, the postlabium or postmentum. The suture between the two is the labial suture (*lb. s.*). The postlabium is further divided by the submentomental suture (*sm. s.*) into two portions, the proximal submentum (*s. m.*) and the distal mentum (*m.*).

The prementum is always smaller than the mentum and submentum. It bears a pair of labial palps and a pair of lobes fused with each other constituting the ligula (*li.*); there is no separate glossa or paraglossa. There is, however, a distal cleft between the two lobes which constitute the ligula and each lobe bears distally a number of thick stumpy setae. The labial palpus (*l. p.*) is smaller than the maxillary palpus and consists of two segments. The proximal segment is broader than long while the distal is longer than broad and bears at its rounded tip a number of minute sensory papillae. An apodeme (*a*) runs backwards and slightly upwards along the mid-dorsal line from the proximal end of the ligula, and in a lateral view looks like a curved U-shaped rod with the two arms of the U being wide apart (fig. 5a.). It extends into the distal region of the mentum and is fused with the hypopharynx for the greater part of its length. The anterior half of this apodeme, as compared with the posterior portion, is deeply chitinised and the anterior or dorsal muscle of the labium is inserted on it at a place where the deeply chitinised portion ends.

The mentum is smaller than the submentum and movable on it to a considerable extent in the vertical plane. It is fused with the basal sclerite of the hypopharynx (text-fig. 5a,b. *scl.*) and this fusion apparently gives the mentum a slightly folded appearance at its lateral margins.

The submentum is the largest of the three plates constituting the labium. It is narrower in its proximal region and is rigidly attached to the ventral margin of the cranium. It gradually becomes wider distally where its lateral margins are more or less rounded. The ventral or posterior surface of the labium is covered with bristles. In the larva of *Dermestes* (Das, 1938) the mentum is larger than the submentum as well as the prementum.

Hypopharynx (text-figs. 5a. & b.).—The hypopharynx is fused with the prelabium and also with the lateral margins of the mentum. It is composed of three parts, namely, a curved distal portion (*d. p.*), a small rectangular portion in the middle (*n.*), and a long proximal portion (*pr. p.*) extending upto the base of the mouth opening.



TEXT-FIG. 5.

Anthrenus fasciatus Herbst.—*a.* Lateral view of labium and hypopharynx. *b.* Surface view of labium and hypopharynx.

a., apodeme; *b. scl.*, basal sclerite; *d. p.*, distal portion of hypopharynx; *l. p.*, labial palp; *li.*, ligula; *m.*, mentum; *mth.*, mouth; *n.*, neck of hypopharynx; *o. s. scl.*, oral branch of suspensorial sclerite of the hypopharynx; *pmt.*, prementum; *pr. p.*, proximal portion of hypopharynx; *s. scl.*, suspensorial sclerite; *scl. n.*, sclerite in neck region; *sg.*, subgusta.

The distal portion is the hypopharynx proper. It runs backwards and upwards and looks very much like a tongue. It is fused anteriorly with the prelabium and laterally with the lateral margins of the mentum forming a pocket-like structure. The lateral walls of the hypopharynx bear a pair of basal sclerites (*b. scl.*) which are fused with the mentum. The dorsal surface of the hypopharynx is deeply grooved.

The rectangular middle portion of the hypopharynx, which may be called the neck (*n.*), is bounded by transverse sutures at its proximal and distal limits, and is supported by an approximately U-shaped sclerite (*scl. n.*). This sclerite serves for the attachment of retractor muscle of the hypopharynx.

The long proximal portion is comparatively narrow in its distal region. It is supported by a pair of strong chitinous rods, the suspensorial sclerites (*s. scl.*), which run laterally. Each suspensorial sclerite near the opening of the mouth bends upwards and runs closely applied to the sides of the oral aperture (*mth.*). In this region it is not deeply pigmented and is called the oral branch of the suspensorial sclerite (*o.s. scl.*), which serves for the attachment of the retractor muscle of the mouth-angle. The hypopharynx is covered with a number of irregularly distributed minute sensory papillae which are present in a fairly large number on the sides of the subgusta.

MUSCULATURE OF THE MOUTH-PARTS.

Labral muscles.—The musculature of the labrum consists of a single group of muscle fibres known as *compressor of the labrum*. It is made up

of a group of small thin fibres running across and between the anterior and posterior walls of the labrum. No other muscles are directly inserted on the walls of the labrum. The fusion of tormae with the lateral sclerites has led to the suppression of *lateral labral muscles* described by Das (1938) in several insect larvae.

Mandibular muscles (text-fig. 4c).—Each mandible is moved by a strong adductor and a much smaller abductor muscle.

Adductor of the mandible : The fibres of the adductor muscle (*ad. m.*) are spread out fan-wise and take their origin from the dorsal and posterior walls of the cranium. They are inserted on a large apodeme, the recto-tendon (*r. t.*), at the inner angle of the mandibular base.

Abductor of the mandible : The fibres of the abductor muscle (*abd. m.*) take their origin from the lateral wall of the cranium and arise a little anterior to the adductor muscle. They are inserted on a small apodeme, the extenso-tendon (*ex. t.*), situated on the outer margin at the base of the mandible between the anterior and posterior articulatory points.

The ventral set of muscles present in certain insects (Snodgrass, 1935) is absent in the larva of *Anthrenus fasciatus*.

Maxillary muscles (text-fig. 4b).—The musculature of each maxilla comprises one paired and six unpaired muscles as follows :—

Promotor of the cardo : This is a branched muscle (*pr. ca.*) having its fibres arranged in three bundles which take their origin from the posterior region of the cranium close to the rim of the foramen magnum, and are inserted through a tendinous cord on the cardo-process.

Adductor of the cardo : There is a pair of this muscle (*ad. c.*) for each maxilla. One member of the pair is short and stout. Its fibres are arranged in two bundles which take their origin on the posterior tentorial arm and get inserted on the mesal side of the cardo. The other member of the pair is comparatively long and slender. Its fibres are arranged in one bundle which take their origin on the posterior tentorial arm and are inserted on the lateral side of the cardo, externally to the cardo-process.

Adductor of the stipes : This is a stout muscle (*ad. st.*) and its fibres are arranged in one bundle. It takes its origin on the posterior tentorial arm and is inserted on a blunt process situated about the middle of the inner or mesal margin of the stipes. This muscle is important in determining the mesal limit of the stipes.

Cranial flexor of the lacinia : This muscle (*cr. f. la.*) is the longest of all the muscles of maxilla and lies dorsally to the adductors of the cardo and stipes. It takes its origin on the posterior region of the cranium slightly dorsal to that of the promotor of the cardo and is inserted through a tendinous cord on the inflected edge of the lacinia.

Stipital flexor of the lacinia : The fibres of this muscle (*st. f. la.*) are arranged in one bundle. It takes its origin on the outer angle of the stipital base and runs dorsally to the muscles of the palpus. Some fibres of this muscle are directly inserted on the inner base of the lacinia, while others have their insertion through the tendinous cord of the cranial flexor of lacinia.

Levator muscle of the maxillary palpus : This muscle (*l.m.p.*) is longer than the depressor muscle. It has its origin on the basal part of the stipes close to the origin of the stipital flexor of lacinia and gets inserted on the dorsal margin of the basal segment of the palpus.

Depressor muscle of the maxillary palp : This is a short and stout muscle (*d.m.p.*) having its origin on the mesal side of the stipes and insertion on the basal segment of the maxillary palp.

It will thus be seen that all the lobes of the maxilla, excepting the galea, are provided with muscles. The absence of the flexor of galea in the larva of *Anthrenus fasciatus* is not a unique feature, for such a condition has been met with in various other Coleopterous larvae (*Agriotes*, *Carabus* etc.) described by Das (1938). Snodgrass (1928) is of the opinion that the inner lobe apparently borne by the basal segment of the palpus in *Sialis* (Neuroptera-Megaloptera), called the galea by Crampton (1922), cannot be given this name, as it lacks muscles. Das (1938), however, does not agree with Snodgrass and points out that the galea in many larval insects has been found to be without muscles. The absence of muscles on the galea in the larva of *Anthrenus fasciatus* supports Das's opinion.

Labial muscles (text-fig. 3b.).—The musculature of the labium comprises the following paired muscles:—

Median or ventral muscles of the prementum (m.m. pr.) : These take their origin on the submentum ventral to the retractor muscles of the hypopharynx and are inserted on the middle of the proximal border of the prementum.

Lateral muscles of the prementum (l.m.pr.) : The fibres of each member of the pair are arranged in two bundles which take their origin on the submentum ventral to the retractor muscles of the hypopharynx and are inserted on the sides of the proximal border of the prementum.

Dorsal muscles of the prementum (d.m.pr.) : These muscles take their origin on the submentum internally to the retractor muscles of the hypopharynx and are inserted on the apodeme (*a*) already described.

Submentomental muscles (sm.m.) : These are very small and slender median muscles which take their origin on the submentum ventral to the median or ventral muscles of the prementum, and are inserted on the middle of the proximal border of the mentum.

Snodgrass (1935) does not distinguish the median muscles from the submentomental muscles and calls the latter the 'median muscles' in many Coleopterous larvae. He states that in many larval Coleoptera the prementum is composed of two principal plates, on the proximal one of which are inserted the 'median muscles' and on the distal one the tentorial adductors. Anderson (1936) supports Snodgrass's view and states that the prementum in Coleopterous larvae is very often subdivided into a first and a second prementum, and the latter serves as the area on which the retractors of the prementum are inserted. He (1936, p. 4) further states: "That the mentum, a subdivision of the postmentum, contains no muscle insertions is shown by examples: *Periplaneta* (pl. I, B) and the labium of adult *Harpalus* (pl. I, C). It is

necessary to accept this interpretation if we are to gain the consistency essential to a comprehensive understanding of the labial structure." Das (1938), however, states that the prementum is never subdivided into a proximal and a distal plate though it may have lateral sclerites. He is of the opinion that when the postmentum is a single plate no muscle is inserted upon it, but when it has two plates, the submentum and the mentum, the latter has the insertion of the submentomental muscle. My observations on the larval labium of *Anthrenus fasciatus* fully support Das's view. The prementum in this insect is undivided. The postmentum consists of two plates, the submentum and mentum, and the submentomental muscles are inserted on the middle of the proximal border of the mentum. Snodgrass maintains that the median muscles of the labium extending from the postmentum to the prementum are the only muscles which have their origin upon the postmentum. But in the larva of *A. fasciatus* besides the median muscles of the prementum, the lateral and dorsal muscles of the prementum, the submentomental muscles and the retractor muscles of the hypopharynx have their origin upon the submentum.

I have not been able to observe distinctly the muscles of the labial palp on account of the small size of the latter. Das (1938) writes "In most larval insects the labial palpus is not provided with antagonistic muscles." The same author has described that in the larva of *Dermestes* the median muscles are absent and the submentomental muscles are inserted on the middle of the mental plate (Das 1938, pl. 6, fig. 36). In the larva of *A. fasciatus* unlike that of *Dermestes vulpinus*, median muscles of the prementum are fully developed and the submentomental muscles are inserted on the middle of the proximal border of the mentum as is the case in most primitive insects.

Hypopharyngeal muscles.—The musculature of the hypopharynx consists of the following paired muscles:—

Retractor of the hypopharynx (text-fig. 3b, *rt. hyp.*): The fibres of this muscle are arranged in one bundle. It takes its origin on the proximal region of the submentum (externally to the dorsal premental muscles) and runs forwards and upwards to be inserted in the neck region of the hypopharynx. Its contraction depresses the hypopharynx and thus serves to increase the intergnathal pre-oral cavity.

Retractor of the mouth angle (text-fig. 2b, *r. a.o.*): It is a branched muscle and its fibres are arranged in three bundles. One of these which runs in a horizontal plane has its origin on the anterior tentorial arm and insertion on the oral branch of the suspensorial sclerite. Of the remaining two, the inner one is longer than the outer. Both these have their origin on the frons and insertion on the oral branch of the suspensorial sclerite. The contraction of this portion of the muscle probably serves to elevate the posterior region of the hypopharynx.

Microtome sections showed that neither of the gnathal appendages is provided with a glandular tissue.

SUMMARY.

The structure of the head capsule and the associated muscles of the larva of *Anthrenus fasciatus* has been described. The mouth-parts consist of an unpaired labrum-epipharynx, a pair of strong mandibles, a pair of maxillae, and an unpaired labium and hypopharynx. The presence of any gland associated with these appendages has not been detected.

ACKNOWLEDGMENTS.

I am highly grateful to Professor K. N. Bahl, under whose guidance this work was conducted at the Lucknow University Zoological Research Laboratory. My sincere thanks are also due to Dr. M. L. Roonwal for going through the manuscript which has, however, been prepared at the Zoological Survey of India, Banaras Cantt.

REFERENCES.

- Anderson, W. H., 1936.—A comparative study of the labium of Coleopterous larvae, *Smithson. misc. Coll.* XCV, (13), pp. 1-29, pls. 1-8.
- Carpenter, G. H. and Mac Dowell, M. C., 1912.—Mouth-parts of some beetle larvae (Dascillidae and Scarabaeidae), with especial reference to the maxillulae and hypopharynx. *Quart. J. micr. Sci.* LVII, pp. 373-396, pls. 35-37.
- Crampton, G. C., 1922.—A comparison of the first maxillae of apterygotan insects and Crustacea from the stand-point of phylogeny. *Proc. ent. Soc. Washington* XXIV, pp. 65-82, pls. 8, 9.
- Crampton, G. C., 1925.—External anatomy of the Roach, *Periplaneta americana*, *Psyche* XXXII, pp. 195-225.
- Das, G. M., 1938.—The musculature of the mouth-parts of insect larvae. *Quart. J. micr. Sci.* LXXX, pp. 39-80, pls. 1-12.
- Dorsey, C. K., 1943.—The musculature of the labrum, labium, and hypopharyngeal region of adult and immature Coleoptera. *Smithson. misc. Coll.* CIII, (7), pp. 1-42, pls. 1-24.
- Pradhan, S., 1938.—Neuromuscular study of the mouth-parts of *Coccinella septempunctata*, with a comparison of mouth-parts in Carnivorous and Herbivorous coccinellids. *Rec. Indian Mus.* XL, pp. 341-358.
- Snodgrass, R. E., 1928.—Morphology and evolution of the insect head and its appendages. *Smithson. misc. Coll.* LXXXI, (3), pp. 1-158.
- Snodgrass, R. E., 1931.—Evolution of the insect head and the organs of feeding. *Ann. Rep. Smithson. Inst.* pp. 443-489.
- Snodgrass, R. E., 1935.—*Principles of Insect Morphology*. New York.

ON A COLLECTION OF MOLLUSCA FROM THE COROMANDEL COAST OF INDIA¹.

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[Plate III]

INTRODUCTION.

The present paper is based on the study of a large collection of mollusca sent for identification to the Zoological Survey of India by Professor P. R. Awati of the Bombay University. The collection comprises specimens of land, freshwater, marine and estuarine forms, which were collected by Professor Awati from the Coromandel Coast. Unfortunately records of exact localities from which the different species were obtained, the dates of collection and other data are not available.

A considerable amount of work has already been done on the Mollusca of the Madras Coast. The most comprehensive work on the subject is that of Melvill and Standen² who catalogued about four hundred species of marine shells. Mörch³ dealt with a comparatively small number of terrestrial and fluviatile species only, and Hornell⁴ mostly discussed the habits and utility of the edible mollusca of South India. Crichton⁵ while giving a list of shells of Madras laid particular stress on the habits of the animals. In so far as the number of species is concerned, Gravely's⁶ work is quite extensive and it proves useful in some respects.

Crepidula fornicata (Linn.), previously known from America, Europe and Africa, and *Fusinus rostratus* (Olivi) from the Mediterranean, the Red Sea and the Canary Islands in the north Atlantic are being recorded for the first time from Indian waters. Hora and Mukherji⁷ in the case of fish and Chopra and Das⁸ in the case of crabs have recently recorded instances of the Atlantic forms being found in the eastern part of the Indo-Pacific area. Alcock⁹ had also previously given many similar examples, and it appears that the occurrence in Indian waters of species of animals that were so far considered as inhabitants of the Atlantic Ocean is not very uncommon. Three new species have been described and several others recorded for the first time from the Coromandel Coast. The collection that I have studied includes 62 genera and 83 species in all. Altogether 44 families are represented.

¹ Published with the kind permission of the Director, Zoological Survey of India.

² Melvill, J. C. and Standen, R. *Journ. Conch.* IX, pp. 30-48, 75-85 (1898).

³ Mörch, C. A. L. *Journ. Conchylol.* XX, pp. 333-345 (1872).

⁴ Hornell, J. *Mad. Fish. Bull.* XI, pp. 1-51 (1917); XIV, pp. 97-215 (1924).

⁵ Crichton, M. D. *Journ. Bomb. Nat. Hist. Soc.* XLII (1), pp. 324-341 (1941).

⁶ Gravely, F. H. *Bull. Mad. Govt. Mus.* (N. S.), V (1), pp. 23-112 (1941); V (2), pp. 1-110 (1942).

⁷ Hora, S. L. and Mukherji, D. D. *Nature*, CXXXVII (Jan., 25), p. 152 (1936); *Rec. Ind. Mus.* XXXVII, pp. 15-39 (1936).

⁸ Chopra, B. N. and Das, K. N. *Rec. Ind. Mus.* XXXIX, p. 381 (1937).

⁹ Alcock, A. *Journ. As. Soc. Bengal*, LXVIII, p. 14 (1899); *Investigator Deep-Sea Madrepোরaria, Calcutta* (1898); *Investigator Deep-Sea Brachyura, Calcutta* (1899).

Lastly, I acknowledge my sincere thanks to Dr. B. N. Chopra, Director, Zoological Survey of India, for his useful suggestions. I am also grateful to Dr. B. Prashad, Fisheries Development Adviser, Government of India, for his valuable comments and criticisms. My thanks are also due to Babu A. K. Mondal, one of the Artists of the Survey, for the care and accuracy with which he has prepared the figures used in this paper.

Class LORICATA.

Order CHITONIDA.

Family CHITONIDAE.

Subfamily CHITONINAE.

Genus *Chiton* Linnaeus, 1758.

Subgenus *Chiton* S. S.

Chiton squamosus Linnaeus, 1764.

- 1764. *Chiton squamosus*, Linné, *Mus. Lud. Ulricae*, p. 465.
- 1785. *Chiton scaber variegatus* and *Ch. marmoreus*, Chemnitz, *Conch.-Cab.*, VIII, pp. 276, 282, pl. xciv, figs. 792, 793, pl. xcv, figs. 803-805.
- 1847. *Chiton marmoreus*, Reeve, *Conch. Icon.* IV, pl. xii, fig. 64.
- 1892. *Chiton (Chiton) squamosus*, Tryon, *Man. Conch.* XIV, pp. 155, 156, pl. xxxv, figs. 80-82.
- 1903. *Chiton (Tonicia) marmoreus*, Clessin, in *Martini and Chemnitz's Syst. Conch.-Cab.* VI, Abth. 4, pp. 21, 22, pl. ii, figs. 7-9.

The species is represented in the collection by only two specimens which have light green shells with minutely beaded lateral areas.

Distribution.—It is a West Indies form and its occurrence on the Coromandel Coast is, therefore, of interest. I have also examined one example of this interesting species sent for identification by Dr. T. S. Mahabale, Gujrat College, who collected it from Port Okha in Baroda.

Class GASTROPODA.

Subclass PROSOBRANCHIA.

Order ARCHAEOGASTROPODA.

Family FISSURELLIDAE.

Subfamily EMARGINULINAE.

Genus *Diodora* Gray, 1821.

Diodora ruppellii (Sowerby, 1834).

1834. *Fissurella rüppellii*, Sowerby, *Proc. Zool. Soc. London*, p. 128.
 1927. *Diodora rüppellii*, Tomlin, *Trans. Zool. Soc.* XXII (3), pp. 298, 316.
 1929. *Capiluna rüppellii*, Dantzenberg, *Faune des Col. Franc.* III, p. 546.
 1937. *Diodora rüppellii*, Viader, *Maur. Inst. Bull.* 1 (2), p. 57.
 1939. *Fissurella (Capiluna) rüppellii*, Moazzo, *Mem. Inst. Egypte*, XXXVIII, pp. 213, 214.

The single specimen in the collection has a shell with closely evenly latticed sculpture and bluish-white interior. For a detailed synonymy of this species reference may be made to Moazzo's paper cited above. This species, as stated by Schepman (1908, p. 87), is erroneously treated by Pilsbry as identical with *D. nigriradiata* (Reeve).

Distribution.—Red Sea, Gulf of Suez, Aden, Mekran Coast, Mauritius, Madagascar, King Island, Cape of Good Hope, Madras, Ceylon, Penang, Malacca and the Philippines. The species, as stated by Tomlin, is common throughout the Suez Canal.

Family PATELLIDAE.

Subfamily NACELLINAE.

Genus **Cellana** H. Adams, 1889.

Cellana capensis (Gmelin, 1790).

1790. *Patella capensis*, Gmelin, *Syst. Nat.* ed. XIII, pp. 3720, 3721, No. 150.
 1848. *Patella capensis*, Krauss, *Die Südafrik. Moll.*, p. 53, pl. iii, fig. 13.
 1920. *Helcioniscus capensis*, Dautzenberg, *Faune des Col. Franc.* III, p. 551.

In the two shells of this species in the collection the central spatula appears to be whitish, instead of brown or orange—a character very rarely found in this form.

Distribution.—Persian Gulf, Gwadur (Baluchistan), Natal, Madagascar, Ceylon and Tranquebar.

Cellana testudinaria (Linnaeus, 1758).

1758. *Patella testudinaria*, Linné, *Syst. Nat.* ed. X, p. 783, No. 674.
 1908. *Helcioniscus testudinarius*, Schepman, *Prosobr. Siboga Exped. Monogr.* XLIX^{1b}, p. 98.
 1938. *Helcioniscus testudinarius*, Suvatti, *Moll. of Siam, Bangkok*, p. 2.
 1939. *Cellana testudinaria*, Lamy and Fischer-Piette, *Bull. Mus. Nat. Hist. Nat.* (2) XI (2), p. 263.

There are only two specimens in the collection which belong to *C. testudinaria*. The shell is depressedly conical and decussated with low, radiating and concentric riblets. Adam and Leloup (1938, p. 10, fig. 2) have figured the radular teeth of this species and have also given its detailed synonymy.

Distribution.—The range of this common species extends widely throughout the Indo-Pacific,

Family TROCHIDAE.

Subfamily TROCHINAE.

Genus **Trochus** Linnaeus, 1758.Subgenus **Trochus** S. S.Section **Infundibulum** Montfort, 1810.**Trochus radiatus** Gmelin, 1790.

1790. *Trochus radiatus*, Gmelin, *Syst. Nat.* ed. XIII, p. 3572, No. 33.

1937. *Trochus radiatus*, Viader, *Maur. Inst. Bull.* 1(2), p. 55.

1938. *Trochus (Infundibulum) radiatus*, Adam and Leloup, *Mém. Mus. Roy. Hist. Nat. Belg. II*, Fasc. 19, pp. 25, 26.

The two specimens in the collection agree with the description of the typical form.

Distribution.—Like the preceding species, it is found all over the Indo-Pacific. But its range also extends as far as the Red Sea.

Genus **Cantharidus** Montfort, 1810.Subgenus **Thalotia** Gray, 1847**Cantharidus kotschyi** (Philippi, 1848).

1848. *Trochus kotschyi*, Philippi, *Zeitschr. f. Malakozool.*, p. 127.

1889. *Cantharidus (Thalotia) kotschyi*, Tryon, *Man. Conch.* XI, p. 144, pl. xlvii, figs. 70-72.

1901. *Cantharidus kotschyi*, Melvill and Standen, *Proc. Zool. Soc. London*, II, p. 348.

One young depressedly-conical shell of chocolate-brown colour represents this species in the collection. The carina of the last whorl is ornamented with regular whitish nodules.

Distribution.—Karrak, Persia, Persian Gulf, Mekran Coast, Karachi, Bombay and Gwadur. It does not appear to have hitherto been recorded from the Coromandel Coast.

Genus **Gibbula** (Leach MS.) Risso, 1826.Subgenus **Enida** A. Adams, 1860.**Gibbula nobonii**, sp. nov.

(Plate III, figs. 1, 2.)

Shell small, solid, dextral, depressedly-conical, widely umbilicated, white but slightly tinged with yellow, conspicuously irregularly radiately blotched with dark grey, blotches appearing much larger on the surface than below the periphery; whorls $5\frac{1}{2}$, each neatly ornamented

with spirally granular, more or less equidistant lirae (fig. 1) which appear to vary considerably in size, but only slightly in number (the larger ones regularly alternating with the smaller ones and are arranged as $5 + 4 + 4 + 4 + 4$ (counting from the last whorl, excluding the carina), in the interstices between the lirae are fine smooth oblique striae varying in number from 2 to 4 in each, crossed by very fine vertical striae which give the surface a fine network-like appearance, the last whorl strongly carinated and crenulated; suture canaliculate; below the periphery are six prominent lirae, though not so unequal in size as the upper ones, with interstices similarly adorned with spiral and vertical striae; base flattened; aperture subquadrate, interior whitish, columella whitish, excavate, peculiarly crossed by a prominent median oblique ridge (fig. 2) which becomes tuberculous at the tip while ending just on its inner margin, slightly above it is another tubercle bulging into the cavity, while below it in the same line are two more tubercles of similar calibre, the last one lying just above the union of the lower end of the columella with the outer lip, the distance between these four tubercles is more or less same, the angle between the inner and the outer lips pronounced.

Measurements.—There are only two shells in the collection which measure 8 mm. in length and 11 mm. in breadth and 7 mm. in length and 10 mm. in breadth respectively.

Type-locality.—Coromandel Coast of India, Madras, S. India.

Holotype.—Reg. No. M 15941/2 Zool. Surv. Ind.

Paratype.—Reg. No. M 15944/2 Zool. Surv. Ind.

Remarks.—*Gibbula (Enida) nobonii* closely resembles *G. (E.) persica* (Melv. and Stand.)¹ from the Gulf of Oman in the general form of the shell as well as in the shape of its aperture, but differs from it in colouration, in having the angle between the inner and the outer lips more pronounced, and also in other important details as mentioned above. In *E. japonica* and *E. speciosa* the inner lip is quite smooth, while in *E. gemmulosa* it is lirate and crenate at the margin. The new species, however, may be readily distinguished from all in having the columella crossed by a median oblique ridge and its margin distinctly tuberculated.

Subfamily *UMBONIINAE*.

Genus *Umbonium* Link, 1807

Umbonium vestiarius (Linnaeus, 1758).

1758. *Trochus vestiarius*, Linné, *Syst. Nat.* ed. X, p. 758, No. 515.

1842. *Rotella vestiaria*, Reeve, *Conch. Syst.* II, p. 162, pl. ccxvi, fig. 2.

1931. *Umbonium vestiarius*, Winckworth, *Proc. Malac. Soc. London*, XIX (4), p. 189.

Seven elegantly painted shells of this very common and extremely variable species, including the var. *rosea*, are present in the collection. In all of them, however, the margin is more or less rounded and the umbilical callosity is large and thick.

¹ Melvill and Standen, *Ann. & Mag. Nat. Hist.* (7) XII, p. 294, pl. xx, fig. 10 (1903).

Distribution.—This variously coloured species is found in the Persian Gulf, Mekran Coast, Karachi, Bombay, Bassein, Goa, Madras, Tranquebar, Pulicat Lake, Tuticorin, Krusadai Island, Ceylon to Java, Singapore, Siam, New Ireland, the Philippines and Japan.

Genus **Monilea** SWAINSON, 1840.

Section **Priotrochus** P. Fisher, 1880.

Monilea obscura (Wood, 1828).

1828. *Trochus obscurus*, Wood, *Index Testaceol. Suppl.*, pl. v, fig. 25.

1880. *Trochus (Aphanotrochus) obscurus*, von Martens, in *Mobius's Beiträge zur Meeresfauna der Insel Mauritius und der Seychellen*, p. 296.

1929. *Monilea (Priotrochus) obscura*, Dautzenberg, *Faune des Col. Franc.* III (4), p. 540.

1937. *Priotrochus obscurus*, Viader, *Maur. Inst. Bull.* 1 (2), p. 55.

There is one beautiful shell of this species in the collection which can easily be recognized by its black streaks or maculations on the surface.

Distribution.—Red Sea, Persian Gulf, Mauritius, Madagascar, Seychelles, Zanzibar, Natal and also in some parts of the Indian and Pacific Oceans. It is interesting to record for the first time its occurrence on the Coromandel Coast.

Subfamily **MARGARITINAE**.

Genus **Sotmatella** Lamarck, 1819.

Subgenus **Stomatella** S. S.

Stomatella elegans Gray, 1847

1847. *Stomatella elegans*, Gray, in *Appendix to a Narrative of the Voy. H. M. S. 'Fly'*, II, p. 359, pl. ii, fig. 1.

1901. *Stomatella elegans*, Melvill and Standen, *Proc. Zool. Soc. London*, II, p. 345.

The two specimens of *S. elegans* in the collection agree in their shell characters with Gray's description and figure.

Distribution.—Karrak, Persia, Mekran Coast and Karachi. Coromandel Coast appears to be a new record.

Family **TURBINIDAE**.

Subfamily **TURBININAE**.

Genus **Turbo** Linnaeus, 1758.

Subgenus **Senectus** Mus. Cal.

Turbo brunneus (Röding, 1798).

1798. *Lunaticus brunea*, Röding, *Mus. Bolt.*, p. 102, No. 1315.
 1930. *Turbo* (*Senectus*) *intercostalis*, Oostingh, *Misc. Zool. Sumatrana*, XLIX, p. 2.
 1938. *Turbo* (*Marmarostoma*) *brunneus*, Adam and Leloup, *Mém. Mus. Roy. Hist. Nat. Belg.* II, Fasc. 19, pp. 34-37, Text-fig. 9 (radular teeth), pl. iii, fig. 4a-b (shell).
 1942. *Turbo brunneus*, Gravely, *Bull. Mus. Govt. Mus. (N. S.)*, V (2), p. 17, fig. 2a-b.

There has been much confusion as to the synonymy of *Turbo brunneus* (Röding), but Tomlin (1936)¹ has clearly shown that *T. intercostalis* Menke (1843) and *T. radiatus* Reeve (nec. Gmelin), which were considered by Schepman, Tryon and others as distinct from *brunneus*, are only synonyms of the latter. Ostergaard's (1935)² remark "It is a question whether *T. intercostalis* Menke should not also be considered a variety of *T. argyrostomus*" appears rather unsatisfactory. Adam and Leloup figured the radular teeth of *T. brunneus* in the paper cited above. Tomlin has nicely summed up the main points of opercular distinction between the groups *senectus* Mus. Cal. and *Sarmaticus* Gray, which evidently show that *T. brunneus* belongs to the former, though Adam and Leloup have placed it into the group *Marmarostoma* Swainson, which Thiele (1929) considers as synonymous with *Lunelia* Röding.

T. brunneus is represented in the collection by only two specimens which appear to be quite typical of the species.

Distribution.—This is a very common South Indian form and occurs widely in the Red Sea, Gulf of Suez, Persian Gulf, Mekran Coast, Karachi, Bombay, Goa, Panjim, Mauritius, Madagascar, Sandwich Islands, Maldives, Ceylon, Maungmagan, Akyab, Arakan, Singapore, Andamans, Nicobars, East Indian Archipelago, Australia, New Caledonia, Gulf of Siam, Annam and the Philippines.

Family NERITIDAE.

Subfamily NERITINAE.

Genus *Nerita* Linnaeus, 1758.

Subgenus *Theliostyla* Mörch, 1852.

Nerita plexa Chemnitz, 1781.

1781. *Nerita plexa*, Chemnitz, *Conch.-Cab.* V, p. 288, pl. cxc, figs. 1944, 1945.
 1885. *Nerita plexa*, von Martens, in *Martini and Chemnitz's Syst. Conch.-Cab.* II, Abth. 11, pp. 10, 107, pl. iv, figs. 1-3.
 1905. *Nerita plexa*, Hidalgo, *Cat. Moll. Test. Filipinas*, p. 223.
 1932. *Nerita plexa*, Dautzenberg, *Journ. de Conchyliol.* LXXVI, p. 75.

Of the two specimens of this species in the collection, one bears nodose spiral ribs, while the other, which is slightly smaller, has rugose ribs only. Other important characters appear to be quite conspicuous in both.

¹ Tomlin, J. R. le B. *Proc. Malac. Soc. London*, XXII (3), pp. 136, 137 (1936).

² Ostergaard, *Bull. B. P. Bishop Mus.* CXXXI, p. 47 (1935).

Distribution.—Red Sea, Mekran Coast, Karachi, Bombay, Mauritius, Madagascar, Mozambique, Natal, Zanzibar, Seychelles, Madras, Tranquebar, Ceylon and the Philippines.

Order MESOGASTROPODA.

Family PILIDAE.

Subfamily *PILINAE*.

Genus **Pila** Röding, 1798.

Pila virens (Lamarck, 1822).

1822. *Ampullaria virens*, Lamarck, *Hist. Nat. Anim. Sans Verteb.* VI (2), p. 179.
 1925. *Pila virens*, Prashad, *Mem. Ind. Mus.* VIII, pp. 75, 76, pl. xiv, figs. 1-3.
 1943. *Pila virens*, Ray, *Journ. Roy. As. Soc. Bengal, Sci.* IX, p. 71.

Three large specimens with smooth and yellowish shells represent *P. virens* in the collection.

Distribution.—Prashad has discussed the chief characteristics and the wide range of distribution of this interesting species in the paper cited above. Its occurrence in the Santal Parganas in Bihar was recorded in my paper mentioned above.

Family TURRITELLIDAE.

Genus **Turritella** Lamarck, 1799.

Subgenus **Haustator** Montfort, 1810.

Section **Zaria** Gray, 1847

Turritella duplicata (Linnaeus, 1767).

1767. *Turbo duplicatus*, Linné, *Syst. Nat.* ed. XII, p. 1239, No. 643.
 1849. *Turritella duplicata*, Reeve, *Conch. Icon.* V, pl. 1, fig. 2.
 1929. *Turritella (Zaria) duplicata*, Thiele, *Handb. der Syst. Weichtierk.* I, pp. 181, 182.

This well-known species is represented in the collection by only two specimens, of which one is a badly worn bleached shell, while the other a half-broken posterior part of a shell. The latter exhibits the true fulvous colour and the strongly keeled spiral ridges of the typical form. Gravely (loc. cit., pp. 22, 99, fig. 3c, 1942) considers *T. duplicatus* Linn. as a synonym of *T. acutangulus* Linn. (1767), while Dautzenberg¹ combines the latter with the former as a variety.

Distribution.—Mauritius, Madagascar, Bombay, Madras, Krusadai Island, Pamban, Ceylon, Hinzé Basin, Nicobars, Malay Archipelago and the Philippines.

¹ Dautzenberg Ph. Ann. Soc. Roy. Malacol. XXIV, p. 4 (1899).

Family **PLANAXIDAE**.Subfamily **PLANAXINAE**.Genus **Planaxis** Lamarck, 1822.Subgenus **Planaxis** S. S.Section **Planaxis** S. S.**Planaxis sulcatus** (Born, 1780).

1780. *Buccinum sulcatum*, Born, *Test. Mus. Caes. Vindob.*, p. 258, pl. x, figs. 5, 6.
1908. *Planaxis sulcatus*, Schepman, *Prosobr. Siboga Exped. Monogr. XLIX*¹ b, p. 171.
1938. *Planaxis (Planaxis) sulcatus*, Adam and Leloup, *Mém. Mus. Roy. Hist. Nat. Belg.* II, Fasc. 19, p. 97.
1942. *Planaxis sulcatus*, Gravely, *Bull. Mad. Govt. Mus. (N. S.)*, V (2), pp. 24, 94, fig. 3b.

There is a single eroded shell of this species in the collection which can readily be distinguished by its deep transverse sulcations on the surface, strongly tooth-ridged interior, and crenated margin.

Distribution.—This common and variable species is widely distributed in the Indo-Pacific. But its range also extends as far as the Gulf of Suez.

Planaxis breviculus Deshayes, 1844.var. **tessellata** Nevill, 1884.

1872. *Planaxis breviculus* var., Smith, *Ann. & Mag. Nat. Hist.* (4) IX, p. 39.
1884. *Planaxis breviculus* var. *tessellata*, Nevill, *Hand List Moll. Ind. Mus.* II, p. 186.
1887. *Planaxis sulcatus* var. *tessellata*, Tryon, *Man. Conch.* IX, p. 277.
1901. *Planaxis breviculus* var. *tessellata*, Melvill and Standen, *Proc. Zool. Soc. London*, II, p. 377.

The single specimen of the variety *tessellata* in the collection has a bluish-black shell covered with a horny epidermis. The spire is more acuminate and the transverse sulcations on the surface are finer than in the *forma typica*, and so are the lirae within the mouth of the shell.

Distribution.—This rare form has so far been known from the Persian Gulf only.

Family **POTAMIDIDAE**.Subfamily **POTAMIDINAE**.Genus **Cerithidea** Swainson, 1840.Subgenus **Cerithideopsis** Thiele, 1929.Section **Cerithideopsilla** Thiele, 1929.**Cerithidea cingulata** (Gmelin, 1790).

1790. *Murex cingulatus*, Gmelin, *Syst. Nat.* ed. XIII, p. 3561, No. 138.
 1938. *Cerithidea (Cerithideopsis) cingulata*, Adam and Leloup, *Mém. Mus. Roy. Hist. Nat. Belg.* II, Fasc. 19, pp. 98, 99.
 1939. *Potamides cingulatus*, Panikkar and Aiyar, *Proc. Ind. Acad. Sci.* IX B (6), p. 357.
 1941. *Cerithidea fluviatilis*, Gravely, *Bull. Mad. Govt. Mus. (N. S.)*, V(2), pp. 22, 24, 25, 94, fig. 3f.

C. cingulata is a common estuarine form, though Townsend considers it distinctly marine. The only instance of this brackish water form occurring in pure freshwater is furnished by Dr. Annandale¹, who collected several dead and worn shells in the lake deposit at Nasariyeh, Lower Mesopotamia. It is represented in the collection by only one small brownish shell which agrees with the description of the typical form. For a detailed synonymy of the species reference may be made to Adam and Leloup's paper cited above. A note on the breeding habits of this animal is given by Panikkar and Aiyar, while Troschel² has described and figured its radular teeth.

Distribution.—It has a wide range in the Indo-Pacific.

Genus **Telescopium** Montfort, 1810.

Telescopium telescopium (Linnaeus, 1758).

1758. *Trochus telescopium*, Linné, *Syst. Nat.* ed. X, p. 760, No. 561.
 1817. *Telescopium fuscum*, Schumacher, *Ess. Nouv. Syst. Test.*, p. 232.
 1921. *Potamides (Telescopium) telescopium*, Prashad, *Rec. Ind. Mus.* XXII, pp. 493, 494.
 1938. *Telescopium telescopium*, Adam and Leloup, *Mém. Mus. Roy. Hist. Nat. Belg.* II, Fasc. 19, p. 99.

This well-known brackish water ponderous Potamidid has a single trochiform shell in the collection. An account of the anatomy of the soft parts of this animal was published by Berkeley and Hoffman (1835)³.

Distribution.—Abundantly found in mangrove swamps on the coasts of India, the Gangetic delta, the Irrawaddy delta, Reunion, Madagascar, Ceylon, the Malay Archipelago, Singapore, Sambelong, Pulo Panjang, Nicobars, Australia and the Philippines. The range of its distribution is more or less similar to that of *Cerithidea cingulata* (Gmelin). It is also known in the fossil state in the Miocene of Java, Pliocene of Nias near Sumatra, Pliocene and Pleistocene of Timor, Pleistocene of Madura, Celebes and New Guinea.

Family AMALTHEIDAE.

Genus **Amalthea** Schumacher, 1817.

Subgenus **Malluvium** Melvill, 1906.

Amalthea lissa (Smith, 1894).

¹ Annandale, N. *Rec. Ind. Mus.* XV, p. 164 (1918).

² Troschel, F. H. *Das Gebiss der Schnecken*, Berlin, Part 3, p. 145, pl. xii, fig. 2 (1858).

³ Berkeley, M. J. and Hoffman, G. H., *Zool. Journ.* V, p. 431, pls. xx, xxi (1835).

1894. *Capulus lissus*, Smith, *Ann. & Mag. Nat. Hist.* (6) XIV, p. 166, pl. iv, figs. 4-6.
 1909. *Amalthea (Malluvium) lissa*, Schepman, *Prosobr. Siboga Exped. Monogr.* XLIX^{1b}, pp. 199, 200.
 1940. *Hipponyx (Malluvium) lissus*, Winckworth, *Proc. Malac. Soc. London*, XXIV (1), p. 20.
 1942. *Amalthea (Malluvium) lissa*, Devanesen, *Curr. Sci.* XI (1), pp. 16, 17.

A series of specimens, numbering thirty-seven, represent the species in the collection. All of them have cup-shaped shells which are pale yellow in colour, but devoid of any radiating sculpture. Peile¹ has described and figured the embryo operculum and the radular teeth of this species, while Thorson² has illustrated its larval development.

Distribution.—Originally described from the Bay of Bengal, but subsequently its range has been extended to the Persian Gulf, Gulf of Oman, Mekran coast, Laccadive, east coast of Africa, Gt. Nicobar, East Indian Archipelago and Japan.

Family CALYPTRAEIDAE.

Genus **Crepidula** Lamarck, 1799.

Section **Crepidula** S. S.

Crepidula fornicata (Linnaeus, 1767).

1767. *Patella fornicata*, Linné, *Syst. Nat.* ed. XII, p. 1257, No. 751.
 1886. *Crepidula fornicata*, Tryon, *Man. Conch.* VIII, p. 124, pl. xxxvi, figs. 1-8.
 1929. *Crepidula fornicata*, Robson, *Proc. Malac. Soc. London*, VIII (6), pp. 272-275.
 1934. *Crepidula fornicata*, Adam and Leloup, *Bull. Mus. Roy. Hist. Nat. Belg.* X, No. 45, pp. 1-6.
 1937. *Crepidula fornicata*, Orton, *Oyster Biology and Oyster Culture being the Buckland Lecture for 1935*, p. 162, London.
 1942. *Crepidula fornicata*, Coe, *Journ. Morph. Philadelphia*, LXX (3), pp. 506, 507.

Two very fine shells of this interesting "Slipper-limpet" or "Boat Shell" or "Crow oyster", as the species is commonly called, are present in the collection. The brown colour of the typical form is only faintly visible near the beak which is peculiarly curved or twisted. The internal partition is distinctly concave and rounded at the periphery.

Distribution.—*C. fornicata* was originally described from North America, but subsequently recorded from Europe (where it is said to have been introduced) and Africa. Adam and Leloup have discussed its range in Europe, while Robson has given a detailed account of its dispersal in English waters, where it has proved a great menace to oyster culture. Coe has shown the possible transformation undergone by the reproductive organs of this species and its allies during the change from male to female phase. Its occurrence for the first time in Indian waters is, therefore, remarkable.

¹ Peile, A. J. *Proc. Malac. Soc. London*, XXI(4), p. 251 (1935).

² Thorson, G. *Danish Sci. Invest. in Iran*, Part II, pp. 160, 172, figs. 4c-f (1940).

Family XENOPHORIDAE.

Genus **Xenophora** Fischer von Waldheim, 1807.Subgenus **Xenophora** S. S.**Xenophora pallidula** (REEVE, 1842).

1842. *Phorus pallidulus*, Reeve, *Proc. Zool. Soc. London*, p. 162.
 1882. *Xenophora pallidula*, Dunker, *Index Moll. Maris Japonici*, p. 123.
 1940. *Xenophora pallidula*, Winckworth, *Proc. Malac. Soc. London*, XXIV (1), p. 21.
 1942. *Xenophora pallidula*, Devanesen, *Curr. Sci.* XI(1), pp. 16, 17.

X. pallidula, though truly a Japanese species, occurs in Indian waters. It is well-represented in the collection by specimens of varying sizes, in which the shell appears to be faintly yellowish and characteristically agglutinated over with fragments of shells of different kinds. The umbilicus is apparently wide in the young shells, but partially closed in the adult.

Distribution.—East coast of Africa, off the Andaman Islands and Travancore coast, coast of Negapatam (Madras), Madura Sea, Sulu Sea, Timor Sea, Flores Sea, Nias-Sud-Canal, Molucca-Passage, the Philippines and Japan.

Family STROMBIDAE.

Genus **Tibia** Röding, 1798.Subgenus **Tibia** S. S.**Tibia curvirostris** (Lamarck, 1822).

1822. *Rostellaria curvirostris*, Lamarck, *Hist. Nat. Anim. Sans Vertéb.* VII, p. 192.
 1898. *Rostellaria curvirostris*, Melvill and Standen, *Journ. Conch.* IX(2), p. 46.
 1945. *Tibia curvirostris*, Winckworth, *Proc. Malac. Soc. London*, XXVI (4 & 5), p. 144.

A handsome specimen of *T. curvirostris* in the collection has a more or less light fulvous brown shell with 6-dentate outer lip and a curved canal. In the character of its outer lip it somewhat resembles *T. delicatula* (Nevill)¹ from the Bay of Bengal.

Distribution.—Red Sea, Persian Gulf, Gulf of Oman, Aden, Arabian Sea, Madras, Indian Ocean and Moluccas.

Family NATICIDAE.

Genus **Natica** Scopoli, 1777.Section **Natica** S. S.**Natica pellis-tigrina** Chemnitz, 1781.

¹ Nevill, G. *Journ. As. Soc. Bengal*, L(2), p. 262 (1881).

1781. *Natica pellis-tigrina*, Chemnitz, *Conch-Cab.* V, p. 265, pl. clxxxvii, figs. 1892, 1893.
 1850. *Natica pellistigrina*, Philippi, in *Martini and Chemnitz's Syst. Conch. Cab.* II, Abth. 1, p. 20, pl. xv, figs. 1, 2.
 1871. *Natica pellistigrina*, Lischke, *Jap. Meeres Conchylien*, II, p. 75.
 1886. *Natica pellis-tigrina*, Tryon, *Man. Conch.* VIII, p. 16, pl. ii, fig. 33.

The two specimens in the collection have their shells densely painted throughout with purplish chestnut dots.

Distribution.—Persian Gulf, Bombay, Madras, Ceylon, Hinzé Basin, Penang, Akyab, Andamans, Singapore, Java, Australia. Hongkong, China, Japan and Manila.

Family CYPRAEIDAE.

Subfamily CYPRAEINAE.

Genus *Mauritia* Troschel, 1863.

Subgenus *Arabica* Jousseaume, 1884.

Mauritia arabica (Linnaeus, 1758).

race *dilacerata* Schilder and Schilder, 1939.

1939. *Mauritia (Arabica) arabica* race *dilacerata*, Schilder and Schilder, *Proc. Malac. Soc. London*, XXIII (4), p. 183.
 1945. *Mauritia (Arabica) arabica* race *dilacerata*, Ray, *Journ. Roy. As. Soc. Bengal, Sci.* XI, p. 50.

The single specimen of this race in the collection agrees in all its essential shell characters with the description given by Schilder and Schilder.

Distribution.—Its range does not seem to extend beyond Mauritius on the west and Singapore on the east. For further details my paper cited above may be consulted.

Mauritia histrio (Gmelin, 1790).

One bleached shell with promiscuous purplish-black spots on its thickened sides and base represents this species in the collection.

Distribution.—Schilder and Schilder have given a detailed list of records of its distribution in the paper cited above.

Subgenus *Mauritia* Troschel, 1863.

Mauritia mauritiana (Linnaeus, 1758).

1758. *Cypraea mauritiana*, Linné, *Syst. Nat.* ed. X, p. 721.
 1945. *Mauritia (Mauritia) mauritiana*, Ray, *Journ. Roy. As. Soc. Bengal, Sci.* XI, p. 51.

Of the two juvenile shells of *M. mauritiana* in the collection, one measures 47 mm. in length and 22 mm. in breadth, while the other measures 42 mm. in length and 19½ mm. in breadth. In general form, colouration and sculpture they conform to Reeve's description and figure

Distribution.—A list of records of its distribution is given in my paper cited above; a few more localities which escaped my notice previously are Pamban, Tuticorin, Nalahia Bay, Nusa-Laut island and Tonga.

Family CYMATIIDAE.

Genus **Gyrineum** Link, 1807.

Section **Gyrineum** S. S.

Gyrineum natator (Röding, 1798).

- 1798. *Tritonium natator*, Röding, *Mus. Bolt.*, p. 127.
- 1901. *Gyrineum* (*Argobuccinum*) *tuberculatum*, Melvill, *Proc. Zool. Soc. London*, p. 387.
- 1932. *Gyrineum natator*, Wrigley, *Proc. Malac. Soc. London*, XX(2), p. 137.
- 1933. *Argobuccinum* (*Gyrineum*) *natator*, Bayer, *Zool. Meded.* XVI, pp. 38, 39.

In the two shells representing this neatly sculptured species in the collection the teeth on the outer lip are small and widely separated, unlike those of *Bursa granularis*. For further details regarding the synonymy of this species Bayer's paper may be consulted.

Distribution.—Red Sea, Persian Gulf, Mekran Coast, Karachi, Bombay, Madras, Adyar, Ceylon, Andamans, Nicobars, Sumatra, Java, New Guinea, Timor, Banka, Madura, Malacca, Gulf of Siam, China, Japan, Manila and Tahiti.

Section **Biplex** Perry, 1811.

Gyrineum perca (Perry, 1811).

var. **aculeata** Schepman, 1909.

- 1909. *Gyrineum* (*Biplex*) *perca* var. *aculeata*, Schepman, *Prosobr. Siboga Exped. Monogr.* XLIX^{1b}, pp. 115, 116, pl. x, fig. 1a-c.
- 1233. *Argobuccinum* (*Biplex*) *perca* var. *aculeata*, Bayer, *Zool. Meded.* XVI, p. 40.

G. perca var. *aculeata* is represented in the collection by a series of specimens which correspond to Schepman's description and figure.

Distribution.—This rare form has so far been known only from the Sulu and Timor Seas in the East Indian Archipelago. Its occurrence on the Coromandel Coast is, therefore, of interest.

Family BURSIDAE.

Genus **Bursa** (Bolten) Röding, 1798.

Bursa awatii, sp. nov.

(Plate III, figs. 3-5.)

Shell fusiformly-ovate, moderately thick, dextral, slightly creamy-white, whorls seven, regularly increasing, rounded, each ornamented with 4 to 6 regular distinct more or less equidistant primary spirals (the one lying in the middle of the whorl appearing, in most cases, to

be more prominent than the rest) which are beset with small spiny tubercles, in the last whorl, however, the number of such spirals is much more greater and varies from eleven to twelve (here the 3rd or 4th one only is more prominent) and their spiny tubercles tend to be gradually smaller as they pass downwards, in the interstices between the spirals in all the whorls are small secondary spirals which are more or less tuberculated in the same way and are crossed by very fine vertical striae throughout which give the surface a network-like appearance; besides these, each whorl has a pair of low rounded ridges or varices, one on each side of the shell forming rather a row which, in most cases, appears discontinuous, especially in the lower whorls; suture impressed; aperture more or less oval, longer than broad, channelled at both ends, the lower channel being more wider than the upper one, especially in front, the callus of the columellar border has a distinct outer margin and shows a continuation of the spiral banding on the inflated part of the whorl (fig. 4), a prominent denticle occurs on the inner margin of the columella just a little below the upper channel, but this may be rudimentary or obsolete in the young individuals, the outer lip is thin on the margin but divided into ten (rarely eleven) well-defined interspaces by the primary whorl spirals (as shown in fig. 5) which bear unequal denticles, varying in number from 12 to 15 in the series, and are arranged in groups from rear to front as mentioned below; in the young shells, however, the denticles are rudimentary or absent. The interior of the aperture is whitish.

No. of shells.	Measurements in millimetres.				Division of outer lip into interspaces.	Number and arrangement of denticles in the interspaces from rear to front.
	Length of shell.	Breadth of shell.	Length of aperture.	Breadth of aperture.		
1	40.5	26	26	13.5	10	absent (young shell).
2	51	30	30	15	10	1+3+2+2+1+1+1+1+1+1=14.
3	40.5	23	24.5	12	11	absent (young shell).
4	46	27	28	14	10	absent (excepting one or two).
5	45	27.5	26	14.5	10	1+2+2+2+1+1+2+1+1+1=14.
6	41	23.5	25	11	11	absent (young shell).
7	55.5	30.5	34	18	10	1+2+1+1+1+1+2+2+2+1=14.
8	49	25	29	14	10	1+2+2+1+1+1+1+1+1+1=12.
9	50	26	29	15	10	1+2+2+1+1+1+1+1+1+2=13.
10	46	26	29	15.5	10	1+2+2+1+1+1+1+1+1+1=12.
11	37.5	20	22.5	11	10	absent (young shell).
12	37	21	22	12	10	absent („ „).
13	34	19	21	11	10	absent („ „ „).
14	37	21	23	12	10	2+2+3+2+1+1+1+1+1+1=15.
15	38	21	23	12	10	1+2+3+1+1+1+1+1+1+1=13.
(Figured) 16	48	27.5	31	16.5	10	1+2+3+2+1+1+1+1+1+1=14.

Type-locality.—There are sixteen individuals of different size and growth in the series which were collected by Prof. P. R. Awati from the Coromandel Coast of India, Madras.

Holotype.—Reg. No. M 15942/2 Zool. Surv. Ind.

Paratypes.—Reg. No. M 15945/2 Zool. Surv. Ind.

Remarks.—The shell of *Bursa awatii* resembles that of *R. vexillum* Sowerby in shape and in the inflated nature of its whorls, but differs from it in being much thinner, in colouration and also in details of sculpture. The division of the outer lip and the consequent arrangement of the denticles are peculiar in the new species and do not agree with what has been described and figured by Wrigley (1942-*Proc. Malac. Soc. London*, XX(2), pp. 127-140, pl. xi) for the Bursidae or Cymatiidae.

Order STENOGLOSSA.

Family MURICIDAE.

Genus **Murex** Linnaeus, 1758.

Subgenus **Murex** S. S.

Section **Murex** S. S.

Murex tribulus Linnæus, 1767

1767. *Murex tribulus*, Linné, *Syst. Nat.* ed. XII, p. 1214, No. 519.

1845. *Murex ternispina*, Reeve, *Conch. Icon.* III, pl. xviii, fig. 73, pl. xix, fig. 76.

1911. *Murex (Tribulus) ternispina*, Schepman, *Prosobr. Siboga Exped. Monogr.* XLIX^{1b}, pp. 340-342.

1939. *Murex tribulus*, Moazzo, *Mem. Inst. Egypte*, XXXVIII, pp. 155, 156.

1940. *Murex tribulus*, Winckworth, *Proc. Malac. Soc. London*, XXIV, p. 22.

The single specimen of this graceful species in the collection has a slightly yellowish shell with three-varicose whorls. Schepman has illustrated the radular teeth of a female specimen of this species.

Distribution.—The range of this species is very wide and extends from the Red Sea to the Philippines and Japan. Tomlin¹ reports it as the commonest species in the southern part of the Suez Canal, but not north of the Bitter Lakes.

Subgenus **Chicoreus** Montfort, 1810.

Section **Chicoreus** S. S.

Murex adustus Lamarck, 1822.

1822. *Murex adustus*, Lamarck, *Hist. Nat. Anim. Sans Verteb.* VII, p. 161.

1938. *Murex (Chicoreus) adustus*, Adam and Leloup, *Mem. Mus. Roy. Hist. Nat. Belg.* II, Fasc. 19, p. 155.

¹Tomlin, J. R. le B. *Trans. Zool. Soc. London*, XXII(3), pp. 294, 318, 320 (1927).

A small worn but heavy shell represents *M. adustus* in the collection; it is jet-black in colour; there are, however, no fronds on the varices in this specimen.

Distribution.—Its range accords more or less with that of the preceding species.

Subgenus **Hexaplex** Perry, 1811.

Section **Hexaplex** S. S.

Murex chicoreus Gmelin, 1790.

- 1790. *Murex chicoreum*, Gmelin, *Syst. Nat.* ed. XIII, p. 3530, No. 17.
- 1822. *Murex endivia*, Lamarck, *Hist. Nat. Anim. Sans Verteb.* VII, p. 1686.
- 1880. *Murex (Phyllonotus) endivia*, Tryon, *Man. Conch.* II, p. 102, pl. xxvi, figs. 221-224.
- 1938. *Murex (Hexaplex) chicoreus*, Adam and Leloup, *Mem. Mus. Roy. Hist. Nat. Belg.* II, Fasc. 19, p. 154.

A small shell in the collection belongs to *M. chicoreus*. The fronds on the varices appear to be very poorly developed, but the characteristic red marginal colouring of its columella and outer lip as well as the dark-brown bands on the whorls are more or less conspicuous. Adam and Leloup have given the full synonymy of this species in the paper cited above.

Distribution.—Persian Gulf, Arabian Sea, Indian and Pacific Oceans. It does not appear to have hitherto been recorded from the Coromandel Coast of India.

Family THAISIDAE.

Genus **Thais** Röding, 1798.

Subgenus **Thais** S. S.

Section **Thais** S. S.

Thais rudolphi (Chemnitz, 1788).

- 1788. *Buccinum rudolphi*, Chemnitz, *Conch.-Cab.* X, p. 196, pl. cliv, figs. 1467, 1468.
- 1822. *Purpura rudolphi*, Lamarck, *Hist. Nat. Anim. Sans Verteb.* VII, p. 235.
- 1879. *Purpura (Microtoma) rudolphi*, von Martens, *Monatsb. der Königl. Akad. Wiss.*, p. 278.
- 1938. *Purpura (Purpura) rudolphi*, Adam and Leloup, *Mem. Mus. Roy. Hist. Nat. Belg.* II, Fasc. 19, p. 168, pl. vii, fig. 4.

The single specimen of *Th. rudolphi* in the collection can readily be distinguished by the reddish and longitudinally grooved columella and brownish-black outer lip of the shell. Melvill and Abercrombie (*loc. cit.* p. 30) have wrongly treated *Th. persica* (Linn.) as synonymous with *Th. rudolphi*.

Distribution.—Widely distributed in the Indo-Pacific, but its range also extends as far as the Red Sea.

Section **Stramonita** Schumacher, 1817.**Thais bufo** (Lamarck, 1822).

1822. *Purpura bufo*, Lamarck, *Hist. Nat. Anim. Sans Verteb.* VII, p. 239.
 1846. *Purpura bufo*, Reeve, *Conch. Icon.* III, pl. ii, fig. 7.
 1901. *Purpura (Thalessa) bufo*, Melvill and Standen, *Proc. Zool. Soc. London*, II, p. 399.
 1942. *Thais bufo*, Crichton, *Journ. Bomb. Nat. Hist. Soc.* XLII, p. 333.

The single specimen in the collection agrees with the description of the species.

Distribution.—The range of this species is more or less like that of *Th. rudolphi* with which it is always found to be closely associated.

Thais bufo (Lamarck)var. **callosa** (Lamarck, 1822).

1822. *Purpura callosa*, Lamarck, *Hist. Nat. Anim. Sans Verteb.* VII, p. 239.
 1859. *Purpura bufo* var. *callosa*, Küster, in *Martini and Chemnitz's Syst. Conch.-Cab.* III, Abth. 1a-b., pp. 100, 101, pl. xviii, figs. 1, 2.
 1929. *Purpura bufo* var. *callosa*, Dautzenberg, *Faune des Col. Franc.* III, p. 425.

There are two fine specimens of the var. *callosa* in the collection with remarkable thickening on the columellar lip.

Distribution.—The range of *Thais bufo* var. *callosa* appears to be the same as that of the *forma typica*.

Genus **Drupa** Röding, 1798.Subgenus **Drupa** S. S.Section **Morula** Schumacher, 1817.**Drupa margariticola** (Broderip, 1832).

1832. *Murex margariticola*, Broderip, *Proc. Zool. Soc. London*, p. 117.
 1911. *Sistrum (Morula) fiscellum*, Schepman, *Prosobr. Siboga Exped. Monogr.* XLIX^{1b}, p. 357.
 1938. *Drupa (Morula) margariticola*, Adam and Leloup, *Mém. Mus. Roy. Hist. Nat. Belg.* II, Fasc. 19, p. 161, pl. vi, fig. 16.

Some authors consider *Sistrum undatum* and *Ricinula fiscellum* of Chemnitz as distinct from *margariticola*, but, as has been shown by Adam and Leloup, these are only synonyms of the latter. The species is represented by two very beautiful shells which are strongly shouldered with round longitudinal ridges crossed by raised spiral lines. The interior of the aperture is bluish-white.

Distribution.—First described from the Lord Hood's Island, but subsequently its range has been extended to the Red Sea, Gulf of Suez, Karachi, Baluchistan, Mauritius, Madagascar, Natal, Madras, Pamban, Kilakarai, Tranquebar, Ceylon, Andamans, Sumatra, Celebes, Sumbawa, New-Guinea, Australia, Lombok, Macassar, Halmaheira, Banda Neira, Bay of Bima, between islands of Wowoni and Buton, Tual in Kei-islands, Pulu Kaniungan Ketjil, South Sea Islands, China, Japan and Polynesia.

Family BUCCINIDAE.

Genus **Babylonia** F. Schlüter, 1838.**Babylonia spirata** (Linnaeus, 1767).1767. *Buccinum spiratum*, Linné, *Syst. Nat.* ed. XII, p. 1203.1887. *Eburna canaliculata*, von Martens, *Journ. Linn. Soc. (Zool.)* XXI, p. 180.1898. *Iatrunculus spiratus*, Melvill and Standen, *Journ. Conch.* IX, p. 41.1941. *Babylonia spirata*, Crichton, *Journ. Bomb. Nat. Hist. Soc.* XLII, p. 334.

Four shells of *B. spirata* in the collection have horny epidermal layers on the surface more or less concealing the colouration.

Distribution.—This is a wide-spread Indo-Pacific form, but has also been recorded from the Mediterranean Sea.

Genus **Cantharus** Röding, 1798.Section **Pollia** Sowerby, 1834.**Cantharus undosus** (Linnaeus, 1767).1767. *Buccinum undosum*, Linné, *Syst. Nat.* ed. XII, p. 1203.1901. *Tritonidea undosa*, Melvill and Standen, *Proc. Zool. Soc. London*, II, p. 415.1931. *Cantharus (Pollia) undosus*, Oostingh, *Arciv f. Molluskenk.* LXIII, p. 216.1935. *Cantharus undosus*, Ostergaard, *Bull. B. P. Bishop Mus. Honolulu*, CXXXI, pp. 7, 18.

This ancient and well-known species is represented in the collection by only two specimens. The blackish-brown spiral ridges on the shell are quite conspicuous.

Distribution.—Abundantly found along the whole of the West Coast of India proper and Baluchistan to Persia and Mauritius, but eastwards its range also extends from Ceylon and Madras through the Malay Archipelago to the Philippines and Polynesia.

Family NASSARIIDAE.

Genus **Nassarius** Dumeril, 1806.Subgenus **Hima** (Leach MS.) Gray, 1852.**Nassarius stolatus** (Gmelin, 1790).1790. *Buccinum stolatum*, Gmelin, *Syst. Nat.* ed. XIII, p. 3496.1930. *Nassarius (Phrontis) stolatus*, Bisacchi, *Ann. Mus. Civ. Stor. Nat. Gen.* LV (24), p. 11.1938. *Nassa stolata*, Suvatti, *Moll. of Siam, Bangkok*, p. 34.

Two worn shells of this backwater species are found in the collection. The three large spiral chestnut bands, so characteristic of the species, can only be seen in the interior of the aperture, though not on the surface where they are totally lost. *Buccinum ornatum* Kiener is a synonym of this species.

Distribution.—This variable species is found plentifully in Bombay, but has also been recorded from the Persian Gulf, Gulf of Aden, Mauritius, Ceylon, Madras, Tranquebar, Pamban, Calcutta, Mergui, Singapore, Java, Borneo, Gulf of Siam and the Philippines.

Family FASCIOLARIIDAE.

Genus **Fusinus** Rafinesque, 1815.

Fusinus rostratus (Olivi, 1792).

- 1792. *Murex rostratus*, Olivi, *Zool. Adriat.*, p. 153.
- 1869. *Fusus rostratus*, Issel, *Malac. del Mar. Rosso, Pisa*, p. 386.
- 1883. *Fusus rostratus*, Dautzenberg, *Journ. de Conchyliol.* XXXI, p. 321.
- 1885. *Fusus rostratus*, Watson, *Zool. Chall. Exped.* XV (2), p. 207.
- 1937. *Fusus (Fusus) rostratus*, Sieber, *Archiv f. Molluskenk.* LXIX, pp. 145, 146, 149, 158.

The single specimen of this delicate and beautifully sculptured species in the collection agrees with the description of the typical form.

Distribution.—This rare form has so far been known from the Mediterranean Sea, Red Sea and the Canary Islands in the North Atlantic. Its existence for the first time in Indian waters is, therefore, remarkable.

Fusinus rubrolineatus (Sowerby, 1870).

- 1870. *Fusus rubrolineatus*, Sowerby, *Proc. Zool. Soc. London*, p. 252.
- 1880. *Fusus rubrolineatus*, Sowerby, *Thes. Conch.* IV (35 & 36), p. 80, pl. ccccx, fig. 68.
- 1925. *Fusus rubrolineatus*, Thiele, *Wiss. Ergebn. Deutsch. Tiefsee-Exped. Gastropoda*, XVII (2), p. 360.
- 1940. *Fusinus rubrolineatus*, Winckworth, *Proc. Malac. Soc. London*, XXIV (1), p. 22.

A series of specimens, numbering eighteen, represents this species in the collection. The shell appears to be slightly yellowish and lineated with spiral red lines, becoming prickly on the ribs.

Distribution.—First described by Sowerby from the Agulhas Bank, South Africa, but subsequently recorded from off the Malabar Coast. This species does not appear to have been recorded before from the Coromandel Coast.

Family OLIVIDAE.

Subfamily OLIVINAE.

Genus **Olivancillaria** Orbigny, 1839.

Section **Agaronia** Gray, 1839.

Olivancillaria nebulosa (Lamarck, 1822).

- 1822. *Oliva nebulosa*, Lamarck, *Hist. Nat. Anim. Sans Verleb.* VII, p. 436.
- 1876. *Oliva (Olivancillaria) nebulosa*, Weinkauff, in *Martini and Chemnitz's Syst. Conch.-Cab.* V, Abth. 1, p. 55, pl. iv, figs. 11, 12; pl. xviii, figs. 6, 7, 9.

1895. *Olivancillaria nebulosa*, Thurston, *Bull. Mad. Govt. Mus.* III, p. 123.

1942. *Oliva nebulosa*, Gravely, *Bull. Mad. Govt. Mus. (N. S.)*, V (2), p. 63.

Of the two young shells of *O. nebulosa* in the collection, one is worn and the other partly broken. This species is often confounded with *O. gibbosa* (Born) owing to the remarkable similarity in shell characters, especially in the young conditions. But the slender and less inflated body-whorls, concavely depressed columella, and more or less acuminate spire are the chief diagnostic features of this species which easily separate it from its allies.

Distribution.— Bombay, Karachi, Goa, Madras, Tuticorin, Pamban, Krusadai Island, Ceylon, Byikhwaaw Bay, Torres Straits and Gulf of Siam.

Family CONIDAE.

Genus **Conus** Linnaeus, 1758.

Subgenus **Chelyconus** Mörch, 1852.

Conus achatinus Chemnitz, 1788.

1788. *Conus achatinus marinus*, etc. Chemnitz, *Conch.-Cab.* X, p. 66, pl. cxlii, fig. 1317.

1792. *Conus achatinus*, Hwass, in *Bruguère's Ency. Meth.* 1, p. 671, pl. cccxxx, fig. 6.

1937. *Conus achatinus*, Dautzenberg, *Mém. Mus. Roy. Hist. Nat. Belg.* II, Fasc. 18, pp. 8-11.

1937. *Conus achatinus*, Tomlin, *Proc. Malac. Soc. London*, XXII (4 & 5), p. 207.

The two specimens of *C. achatinus* seem to agree in their essential shell characters with the description of the typical form. Dautzenberg in his paper cited above has given the full synonymy and a list of records of distribution of this wide-spread species. Melvill and Abercrombie (1893, p. 26) seem to have wrongly combined it with *C. monachus* (Linn.) as a variety.

Family TURRIDAE.

Subfamily *TURRINAE*.

Genus **Turris** O. F. Müller, 1766.

Subgenus **Gemmula** Weinkauff, 1876.

Section **Gemmula** S. S.

Turris congener (Smith, 1894).

1894. *Pleurotoma congener*, Smith, *Ann. & Mag. Nat. Hist.* (6) XIV, p. 160, pl. iii, figs. 4, 5.

1905. *Pleurotoma congener*, Melvill and Standen, *Journ. Bomb. Nat. Hist. Soc.* XVI (2), p. 223.

1917. *Pleurotoma (Gemmula) congener*, Vredenburg, *Rec. Ind. Mus.* XIII, pp. 315-320.

1940. *Turris* (*Gemmula*) *congener*, Winckworth, *Proc. Malac. Soc. London*, XXIV (1), p. 24.

The single specimen of this species in the collection has a shell with a narrow tuberculated band round the middle of its whorls. Vredenburg's note on some important peculiarities of the outer lip of its shell is of interest.

Distribution.—Originally described from west of Colombo, off the Coast of Ceylon, but subsequently recorded from off the Travancore and Malabar Coasts, Persian Gulf, Gulf of Oman, Andaman Sea, Bali Sea and near Batjan. The Coromandel Coast appears to be a new record.

***Turris vagata* (Smith, 1896).**

1896. *Pleurotoma vagata*, Smith, *Ann. & Mag. Nat. Hist.* (6) XVI, p. 3, pl. i, fig. 3.
 1906. *Pleurotoma vagata*, Smith, *Ann. & Mag. Nat. Hist.* (7) XVIII, p. 161.
 1906. *Pleurotoma vagata*, Smith, *Illustr. Zool. "Investigator"*, pl. xiv, figs. 3, 3a.

Of the three specimens of *T. vagata*, one is small and in good condition, while the other two are considerably larger but slightly worn. In all of them, however, the characteristic tuberculated keel on the middle of the whorls is quite conspicuous.

Distribution.—Off Trincomalee, off the Travancore and Malabar Coasts, W of Malabar Coast and off the Andaman Islands.

Subfamily CLAVATULINAE.

Genus ***Clavatula*** Lamarck, 1801.

Subgenus ***Turricula*** Schumacher, 1817.

Section ***Surcula*** H. & A. Adams, 1852.

***Clavatula javana* (Linnaeus, 1767).**

1767. *Murex javanus*, Linné, *Syst. Nat.* ed. XII, p. 1221, No. 550.
 1822. *Pleurotoma nodifera*, Lamarck, *Hist. Nat. Anim. Sans Verteb.* VII, p. 96.
 1925. *Surcula javana*, Thiele, *Wiss. Ergebn. Deutsch. Tiefsee-Exped.* XVII, p. 370.
 1929. *Clavatula* (*Surcula*) *javana*, Thiele, *Handb. der Syst. Weichtierk.* 1, p. 360.

One worn shell of pale yellow colour represents this species in the collection. The synonymy of the species is given by Hedley (1922)¹.

Distribution.—Panjim, Goa, Karachi, Bombay, Dar-es-Salaam, Sullivan Island, Ceylon, Pamban, Tranquebar, Madras, Annam, Gulf of Siam, Singapore, Java, Malacca, Pulo-Pinang, Queensland, the Philippines and Japan.

Order STYLOMMATOPHORA.

Family ONCIDIIDAE.

Genus ***Oncidium*** Buchanan, 1800 (Emend. Plate 1893).

¹ Hedley, C. *Rec. Austr. Mus.* XIII, p. 254 (1922).

Oncidium verruculatum Cuvier, 1830.

1830. *Onchidium verruculatum*, Cuvier, *Le Regne Animal* (2nd ed.), III, p. 46.
 1893. *Onchidium verruculatum*, Plate, *Zool. Jahrb.* VII, pp. 168-170, 232-234, pl. vii, figs. 15-21, pl. viii, figs. 26-29, 33, pl. ix, figs. 40, 42, pl. x, figs. 50a, 55, pl. xi, figs. 56, 60, pl. xii, figs. 83, 86, 88, 90, 98, 99.
 1928. *Oncidium verruculatum*, Hoffmann, *Zool. Jahrb.* LV, pp. 44, 45, 72-75.
 1933. *Oncidium verruculatum*, Awati, *Journ. Univ. Bomb.* 1(5), pp. 62, 70.
 1939. *Onchidium verruculatum*, Connolly, *Ann. S. Afric. Mus.* XXXIII, pp. 454-456.

This well-known species has only two specimens which have their mantles studded over with simple and compound tubercles. Connolly who has given the synonymy of the species considers *O. savignyii* and *O. peronii* Cuvier (1817) as identical with it.

Distribution.—Red Sea, Gulf of Suez, Karachi, Bombay, Owen Island, Natal, Madagascar, Krusadai Island, Pamban, Tranquebar, Ceylon, Singapore, Andamans, Nicobars, Java, Celebes, Malacca, Timor, New Guinea, Australia, Japan, New Caledonia, Honolulu and Oahu, and the Philippines. In distribution this species appears somewhat similar to *O. peronii* Cuv. (1804)¹.

Genus **Oncis** Plate, 1893.**Oncis Stuxbergi** (Westerlund, 1883).

1883. *Vaginulus stuxbergi*, Westerlund, *Nachr. Bl. Malak. Ges.* XV, p. 165.
 1885. *Onchidium coriaceum*, Semper, *Reisen im Archipel der Philippinen*, III, pp. 271-273, pl. xix, figs. 1, 16, pl. xxi, fig. 7, pl. xxiii, fig. 12.
 1928. *Oncis stuxbergi*, Hoffmann, *Zool. Jahrb.* LV, pp. 55, 56, 88, 89.
 1931. *Oncis coriacea*, Thiele, *Handb. der Syst. Weichtierk.* 1, p. 488.

The single specimen in the collection exhibits the distinctive characters of the species.

Distribution.—First described from Borneo, but later on from the Sullivan Island, Penang, Burma, Singapore, Nicobars, Java, Celebes, Malacca, Australia, Gulf of Siam, Cochinchina, and the Philippines. Its occurrence on the Coromandel Coast is, therefore, of interest.

Family **ARIOPHANTIDAE**.Subfamily **ARIOPHANTINAE**.Genus **Ariophanta** Desmoulins, 1829.Subgenus **Ariophanta** S. S.**Ariophanta interrupta** (Benson, 1832-34).

- 1832-34. *Helix interrupta*, Benson, *Zool. Journ.* V, p. 461.
 1943. *Ariophanta (Ariophanta) interrupta*, Ray, *Journ. Roy. As. Soc. Bengal, Sci.* IX, pp. 68, 69.

The single specimen of *interrupta* in the collection corresponds to Benson's description.

¹ Cuvier, G. L. C. F. D. *Ann. Mus. Nat. Hist. Paris*, V, p. 38 (1804).

Distribution.—Widely distributed in the Gangetic Provinces of India and the Himalayan Mountains. But records are also known from South India.

Ariophanta laevipes (Müller, 1774).

1774. *Helix laevipes*, Müller, *Verm. Terr. and Fluv. Hist.* II, p. 22.
 1876. *Helix trifasciata*, Hanley and Theobald, *Conch. Ind.*, p. 52, pl. cxxxi, fig. 4.
 1908. *Ariophanta (Ariophanta) laevipes*, Blanford and Godwin-Austen, *Faun. Brit. Ind. Moll.*, pp. 29, 30, Text—fig. 18.
 1931. *Ariophanta (Ariophanta) laevipes*, Thiele, *Handb. der Syst. Weichtierk.* 1, p. 631.

I assign to this species only one white shell ornamented with three chestnut spiral bands which are characteristic of the species. This peculiar feature perhaps gave some authors the opportunity of describing it as a new species under the name of *trifasciata*.

Distribution.—This land snail, like *Macrochlamys pedina* (Bens.), is very common in gardens of Bombay. It was originally described from the Rajpipla Hills, but has since been recorded from the Satpura Hills, Tranquebâr and Coromandel.

Class BIVALVIA.

Order TAXODONTA.

Family ARCIDAE.

Genus **Arca** Linnaeus, 1758.

Subgenus **Arca** S. S.

Section **Arca** S. S.

Arca deyrollei (Jousseaume, 1893).

1893. *Scapharca deyrollei*, Jousseaume, *Le Naturaliste*, 15e année, p. 191.
 1907. *Arca (Anadara) deyrollei*, Lamy, *Journ. de Conchyliol.* LV, p. 254. pl. iii, fig. 5.

The single specimen of the species in the collection has an inaequilateral shell with a marked concavity in the middle.

Distribution.—Penang, Tavoy Coast, Sandheads (River Hooghly) and Madras.

Section **Cunearca** Dall, 1898.

Arca rhombea Born, 1780.

1780. *Arca rhombea*, Born, *Test. Mus. Caes. Vindob.*, p. 90.
 1938. *Arca (Cunearca) rhombea*, Fischer and Fischer-Piette, *Bull. Mus. d'Hist. Nat. Paris*, (2)X (4), p. 406.
 1939. *Arca (Cunearca) rhombea*, Adam and Leloup, *Mem. Mus. Roy. Hist. Nat. Belg. II*, Fasc. 20, p. 44.

Two young pale rusty-red shells represent *A. rhombea* in the collection.

Distribution.—Elphinstone Island, Bombay, Madras, Ceylon, Salang, Sumatra, Java and the Chinese Seas.

Subgenus **Acar** (Gray) H. & A. Adams, 1857.

Section **Bathyarca** Kobelt, 1891.

Arca profundicola Verrill, 1885.

- 1885. *Arca profundicola*, Verrill, *Trans. Connect. Acad. Sci.* VI, p. 439, pl. xliv, figs. 23, 23a.
- 1886. *Arca (Barbatia) pteroessa*, Smith, *Rept. Chall. Lamellibr.*, p. 262, pl. xvii, fig. 4-b.
- 1907. *Arca (Bathyarca) profundicola*, Lamy, *Journ. de Conchyliol.* LV, p. 286.
- 1931. *Arca (Acar) profundicola*, Thiele and Jaeckel, *Wiss. Ergebn. Deutsch. Tiefsee-Exped.* XXI(1), pp. 172, 178.
- 1940. *Arca pteroessa*, Winckworth, *Proc. Malac. Soc. London*, XXIV(1), p. 26.

There are some dirty white shells of *A. profundicola* in the collection, which correspond to Verrill's description and figures. For a detailed synonymy of the species reference may be made to Lamy's paper cited above.

Distribution.—Ceylon, Bay of Bengal, Gulf of Guinea, Atlantic and the Pacific Oceans.

Subgenus **Argina** Gray, 1842.

Arca indica Gmelin, 1790.

- 1784. *Arca indiae orientalis*, Chemnitz, *Conch.-Cab.* VII, p. 196, pl. lv, fig. 543.
- 1790. *Arca indica*, Gmelin, *Syst. Nat.* ed. XIII, p. 3312, No. 27.
- 1909. *Arca (Scapharca) indica*, Lynge, *D. Kgl. Dansk. Vidensk. Selsk. Skr. Nat.-Math.* (7)V, p. 30, pl. ii, figs. 5-12.
- 1935. *Anadara (Argina) indica*, Reinhart, *Bull. Mus. Roy. Hist. Nat. Belg.* XI, p. 44.

The single specimen of *A. indica* has a whitish inaequilateral shell bearing thirty broad and flattened ribs on each valve. The concavity in the middle of the shell is also well-marked.

Distribution.—Originally described from Travancore, but subsequently from Bombay, Madras, Pulicat Lake, Sumatra, N.-W. Australia and the Gulf of Siam.

Subgenus **Barbatia** Gray, 1842.

Arca obtusoides Nyst, 1848.

- 1848. *Arca obtusoides*, Nyst, *Mém. Acad. Roy. Belg.* XXII, p. 50.
- 1932. *Arca (Barbatia) obtusoides*, Prashad, *Siboga Exped. Monogr. Pelecypoda*, LIIIC, p. 47.
- 1936. *Barbatia obtusoides*, Hirase, *A Coll. of Jap. Shells*, p. 3, pl. ii, fig. 3.

The modiola-like form of the shell with beak-like anterior and broad posterior ends is a remarkable feature of this species.

Distribution.—Widely distributed in Bombay, Madras, Ceylon, Bay of Labuan Tring, West Coast of Lombok, the Philippines, China, Japan, Korea and New Caledonia.

Family LIMOPSIDAE.

Genus **Limopsis** Sasso, 1827.

Subgenus **Limopsis** S. S.

Limopsis indica Smith, 1894.

1894. *Limopsis indica*, Smith, *Ann. & Mag. Nat. Hist.* (6) XIV, p. 171, pl. v fig. 7.
 1932. *Limopsis indica*, Prashad, *Siboga Exped. Monogr. Pelecypoda*, LIIIC, p. 59.
 1940. *Limopsis indica*, Winckworth, *Proc. Malac. Soc. London*, XXIV(1), pp. 19, 26.

This species is well-represented in the collection by a large number of specimens which correspond to Smith's description and figure.

Distribution.—Off Ceylon and off Travancore Coast, off Maldives and off Minikoi Island in the Arabian Sea.

Order ANISOMYARIA.

Family MYTILIDAE.

Genus **Lithophaga** Röding, 1798.

Subgenus **Botula** Mörch, 1853.

Lithophaga cinnamomea (Lamarck, 1819).

1819. *Modiola cinnamomea*, Lamarck, *Hist. Nat. Anim. Sans Verteb.* VI, p. 114.
 1926. *Lithophaga (Botula) cinnamomina*, Pallary, *Mem. Inst. Egypte*, XI, p. 115, pl. xv, figs. 1-3, 8.
 1932. *Lithophaga (Botula) cinnamomea*, Prashad, *Siboga Exped. Monogr. Pelecypoda*, LIIIC, pp. 79, 80.
 1937. *Lithophaga cinnamomina*, Viader, *Maur. Inst. Bull.* 1(2), p. 60.

In the two fine specimens of *L. cinnamomea* the shell is peculiarly chestnut-coloured and has a swollen wedge-shaped modiola-like form. Prashad has given the full synonymy of this well-known species.

Distribution.—A list of records of its distribution is furnished by Lynge (1909, p. 138.).

Subgenus **Lithophaga** S. S.

Lithophaga cumingiana (Reeve, 1857).

1857. *Lithodomus cumingianus*. Reeve, *Conch. Icon.* X, pl. ii, figs. 8a, 8b.
 1941. *Lithophaga cumingiana*, Gravely, *Bull. Mad. Govt. Mus. (N. S.)*, V(1), pp. 37, 97.
 1942. *Lithophaga cumingiana*, White, *Proc. Malac. Soc. Lond.* XXV(2), p. 49.

Two specimens with partly broken shells of pale brown colour and having tapered posterior ends represent the species in the collection.

Distribution.—Gulf of Suez, Gwadur, Karachi, Madras, North Australia, Mazatlan and the Philippines.

Family PINNIDAE.

Genus **Pinna** Linnaeus, 1758.

Subgenus **Atrina** Gray, 1842.

Section **Atrina** S. S.

Pinna vexillum Born, 1880.

1780. *Pinna vexillum*, Born, *Test. Mus. Caes. Vindob.*, p. 134, pl. vii, fig. 8.

1785. *Pinna nigra*, Chemnitz, *Conch-Cab.* VIII, p. 221, pl. lxxxviii, fig. 774.

1938. *Pinna (Atrina) vexillum*, Lamy, *Bull. Mus. Hist. Nat. Paris*, (2)X (4), pp. 397, 399, 400.

1942. *Pinna vexillum*, Crichton, *Journ. Bomb. Nat. Hist. Soc.* XLII, p. 196.

P. vexillum or "Fan-Oyster", as it is commonly known, is a greatly variable species which is represented in the collection by one young specimen only. The shell is smooth and slightly spinous and has a characteristic dark-brown colour of the species. Winckworth¹ treats *P. nigrina* Lam. (1819) as distinct, while Lamy, Dautzenberg and Prashad merge it with *P. vexillum*. A detailed list of its synonymy is given by Prashad.

Distribution.—Red Sea, Persian Gulf, Mauritius, Madagascar, Mozambique, King Island, Elphinstone Island, Amboina, Madras, Ennur, Trincomalee, Mergui, Andamans, Indo-China, Singapore, Sumatra, New Guinea, Poulo-Condor, North Australia, the Philippines, New Caledonia, Japan and Society Islands.

Family ANOMIIDAE.

Genus **Anomia** (Linné) Müller, 1776

Subgenus **Anomia** S. S.

Section **Anomia** S. S.

Anomia achaeus Gray, 1849.

1849. *Anomia achaeus*, Gray, *Proc. Zool. Soc. London*, p. 116.

1932. *Anomia (Anomia) achaeus*, Prashad, *Siboga Exped. Monogr. Pelecypoda*, LIIIC, pp. 29, 30, pl. i, figs. 54-57.

1941. *Anomia achaeus*, Gravely, *Bull. Mad. Govt. Mus. (N. S.)*, V(1), pp. 41, 98, fig. 16d.

There are only two specimens in the collection which belong to this common and variable species. For a detailed synonymy reference may be made to Prashad's paper cited above.

Distribution.—Persian Gulf, Aden, Karachi, Bombay, Madras, Ceylon, Calcutta, Penang, Malacca, Kawa Bay and Ambon Anchorage.

¹ Winckworth, R. *Proc. Malac. Soc. London*, XVIII, pp. 287, 288 (1931).

Genus **Placenta** Retzius, 1788.

Subgenus **Placenta** S. S.

Placenta placenta (Linnaeus, 1758).

1758. *Anomia placenta*, Linné, *Syst. Nat.* ed. X, p. 703, No. 205.
 1788. *Placenta orbicularis*, Retzius, *Diss. Sist. Nova Test. Gen.*, p. 15.
 1931. *Placenta (Placenta) placenta*, Oostingh, *Archiv f. Molluskenk.* LXIII, p. 228.
 1939. *Placuna placenta*, Moses, *Journ. Bomb. Nat. Hist. Soc.* XLI(1), pp. 119-122.

The two young specimens of *P. placenta* in the collection have more or less orbicular shells provided with the characteristic V-shaped ribs on the inner surface of their dorsal valves.

Distribution.—This is the most common “Window-pane oyster” which has an extensive range in the Indo-Pacific. Moses has enumerated the localities of its distribution in different parts of Baroda, laying particular stress on its fishery.

Family OSTREIDAE.

Genus **Ostrea** Linnaeus, 1758.

Ostrea gryphoides (Schlotheim, 1813)

var. **cuttackensis** Newton and Smith, 1912.

1912. *Ostrea gryphoides* var. *cuttackensis*, Newton and Smith, *Rec. Geol. Surv. Ind.* XLII(1), pp. 13-15, pl. vii & pl. viii, figs. A, B.
 1921. *Ostrea gryphoides* var. *cuttackensis*, Hornell, *Mad. Fish. Bull.* XIV(6), p. 170.

The single specimen in the collection, though young, appears to agree in its general form and the character of the adductor scar with Newton and Smith's description and figure.

Distribution.—So far known from Hukitola near False Point on the Cuttack Coast, Orissa, and Clive Street excavations at Calcutta. Coromandel Coast appears to be a new record.

Ostrea arakanensis SOWERBY, 1871.

1871. *Ostrea arakanensis* and *O. nigromarginata*, Sowerby, *Conch. Icon.* XVIII, pl. xxxiii, figs. 83, 85.
 1916. *Ostrea madrasensis*, Preston, *Rec. Ind. Mus.* XII, pp. 33-35, figs. 11, 11a.
 1931. *Ostrea arakanensis*, Winckworth, *Proc. Malac. Soc. London*, XIX, p. 189.
 1939. *Ostrea arakanensis*, Panikkar and Aiyar, *Proc. Ind. Acad. Sci.* IXB(6), p. 356.
 1942. *Ostrea madrasensis*, Paul, *Proc. Ind. Acad. Sci.* XVB (I), p. 2.

O. arakanensis is the most common edible mud or backwater oyster of Madras. It is extremely variable in form and, as such, described under various names by different authors. The single specimen in the collection appears to be quite typical of the species.

Distribution.—It is quite common in the Madras Presidency, but its range also extends as far as Arakan on the east. Panikkar and Aiyar have described the breeding habits of this animal, while Winckworth has discussed its synonymy.

Order EULAMELLIBRANCHIATA.

Suborder SCHIZODONTA.

Family UNIONIDAE.

Subfamily UNIONINAE.

Genus *Parreysia* Conrad, 1853¹.

Subgenus *Parreysia* S. S.

Parreysia corrugata (Müller, 1774)

var. *laevirostris* (Benson, 1862).

1862. *Unio laevirostris*, Benson, *Ann. & Mag. Nat. Hist.* (3)X, pp. 191, 192.

1876. *Unio corrugatus* var. *laevirostris*, Hanley and Theobald, *Conch. Ind.*, p. 21, pl. xlv, figs. 5, 6.

1915. *Parreysia* (*Parreysia*) *corrugata* var. *laevirostris*, Preston, *Faun. Brit. Ind. Moll. Freshw. Gastr. & Pelec.*, p. 156.

There are only two very beautiful specimens of this variety in the collection. The shell is thick, more or less yellowish, and the two raised dark rays on the posterior slopes are quite conspicuous.

Distribution.—Hutton first found this interesting variety in tanks and streams near the Fort of Chunar, above Banaras, U. P., but subsequently its range has been extended to the Chittagong Hills, Sudiya, Arrah and Hyderabad. It has not been recorded before from the Coromandel Coast of India.

Suborder HETERODONTA.

Family CORBICULIDAE.

Subfamily CORBICULINAE.

Genus *Corbicula* Megerle von Mühlfeldt, 1811.

Corbicula striatella Deshayes, 1854.

1928. *Corbicula striatella*, Prashad, *Mém. Ind. Mus.* 1X, pp. 18-20, pl. iii, figs. 9-11.

1943. *Corbicula striatella*, Ray, *Journ. Roy. As. Soc. Bengal, Sci.* IX, p. 77.

Six specimens of this extremely variable species are found in the collection. Prashad has discussed in detail the chief characteristics and the wide range of distribution of this well-known species in the paper already referred to.

¹ This genus was considered by Prashad (*Proc. Malac. Soc. London*, XXII, p. 120, 1936) as a synonym of *Potomida* Swainson (1840) and I also supported his view (*Journ. Roy. As. Soc. Bengal, Sci.* IX, p. 77, 1943). But recently Ellis (*Proc. Malac. Soc. London*, XXVII, pp. 105-108, 1946), after a careful study of the shell characters, has ranked both as generically distinct.

Family LIBITINIDAE.

Genus **Libitina** Schumacher, 1817.Subgenus **Libitina** S. S.**Libitina vellicata** (Reeve, 1843).

1843. *Cypricardia vellicata*, Reeve, *Proc. Zool. Soc. London*, p. 195.
 1918. *Trapezium sublaevigatum*, Lamy, *Journ. de Conchyliol.* LXIV, pp. 276-278, pl. viii, figs. 7, 8.
 1941. *Libitina vellicata*, Gravely, *Bull. Mad. Govt. Mus. (N.S.)*, V(1), pp. 44, 99, fig. 18.

A single specimen with whitish irregular shell represents *L. vellicata* in the collection. It is peculiarly pinched near the anterior part of its ventral margin, but is devoid of any purplish brown ray at its posterior end, as in the case of specimens recorded from the Gulf of Siam, Japan, Philippines and North Australia. Lamy has given the full synonymy of this species in the paper cited.

Distribution.—The range of this fairly common species extends from the Persian Gulf and Madagascar to the Philippines and Japan.

Family CARDIIDAE.

Genus **Cardium** Linnaeus, 1758.Subgenus **Trachycardium** Mörch, 1853.**Cardium flavum** Linnaeus, 1758.

1758. *Cardium flavum*, Linné, *Syst. Nat.* ed. X, p. 680, No. 71.
 1819. *Cardium rugosum*, Lamarck, *Hist. Nat. Anim. Sans Verteb.* VI, p. 10.
 1932. *Cardium (Trachycardium) flavum*, Prashad, *Siboga Exped. Monogr. Pelecypoda*, LIIIC, pp. 266-268.
 1939. *Laevicardium (Trachycardium) flavum*, Adam and Leloup, *Mém. Mus. Roy. Hist. Nat. Belg.* II, Fasc. 20, pp. 71-72.

The single specimen of *C. flavum* in the collection has a yellowish shell nicely banded on the surface with dark red spots. Prashad and Oostingh (with whom I also quite agree) consider *C. dupuchense* Rv. as identical with *C. flavum*, but Fischer and Fischer-Piette (*loc. cit.*, p. 409, 1938) separate it from the latter as a variety, while Dautzenberg ranks it as distinct.

Distribution.—Widely distributed throughout the Indo-Pacific, but its range also extends as far as the Red Sea and the Gulf of Suez.

Genus **Corculum** Röding, 1798.Subgenus **Fragum** Röding, 1798.**Corculum simillimum** (Smith, 1896).

1896. *Cardium (Fragum) simillimum*, Smith, *Ann. & Mag. Nat. Hist.* (6) XVIII, p. 372.

1898. *Cardium (Fragum) simillimum*, Smith, *Illustr. Zool. "Investigator"*, pl. vii, figs. 6, 6a.
 1937. *Cardium simillimum*, Viader, *Maur. Inst. Bull.* 1(2), p. 68.
 1940. *Corculum (Fragum) simillimum*, Winckworth, *Proc. Malac. Soc. London*, XXIV(1), p. 27.

Nine complete shells and four valves of *C. simillimum* are found in the collection; these agree in their essential shell characters with Smith's description and figure.

Distribution.—This extremely rare form has so far been recorded from off the Colombo Lighthouse, Ceylon, and Mauritius. Its occurrence on the Coromandel Coast is, therefore, of interest.

Family VENERIDAE.

Subfamily DOSINIINAE.

Genus *Dosinia* Scopoli, 1777.

Dosinia aspera (Reeve, 1850).

1850. *Artemis aspera*, Reeve, *Conch. Icon.* VI, pl. ix, fig. 49.
 1852. *Artemis aspera*, Sowerby, *Thes. Conch.* II(13), p. 668, pl. clxiii, fig. 56.
 1863. *Dosinia aspera*, Römer, *Norit. Conch.* II, *Suppl.* 1, *Dosinia*, pp. 56, 57, pl. x, fig. 4.

The single specimen of *D. aspera* in the collection has a shell sculptured with fine and sharp concentric striae, which are slightly raised at the sides, particularly at the edge of the ligamental area.

Distribution.—Penang, Maungmagan, Port Curtes and Manila. The Coromandel Coast is a new record¹.

Subfamily MERETRICINAE.

Genus *Meretrix* Lamarck, 1799.

Meretrix meretrix (Linnaeus, 1758)

var. *castanea* (Lamarck, 1835).

1835. *Cytherea castanea*, Lamarck, *Hist. Nat. Anim. Sans Verteb.* VI, p. 299.
 1917. *Meretrix meretrix* var. *castanea*, Horucll, *Rec. Ind. Mus.* XIII, p. 161, pl. iv, fig. 12.
 1932. *Meretrix meretrix* var. *castanea*, Prashad, *Siboga Exped. Monogr. Pelecypoda*, LIIIC, p. 215.
 1937. *Meretrix castanea*, Lamy et Fischer-Piette, *Bull. Mus. Hist. Nat.* (2)IX (2), p. 157.

This variety is represented in the collection by only two shells which are of uniform chestnut colour, with the vulva distinctly much darker than the rest of the body.

Distribution.—Bombay, Madras, Tuticorin, Tambraparni delta, Malabar, Trincomalee, Tampalakam, Hinzé Basin, Arakan, Tavoy Coast, Singapore, Lombok and the Philippines.

¹ There was one specimen of *Dosinia excisa* Phil. also in the collection, but this has unfortunately been lost in the Varuna flood. This species is very common in Madras and Bombay.

Subfamily *VENERINAE*.Genus **Gafrarium** Röding, 1798.Subgenus **Gafrarium** S. S.**Gafrarium divaricatum** (Dillwyn, 1817).

1817. *Venus divaricata*, Dillwyn, *Descr. Cat. Rec. Shells*, 1, p. 200.
 1939. *Gafrarium* (*Gafrarium*) *divaricatum*, Adam and Leloup, *Mem. Mus. Roy. Hist. Nat. Belg.* II, Fasc. 20, p. 82, pl. v, fig. 4.
 1942. *Gafrarium divaricatum*, White, *Proc. Malac. Soc. London*, XXV(2), p. 72.

The single shell in the collection can easily be recognized by its strong divaricate plications on the surface. The dark-brown streaks and spots are not very prominent.

Distribution.—This is the most common species of the genus and its range extends from the Red Sea and Persian Gulf to the Philippines and Japan.

Genus **Katelsia** Römer, 1857.Subgenus **Eumarcia** Iredale, 1924.**Katelsia opima** (Gmelin, 1790).

1782. *Venus pinguis*, Chemnitz, *Conch. Cab.* VI, p. 355, pl. xxxiv, figs. 355-357.
 1790. *Venus opima*, *V. triradiata* and *V. nebulosa*, Gmelin, *Syst. Nat.* ed. XIII, p. 3279, nos. 44-46.
 1939. *Katelsia* (*Eumarcia*) *opima*, Adam and Leloup, *Mém. Mus. Roy. Hist. Nat. Belg.* II, Fasc. 20, p. 86.
 1939. *Marcia* (*Hemitapes*) *opima*, Lamy and Fischer-Piette, *Bull. Nat. Hist. Nat.* (2) XI (2), p. 258.
 1941. *Katelsia opima*, Gravely, *Bull. Mad. Govt. Mus. (N.S.)*, V(1), pp. 49, 51, 52, 55, 81, fig. 201.

A single specimen with a turgid shell of fulvous cream colour represents *K. opima* in the collection. A detailed synonymy of this species is given by Adam and Leloup in the paper already referred to.

Distribution.—This backwater clam is extremely common in Bombay, but has also been recorded from Madras, Tranquebar, Pamban, Pulicat Lake, Dutch Bay, Ceylon, Chilka Lake, Arakan, Maungmagan and Sumatra.

Subgenus **Hemitapes** Römer, 1864.**Katelsia marmorata** (Lamarck, 1835).

1835. *Venus marmorata*, Lamarck, *Hist. Nat. Anim. Sans Vertéb.* VI, p. 361.
 1872. *Tapes* (*Hemitapes*) *marmorata*, *T. variabilis* and *T. laterisulca*, Römer, *Monogr. Venus*, II, p. 104, pl. xxxiv, fig. 3a-c, p. 106, pl. xxxvi, fig. 1a-c, p. 107, pl. xxxvi, fig. 2a-e.
 1931. *Katelsia marmorata*, Winckworth, *Proc. Malac. Soc. London*, XIX(4), p. 139.
 1941. *Paphia marmorata*, Gravely, *Bull. Mad. Govt. Mus. (N.S.)*, V(1), p. 52.

Three specimens of this extremely common backwater species have concentrically grooved shells, each being ornamented with three broad dark-brown longitudinal bands.

Distribution.—This form is known from various localities from Karachi to the Philippines.

Genus **Paphia** Röding, 1798.

Section **Protapes** Dall, 1902.

Paphia gallus (Gmelin, 1790).

1790. *Venus gallus*, Gmelin, *Syst. Nat.* ed. XIII, p. 3277, No. 37.

1932. *Paphia* (*Protapes*) *gallus*, Prashad, *Siboga Exped. Monogr. Pelecypoda*, LIIIC, p. 233.

1941. *Paphia malabarica*, Gravely, *Bull. Mad. Govt. Mus. (N.S.)*, V(1), p. 52, fig. 20n.

P. gallus is a greatly variable marine form and is represented in the collection by only one young specimen. The shell is devoid of any longitudinal rays on the surface, but has a somewhat flexuous posterior side. For a detailed synonymy Prashad's paper may be consulted.

Distribution.—Widely distributed throughout the Indo-Pacific.

Paphia cor (Sowerby, 1853).

1853. *Venus cor*, Sowerby, *Thes. Conch.* II(14), p. 727, pl. clx, fig. 184.

1872. *Tapes* (*Hemitapes*) *cor*, Römer, *Monogr. Venus*, II, p. 103, pl. xl, fig. 4a-b.

1893. *Venus* (*Chione*) *cor*, Melvill and Abercrombie, *Mém. Manchest. Lit. and Phil. Soc.* (4)VII, p. 46.

P. cor is represented in the collection by only two yellowish shells of trapeziformly globose shape, which are more or less rusted and sculptured with numerous small irregular undulating concentric ridges.

Distribution.—Originally described from the River Indus, Karachi but subsequently recorded from Bombay, Cutch, Kathiwar and South India.

Section **Paratapes** Stoliezka, 1871.

Paphia textile (Gmelin, 1790).

1790. *Venus textile*, Gmelin, *Syst. Nat.* ed. XIII, p. 3280, No. 51.

1935. *Paphia* (*Paratapes*) *textile*, Thiele, *Handb. der Syst. Weichtierk.* II, p. 893.

1942. *Paphia textile*, Crichton, *Journ. Bomb. Nat. Hist. Soc.* XLII, p. 331.

I assign to this species two young specimens only which have smooth and yellowish shells entirely devoid of the characteristic textile paintings. Prashad (*loc. cit.*, pp. 239, 240) has given a detailed list of synonymy of this species.

Distribution.—This is a very common Indo-Pacific form and its range extends as far as the Red Sea.

Genus **Venerupis** Lamarck, 1818.

Subgenus **Venerupis** S. S.

Venerupis dashamii sp. nov.

(Plate III, figs. 6, 7.)

Shell triangularly-ovate, solid, more or less regular, aequilateral, pale creamy, inflated, nicely sculptured with fine equidistant radial riblets, crossed by distant crenulated concentric laminae which are broad, fluted and slightly obliquely angular posteriorly, from the middle downwards the laminae are much more close; anterior side bluntly rostrated, posterior side very broad and rounded; umbones situated almost in the middle of the shell, slightly prominent, anterior margin slopingly straight, posterior margin slightly raised and arched, ventral margin convex, but curving a little immediately beyond the middle line, gradually becomes narrow upwards so as to form the blunt rostrum in front; anterior muscular impression shallow, elongately-oval, pointed in front and larger than the posterior one which is slightly smaller and deeper, but more or less oval; the lunule is sinuous posteriorly. The animal is of chocolate-brown colour. The shell measures 29 mm. in length, 23 mm. in height and 18 mm. in thickness.

Type-locality.—The single specimen in the collection was collected by Professor P. R. Awati from the Coromandel Coast of India, Madras.

Holotype.—Reg. No. M15940/2 Zool. Surv. Ind.

Remarks.—*Venerupis dashamii* can readily be distinguished from all other species of the genus by its broad and rounded posterior end and bluntly rostrated anterior end. In the nature of the laminae this species somewhat approaches *V. vertumnalium* Melvill (1918)¹ from Karachi which has wrongly been described as *Cypricardia*.

Family DONACIDAE.

Genus **Donax** Linnaeus, 1758.

Subgenus **Hecuba** Schumacher, 1817.

Donax scortum (Linnaeus, 1758).

1758. *Venus scortum*, Linné, *Syst. Nat.* ed. X, p. 686, No. 103.

1939. *Donax (Hecuba) scortum*, Adam and Leloup, *Mém. Mus. Roy. Hist. Nat. Belg.* II, Fasc. 20, pp. 90, 91.

This widely-distributed Indo-Pacific form has a single shell in the collection which appears to be quite typical of the species.

Family PHOLADIDAE.

Subfamily *MARTESIINAE*.

Genus **Martesia** (Leach) Blainville, 1825.

Section **Martesia** S. S.

Martesia striata (Linnaeus, 1758).

1758. *Pholas striata*, Linné, *Syst. Nat.* ed. X, p. 669, No. 12.

1909. *Pholas (Martesia) striata*, Lynge, *D. Kgl. Dansk. Vidensk. Selsk. Shr. Nat.-Math.* (7)V, pp. 187, 188.

¹ Melvill, J.C. *Ann. & Mag. Nat. Hist.* (9) 1, p. 157, pl. v, fig. 34 (1918).

1936. *Martesia striata*, Calman and Crawford, *Brit. Mus. (Nat. Hist.) Econ. Ser. X*, pp. 1-38.

This well-known boring mollusc is represented in the collection by one typical specimen only.

It is by far the most widely distributed species of the genus and its range extends to Europe, Africa, America, India, Ceylon, Burma, Malay Archipelago, Siam, Annam, the Philippines, China, Japan and Polynesia.

***Martesia multistriata* (Sowerby, 1849).**

1849. *Pholas multistriata*, Sowerby, *Thes. Conch.* II(10), p. 494, pl. civ, figs. 35, 36.
 1932. *Martesia multistriata*, Prashad, *Siboga Exped. Monogr. Pelecypoda*, LIIC, p. 318.
 1938. *Martesia multistriata*, Suvatti, *Moll. of Siam, Bangkok*, p. 71.

The single shell of *M. multistriata* in the collection has exceedingly fine striae on its umbonal part.

Distribution.—Majunga, Ankify (Decary), Gwadur, Cutch, Kathiawar, Hinzé Basin, Byikhwaaw Bay, Macassar, Mekong, Gulf of Siam, Annam, Turtle's Island, N. Coast of Australia. It does not appear to have been recorded so far from the Coromandel Coast.

Suborder ANOMALODESMATA.

Family MYOCHAMIDAE.

Genus ***Myodora*** Gray, 1840.

***Myodora quadrata* Smith, 1899.**

1899. *Myodora quadrata*, Smith, *Ann. and Mag. Nat. Hist.* (7) IV, p. 250.
 1901. *Myodora quadrata*, Smith, *Illustr. Zool. "Investigator"*, pl. xiii, figs. 5, 5a.
 1932. *Myodora quadrata*, Prashad, *Siboga Exped. Monogr. Pelecypoda*, LIIC, p. 322.
 1936. *Myodora quadrata*, Lamy, *Journ. de Conchyliol.* LXXIX(3), p. 256.
 1940. *Myodora quadrata*, Winckworth, *Proc. Malac. Soc. London*, XXIV(1), p. 28.

Seven right valves, of which only two are complete and the rest partly broken, and two broken pieces of a left valve represent the species *quadrata* in the collection. The concentric sulcations are stronger in the former than in the latter. It is closely allied to *M. weberi* Prashad.

Distribution.—So far known from off the Travancore Coast, Dares-Salam and off the Andaman Islands, but not from the Coromandel Coast.

Class CEPHALOPODA.

Subclass DIBRANCHIA.

Order OCTOPODA.

Family OCTOPODIDAE.

Subfamily OCTOPODINAE.

Genus **Octopus** Lamarck, 1798.

Subgenus **Octopus** S. S.

Octopus cyanea Gray, 1849.

1849. *Octopus cyanea*, Gray, *Cat. Moll. Brit. Mus.* Part 1, p. 15.

1885. *Octopus marmoratus*, Hoyle, *Ann. and Mag. Nat. Hist.* (5)XV, pp. 227, 228.

1929. *Octopus (Octopus) cyanea*, Robson, *A Monograph of the Recent Cephalopoda*, Part 1, pp. 94-98.

Of the two specimens of this greatly variable species, one is quite young. Robson has given a detailed list of records of distribution of this common species.

Order DECAPODA.

Family SEPIIDAE.

Genus **Sepiella** (Gray) Steenstrup, 1880.

Sepiella inermis Férussac et d'Orbigny, 1839.

1839. *Sepiella inermis*, Fér. et d'Orbig., *Hist. Nat. gen. et part Les Cephalopodes Acetabulifères viv. et foss.*, p. 286.

1916. *Sepiella inermis*, Massy, *Rec. Ind. Mus.* XII, p. 231-237, pl. xxiii, fig. 6 (radula), pl. xxiv, figs. 1-8 (shells), 9 (mandibles).

1939. *Sepiella inermis*, Adam, *Siboga Exped. Cephalopoda*, LVb, pp. 93-98, Text-figs. 1-5, pl. iv, figs. 5, 6.

1941. *Sepiella inermis*, Gravely, *Bull. Mad. Govt. Mus. (N.S.)*, V(1), p. 69, fig. 25c.

Two specimens in the collection belong to this species. Adam has recently discussed the chief diagnostic features of this species.

Distribution.—*S. inermis* is a very common species of the Indo-Malayan Region, but its range seems to extend through East Indies to Japan also.

EXPLANATION OF PLATE III.

Mollusca from the Coromandel Coast.

Gibbula (Enida) nobonii, sp. nov.

FIG. 1.—Dorsal view of the Holotype $\times 5\frac{1}{4}$.

FIG. 2.—Ventral view of the same showing the columella with its median oblique ridge and marginal tubercles $\times 5\frac{1}{4}$.

Bursa awatii, sp. nov.

FIG. 3.—Dorsal view of the Holotype $\times 1\frac{1}{2}$.

FIG. 4.—Ventral view of the same $\times 1\frac{1}{2}$.

FIG. 5.—Outer lip of the same showing its division into interspaces and the number of denticles present $\times 1\frac{1}{2}$.

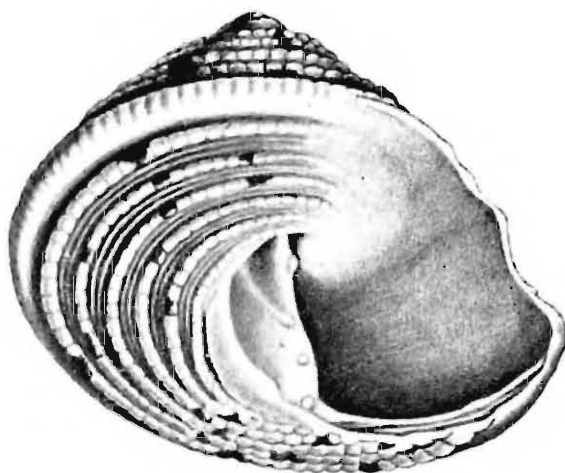
Venerupis (Venerupis) dashamii, sp. nov.

FIG. 6.—Outer view of the Holotype $\times 1\frac{1}{2}$.

FIG. 7.—Inner view of the same.



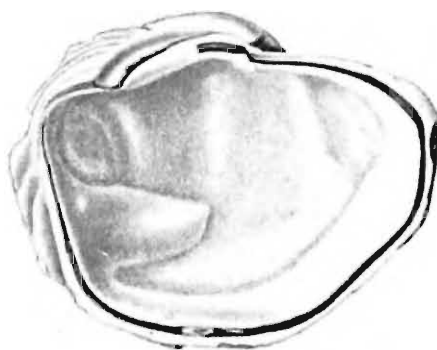
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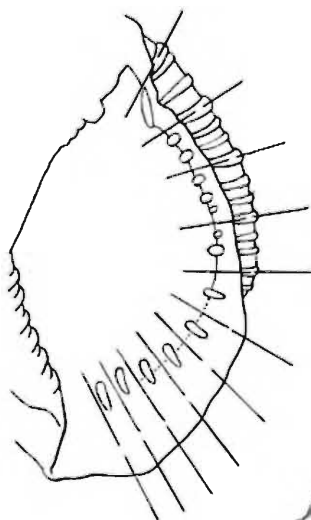
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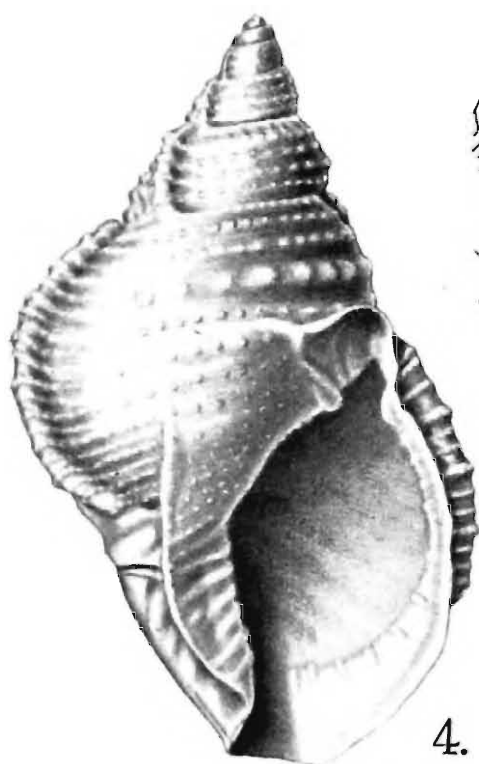
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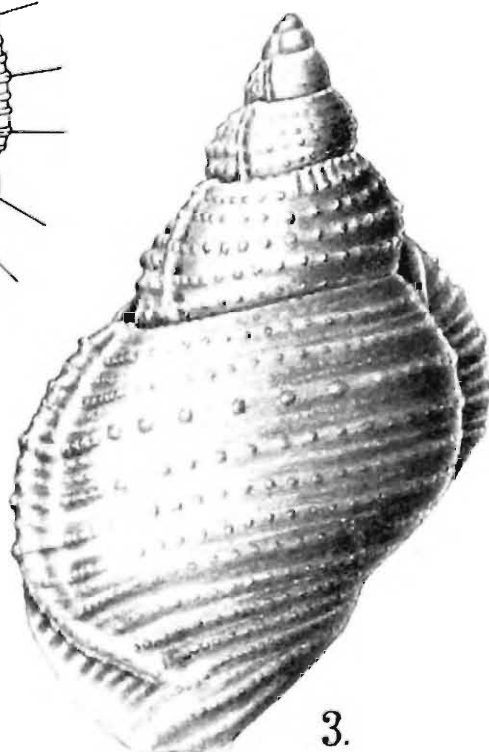
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4.



3.

MOLLUSCA FROM THE COROMANDEL COAST

CONTRIBUTIONS TO THE FAUNA OF MANIPUR STATE, ASSAM.

PART I. GENERAL INTRODUCTION.

By M. L. ROONWAL¹, *M.Sc., Ph.D. (Cantab.), F.N.I., Hony. Major,*
Zoological Survey of India, Calcutta.

[PLATE IV.]

CONTENTS.

	PAGE.
I. General	123
II. Physiography, Climate, etc. of Manipur	124
III. Acknowledgments	126
IV. References	126

I. GENERAL.

While serving as Mammalogist to the General Headquarters (India) Field Typhus Research Team, based on Imphal (Manipur, Assam), during the last year of the War (1945), the writer took the opportunity of making a general zoological collection covering several groups of animals, particularly the following :—

(1) Mammals, (2) Birds, (3) Reptiles, (4) Fishes, (5) Insects, spiders, parasitic mites and some other Arthropods, and (6) Helminths from mammals.

Of these, the largest collections belonged to the mammals, birds, insects and spiders ; a few molluscs and Crustacea were also collected. With the permission of the Army Headquarters, India, these collections have been incorporated with the Reserve Collections of the Zoological Survey of India.

As Manipur is, zoologically speaking, a comparatively rather poorly known area, except in regard to certain groups such as fishes, molluscs, the larger mammals, etc., the collections in other groups are likely to be of considerable systematic and distributional interest. It has, therefore, been considered worthwhile to study the collections and to issue the systematic results in a series of contributions by the writer, and by other specialists as available. The field notes, where given, are all by the writer.

My collections cover a continuous period of six months from the beginning of July until the end of December 1945. They were made mostly in the Imphal Valley, in the stretch of country about two miles on either side of the metalled Dimapur-Imphal Road from about Milestone 105 to Imphal on the north, a distance of 28 miles ; and a similar stretch on the Imphal-Tamu Road from Imphal to about Milestone 37, eight miles beyond Palel. This continuous stretch was, therefore, about 65 miles in length and about 4 miles wide (Pl. IV). The

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area between Milestones 110 and 118, which was most intensively surveyed, has been referred to as the "Kanglatongbi area" after the village of Kanglatongbi (Milestone 121). The "Kanglatongbi Field Typhus Station" was situated near the road at Milestone 117; and the main Base Laboratory about $1\frac{1}{2}$ miles away from the road off Milestone 127 and about 6 miles north of Imphal town. A few mammals were also collected in the Kabaw Valley up to Kalewa on the R. Chindwin in western Burma.

In addition to this collection, the mammal and bird reports will also include an account of the collections made in Manipur by a party of the Zoological Survey of India in February 1936—this collection was made in the Imphal Valley and in the western hills of Manipur along the Imphal-Silchar road, the collecting stations and dates of collection (1936) being as follows:—"Manipur" [=Imphal] (4 Feb.), Karong (5 Feb.), Tairenpokpi (7 Feb.), Luanglong Khunow and Luanglong Khulen (9 Feb.), Regailous Camp (9 and 11 Feb.), Nanglea Atrow (12-14 Feb.), and Kalanaga (15-16 Feb.).

The following is a list of all the collecting localities (Pl. IV), with their altitudes in feet above sea-level:—

I—Manipur.

(a) <i>Imphal-Dimapur Road.</i>					
Imphal town	..	..	..	..	2,570 feet.
Kanglatongbi Village (Milestone 121) ..	..	..	..	..	2,930 feet.
"Kanglatongbi area" (Milestones 110-118)	3,000-3,500	feet.			
Modbung (off Milestone 117)	..	..	..	..	3,750 feet.
Kangpokpi (Milestone 105)	..	..	..	..	3,750 feet.
Karong	..	..	..	..	circa 4,500 feet.
(b) <i>Imphal-Palel-Tamu Road.</i>					
Palel (Milestone 129)	..	..	..	..	2,500 feet.
Milestone 34	..	..	..	..	3,750 feet.
Milestones 35-37	..	..	..	..	circa 4,000 feet.
(c) <i>Imphal-Ukhrul Road.</i>					
Ukhrul	..	..	..	..	circa 3,500 feet.
(d) <i>Imphal-Silchar Road.</i>					
Tairenpokpi	..	..	..	..	3,000 feet.
Luanglong Khulen (Gangloangmai) ..					} circa 3,250 feet.
Luanglong Khunow (Gangloangnamthanmai)					
Regailous Camp	..	..	..	..	
Nanglea Atrow	..	..	..	..	
Kalanaga (Oinamlong)	..	..	..	..	

II—Western Burma.

Moreh	..	..	..	..	..	circa 580 feet.
Tamu	..	..	..	..	..	580 feet.
Kindat	..	..	..	..	..	400 feet.
Kalewa	..	..	..	..	..	360 feet.

II. PHYSIOGRAPHY, CLIMATE, ETC. of MANIPUR.

Manipur State lies at the extreme east of India and abuts on Burma. It is situated between $23^{\circ} 50'$ and $25^{\circ} 41'$ north latitudes and $93^{\circ} 2'$ and $94^{\circ} 47'$ east longitudes, and covers an area of about 8,456 square miles.

The greater part of Manipur is hilly and varies in altitude from about 2,600 feet (Imphal or Manipur Valley) to about 10,000 feet (Mao Thana peak in N. Manipur) above sea-level. The hill-ranges generally run

north to south. The Imphal Valley, which forms the centre of Manipur, is about 30 miles long and 20 miles broad, and is surrounded by hills some of which rise upto about 6,000 feet above sea-level. The principal rivers in the western hills are the Barak (with its tributary, the Irang) and the Imphal (or Manipur), both rising in the north and running to the south. The former drains into the Brahmaputra, the latter into the Chindwin. South of Imphal lies the large fresh-water sheet named Loktak (Logtak) Lake which is about 8 miles long and 5 miles broad.

The climate of the Imphal Valley is mild, with cool summers and cold, but not severe, winters. The highest shade temperate is about 92°F. and the lowest about 30° F. At higher altitudes it is, of course, colder. The average annual rainfall at Imphal is about 70 inches, by far the greatest portion of it being received during the few monsoon months of June to September. The prevailing winds are from the south and west; storms are uncommon.²

The chief cultivation in the Imphal Valley is rice. In the uncultivated portions, the flat areas are occupied by oak scrub, riverine associations and partly by evergreen rain jungle, the last named also covering all the hill-sides; there are no bamboo jungles. At higher altitudes, that is, towards Kohima in the north and Palel in the south-east, the hills-sides are less rich in trees and are mainly covered with grass and scrub. In the western portions of Manipur, between Imphal and Silchar (Cachar), the country is covered largely with dense evergreen forests and bamboo jungle.

The detailed ecological (physico-botanical) characterization of the collecting areas in the Imphal Valley and the vicinity has been given elsewhere (Roonwal, 1949). Here it will be sufficient to mention that six major types of associations have been recognized as follows:—

- (1) Oak Scrub. (In “Kanglatongbi area”; altitude *ca.* 3,500 feet above sea-level.)
- (2) Evergreen Rain Jungle. (Ditto.)
- (3) Riverine Associations. (Ditto.)
 - (a) Riverine scrub.
 - (b) Riverine jungle.
 - (c) Riverine meadow.
 - (d) *Butea minoa* community.
- (4) Oak Parkland. (In “Palel area”; altitude *ca.* 4,000 feet above sea-level.)
- (5) Human Habitations. (Temporary army camps, in “Kanglatongbi”, “Palel” and other areas in the vicinity of Imphal; altitude *ca.* 2,600-4,000 feet above sea-level.)
- (6) Cultivated Fields. (In “Kanglatongbi area” and on Imphal-Palel Road; altitude *ca.* 2,600-3,500 feet above sea-level.)

² This portion of the account has been largely taken from Allen (1905) and Annandale (1921).

III. ACKNOWLEDGMENTS.

I am indebted, above all, to the Medical Directorate of the General Headquarters for the facilities provided. The co-operation received from all the members of the Indian and British Typhus Research Teams in S. E. Asia is thankfully acknowledged. I am particularly indebted to my friend Flight-Lieutenant A. A. Bullock, R.A.F., D.Sc., Botanist with the Scrub Typhus Research Laboratory, and his Assistant, Sergeant N. Kennedy, R.A.F., for great assistance in procuring zoological specimens, particularly mammals and birds. Jamadar Kartar Singh I.A.M.C. did most of the field taxidermy work.

To Dr. B. N. Chopra, D.Sc., F.N.I., lately Officiating Director, Zoological Survey of India, I am indebted for facilities and courtesies of every kind that he extended during my service with the Forces both while in the Field and later at the Headquarters of the Zoological Survey. My thanks are also due to the following members of the Survey for various forms of assistance provided: Mr. Bhola Nath, M.Sc., Assistant, Mr. B. Biswas, M.Sc., Research Scholar and Mr. A. N. Fernandez, Taxidermist.

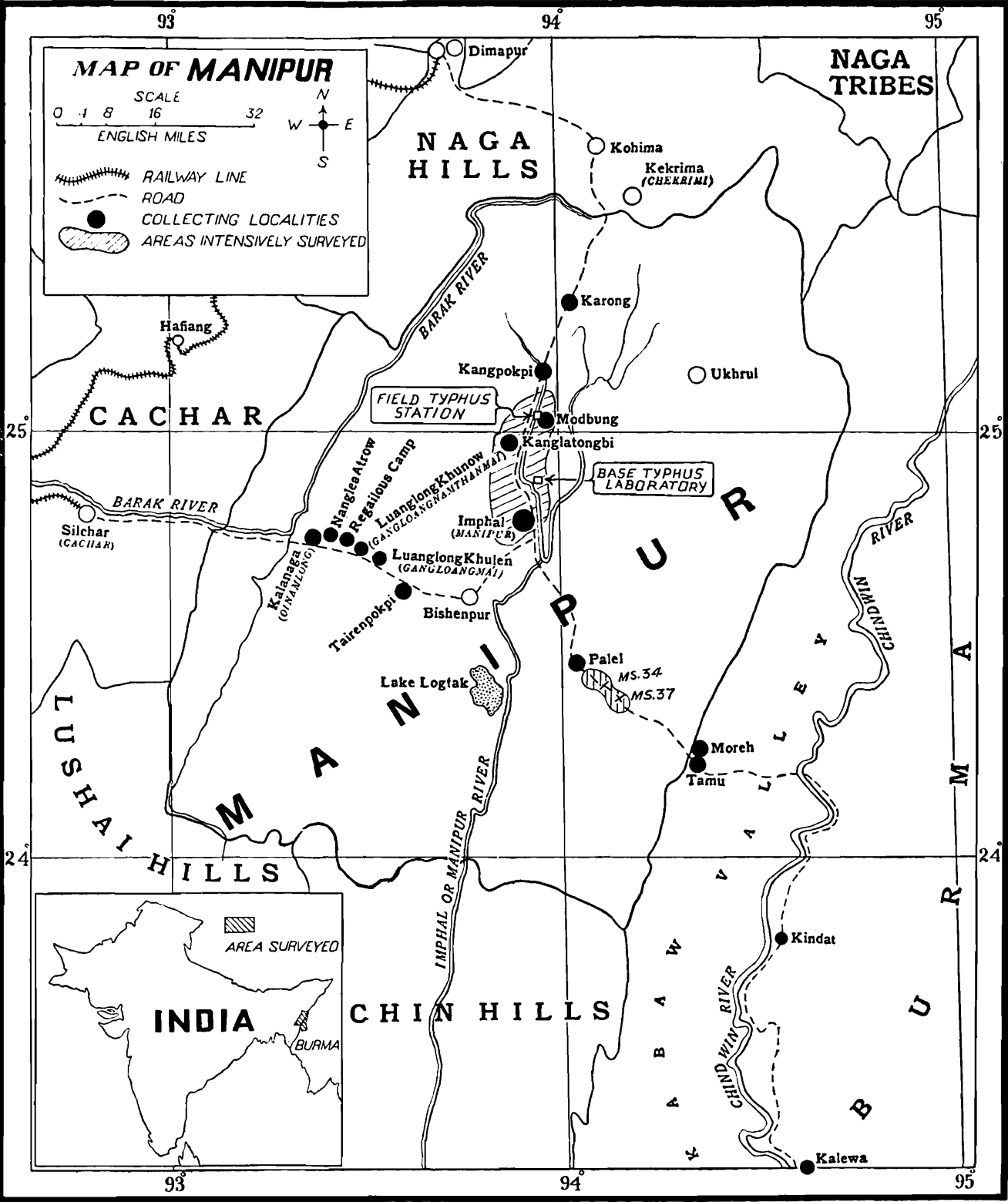
To the Director, Eastern Circle, Survey of India, Shillong, I am obliged for information regarding the altitudes of some of the collecting localities.

IV. REFERENCES.

- Allen, B. C., 1905. Naga Hills and Manipur. In *Assam District Gazetteers*, vol. IX, part 2, Manipur, pp. ii + 151. Calcutta.
- Annandale, N., 1921. The aquatic and amphibious Mollusca of Manipur. Prefatory note, and Introduction. *Rec. Indian Mus.* XXII, pp. 529-538.
- Roonwal, M. L., 1949. Systematics, ecology and bionomics of mammals studied in connexion with Tsutsugamushi Disease (Scrub Typhus) in the Assam-Burma War Theatre during 1945. *Trans. nation. Inst. Sci. India*, Calcutta, III (2), 52 pp., 6 pls.

EXPLANATION OF PLATE IV.

Map of Manipur State and the adjacent areas of Assam and Burma showing the collecting localities.



MAP OF MANIPUR

CONTRIBUTIONS TO THE FAUNA OF MANIPUR STATE, ASSAM.

PART II. BIRDS.¹

By M. L. ROONWAL, *M.Sc., Ph.D. (Cantab.), F.N.I., Hony. Major*, and
BHOLA NATH, *M.Sc., Zoological Survey of India, Calcutta.*

[With Plate V.]

CONTENTS.

	PAGE.
I. Introduction ..	127
II. Systematic Account	128
Ord. 1. Passeriformes	128
Ord. 2. Coraciiformes	155
Ord. 3. Accipetres	167
Ord. 4. Columbæ	170
Ord. 5. Gallinæ ..	173
Ord. 6. Charadriiformes ..	175
Ord. 7. Herodiones	176
III. References	178

I. INTRODUCTION.

The first systematic account of the birds of Manipur State was given in a series of papers by Godwin Austen (1874-82) who dealt with the birds of the "North-east Frontier of India", that is, mainly of the Khasia and Naga Hills in Assam. Hume's (1888), however, was the first really comprehensive systematic account of the Manipur birds, and it remains so to this day. He listed about 500 species from Manipur. Oates (1883-90), in his volumes on the birds of British Burma, gave valuable distributional notes on Manipur species. Allen (1905) referred briefly to the commoner game birds, while Annandale (1921, p. 538) mentioned a few of them. In recent years, Higgins (1913, 1914, 1933-34a) gave a useful account, accompanied by field notes, of the game birds of Manipur. The minor papers dealing with Manipur birds will be found in the list of References at the end.

The present report deals with two collections :—

(i) One made by a Party of the Zoological Survey of India in February 1936 during the "Naga Hills and Manipur Survey", covering the following regions as far as Manipur is concerned : The Imphal Valley ; and the northern (Imphal-Dimapur Road) and western (Imphal-Silchar Road) portions of Manipur. This collection, which consisted of some 60 skins, was unaccompanied by any field notes.

(ii) A second collection consisting of about 130 skins made by one of us (M.L.R.) during July-December 1945, from the Imphal Valley and the hills in the vicinity (*vide* Part I, Roonwal, 1949, for map, etc.). The field notes, etc. given in the following account refer to this collection.

¹For Part I, General Introduction, see Roonwal, *Rec. Indian Mus.*, XLVI, pp.123-126, 1949.

Both the collections together comprise 91 species and subspecies. In the following list, critical systematic notes have been given wherever necessary; and the following are the principal new facts brought to light :—

A new subspecies, *Otus bakkamoena manipurensis* subsp. nov., the Manipur Collared Scops Owl (Fam. Asionidae), has been described and figured (pp. 162-166; and Pl. V).

The following are the other points discussed :

Monticola solitaria affinis (Bly.) and *M. s. longirostris* (Bly.) (Fam. Turdidae).—The systematic status of the various subspecies of *M. solitaria* is discussed, together with the question of type-specimens and type-localities (pp. 139-143). The two type-specimens of *M. s. affinis* Bly. (from “Tenasserim provinces”) are lost. The holotype of *M. s. longirostris* (Bly.) is in the Indian Museum (Zool. Surv. India); the type-locality is “between Sind and Ferozepur” (in the Punjab). A key to the various subspecies of *M. solitaria* is given.

Dicrurus macrocerus macrocerus Viell. (Fam. Dicruridae).—It is shown (p. 146) that the separation of these drongoes into a western and an eastern race in India is unjustified, and all Indian specimens are *D. m. macrocerus*.

Strix indranee newarensis (Hodgs.) (Fam. Asionidae).—A peculiar clicking sound made with the tongue is recorded in this Wood-Owl (p. 161).

Otus bakkamoena lettia (Hodgs.) (Fam. Asionidae).—The question of the type-specimens of *lettia* is clarified. A key for the differentiation of the various Indian subspecies of *O. bakkamoena* is given (pp. 163-166).

Gyps himalayensis Hume (Fam. Aegypiidae).—The first record is now provided from eastern Assam (Manipur), thus extending the range of this griffon (p. 167).

Streptopelia decaocto decaocto (Frivald.) (Fam. Columbidae).—The Manipur ring-doves are clearly *S. d. decaocto* and not of the Burmese race, *S. d. xanthocyclus* New., as hitherto believed (p. 172).

The following abbreviations have been used :—

Measurements: W., wing-length; Tl., tail-length; Tr., tarsus-length; B., bill-length (from base).

Ad., adult; av., average; juv., juvenile.

II. SYSTEMATIC ACCOUNT.

Ord. 1. PASSERIFORMES.

Fam. 1. CORVIDÆ.

1. *Corvus macrorhynchos intermedius* Adams.

(The Himalayan Jungle Crow.)

- 1859. *Corvus intermedius*, Adams, *Proc. zool. Soc. London*, p. 171. (Kashmir, Dagshai and Simia. Restricted to Kashmir, *vide* Stresemann, *Orn. Gessel. Boyern* XII (1916), p. 282.)
- 1874. *Corvus culminatus*, Godwin Austen, *J. Asiat. Soc. Bengal* XLIII, p. 170.
- 1888. *Corvus macrorhynchus*, Hume, *Str. Feath.* XI, p. 256.

1922. *Corvus coronoides intermedius*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) I, p. 28.

1932. *Corvus macrorhynchos intermedius*, Whistler and Kinnear, *J. Bombay nat. Hist. Soc.* XXXV (2), p. 512.

Specimens collected.—2 (1♂, 1♀) from Imphal Valley, along Dimapur Road, 2,500 ft., 20th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
1♂	329	219	61	65
1♀	325	231	58	62

Colour of soft parts.—Bill, legs and claws jet black. Iris dark brown. Foot-pads (♂) dirty smoky.

Field notes.—This crow was common all over the Imphal Valley upto at least 3,500 ft. elevation, perhaps more. It tended to be more frequent near human habitations. *Corvus splendens* was entirely absent in the valley.

The gonads were in the non-breeding condition. The testes measured 3 × 5 mm.; the ovary 7 × 12 mm., with the largest ova about 1.2 mm. in diameter.

Remarks.—Hume (1888, p. 256) found *C. m. intermedius* to be the common crow of Manipur. He also remarked upon the complete absence of *Corvus splendens* there.

2. *Urocissa erythrorhyncha magnirostris* (Blyth).

(The Burmese Red-billed Blue Magpie.)

1846. *Psilorhinus magnirostris*, Blyth, *J. Asiat. Soc. Bengal* XV, p. 27. (Ya Ma Dong Mt.)

1922. *Urocissa melanocephala magnirostris*, Stuart Baker, *Fauna Brit. India Birds* (2nd ed.) I, p. 42.

1930. *Urocissa erythrorhyncha magnirostris*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) VIII, p. 594.

Specimen collected.—1 ♂ from Kanglatongbi area, 18 miles N. of Imphal on Dimapur Road, Manipur, ca. 3,500 ft., 22nd December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—1♂ : W 194 ; Tl. 446 ; Tr. 46 ; B. 36.

Colour of soft parts.—Bill and legs coral red ; mouth and foot-pads orange ; claws smoky brown.

Field notes.—This magpie was common in the jungles around Imphal on the Dimapur Road. It usually occurred in small groups of a dozen or less, flying gracefully from tree to tree. Being very wary, it was difficult to shoot.

The gonads were in the non-breeding condition. The ovary measured 7 × 12 mm., with the largest ova about 1.2 mm. in diameter.

Remarks.—Hume (1888, p. 257) failed to notice this bird in Manipur although he wrote that one of his men saw it there. Godwin Austen (1874, p. 170) obtained it in the Naga Hills. Stuart Baker (1922, p. 42) had included Manipur area within its range.

3. *Dendrocitta formosae himalayensis* (Blyth).

(The Himalayan Tree-pie.)

1865. *Dendrocitta himalayensis*, Blyth, *Ibis* I, p. 45. (Himalayas.)
 1888. *Dendrocitta himalayensis*, Hume, *Str. Feath.* XI, p. 259.
 1922. *Dendrocitta sinensis himalayensis*, Stuart Baker,² *Fauna Brit. India, Birds* (2nd ed.) I, p. 52.
 1930. *Dendrocitta formosae himalayensis*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) VIII, p. 595.

Specimen collected.—1♀ from Tairenpokpi, ca. 3,000 ft., 7th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♀: W 144; Tl. 208; Tr. 34; B. 30.

Remarks.—Hume (1888, p. 259) found this tree-pie in both the western and eastern hills of Manipur.

Fam. 2 TIMALIIDAE.

4. *Dryonastes ruficollis* (Jardine & Selby).

(The Rufous-necked Laughing Thrush.)

1838. *Garrulax ruficollis* Jardine and Selby, *Ill. Orn.* II, pl. 21. (Himalayas.)
 1888. *Garrulax ruficollis*, Hume, *Str. Feath.* XI, p. 158.
 1922. *Dryonastes ruficollis*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) I, p. 139.

Specimens collected.—2♂♂ as follows:—One from Karong (5th February 1936) and another from Luanglong Khulen (8th February 1936). (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♂: W 100; Tl. 113; Tr. 37; B. 21.

Remarks.—(Hume 1888, p. 158) found this thrush very common in Manipur.

5. *Garrulax pectoralis pectoralis* (Gould).

(The Indian Black-gorgeted Laughing Thrush.)

1835. *Ianthocincla pectoralis* Gould, *Proc. zool. Soc. London*, p. 186. (Nepal.)
 1888. *Garrulax pectoralis*, Hume, *Str. Feath.* XI p. 859.
 1922. *Garrulax pectoralis pectoralis*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) I, p. 150.

Specimen collected.—1♀ from Kanglatongbi area, about 16 miles N. of Imphal on Dimapur Road, ca. 3,500 ft., 29th December 1945. (Major M. I. Roonwal.)

Measurements (mm.).—1♀: W 144; Tl. 132; Tr. 48; B. 32.

Colour of soft parts.—Bill horny; legs, feet and claws bluish horny.

Field notes.—This thrush was common in hillside forests, usually occurring in parties of 10-12.

The ovary was in the non-breeding condition, measuring 6 × 10 mm., with the largest ova about 1 mm. in diameter.

Remarks.—Hume (1888, p. 159) found it abundant in the Barak Valley between Kalanaga and Koombiron in Manipur.

² Stuart Baker wrongly gives the first reference of Blyth as "Catal., p. 92 (1865)", whereas Blyth in his *Catal. Birds. Mus. Asiat. Soc. [Bengal]*, 1849, p. 92, refers only to "*D. sinensis*", and not *himalayensis*.

6. *Pomatorhinus erythrogenys maclellandi* Godwin Austen.

(McClelland's Scimitar-Babbler.)

1870. *Pomatorhinus McClellandi* Godwin Austen, *J. Asiat. Soc. Bengal*, XXXIX, p. 103. (Nenglo, beyond Asaly, Burraill Range, Khasia Hills, Assam.)
 1888. *Pomatorhinus maclellandi* Jerd. (=God. Aust.), Hume, *Str. Feath* XI, p. 149.
 1922. *Pomatorhinus erythrogenys maclellandi*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) I, p. 221.

Specimen collected.—1♀ from Karong, 5th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♀ : W 84 ; Tl. 98 ; Tr. 41 ; B. 29.

Remarks.—Hume (1888, p. 149) found this babbler common in Manipur.

7. *Alcippe nipalensis nipalensis* (Hodgson).

(The Nepal Babbler.)

1838. *Siva nipalensis* Hodgson, *Indian Rev.* II, p. 89. (Nepal.)
 1888. *Alcippe nipalensis*, Hume, *Str. Feath.* XI, p. 138.
 1922. *Alcippe nipalensis nipalensis*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) I, p. 275.

Specimen collected.—1♀ from Luagnlong Khunow, ca. 3,250 ft., 9th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♀ : W 59 ; Tl. 55 ; Tr. 18 ; B. 12.

Remarks.—Hume (1888, p. 138) found this babbler very common in many parts of Manipur.

8. *Alcippe poiocephala phayrei* Blyth.

(The Arakan Quaker-Babbler.)

1845. *Alcippe phayrei* Blyth, *J. Asiat. Soc. Bengal* XIV (2), p. 601.
 1888. *Alcippe phayrei*, Hume, *S r. Feath.* XI, p. 139.
 1922. *Alcippe poiocephala phayrei*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) I, p. 278.

Specimen collected.—1 ♀ from Nanglea Atrow, ca. 3,250 ft., 63 miles from Imphal on Silchar Road, Manipur, 12th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♀ : W 66 ; Tl. 68 ; Tr. 24 ; B. 12.

Remarks.—Hume (1888, p. 139) found this bird occasionally in central Manipur, west of Imphal.

9. *Leioptila gracilis* (Horsfield).

(The Grey Sibia.)

1839. *Hypsipetes gracilis* Horsfield (ex McClelland MS.), *Proc. zool. Soc. London*, p. 159. (Assam.)
 1922. *Leioptila gracilis*, Stuart Baker, *Fauna Brit. India Birds* (2nd ed.) I, p. 298.

Specimen collected.—1♂ from Tairenpokpi, ca. 3,000 ft., 7th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1 ♂ : W 92 ; Tl. 119 ; Tr. 31 ; B. 21.

Remarks.—Hume (1888) did not record the Grey Sibia from Manipur, but Stuart Baker (1922, p. 298) had included that area within its range.

10. *Leioptila annectans annectans* Blyth.

(Blyth's Sibia.)

1847. *Leioptila annectans* Blyth, *J. Asiat. Soc. Bengal* XVI, p. 450. (Darjeeling, N. Bengal.)
 1888. *Lioptila* (sic!) *annectans*, Hume, *Str. Feath.* XI, p. 246.
 1922. *Leioptila annectans annectans*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) I, p. 300.

Specimen collected.—1♂ from Tairenpokpi, 3,000 ft., 7th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♂ : W 81 ; Tl. 89 ; Tr. 25 ; B. 16.

Remarks.—Hume (1888, p. 246) found Blyth's Sibia common in the higher portions (above 4,500 ft.) of the eastern hills of Manipur.

11. *Siva cyanouroptera cyanouroptera* Hodgson.

(Hodgson's Blue-winged Siva)

1838. *Siva cyanouroptera* Hodgson, *Indian Rev.* II, p. 88. (Nepal.)
 1888. *Siva cyanouroptera*, Hume, *Str. Feath.* XI, p. 248.
 1922. *Siva cyanouroptera cyanouroptera*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) I, p. 314.

Specimens collected.—3 (2♂♂, 1♀) from Nanglea Atrow, ca. 3,250 ft., 13th and 14th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
2♂♂ :	61—62	71	23—25	12—13
1♀ :	60	69	22	13

Remarks.—Hume (1888, p. 248) found this bird common above 4,500 ft. in the western and eastern hills of Manipur.

12. *Chloropsis hardwickii hardwickii* Jardine & Selby.

(The Orange-bellied Chloropsis.)

1929. *Chloropsis Hardwickii* Jardine and Selby, *Ill. Orn.* II, Add. 1, p. 1. (Nepal.)
 1888. *Phyllornis hardwickii*, Hume, *Str. Feath.* XI, p. 185.
 1922. *Chloropsis hardwickii hardwickii*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) I, p. 349.

Specimen collected.—1♀ from Regailous Camp, ca. 3,250 ft., 11th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♀ : W 87 ; Tl. 72 ; Tr. 19 ; B. 20.

The wing and tail in this case measure much less than the measurements given for this subspecies by Stuart Baker (1922, p. 349).

Remarks.—Hume (1888, p. 185) found this chloropsis common in many parts of Manipur even above 5,000 ft. There is also a specimen in the Zoological Survey of India Collection (No. 12981) labelled "Manipur, R. D. Oldham", obtained in 1882 or earlier.

13. *Mesia argenteauris argenteauris* Hodgson.

(The Silver-eared *Mesia*.)

1838. *Mesia argenteauris* Hodgson, *Indian Rev.* II, p. 88. (Nepal.)
 1888. *Mesia argenteauris*, Hume, *Str. Feath.* XI, p. 247.
 1922. *Mesia argenteauris argenteauris*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) I, p. 354.

Specimen collected.—1♂ from Luanglong Khulen, 9th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♂ : W 76 ; Tl. 70 ; Tr. 25 ; B. 15.

Remarks.—Hume (1888, p. 247) found this *mesia* rare in the western hills of Manipur but common in the eastern hills.

Fam. 3 PCYNONOTIDAE.

14. *Criniger gularis flaveolus* (Gould).

(The Indian White-throated Bulbul.)

1836. *Trichophorus flaveolus* Gould, *Proc. zool. Soc. London*, p. 6. (Himalayas and Nepal.)
 1888. *Criniger flaveolus*, Hume, *Str. Feath.* XI, p. 178.
 1922. *Criniger tephrogenys flaveolus*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) I, p. 363.
 1930. *Criniger gularis flaveolus*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) VIII, p. 612.

Specimen collected.—1♂ from evergreen forest near Kanglatongbi, about 16 miles N. of Imphal on Dimapur Road, ca. 3,500 ft., 8th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—1♂ : W 106 ; Tl. 92 ; Tr. 21 ; B. 20.

Colour of soft parts.—Iris dark brown ; bill, legs, feet and claws horny grey.

Field notes.—This bulbul was met with in small numbers in evergreen forests ; it was usually found in parties of two or three.

The testes were in the non-breeding condition, measuring 1 × 3 mm.

Remarks.—Hume (1888, p. 178) found this bulbul common in the western hills of Manipur, frequenting dense scrub and creepers. He, however, failed to meet it in the Imphal Valley and in the eastern hills.

15. *Ixos maccllellandi* ? *maccllellandi* (Horsfield).

(The Rufous-bellied Bulbul.)

1839. *Hypsipetes maccllellandi* Horsfield, *Proc. zool. Soc. London*, p. 59 (Assam)
 1888. *Hypsipetes maccllellandi*, Hume, *Str. Feath.* XI, p. 176.
 1922. *Hemixus maccllellandi maccllellandi*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) I, p. 377.
 1930. *Ixos maccllellandi maccllellandi*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) VIII, p. 613.

Specimens collected.—2♂♂ from Kalanaga, ca. 3,250 ft., 15th and 17th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—2♂♂ : W 105-107 ; Tl. 103-113 ; Tr. 20-22 B. 23-26.

Remarks.—Hume (1888, p. 176) found this bulbul fairly common in the eastern hills of Manipur but absent elsewhere.

Systematic note.—The present specimens are intermediate in coloration between *Ixos m. maccllellandi* (Horsf.) and *Ixos m. tickelli* (Blyth).

16. *Molpastes cafer burmanicus* (Sharpe).

(The Burmese Red-vented Bulbul.)

1881. *Pycnonotus burmanicus* Sharpe, *Cat. Birds Brit. Mus.* VI, p. 125. (Pegu, Burma.)
 1888. *Molpastes burmanicus*, Hume *Str. Feath.* XI, p. 183.
 1922. *Molpastes haemorrhous burmanicus*, Stuart Baker, *Fauna Brit. India Birds* (2nd ed.) I, p. 385.
 1930. *Molpastes cafer burmanicus*, Stuart Baker, *Fauna Brit. India, Birds* VIII, p. 613.

Specimens collected.—6 as follows :—

1 ♂ from Luanglong Khulen, ca. 3,250 ft., 9th February 1936. (Naga Hills and Manipur Survey.)

5 (2♂♂, 3♀♀) from forest area about 9-16 miles N. of Imphal on Dima-pur Road, ca. 3,000-3,500 ft., 14th, 28th and 29th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
3♂♂	98—106	101—106	24—27	19—21
3♀♀	98—99	98—100	25—26	20—21

Colour of soft parts.—Iris dark brown to chocolate ; bill, legs and feet dark olivaceous to black ; claws horny (in♀♀) ; foot-pads pale olivaceous.

Field notes.—This bulbul was very common in evergreen forests especially in the more open areas.

The pair shot on 14th December 1945 was evidently courting, but the gonads of the specimens collected during December 1945 were in the non-breeding condition. The ovary measured 4 × 8 mm., with the largest ova not more than 1 mm. in diameter ; the testes measured 1 × 1 mm.

Remarks.—Hume (1888, p. 183) also found this bulbul very common in the western hills of Manipur but less so in the eastern hills ; he reported that they were found in association with "*Otocompsa emeira*"

17. *Otocompsa flaviventris flaviventris* (Tickell).

(The Black-crested Yellow Bulbul.)

1133. *Vanga flaviventris* Tickell, *J. Asiat. Soc. Bengal* II, p. 573. (Dampara in Dholbhum, Bihar.)
 1888. *Ruliyula flaviventris*, Hume, *Str. Feath.* XI, p. 180.
 1922. *Otocompsa flaviventris flaviventris*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) I, p. 397.

Specimens collected.—3 as follows (Naga Hills and Manipur Survey) :—
 1♂ from Luanglong Khulen, ca. 3,250 ft., 9th February 1936 ; and 2 (1♂, 1♀) from Kalanaga, ca. 3,250 ft., 16th February 1936.

Measurements (mm.).—

	W.	Tl.	Tr.	B.
2♂♂	92	91—97	16—19	13—14
1♀	83	82	18	15

Remarks.—Hume (1888, p. 180) found this bulbul common in the western hills of Manipur but absent in the Imphal Valley and the eastern hills.

18. *Spizixos canifrons canifrons* Blyth.

(The Finch-billed Bulbul.)

1845. *Spizixos canifrons* Blyth, *J. Asiat. Soc. Bengal* XIV, p. 571. (Khasia Hills, Assam.)1888. *Spizixus canifrons*, Hume, *Str. Feath.* XI, p. 180.1922. *Spizixus canifrons canifrons*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) I, p. 400.*Specimen collected*.—1♂ from Kalanaga, ca. 3,250 ft., 16th February 1936. (Naga Hills and Manipur Survey.)*Measurements* (mm.).—1♂ : W. 95 ; Tl. 98 ; Tr. 21 ; B. 15.*Remarks*.—Hume (1888, p. 180) found this bulbul rare in Manipur ; he met with it only in the western hills.**19. *Microtarsus atriceps major* (Robinson & Kloss).**

(The Black-headed Bulbul.)

1922. *Microtarsus melanocephalus melanocephalus* (Gm.) (in part), Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) I, p. 423.1923. *Brachypodius atriceps major* Robinson & Kloss, *J. Fed. Malay States Mus.* XI, p. 55. (Cachar, Assam.)1930. *Microtarsus atriceps major*, Stuart Baker, *Fauna Brit. India, Birds* VIII, p. 617.*Specimen collected*.—1♂ from Nanglea Atrow, ca. 3,250 ft., 14th February 1936. (Naga Hills and Manipur Survey.)*Measurements* (mm.).—1♂ : W. 85 ; Tl. 81 ; Tr. 15 ; B. 16.*Remarks*.—Neither Godwin Austen (1874) nor Hume (1888) recorded this bulbul from Manipur ; Stuart Baker (1922), however, had included that area within its range.

Fam. 4. TURDIDAE.

20. *Heteroxenicus cruralis cruralis* (Blyth).

(The White-browed Short-wing.)

1843. *Calliope(?) cruralis* Blyth, *J. Asiat. Soc. Bengal* XII, p. 933. (Darjeeling, N. Bengal.)1888. *Brachypteryx cruralis*, Hume *Str. Feath.* XI, p. 121.1924. *Heteroxenicus cruralis*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) II, p. 17.1949. *Heteroxenicus cruralis cruralis*, Roonwal & Nath, *Rec. Indian Mus.* XLV [1947], p. 321.*Specimens collected*.—3 (1♂, 2♀♀) from Nanglea Atrow, ca. 3,250 ft., 13th and 14th February 1936. (Naga Hills and Manipur Survey.)*Measurements* (mm.).—

	W.	Tl.	Tr.	B.
1♂	71	48	32	
2♀♀	65—68	46—47	29—30	15(1♀)

Remarks.—Hume (1888, p. 121) wrote that “ he never met with it in Manipur ” But later authors give its range as : Himalayas from Simla, through Sikkim and Assam to Karenni in N. Burma. The present specimens, however, constitute, we believe, the first actual record from Manipur.

Systematic note.—Some aspects of the systematics of this bird had been in a state of confusion, and the account in Stuart Baker's *Fauna* (1924, p. 17) only worsened that confusion. These points have been cleared by Roonwal and Nath (1949).

21. *Saxicola caprata burmanica* Stuart Baker.

(The Burmese Stone-chat.)

1888. *Pratincola caprata* Linn. (in part), Hume, *Str. Feath.* XI, p. 190.

1923. *Saxicola caprata burmanica* Stuart Baker, *Bull. Brit. orn. Cl.* XLIII, p. 19. (Pegu, Burma.)

1924. *Saxicola caprata burmanica*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) II, p. 24.

Specimens collected.—2♂♂ as follows :—1♂ from Imphal Valley, ca. 2,500 ft., 3rd December ; and 1♂ from 9 miles N. of Imphal on Dimapur Road, ca. 3,000 ft., 29th December 1945. (Major M. L. Roonwal.)

Measurements (mm).—2 ♂♂ : W. 63-69 ; Tl. 52-53 ; Tr. (1♀) 23 ; B. 9-10.

Colour of soft parts.—Iris dark chocolate ; bill black ; legs, feet and claws dark horny.

Field notes.—The Burmese Stone-chat was found in small numbers in the Imphal Valley up to about 3,500 ft., but not in the higher altitudes.

The testes were in the non-breeding condition and measured 1 × 1 mm.

Remarks.—Hume (1888, p. 190) found the Burmese Stone-chat common in the Manipur basin but absent in the hills.

22. *Saxicola torquata* (Linn.) (subsp.?).

(The Indian Bush-chat.)

1766. *Muscicapa torquata* Linn., *Syst. Nat.* (12th ed.) I, p. 328. (West South Africa.)

1888. *Pratincola maurus*, Hume, *Str. Feath.* XI, p. 191.

1924. *Saxicola torquata* and its subspecies, Stuart Baker, *Fauna Brit. India Birds* (2nd ed.) II, p. 27.

Specimens collected.—2 as follows :—

1 ♂ from Karong, 5th February 1936. (Naga Hills and Manipur Survey.)

1 (unsexed) from Imphal Valley, ca. 3,000 ft., 3rd December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—2♂♂ : W 71-72 ; Tl. 52-60 ; Tr. 23-24 ; B. 13 (1 ♂).

Colour of soft parts.—Iris dark chocolate, bill black ; legs, feet and claws horny black.

Field notes.—The Indian Bush-chat was fairly common in the Imphal Valley.

Remarks.—Hume (1888, p. 191) found it fairly common in Manipur.

Systematic note.—The differentiation of the various subspecies of *Saxicola torquata*, as given by Stuart Baker (1924, pp. 27-28) is not at all clear to us. An examination of the moderately large series of specimens in the collection of the Zoological Survey of India from India, Burma, Afghanistan and Central Asia (Yarkand) shows that the extent of white area at the extreme base of the tail feathers is a very variable character and cannot be used for subspecific distinction. In specimens from the same area the white may be either wholly absent or present in a variable degree. There is no other clear character known to us which would make subspecific distinction of the Indian examples possible beyond a reasonable measure of doubt. Pending a proper revision, therefore, we consider it desirable to designate Indian birds as *S. torquata* only.

23. *Enicurus immaculatus* Hodgson.

(The Black-backed Forktail.)

1836. *Enicurus immaculatus* Hodgson, *Asiat. Res.* XIX, p. 190. (Nepal.)
 1888. *Henicurus immaculatus*, Hume, *Str. Feath.* XI, p. 288.
 1924. *Enicurus immaculatus*, Stuart Baker, *Faun. Brit. India, Birds* (2nd ed.) II, p. 61.

Specimens collected.—2♀♀ from Nanglea Atrow, 63 miles from Imphal on Silchar Road, ca. 3,250 ft., 12th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—2♀♀ : W 87-90 ; Tl. 110-115 ; Tr. 26-27 ; B. 15.

Remarks.—Hume (1888, p. 228) found it common in the western hills of Manipur but absent in the eastern hills.

24. *Chaimarrhornis leucocephala* (Vigors).

(The White-capped Redstart.)

1831. *Phoenicurus leucocephala* Vigors, *Proc. zool. Soc. London*, p. 35. (Himalayas.)
 1888. *Chaimarrhornis leucocephalus*, Hume, *Str. Feath.* XI, p. 197.
 1924. *Chaimarrhornis leucocephalus*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) II, p. 79.

Specimens collected.—2♂♂ from Kanglatongbi area about 16 miles N. of Imphal, ca. 3,500 ft., 26th November 1946. (Major M. L. Roonwal.)

Measurements (mm.).—2♂♂ : W 100 ; Tl. 77-80 ; Tr. 31 ; B. 15-16.

Colour of soft parts.—Iris dark brown ; bill, legs and claws black.

Field notes.—This redstart was frequently met with on rocky water-courses in or near forests.

The testes were in the non-breeding condition, measuring 1 × 1 mm.

Remarks.—Hume (1888, p. 197) found this redstart common in the western hills of Manipur but absent in the Imphal Valley and the eastern hills.

25. *Rhyacornis fuliginosa fuliginosa* (Vigors).

(The Plumbeous Redstart.)

1831. *Phoenicurus fuliginosa* Vigors, *Proc. zool. Soc. London*, p. 35. (Himalayas.)
 1888. *Rhyacornis fuliginosus*, Hume *Str. Feath.* XI, p. 196.
 1924. *Rhyacornis fuliginosa fuliginosa*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) II, p. 81.

Specimens collected.—3(2♂♂, 1♀) from Kanglatongbi area, 18 miles N. of Imphal on Dimapur Road, ca. 3,500 ft., 19th, 22nd and 23rd December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
2♂♂	78—79	49—56	22—23	11—12
1♀	72	45	21	11

Colour of soft parts.—Iris, legs, feet and claws dark brown ; bill black.

Field notes.—This redstart was noticed occasionally on the banks of the Imphal River and other smaller streams either in or near evergreen forest.

The gonads were in the non-breeding condition. The testes measured 1×2 mm. ; and the ovary 4×7 mm., with largest ova not more than 1 mm. in diameter.

Remarks.—Hume (1888, p. 196) found this redstart common in the western hills of Manipur.

26. *Copsychus saularis saularis* (Linnaeus).

(The Indian Magpie-Robin.)

1758. *Gracula saularis* Linnaeus, *Syst. Nat.* (10th ed.) I, p. 109. (Asia=Bengal.)
 1888. *Copsychus saularis*, Hume, *Str. Feath.* XI., p. 189.
 1924. *Copsychus saularis saularis*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) II, p. 113.

Specimen collected.—1 (unsexed) from Kanglatongbi area, 17 miles N. of Imphal on Dimapur Road, ca. 3,500 ft., 10th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—1 (unsexed) : W 95 ; Tl. 84 ; Tr. 28 ; B. 20.

Colour of soft parts.—Iris olive brown ; bill black ; legs, feet and claws dark horny.

Field notes.—This bird was found to be quite common in the open country around Imphal.

Remarks.—Hume (1888, p. 189) found it fairly common in Manipur.

27. *Turdus boulboul* (Latham).

(The Grey-winged Blackbird.)

1790. *Lanius boulboul* Latham, *Index Orn.* I, p. 80. (India ; subsequently restricted to Darjeeling, N. Bengal.)
 1888. *Merula boulboul*, Hume, *Str. Feath.* XI, p. 128.
 1924. *Turdus boulboul*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) II, p. 130.

Specimens collected.—2(1♂?, 1♀) from Luanglong Khulen, Imphal-Silchar Road, Manipur, ca. 3,250 ft., 9th February 1936. (Naga Hills and Manipur Survey.)

The ♂ has the typical ♂ plumage, but was labelled “♀” in the field, probably by error.

Measurements (mm).—

	W.	Tl.	Tr.	B.
1♂ (?)	147	112	31	25
1♀	139	112	35	25

Remarks.—Hume (1888, p. 128) shot a pair of this blackbird in the Barak Valley (western hills of Manipur), but did not meet it elsewhere.

28. *Turdus dissimilis* Blyth.

(The Black-breasted Thrush.)

1847. *Turdus dissimilis* Blyth, *J. Asiat. Soc. Bengal* XVI, p. 144. (“Lower Bengal”; “in the south”, i.e., Peninsular India; and “the Himalaya”.)

1924. *Turdus dissimilis*, Stuart Baker, *Fauna Brit. India. Birds* (2nd ed.) II, p. 140.

Specimen collected.—1♀ from Regailous Camp, about 63 miles west of Imphal on Silchar Road, Manipur, ca. 3,250 ft., 11th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm).—1♀ : W 123 ; Tl. 80 ; Tr. 32 ; B. 18.

Remarks.—Hume (1888) did not find this bird in Manipur, but Oates (1890, p. 133) recorded specimens from that area.

29. *Monticola solitaria affinis* (Blyth).

(The Burmese Blue Rock-Thrush.)

1842. “*Petrocincla Manillensis* (?)” Blyth, *J. Asiat Soc. Bengal* XI, part 1, p. 460.

1843. *Petrocincla affinis* Blyth, *J. Asiat. Soc. Bengal* XII, part 1, p. “177*” (bis). (“Tenasserim provinces” in Burma; and Darjeeling in N. Bengal. Restricted to “Tenasserim provinces”, *vide infra*.)

1847. *Petrocincla affinis*, Blyth, *J. Asiat. Soc. Bengal* XVI, part 1, p. 151.

1849. *Petrocincla affinis*, Blyth, *Catal. Birds. Mus. Asiat. Soc. [Bengal]*, Calcutta, p. 164, No. 961.

1877. *Petrocossyphus cyaneus* (in part), Jerdon, *Birds of India* I, p. 511.

1881. *Monticola cyanus* (in part), Seebohm, *Catal. Birds. Brit. Mus.* V, pp. 316-318.

1881. *Monticola cyanus solitaria* (in part), Seebohm, *Catal. Birds Brit. Mus.* V, pp. 318-319.

1888. *Cyanocinclus cyanus*, Hume, *Str. Feath* XI, p. 124.

1890. *Petrophila cyanus* (in part), Oates, *Fauna Brit. India, Birds* II, p. 146.

1910. *Monticola solitaria pandoo* (in part), Hartert, *Vögel paläarkt. Fauna* I, p. 675.

1924. *Monticola solitaria affinis*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) II, p. 175.

1935. *Monticola solitaria affinis*, Stanford [& Ticehurst], *J. Bombay nat. Hist. Soc.* XXXVII (4), p. 866.

1938. *Monticola solitaria affinis*, Stanford and Ticehurst, *Ibis* (14) II, p. 397.

Specimens collected.—10 (6♂♂, 3♀♀, 1 unsexed) from Kanglatongbi area, about 17 miles N. of Imphal on Dimapur Road, Manipur, ca. 3,500 ft., 27th and 29th November and 3rd, 14th, 18th and 29th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
6♂♂	117—127	86—92	28—30	20—25
3♀♀	110—119	80—87	29	21—23
1 unsexed	127	94	30	24

Colour of soft parts.—Iris hazel to dark hazel brown ; mouth yellow ; bill, legs, feet and claws dark olivaceous horny to horny black ; rim of eyelids also black.

Field notes.—This thrush was quite common in the Imphal valley and the foot-hills.

The gonads were in the non-breeding condition. The ovaries (3rd, 18th and 29th December) measured about 4×7 mm., with the largest ova not more than one mm. in diameter ; the testes (27th November to 29th December) measured about 1×1 mm. In two of the males only the left testis was present, the right one being entirely wanting.

Remarks.—Hume (1888, p. 124) found “*cyanus* Linn.” common in the western hills of Manipur, but he wrote that among the several specimens that he obtained, “not one showed a single rufous feather” This suggests that his specimens were not *affinis* Bly. but probably *pandoo* Sykes. Stanford (1935, p. 866) found *affinis* Bly. common in Lower Burma ; and Stanford and Ticehurst (1938, p. 397) remarked that while none was procured in N. Burma, it certainly occurs there.

Systematic Note.

Both the males and females in the specimens collected from Manipur are clearly assignable to *affinis* Blyth. The males are greyish blue with a dirty brown tinge and there is a considerable amount of white mottling, in contrast to *pandoo* Sykes where such markings are practically absent. The female of *affinis* is similarly contrasted from *pandoo* as regards white markings specially above, and also differs in having more blue mixed with brown, whereas in *pandoo* there is hardly any blue.

One male (coll. 29th December) with a clear pair of testes (and no ovaries) had the female plumage—there cannot be any mistake about the sexing as it was done with special care for this series of rock-thrushes.

The rufous-chestnut patch on the under tail-coverts, which characterises the males of *affinis*, varies in extent from about 10×12 mm. to barely a touch of rufous on the tips of a few feathers. Even in the absence of the rufous-chestnut, however, it is quite easy to distinguish *affinis* from the other subspecies.

As the key and description given by Stuart Baker (1924, p. 173), for the separation of the subspecies of *Monticola solitaria* are not satisfactory, the following key is given for the separation of the subspecies *longirostris* Bly.(=*transcaspica* Hart.), *pandoo* Sykes and *affinis* Bly.

Key to Indian subspecies of Monticola solitaria.

(A) Colour all over grey-blue both above and below. White transverse mottlings almost wholly obsolete both above and below. No rufous-chestnut on breast, abdomen, under tail-coverts and around vent.

(a) Paler all over *M. s. longirostris* (Bly.), ♂

(b) Darker all over *M. s. pandoo* (Syk.), ♂.

(B) Colour all over dark grey-blue with a tinge of dark brown owing to feathers being so tipped. White transverse mottlings conspicuously present below and on the wings, and less so above. More or less rufous-chestnut present around vent and on under tail-coverts (occasionally wanting here), and sometimes even on breast and abdomen *M. s. affinis* (Bly.), ♂.

(C) Colour all over brown with or without a grey-blue tinge.

(a) Colour dark-brown. White transverse mottlings more or less conspicuously present below and on the wings, and less so above.

(aa) White transverse mottlings more conspicuous; colour tinged with grey-blue *M. s. affinis* (Bly.), ♀.

(bb) White transverse mottlings less conspicuous, especially above and on abdomen. Colour not tinged with grey-blue. *M. s. pandoo* (Syk.), ♀.

(b) Colour pale brown. White transverse mottlings almost obsolete.

.... *M. s. longirostris* (Bly.), ♀.

*Type-specimens and Type-localities.**M. s. affinis* (Blyth).—

Type-specimens.—The type series believed to be present in the Indian Museum (Zoological Survey of India), Calcutta, is no longer traceable, as shown below. Out of the 7 specimens, including the types, listed by Blyth in his *Catal.* (1849, p. 164, No. 961), only 5 are now present in the collection of the Indian Museum which received the entire collection of the Asiatic Society of Bengal. The particulars of these 5 specimens are given below, along with the particulars on the original A.S.B. parchment labels that they bear :—

1 and 2. Two males. “No. 961. *Petrocincla affinis* Blyth. Arakan. ♂. Capt. Abbott. 1843-5. A.S.B.” Evidently two out of the three, Nos. 961A, B, C of *Catal.*

3 and 4. Two females. “Type No. 961. *Petrocincla affinis* Blyth ♂. Arakan. Capt. Phayre. 1843-5. A.S.B.” In one of these (with the tail wanting), the word “Type” is absent. Evidently Nos. 961 D, E of *Catal.*

5. One male. “No. 961. Type of *Petrocincla affinis* Blyth. Darjeeling. F Mr. Webb. 1845. A.S.B.” ♂ with considerable rufous chestnut on belly and under tail-covers. Clearly No. 961 F of *Catal.*

The remaining two specimens, viz., one out of Nos. 961 A, B, C (♂ from Arakan, Capt. Abbott, 1843-5) and No. 961 G (♂, “with more rufous on belly”, from “Tenasserim, E. O. Ryley Esq. (1847)”), are not traceable.

In the first account, Blyth (*op. cit.*, 1843, p. 177*, *his*) wrote as follows :—“A second species appears to exist in the specimens from the Tenasserim provinces, and to this I refer a fine male from Darjeeling, where the collector lately employed by the Society never obtained more

than this one example. Judging from the Darjeeling specimen (for those from Tenasserim have the tail imperfect), it would appear readily distinguishable from *P. Manillensis* by the shape of the tail, which (instead of being squared) has its outermost feathers nearly half an inch shorter than the middle ones. The mottlings on the upper-parts are nearly obsolete, and those of the lower-parts but little more developed; and there would appear to be generally some trace of ferruginous, more or less: in the Darjeeling specimen this is confined to the lateral margins of two or three of the lower tail-coverts; and successively more developed in two from Tenasserim, as formerly described by me. I shall designate this presumed species *P. affinis*."

The earlier description referred to above by Blyth is to be found in his report published in 1842, pp. 460-461 (*op. cit.*, Synonymy) where two specimens were described from "Tenasserim", in addition to others from different localities, as "*Petrocincla Manillensis* (?)".

Subsequently, Blyth (*op. cit.*, 1847, p. 151) amplified the above description thus:—"Rare at Darjeeling; but common along the eastern side of the Bay of Bengal, from Tipperah and Arracan to the Tenasserim Provinces. The males of this species have generally some intermixture of rufous about the vent and lower tail-coverts, varying in quantity, but seldom nearly so much as in *P. Manillensis*; whereas in *P. pandoo*, I believe that there is never a trace of this rufous†..."

"† A Tennasserim specimen just received has much more rufous on the abdomen than I ever observed before in *P. affinis*, but its distinctness from *P. manillensis* is nevertheless obvious. This bird likewise inhabits Assam; and the Society has just received a specimen of it from Goalpara."

It is thus clear that Blyth's two type-specimens of *affinis* came from the "Tenasserim provinces".³ It must, however, be borne in mind that the Tenasserim of those days was not as restricted as it is to-day, but also included a considerable portion of Central Burma—it covered a narrow strip of territory from the Mergui Archipelago in the south (latitude 13.5° N.) to about latitude 19° N., as given in Hume's map.⁴

The two type-specimens of *affinis* Bly. (mentioned by Blyth in 1842 and 1843) were thus not listed in Blyth's *Catal.* (1849), nor are they traceable in the Indian Museum Collection; they must be presumed to be lost. The third specimen from Tenasserim, a topotype (Blyth, 1847), is also not traceable.⁵

M. s. longirostris (Bly.).—

Type-specimen.—Ticehurst⁶ (1922) has shown that *transcaspicus* Hartert⁷ (1909) is a synonym of *longirostris* Blyth⁸ (1847). The holotype of *longirostris* Bly. is in the Indian Museum (Z.S.I.), Calcutta. It is

³ Hartert, E. *Vög. paläark. Fauna* I, p. 675 (1910), wrongly gives the type-locality as Darjeeling.

⁴ Hume, A. *Stray Feath.* II (6), (1874), frontpiece.

⁵ Seebohm (1881, *op. cit.*) lists 3 specimens from Tenasserim, in the British Museum Collection, but these are not types.

⁶ Ticehurst, C. B. *Ibis* (11) IV, p. 641 (1922).

⁷ Hartert, C. B., *Bull. Brit. Orn. Cl.* XXIII, p. 43 (1909).

⁸ Blyth, E., *J. Asiat. Soc. Bengal* XVI (1) p. 150 (1847).

a faded, tailless female with a very long upper mandible (as Blyth had stated); the colour is pale, faded brown with grey tinge above; the lower parts are similar but with many dusky patches. It bears the following Asiatic Society of Bengal label on parchment :— “ No. 960. Type of *Petrocincla longirostris* Blyth. Scinde. Capt. Boys. (C of Cat. ♀) 1847 A.S.B. ” It is thus clearly No. 960C, *Petrocincla cyaneous* (syn. *P. longirostris* Bly.) of Blyth's *Catalogue* (1849, p. 164). It measures (in mm.) as follows, Blyth's measurements (1847, p. 150), in inches, being given for comparison :—

Wing	Tail	Tarsus	Bill
Blyth : 4½"	3½"	1"	1½" (from gape).
110 mm.		30 mm.	$\left\{ \begin{array}{l} 33.5 \text{ mm. (from gape).} \\ 29.0 \text{ mm. (from base).} \\ 24.0 \text{ mm. (exposed culmen).} \end{array} \right.$

Type-locality.—Blyth (1847, p. 150) wrote that the type female was “ presented to the Society by Captain Boys who procured it on the march from Scinde to Ferozepore ”, though the label on the specimen merely states “ Scinde ” and the *Catal.* (Blyth, 1849, p. 164) gives the locality as “ from Sindh ” Following the original description, the type-locality must be “ between Sind and Ferozepore ”, the latter place being in the Punjab⁹. Stuart Baker (1930, p. 124 ; 1930x, p. 625) gives the type-locality merely as “ Ferozepore ”, but without justification.

30. *Myiophonus coeruleus temminckii* Vigors.

(The Himalayan Whistling Thrush.)

1831. *Myiophoneus temminckii* Vigors, *Proc. zool. Soc. London*, p. 171.
 (Himalayas ; restricted to Simla-Almora Districts, *vide* Ticehurst & Whistler, *Ibis*, 1924, pp. 468-473.)
 1888. *Myiophoneus temminckii*, Hume, *Str. Feath.* XI, p. 122.
 1924. *Myiophoneus temminckii temminckii*, Stuart Baker, *Faun. Brit. India, Birds* (2nd ed.) II, p. 180.
 1930. *Myiophonus coeruleus temminckii*, Stuart Baker, *Faun. Brit. India, Birds* (2nd ed.) VIII, p. 626.

Specimens collected.—9(3♂♂, 6♀♀) from Manipur, as follows :—

1♂ and 1♀ from Luanglong Khulen, 8th and 9th February 1936 ; 1♂ from Tairenpokpi, 7th February 1936 ; 1♀ from Nanglea Atrow, 14th February 1936. (Naga Hills and Manipur Survey.)

1♂ and 4♀♀ from Kanglatongbi area, 16-18 miles N. of Imphal on Dimapur Road, 23rd and 26th November, and 18th, 22nd and 23rd December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
3♂♂	168—179	120—134	52—58	28—34
Av. :	(173)	(129)	(54)	(23)
6♀♀	167—177	121—139	49—56	26—34
Av. :	(170)	(128)	(52)	(31)
				(5♀♀ only)

⁹ There is a town called Ferozepore also in the United Provinces, but this probably is not the one meant.

Colour of soft parts.—Iris dark brown. Upper bill smoky, yellow at tip; lower bill orange. Legs, feet and claws black; pads olive green in male and smoky olivaceous in female.

Field notes.—This bird was commonly seen near hill-streams and on banks of the Imphal River.

The gonads were in the non-breeding condition. The ovary measured 6×9 mm., with the largest ova not more than 1 mm. in diameter; the testes measured 2×2 mm.

Remarks.—Hume (1888, p. 122) found this thrush common in the western hills of Manipur but absent in the eastern hills.

Fam. 5. MUSCICAPIDAE.

31. *Niltava sundara sundara* Hodgson.

(The Indian Rufous-bellied Niltava.)

1837. *Niltava sundara*, Hodgson, *Indian Rev.* I, p. 650. (Nepal.)

1888. *Niltava sundara*, Hume, *Str. Feath.* XI, p. 112.

1924. *Niltava sundara sundara*, Stuart Baker, *Faun. Brit. India, Birds* (2nd ed.) II, p. 259.

Specimen collected.—1♂ from Nanglea Atrow, 63 miles from Imphal on Imphal-Silchar Road, Manipur, 12th December 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♂: W 85; Tl. 71; Tr. 22; B. 12.

Remarks.—Hume (1888, p. 112) did not find this bird in Manipur, but Stuart Baker (1924) includes that area within its range.

Fam. 6. LANIIDAE.

32. *Lanius nasutus tricolor* (Hodgson).

(The North India Black-headed Shrike.)

1837. *Collurio tricolor* Hodgson, *Indian Rev.* I, p. 446. (Nepal.)

1888. *Lanius nigriceps* (Fr.) (in part), Hume, *Str. Feath.* XI, p. 89.

1924. *Lanius nigriceps nigriceps* (in part), Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) II, p. 292.

Specimens collected.—1♂ and 1♀, about 16 miles N. of Imphal on Dimapur Road, ca. 3,500 ft., 24th November 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

		W.	Tl.	Tr.	B.
1♂	.	96	122	31	
1♀	.	98	121	31	15

Colour of soft parts.—Iris chocolate brown; bill horny black, lower bill pale pinkish grey at base; legs, feet and claws black.

Field notes.—This shrike was common. It was usually found singly on telegraph wires and such other perches in the open.

The gonads were in the non-breeding condition. The ovary measured 4×7 mm., with the largest ova less than 1 mm. in diameter ; the testes measured 2×2 mm.

Remarks.—Hume (1888, p. 89) found it common in Manipur.

Systematic note.—Whistler and Kinnear (1933, p. 334) have shown that the specific name for this shrike should be *nasutus*, and further that there are two subspecies in India, viz., a southern grey-headed *L. nasutus nigriceps* (Franklin) and a northern rufous-backed *L. nasutus tricolor* (Hodgson). The Manipur birds recorded here are, of course, *tricolor*.

33. *Lanius schach nipalensis* Hodgson.

(The Grey-backed Shrike.)

1837. *Lanius schach nipalensis* Hodgson, *Indian Rev.* I, p. 445. (Nepal.)

1888. *Lanius tephronotus* Vig., Hume, *Str. Feath.* XI, p. 88.

1924. *Lanius tephronotus* (in part), Stuart Barker, *Fauna Brit. India, Birds* (2nd ed.) II, p. 297.

1933. *Lanius schach nipalensis*, Whistler and Kinnear, *J. Bombay nat. Hist. Soc.* XXXVI (2), p. 337.

Specimens collected.—3 specimens from Manipur, as follows :—

1♂ from Imphal, ca. 2,800 ft., 3rd February 1936 ; and 1♀ from Luanglong Khulen, 8th February 1936. (Naga Hills and Manipur Survey.)

1♂ from Kanglatongbi area, 15 miles N. of Imphal on Dimapur Road, ca. 3,500 ft., 14th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
2♂♂	97-100	109-112	28-30	17-18
1♀	104	117	28	18

Colour of soft parts.—Iris dark chocolate ; bill dark horny, pale at base ; legs, feet and claws horny black.

Field notes.—This shrike was seen frequently perching singly on telegraph wires and such other perches in the open.

The testes were in the non-breeding condition and measured 1×1 mm.

Remarks.—Hume (1888, p. 88) found this shrike common in Manipur.

34. *Lanius cristatus cristatus* (Linnaeus).

(The Brown Shrike.)

1758. *Lanius cristatus* Linnaeus, *Syst. Nat.* (10th ed.), p. 93. (Bengal.)

1888. *Lanius cristatus*, Hume, *Str. Feath.* XI, p. 92.

1924. *Lanius cristatus cristatus*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) II, p. 300.

Specimen collected.—1♂ from Imphal Valley, ca. 2,500 ft., 3rd December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—1♂: W 90; Tl. 86; Tr. 26; B. 16.

Colour of soft parts.—Bill black towards tip, pale horny at base; legs, feet and claws dark brown.

Field notes.—This species was seen occasionally and was less common than *Lanius nasutus tricolor* mentioned above.

The testes were in the non-breeding condition and measured 1 × 1 mm.

Remarks.—Hume (1888, p. 92) found this shrike fairly common in Manipur.

Fam. 7. DICRURIDAE.

35. *Dicrurus macrocercus macrocercus* Vieillot.

(The Black Drongó.)

1817. *Dicrurus macrocercus* Vieillot, *Nouv. Dict. d'Hist. Nat.* IX, p. 588. (Java.)

1888. *Buchanga atra* (Herm.), Hume, *Str. Feath.* XI, p. 98.

1924. *Dicrurus macrocercus albirictis* Hodgs., Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) II, p. 356.

Specimens collected.—4 specimens from Manipur, as follows:—1♀ and 1 unsexed, from 9 miles N. of Imphal on Dimapur Road, ca. 3,000 ft., 29th December 1945; 1♂ and 1 juv. ♀ from Kanglatongbi area, 16-18 miles N. of Imphal, ca. 3,500 ft., 8th and 11th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
1♂ (first winter ?)	127	125	16	21
1 ad. ♀	150	153	24	23
1 ad. (unsexed)	148	152	19	23
1 juv. ♀	121	120	14	21

Colour of soft parts.—Iris (♂) brownish purple with a thin inner ring of brown; bill black; legs, feet and claws horny black.

Field notes.—The Black Drongó was fairly common in the open forest.

The gonads were in the non-breeding condition. The ovary measured 4 × 6 mm., with the largest ova less than 1 mm. in diameter; the testes measured 1 × 3 mm.

Remarks.—Hume (1888, p. 98) found the Black Drongó rare in northern and central Manipur, fairly common in the southern parts and absent in the eastern and western hills.

Systematic note.—Stuart Baker (1924) separates the Black Drongoes of India into two subspecies—a western *D. m. macrocercus* Vieillot and an eastern *D. m. albirictis* Hodgson. However, an examination of several skins from all over India has convinced us that no such distinction is possible, and all Indian birds, including those found in Manipur, are *D. m. macrocercus*.

36. *Dicrurus leucophaeus hopwoodi* Stuart Baker.

(The Assam Grey Drongo.)

1888. *Buchanga pyrrhops* Hodgs.(?), Hume, *St. Feath.* XI, p. 99.
 1918. *Dicrurus leucophaeus hopwoodi* Stuart Baker, *Novit. Zool.* XXV, p. 294.
 (Dacca, E. Bengal.)
 1924. *Dicrurus leucophaeus hopwoodi*, Stuart Baker, *Fauna Brit. India, Birds*
 (2nd ed.) II, p. 361.

Specimen collected.—1♂ from Kanglatongbi area, about 16 miles N. of Imphal on Dimapur Road, ca. 3,500 ft., 29th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—1♂: W 140; Tl. 147; Tr. 21; B. 25.

Colour of soft parts.—Bill dull black; legs, feet and claws black.

Field notes.—The testes were in the non-breeding condition, measuring about 1 × 1 mm.

Remarks.—Hume (1888, p. 99) found it “not rare” in the eastern and western hills of Manipur but absent in the Imphal basin.

Fam. 8. IRENIDAE.

37. *Irena puella puella* (Latham).

(The Fairy Bluebird.)

1790. *Coracias puella* Latham, *Index. Orn.* I, p. 171. (India.)
 1888. *Irena puella*, Hume, *Str. Feath.* XI, p. 186.
 1926. *Irena puella puella*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.)
 III, p. 1.

Specimen collected.—1♀ from Nanglea Atrow, 63 miles from Imphal on Silchar Road, 9th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♀: W. 136; Tl. 119; Tr. 19; B. 23.

Remarks.—Hume (1888, p. 186) found this bird very common in forests in certain parts of Manipur.

Fam. 9. ORIOLIDAE.

38. *Oriolus chinensis tenuirostris* Blyth.

(The Burmese Black-naped Oriole.)

1846. *Oriolus tenuirostris* Blyth, *J. Asiat. Soc. Bengal* XV, p. 48. (Central India.)
 1888. *Oriolus tenuirostris*, Hume, *Str. Feath.* XI, p. 187.
 1926. *Oriolus chinensis tenuirostris*, Stuart Baker, *Fauna Brit. India, Birds*
 (2nd ed.) III, p. 9.

Specimen collected.—1♀ from Imphal, ca. 2,600 ft., 4th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♀: W 152; Tl. 91; Tr. 25; B. 30.

Remarks.—Godwin Austen (1874, p. 166) recorded it from Bishenpur a little west of Imphal, while Hume (1888, p. 187) found it fairly common in and immediately around the Imphal basin but not higher up in the hills.

39. Oriolus traillii traillii (Vigors).

(The Maroon Oriole.)

1831. *Pastor traillii* Vigors, *Proc. zool. Soc. London*, p. 175, (Darjeeling, Himalayas.)
 1889. *Oriolus traillii*, Oates, *Fauna Brit. India, Birds I*, p. 508.
 1926. *Oriolus traillii*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) III, p. 14.

Specimen collected.—1 juv. ♂ from Luanglong Khulen, 9th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1 juv. ♂: W 141; Tl. 109; Tr. 30; B. 28.

Remarks.—Godwin Austen (1874) and Hume (1888) did not record this oriole from Manipur, but Oates (1889, p. 508) included that area within its range.

Fam. 10. STURNIDAE.

40. Acridotheres tristis tristis (Linnaeus).

(The Common Myna.)

1766. *Paradisea tristis* Linnaeus, *Syst. Nat.* (12th ed.) I, p. 167. (Philippines, in errore=Calcutta.)
 1888. *Acridotheres tristis*, Hume, *Str. Feath.* XI, p. 262.
 1926. *Acridotheres tristis tristis*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) III, p. 53.

Specimens collected.—4 (3♂♂, 1♀.), 10 miles N. of Imphal on Dimapur Road, Manipur, ca. 3,000 ft., 9th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
3♂♂	140-144	91-95	39-42	22-25
1♀	136	87	38	24

Colour of soft parts.—Irish brownish red, with a circle of about 14-15 white spots; these spots appear to be a regular feature, as they are present in all the specimens. Skin around eye orange. Bill, legs and feet yellow; claws greyish yellow at base, greyish horny at tips.

Field notes.—This Myna was very common in the Imphal Valley and higher up around Kanglatongbi (ca. 3,500 ft.).

The testes measured 2 × 4 mm.; and the ovary 4 × 10 mm., with the largest ova not more than 1 mm. in diameter.

Remarks.—Hume (1888, p. 262) found this bird fairly common in the Imphal Valley, but stated that it is never seen in the hills, though it is elsewhere by no means confined to the plains, being found, for instance, in the Himalayas up to over 7,000 ft. altitude. However, as mentioned above, I found it up to at least 3,500 ft. in the Kanglatongbi area in Manipur.

41. *Aethiopsar grandis infuscatus* Stuart Baker.

(The Assam Jungle Myna.)

- 1888. *Acridotheres siamensis* (Swin.), Hume, *Str. Feath.* XI, p. 264.
- 1889. *Acridotheres grandis* (Moore) (in part), Oates, *Fauna Brit. India, Birds* I, p. 541.
- 1918. *Aethiopsar grandis infuscatus* Stuart Baker, *Bull. Brit. orn. Club* XXXVIII, p. 70. (Lower Chindwin, Burma.)
- 1926. *Aethiopsar grandis infuscatus*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) III, p. 59.

Specimens collected.—3♂♂ from Kanglatongbi area, 15 miles N of Imphal on Dimapur Road, Manipur, ca. 3,500 ft., 14th November and 14th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—3♂♂ : W 133-137 ; Tl. 83-100 ; Tr. 37-40 ; B. 22-25.

Colour of soft parts.—Iris brown ; bill, legs and feet orange yellow ; claws yellowish horny.

Field notes.—This species was common in the open country near Kanglatongbi.

The testes were in the non-breeding condition, measuring 1×1 mm.

Remarks.—Hume (1888, p. 264) observed it only in south and south-east Manipur, and remarked that even there it is extremely rare.

42. *Aethiopsar albocinctus* (Godwin Austen & Walden).

(The Collared Myna.)

- 1875. *Acridotheres albocinctus* Godwin Austen and Walden, *Ibis*. (3) V, p. 251. ("Munipur Valley", Assam.)
- 1888. *Acridotheres albocinctus*, Hume, *Str. Feath.* XI, p. 262.
- 1926. *Aethiopsar albocinctus* Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.), III, p. 60.

Specimen collected.—1♀ from Kanglatongbi area, 18 miles, N. of Imphal on Dimapur Road, Manipur, ca. 3,500 ft., 22nd December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—1♀ : W 125 ; Tl. 76 ; Tr. 39 ; B. 25.

Colour of soft parts.—Iris yellow ; bill yellow, pale orange at base ; legs and feet dirty orange ; claws pale smoky ; pads pale orange.

Field notes.—Godwin Austen and Walden (1875, p. 251), Godwin Austen (1876a, p. 200) and Hume (1888, p. 262) found it common in the Manipur Valley.

43. *Sturnopaster contra superciliaris* Blyth.

(The Burmese Pied Myna.)

- 1863. *Sturnopaster superciliaris* Blyth, *J. Asiat. Soc. Bengal* XXXII, p. 77. (Rangoon, Burma.)
- 1888. *Sturnopaster superciliaris*, Hume, *Str. Feath.* XI, p. 261.
- 1926. *Sturnopaster capensis superciliaris*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) III, p. 64.
- 1930. *Sturnopaster contra superciliaris*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) VIII, p. 651.

Specimens collected.—3 (2♂♂, 1♀) from 9-10 miles N. of Imphal on Dimapur Road, ca. 2,800-3,000 ft. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
2 ♂♂	112-118	65-72	33-34	31
1 ♀	113	72	34	29

Colour of soft parts.—Iris yellow, with a white outer ring; skin around eyes yellow; eye-lids orange. Bill yellow, orange at base; legs and feet pinkish olivaceous; claws smoky horny.

Field notes.—This Myna was fairly common all over the Imphal Valley and the Kanglatongbi area at least up to 3,500 ft.

The gonads were in the non-breeding condition. The ovary measured 4×8 mm., with the largest ova not more than 1 mm. in diameter; the testes measured 2×2 mm.

Remarks.—Hume (1888, p. 261) also found this Myna fairly common in the Manipur Valley but absent in the hills.

Fam. 11. FRINGILLIDAE.

44. *Passer montanus malaccensis* Dubois.

(The Malay Tree-Sparrow.)

1885. *Passer malaccensis* Dubois, *Faun. III. Vert. Belge., Ois. I.* p. 572. (Malacca.)

1888. *Passer montanus* Linn., Hume, *Str. Feath.* XI, p. 275.

1926. *Passer montanus malaccensis*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) III, p. 117.

Specimens collected.—6 specimens as follows:—

1♂, 1♀ from Imphal, ca. 2,600 ft., Manipur, 6th February 1936. (Naga Hills and Manipur Survey.)

2♂♂, 2♀♀ from Kanglatongbi area, 16 miles N. of Imphal on Dimapur Road, ca. 3,500 ft., 17th and 18th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
3 ♂♂	69-72	52-58	17-19	12
3 ♀♀	67-69	52-53	17	10-12

Colour of soft parts.—Iris hazel brown; bill horny black, yellowish at base; legs, feet and claws pale olivaceous.

Field notes.—This bird was very common near human habitations in the Imphal and Kanglatongbi areas (2,600-3,500 ft.), being found in groups of 10-20 on the ground. The House Sparrow (*P. domesticus*) was entirely absent.

The gonads were in the non-breeding condition. The ovary measured 4×5 mm., and the testes 1×1 mm.

Remarks.—Hume (1888, p. 275) also found this sparrow very common in the Imphal Valley.

Fam. 12. HIRUNDINIDAE.

45. *Hirundo rustica rustica* Linnaeus.

(The Common Swallow.)

1758. *Hirundo rustica* Linnaeus, *Syst. Nat.* (10th ed.) I, p. 191. (Europe = Sweden.)
1888. *Hirundo rustica*, Hume, *Str. Feath.* XI, p. 24.
1926. *Hirundo rustica rustica*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) III, p. 240.

Specimens collected.—2♂♂ from Nanglea Atrow, 63 miles from Imphal on Silchar Road, Manipur, 12th and 14th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—2♂♂: W 114-119; Tl. 91-95; Tr. 11-12; B. 8-9.

Remarks.—Hume (1888, p. 24) recorded these swallows from Manipur and remarked that the Manipur birds ought rather to stand as *rustica* and not *H. r. gutturalis*. The present specimens, with fulvous chest and abdomen, are clearly assignable to *H. r. rustica*.

Fam. 13. MOTACILLIDAE.

46. *Motacilla alba dukhunensis* Sykes.

(The Indian White Wagtail.)

1832. *Motacillia dukhunensis* Sykes, *Proc. zool. Soc. London*, p. 91. (Deccan, S. India.)
1888. *Motacilla dukhunensis*, Hume, *Str. Feath.* XI, p. 230.
1926. *Motacilla alba dukhunensis*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) III, p. 257.

Specimens collected.—2♂♂ as follows:—One (21st December 1945) from Kanglatongbi area, 16 miles N. of Imphal on Dimapur Road, ca. 3,500 ft.; and another (23rd December 1945) from Imphal Valley, ca. 2,600 ft. (Major M. L. Roonwal.)

Measurements (mm.).—2♂♂: W 91-93; Tl. 92-95; Tr. 24; B. 15.

Colour of soft parts.—Iris dark brown, bill dark horny; legs, feet and claws horny black.

Field notes.—These birds were common, being usually found singly or in twos (not in flocks). They were present throughout the period of observation (July-December), being presumably resident in Manipur.

The testes were in the non-breeding condition, measuring 1×1 mm.

Remarks.—Hume (1888, p. 230) found this wagtail scarce in Manipur.

47. *Motacilla alboides* Hodgson.

(Hodgson's Pied Wagtail.)

1836. *Motacilla alboides* Hodgson, *Asiat. Res.* XIX, p. 191. (Nepal.)
 1888. *Motacilla hodgsoni* Bly. (ex. G. R. Gray, MS.), Hume, *Str. Feath.* XI, p. 230.
 1926. *Motacilla lugubris alboides*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) III, p. 262.
 1930. *Motacilla alboides*, Stuart Baker, *Faun. Brit. India, Birds* (2nd ed.) VIII, p. 660.

Specimens collected.—2♀♀ from Manipur as follows :—One (18th December 1945) from Kanglatongbi area, 16 miles N. of Imphal on Dimapur Road, ca. 3,500 ft.; and another (22nd December 1945) from Imphal Valley, ca. 2,500 ft. (Major M. L. Roonwal.)

Measurements (mm.).—2♀♀: W 86-94; Tl. 88-92; Tr. 23-24; B. 14-15.

Colour of soft parts.—Bill, legs, feet and claws dull black.

Field notes.—This wagtail was very common throughout the period of observation (July-December) and is evidently resident in Manipur.

The ovaries (in December) were in the non-breeding condition measuring about 3 × 6 mm.

Remarks.—Hume (1888, p. 230) found this wagtail fairly common in the Imphal Valley (near Imphal and a little north of it), but more rare in the south.

48. *Motacilla leucopsis* Gould.

(The White-faced Wagtail.)

1837. *Motacilla leucopsis* Gould, *Proc. zool. Soc. London*, p. 78. (India.)
 1888. *Motacilla leucopsis*, Hume, *Str. Feath.* XI, p. 230.
 1926. *Motacilla lugubris leucopsis*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) III, p. 264.
 1930. *Motacilla leucopsis*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) VIII, p. 660.

Specimen collected.—1 (unsexed) from Imphal Valley, Manipur, ca. 3,000 ft., 20th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—1 (unsexed): W 88; Tl. 90; Tr. 24; B. 13.

Colour of soft parts.—Iris dark brown; bill horny; legs, feet and claws dull horny black.

Field notes.—This wagtail was very common throughout the period of observation (July-December) in the Imphal Valley and in the Kanglatongbi area.

Remarks.—Hume (1888, p. 230) also found it very common in Manipur, specially in the basin.

49. *Motacilla cinerea caspica* (S. G. Gmelin).

(The Eastern Grey Wagtail.)

1774. *Parus caspicus* S. G. Gmelin, *Reise Russ. z. Unters. d. Natur-Reiche* III, p. 104, pl. xx, fig. 2. (Caspian Sea.)
 1888. *Calobates melanope* (Pall.), Hume, *Str. Feath.* XI, p. 231.
 1926. *Motacilla cinerea caspica*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) III, p. 265.

Specimens collected.—4 (2♂♂, 1♀, 1 unsexed) from Kanglatongbi area, 16-18 miles N. of Imphal on Dimapur Road, ca. 3,500 ft., 8th, 22nd and 23rd December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
2♂♂	82-87	95-96	20-21	15
1♀	83	89	21	15
1 (unsexed)	85	93	22	15

Colour of soft parts.—Iris dark brown; bill smoky brown, base of the lower beak paler; legs and feet pale smoky fleshy; claws, fleshy horny.

Field notes.—This wagtail was common in open forest and oak scrub, being usually found singly or in twos (not in flocks). They were not met with in July and August. The first specimens were seen in early September following which they soon become common, and remained so until the end of December after which no observations were made.

The gonads were in the non-breeding condition. The ovary measured 3×6 mm., with the largest ova less than 1 mm. in diameter; the testes measured 1×1 mm.

Remarks.—Hume (1888, p. 231) found this wagtail fairly common in the western hills and the Imphal Valley in Manipur.

Systematic note.—The tail-length of *M. cinerea caspica* given by Stuart Baker (1926, p. 265) as “under 75 mm.” and “67-73 mm.” is incorrect, as already pointed out by Ticehurst¹⁰ (1927, p. 351). In the Manipur specimens the tail is 89-96 mm. long.

50. *Anthus hodgsoni hodgsoni* Richmond.

(The Indian Tree-Pipit.)

1888. *Anthus maculatus* Hodgs., Hume, *Str. Feath.* XI, p. 233.
 1907. *Anthus trivialis hodgsoni* Richmond, *Blackwelder's Res. in China* II, p. 493. (Nepal.)
 1926. *Anthus hodgsoni hodgsoni*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) III, p. 281.

Specimen collected.—1♂ from Kanglatongbi area, 16 miles N. of Imphal on Dimapur Road, ca. 3,500 ft., 23rd December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—1♂: W 86; Tl. 63; Tr. 20; B. 12.

¹⁰ Ticehurst, C. B. 1927. *J. Bombay nat. Hist. Soc.* XXXII, p. 351.

Colour of soft parts.—Iris dark brown. Bill dark brown, base of the lower bill fleshy. Legs, feet and claws pale fleshy.

Field notes.—This pipit was met with infrequently.

The testes were in the non-breeding condition and measured 1×1 mm.

Remarks.—Hume (1888, p. 233) found this pipit very common in the western hills, but more rare in the eastern hills of Manipur. He also recorded that there occasionally occurs a peculiar variety in which the upper plumage is grey instead of the normal olive green and the wing bands white instead of buffy; in other respects they are exactly like the normal birds.

Fam. 14. ZOSTEROPIDAE.

51. *Zosterops palpebrosa palpebrosa* (Temminck).

(The Indian White-Eye.)

1824. *Sylvia palpebrosa* Temminck, *Pl. Col. d'Ois.*, pl. 203, fig. 3. (Benga vide Ticehurst *infra*.)
 1888. *Zosterops palpebrosa* Hume, *Str. Feath.* XI, p. 253.
 1922. *Zosterops palpebrosa cacharensis*, Stuart Baker, *Ibis* (11) IV, p. 144.
 1926. *Zosterops palpebrosa cacharensis*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) III, p. 361.
 1927. *Zosterops palpebrosa palpebrosa*, Ticehurst, *J. Bombay. nat. Hist. Soc.* XXXII, p. 354.

Specimen collected.—1♀ from Ragailous Camp, about 63 miles from Imphal on Silchar Road, Manipur, ca. 3,250 ft., 11th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♀: W 53; Tl. 36; Tr. 16; B. 11.

Remarks.—(Hume 1888, p. 253) found this white-eye common in the Imphal Valley but absent in the hills.

Fam. 15. NECTARINIIDAE.

52. *Aethopyga saturata saturata* (Hodgson).

(The Black-breasted Sunbird.)

1837. *Cinnyris saturata* Hodgson, *Indian Rev.* I, p. 273. (Nepal.)
 1888. *Aethopyga saturata*, Hume, *Str. Feath.* XI, p. 82.
 1926. *Aethopyga saturata saturata*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) III, p. 388.

Specimen collected.—1♂ from Nanglea Atrow, 63 miles from Imphal on Silchar Road, Manipur, 14th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♂: W 51; Tl. 71; Tr. 16; B. 18.

Remarks.—Hume (1888, p. 82) found this bird common in both the eastern and western hills of Manipur.

Fam. 16. EURYLAIMIDAE.

53. *Psarisomus dalhousiae* (Jameson).

(The Long-tailed Broadbill.)

1835. *Eurylaimus dalhousiae* Jameson, *Edinb. new philos. J.* XVIII, p. 389.
(North India.)
1888. *Psarisomus dalhousiae*, Hume, *Str. Feath.* XI, p. 48.
1926. *Psarisomus dalhousiae*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.)
III, p. 472.

Specimens collected.—2 (1♀, 1♂) from Nanglea Atrow, 63 miles from Imphal on Silchar Road, Manipur, 13th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
1♂	102	124	27	18
1♀	100	112	27	19

Remarks.—Hume (1888, p. 48) found this bird common in both the eastern and western hills of Manipur, but not in the Valley.

Ord. 2. CORACIIFORMES.

Subord. *PICI*.

Fam. 17. PICIDAE.

54. *Dryobates atratus* (Blyth).

(The Stripe-breasted Pied Woodpecker.)

1849. *Picus atratus* Blyth, *J. Asiat. Soc. Bengal* XVIII, p. 803. ("Tenasserim provinces", S. Burma.)
1888. *Picus atratus*, Hume, *Str. Feath.* XI, p. 58.
1927. *Dryobates atratus*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.)
IV, p. 41.

Specimens collected.—1♀ from "Manipur" (= Imphal), ca. 2,600 ft., Manipur, 4th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♀ : W 110 ; Tl. 71 ; Tr. 23 ; B. 21.

Remarks.—Hume (1888, p. 58) found it only in the eastern hills of Manipur and remarked that it was rare.

55. *Yungipicus nanus canicapillus* (Blyth).

(The Burmese Pigmy Woodpecker.)

1845. *Picus canicapillus* Blyth, *J. Asiat. Soc. Bengal* XIV, pt. 1, p. 197.
(Arakan, Burma.)
1888. *Yungipicus canicapillus*, Hume, *Str. Feath.* XI, p. 60.
1927. *Yungipicus hardwickii canicapillus*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) IV, p. 51.

Specimens collected.—1♀ (labelled ♂) from Tairenpokpi, ca. 3,000 ft. 7th February 1936. (Naga Hills and Manipur Survey.) There are no crimson feathers on head, and hence we regard the specimen as a ♀.

Measurements (mm.).—1♀ : W 92 ; Tl. 45 ; Tr. 15 ; B. 16.

Remarks.—Hume (1888, p. 60) found it fairly common in Manipur.

Fam. 18. CAPITONIDAE.

56. *Cyanops asiatica asiatica* (Latham).

(The Blue-throated Barbet.)

1790. *Trogon asiaticus* Latham, *Index Orn.* I, p. 201. (India.)
 1874. *Cyanops asiatica*, Godwin Austen, *J. Asiat. Soc. Bengal* XLIII (2), p. 176.
 1888. *Megalema asiatica*, Hume, *Str. Feath.* XI, p. 67.
 1927. *Cyanops asiatica*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) IV, p. 116.

Specimen collected.—1♂ from Regailous Camp, on Imphal-Silchar Road, Manipur, ca. 3,250 ft., 11th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♂: W 105; Tl. 69; Tr. 25; B. 25.

Remarks.—Both Godwin Austen (1874, p. 176) and Hume (1888, p. 67) recorded this barbet from Manipur, the later remarking that it is common all over Manipur upto 4,000 ft. or a little higher.

Subord. CUCULI.

Fam. 19. CUCULIDAE.

57. *Centropus sinensis intermedius* (Hume).

(Hume's Crow-Pheasant.)

1873. *Centroccocyx intermedius* Hume, *Str. Feath.* I, p. 454. ("Dhoon, Dacca, Thayetmyo". Restricted to Thayetmyo, Burma, by Stuart Baker, 1927, *infra*.)
 1888. *Centroccocyx intermedius*, Hume, *Str. Feath.* XI, p. 77.
 1927. *Centropus sinensis intermedius*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) IV, p. 192.

Specimen collected.—1 (unsexed) from Kanglatongbi area, 16 miles N. of Imphal, ca. 3,500 ft., 10th November 1945. (Major M.L. Roonwal.)

Measurements (mm.).—1 (unsexed): W 197; Tl. 238; Tr. 60; B. 36.

Colour of soft parts.—Iris red; bill, feet and claws horny black.

Field notes.—This crow-pheasant was quite common in the forests skirting the Imphal Valley, upto at least 3,500 ft. altitude.

Remarks.—Hume (1888, p. 77) also found it common in that area but stated that he did not find it in the hills.

Subord. CORACII

Fam. 20. CORACIIDAE.

58. *Coracias benghalensis affinis* Horsfield.

(The Burmese Roller or Blue Jay.)

1839. *Coracias affinis* Horsfield (*ex* McClelland MS.), *Proc. zool. Soc. London*, p. 164. (Assam.)
 1888. *Coracias affinis*, Hume, *Str. Feath.* XI, p. 43.
 1927. *Coracias benghalensis affinis*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) IV, p. 226.

Specimens collected.—2 (1♂, 1♀) from Kanglatongbi area, about 16 miles N. of Imphal on Dimapur Road, ca. 3,500 ft., Manipur, 26th November 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
1♂	183	132	27	37
1♀	188	130	27	40

Colour of soft parts.—Bill and claws horny; legs and feet ochreous yellow.

Field notes.—This roller was found commonly, but was rarer in November and December as compared to the period July-October.

The gonads were in the non-breeding condition. The ovary measured 7×10 mm., with the largest ova about 1 mm. in diameter; the testes measured 2×2 mm.

Remarks.—Hume (1888, p. 43) found it absent both in the eastern and western hills of Manipur, and rare in the basin. This does not agree with my observations, for it was seen commonly throughout the Imphal Valley, upto at least 3,500 ft. altitude.

Fam. 21. ALCEDINIDAE.

59. *Ceryle rudis leucomelanura* Reichenbach.

(The Indian Pied Kingfisher.)

1851. *Ceryle leucomelanura* Reichenbach, *Icon. Syst. Ar. Alced.*, p. 21. (Ceylon.)

1888. *Ceryle rudis* Reich. (not Linn.), Hume, *Str. Feath.* XI, p. 47.

1927. *Ceryle rudis leucomelanura*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) IV, p. 246.

Specimen collected.—1♀ from Imphal Valley, Manipur, ca. 2,600 ft., 29th November 1945. (Major M. L. Roonwal.)

Measurements (mm.).—1♀: W 137; Tl. 80; Tr. 11; B. 63.

Colour of soft parts.—Bill, legs and claws horny black.

Field notes.—This bird was met with fairly commonly though much less so than the other species of kingfishers. It was usually seen singly near water or on telegraph wires.

The ovary was in the non-breeding condition, measuring about 7×11 mm.

Remarks.—Hume (1888, p. 47) found it very rare in the Imphal Valley and entirely absent in the hills.

60. *Alcedo atthis bengalensis* Gmelin.

(The Common Indian Kingfisher.)

1788. *Alcedo bengalensis* Gmelin, *Syst. Nat.* (13th ed.) I (1), p. 450. (Bengal.)

1888. *Alcedo bengalensis*, Hume, *Str. Feath.* XI, p. 46.

1927. *Alcedo atthis bengalensis*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) IV, p. 250.

Specimen collected.—1♀ from 10 miles N. of Imphal, Manipur, ca. 2,800 ft., 3rd December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—1♀: W 71; Tl. 35; Tr. 10; B. 42

Colour of soft parts.—Iris dark chocolate. Upper bill horny black; lower bill orange-pink at base, smoky at tip. Legs and feet smoky in front, orange-pink behind. Pads orange-pink; claws horny black.

Field notes.—The ovary was in the non-breeding condition, measuring 2×4 mm.

Remarks.—Hume (1888, p. 46) found it “not uncommon” in the western hills, but rare in the eastern hills of Manipur.

61. *Halcyon smyrnensis fusca* (Boddaert).

(The Indian White-breasted Kingfisher.)

1783. *Alcedo fusca* Boddaert, *Tabl. Pl. Enlum.*, p. 54 (based on *Pl. Enlum.*, 894). (Malabar.)

1888. *Halcyon smyrnensis* (Linn.), Hume, *Str. Feath.* XI, p. 44.

1927. *Halcyon smyrnensis fusca*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) IV, p. 269.

Specimens collected.—2, collected in Manipur on 26th November 1945, as follows :—1♂ from Kanglatongbi area, about 16 miles N. of Imphal on Dimapur Road, ca. 3,500 ft.; and 1♀ from Imphal Valley, ca. 2,800 ft. (Major M. L. Roonwal.)

Measurements (mm.).—

		W.	Tl.	Tr.	B.
1♂	. .	113	83	20	60
1♀	.	125	87	16	63

Colour of soft parts.—Bill dark red, smoky at edges. Legs and feet in front dark red; behind bright red in ♂ and orange in ♀.

Field notes.—The bird was seen quite frequently.

The gonads were in the non-breeding condition. The ovary measured 6×9 mm., with the largest ova less than 1 mm. in diameter; the testes measured 2×2 mm.

Remarks.—Hume (1888, p. 44) found it “not rare” around Imphal and in the valley, but absent in the eastern and western hills of Manipur.

Fam. 22. BUCEROTIDAE.

62. *Hydrocissa malabarica malabarica* (Gmelin).

(The Large Indian Pied Hornbill.)

1788. *Buceros malabaricus* Gmelin, *Syst. Nat.* I. p. 359. (Malabar, *errore* = Chandranagar, W. Bengal, *vide* Stuart Baker, *infra*.)

1888. *Hydrocissa albirostris* (Sh. & Nod.), Hume, *Str. Feath.* XI, p. 51.

1927. *Anthracoceros malabaricus*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) IV, p. 288.

1930. *Hydrocissa malabarica*, Stuart Baker, *Fauna Brit. Indic, Birds* (2nd ed.) VIII, p. 678.

Specimen collected.—1♀ from Naglea Atrow, 63 miles from Imphal on Silchar Road, ca. 3,250 ft., 13th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♀ : W 294 ; Tl. 273 ; Tr. 62 ; B. 142.

Remarks.—Hume (1888, p. 51) found it common in the western hills of Manipur but absent in the eastern hills.

Fam. 23. UPUPIDAE.

63. *Upupa epops epops* Linnaeus.

(The European Hoopoe.)

1758. *Upupa epops* Linnaeus, *Syst. Nat.* (10th ed.) I, p. 117. (Sweden).

1888. *Upupa epops*, Hume, *Str. Feath.* XI, p. 87.

1927. *Upupa epops epops*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) IV, p. 308.

Specimens collected.—3 (1♂, 2♀♀) from Imphal Valley, about 6-9 miles N. of Imphal, ca. 2,600-3,000 ft., 21st November and 29th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
1♂ . . .	150	115	25	59
2♀♀ . . .	140—145	101—103	21—23	52 (one ♀)

Colour of soft parts.—Bill dark smoky horny, lower bill fleshy at base. Legs, feet and claws dark horny.

Field notes.—Both *U. e. epops* and *U. e. longirostris* were found in Manipur. They were met with occasionally and were distinctly infrequent. They first arrived about early November, and were not in evidence during July-October.

In *U. e. epops* the gonads were in the non-breeding condition. The ovaries measured 5×7 mm., with the largest ova not more than 1 mm. in diameter ; the testes measured 1×1 mm.

Remarks.—Hume (1888, p. 87) found this hoopoe sparingly ; he recorded both this and the following subspecies (*U. e. longirostris*) from Manipur.

64. *Upupa epops longirostris* Jerdon.

(The Burmese Hoopoe.)

1862. *Upupa longirostris* Jerdon, *Birds of India* I, p. 293. (Burma.)

1888. *Upupa longirostris*, Hume, *Str. Feath.* XI, p. 88.

1927. *Upupa epops longirostris*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) IV, p. 312.

Specimen collected.—1♂ from Kanglatongbi area, 18 miles N. of Imphal on Dimapur Road, ca. 3,500 ft., 22nd December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—1♂ : W, 148 ; Tl. 110 ; Tr. 25 ; B. 65.

Colour of soft parts.—Bill smoky ; legs and feet pinkish smoky ; claws horny.

Field notes.—The testes were in the non-breeding condition, measuring about 2×2 mm.

Subord. *TROGONES*.

Fam. 24. TROGONIDAE.

65. *Harpactes erythrocephalus erythrocephalus* (Gould).

(The Red-headed Trogon.)

1834. *Trogon erythrocephalus* Gould, *Proc. zool. Soc. London*, p. 25. (Rangoon, Burma.)
 1888. *Harpactes erythrocephalus*, Hume, *Str. Feath.* XI, p. 41.
 1927. *Pyrotrygon erythrocephalus erythrocephalus*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) IV, p. 318.
 1930. *Harpactes erythrocephalus erythrocephalus*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) VII, p. 362.

Specimen collected.—1♂ from Luanglong Khunow, ca. 3,250 ft., 9th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♂ : W 149 ; Tl. 187 ; Tr. 16 ; B. 20.

Remarks.—Hume (1888, p. 41) found it common in Manipur.

Subord. *CAPRIMULGI*.

Fam. 25. CAPRIMULGIDAE.

66. *Caprimulgus macrourus* ?*albonotus* Tickell.

(The Indian Long-tailed Nightjar.)

1933. *Caprimulgus albonotus* Tickell, *J. Asiat. Soc. Bengal* II, p. 580. ("Boralhum, Bengal").
 1888. *Caprimulgus macrourus* Horsf., Hume, *Str. Feath.* XI, p. 39.
 1927. *Caprimulgus macrourus albonotus*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) IV, p. 364.

Specimen collected.—1♂ from Imphal Valley, Manipur, ca. 3,000 ft., 18th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—1♂ : W 206 ; Tl. 158 ; Tr. 24 ; B. 7.

Colour of soft parts.—Bill dark horny at tip, fleshy at base. Legs and feet smoky fleshy ; claws horny black ; middle claw with a horny brown membranous frill.

Field notes.—This specimen, which was shot at night in oak scrub, was the only one ever met with.

The testes were in the non-breeding condition, measuring 2×4 mm.

Remarks.—Hume (1888, p. 39) recorded it from both the western and eastern hills of Manipur.

Subord. *STRIGES*.

Fam. 26. TYTONIDAE.

67. *Tyto alba javanica* (Gmelin).

(The Indian Barn-Owl.)

1788. *Strix javanica* Gmelin, *Syst. Nat.* I, p. 295. (Java.)

1888. *Strix javanica*, Hume, *Str. Feath.* XI, p. 18.

1927. *Tyto alba javanica*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) IV, p. 385.

Specimen collected.—1♂ from Imphal Valley, Manipur, ca. 2,500 ft., 14th November 1945. (Major M. L. Roonwal.)

Measurements (mm.).—1♂: W 289; Tl. 116; Tr. 72; B. 37.

Field notes.—Only one specimen was obtained in the jungles.

The testes were in the breeding condition and measured 4×13 mm.

Remarks.—Hume (1888, p. 18) found it rare in Manipur.

Fam. 27 ASIONIDAE.

68. *Strix indranee newarensis* (Hodgson).

(The Himalayan Brown Wood-Owl.)

1836. *Ulula newarensis* Hodgson, *Asiat. Res.* XIX, p. 168. (Nepal.)

1888. *Syrnium newarense*, Hume, *Str. Feath.* XI, p. 19.

1927. *Strix indranee newarensis*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) IV, p. 400.

Specimens collected.—3♀♀ from hill forests around Modbung village (ca. 3,750 ft.) and Kanglatongbi area (ca. 3,500 ft.), about 16 miles N. of Imphal, Manipur, 23rd November and 6th and 13th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—3♀♀: W 372-385; Tl. 223-238; Tr. 68-69; B. 39-42.

Colour of soft parts.—Iris dark brown; bill dull pale grey, whitish at tip; pads dirty white; claws pale horny, white at base and smoky at tips.

Field notes.—In Manipur the Naga tribesmen, from whom all the three specimens were purchased, stated that it is frequently trapped by them. The specimens were bought alive and kept in captivity, but they refused to eat bird-flesh and died within a few days. When disturbed in captivity they make a loud, clicking sound with the tongue, and also a hissing sound, both of which have probably not been recorded before.

The ovaries in the 3♀♀ were in the non-breeding condition and measured 5×25, 7×24, and 10×22 mm., with the largest ova not more than 1 mm. in diameter.

Remarks.—Hume (1888, p. 19) found this owl “not uncommon” in Manipur.

69. Otus bakkamoena manipurensis subsp. nov.

(The Manipur Collared Scops Owl.)

(Plate V, figs. 2, 2a, 3, 3a.)

Description.—Dorsum deep brown, streaked and vermiculated all over with buff or rufous. Venter white to buff, boldly streaked with dark brown to black and vermiculated with the same. Forehead in front and the stiff feathers around the sides of beak and above it white, tipped with black and buff and ending in black bristles. Sides of forehead and lores white; feathers around the eyes brown. Crown, nape and back deep brown, the individual feathers mottled with buff and rufous at the sides; in some the deep brown is reduced to a central streak and transverse vermiculations. The feathers behind the nape buff, tipped with brown, forming a dorsal collar which is sometimes obsolescent. Upper tail-coverts same as back. Lower tail-coverts white to buff. Tail feathers above dull brown, with 7-9 transverse wavy bars of fulvous; tail below similar but much paler. Upper wing-coverts and tertiaries like back. Primary wing-quills dark smoky brown, with a series of large buff spots at edges of outer webs and pale wide transverse bars on inner, these latter becoming obsolescent on the outer primaries. Secondaries like primaries, but with the buff spots and bars mottled with brown. Bastard wing buff, mottled with dark brown. Inner surface of wing silvery smoky, transversely barred with whitish, especially on the secondaries. Under wing-coverts and axillaries whitish buff with grey bases. Chin and throat whitish buff, the feathers barred or mottled with brown, especially on the middle and lower throat. Rest of ventrum white to buff, each feather with a bold brown streak (reduced to a fine one in some) in centre and fine wavy transverse vermiculations. Feathers on legs white to buff with brown vermiculations, the feathers well covering the bases of toes in some and in others leaving them naked.

Colour of soft parts.—Iris brown to dark olivaceous brown. Bill horny to ashy, with more or less yellow towards base. Legs and toes pale pink-olivaceous to dirty horny. Claws horny, sometimes with some yellow; tips of claws smoky.

Specimens collected.—5 (2♂♂, 1♀, 2 unsexed), 5-10 miles, N. of Imphal on Dimapur Road, Manipur, Assam, ca. 2,600-2,800 ft., 19th November to 27th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
2♂♂	172	81—86	35—37	25
1♀	174	86	39	24
2 unsexed	169—171	83—87	35—38	22—24
Range	169—174	81—87	35—38	22—25
Average	171.6	84.6	36.4	23.4

Type-specimen.—(Plate V, figs. 2, 2a) HOLOTYPE: Z. S. I. Reg. No. 27,082, ♂, deposited in the Zoological Survey of India. Imphal Valley, 6 miles north of Imphal, Manipur, Assam, ca. 2,600 ft., above sea-level. Collected by Major M. L. Roonwal, 17th December 1945. Measurements (mm.) of type: W 172; Tl. 81; Tr. 35; B. 22. PARATYPE: Z. S. I. Reg. No. 27,083, unsexed.

Field notes.—This owl was quite common in the Imphal Valley and the bases of the surrounding hills in Manipur. It is nocturnal in habits, sitting solitarily on telegraph wires and such other perches. Hume (1888, p. 22) also found it common in Manipur, "throughout the basin and along the lower spurs of all the surrounding hills", though of course he did not recognize it as a distinct subspecies.

The gonads were in the non-breeding condition, the ovary in ♀ No. 27,084 (7th December) measuring about 8×10 mm., with the largest ova less than 1 mm. in diameter; the testes in 2♂♂, Nos. 27,086 and 27,082 (19th November and 17th December) measured about 3×4 mm.

Distribution.—*O. b. manipurensis*: The Himalayas from Manipur Valley (Assam) in the east to Darjeeling (N. Bengal) in the west; from the foot-hills to 4,000 feet or higher. Darjeeling specimens, in both size and coloration, are intermediate between *O. b. manipurensis* and *O. b. lettia*, though closer to the former, but a specimen from further down (Jalpaiguri District) is referable to the latter.

O. b. lettia: Eastern Himalayas from Nepal in the west to Jalpaiguri District (Bengal Duars) in the east, but not Darjeeling.

Systematic Note.

Otus bakkamoena is a very variable species distributed over a large portion of eastern and southern Asia, viz., Manchuria, Shakalin and the Japanese Islands, central and southern China, India, south-eastern Arabia, Burma, Malaya, Siam, Indo-China, the whole of the East Indies and the Philippines. Peters (1940, pp. 98-100) recognizes 18 subspecies, of which about 9 belong to India, S. China and Malayasia. For the latter regions the following are the available names with their type-localities; those recognized as valid by Peters are marked with an asterisk (*), the remaining ones being synonymies:—

- *1769. *Otus bakkamoena*, Pennant, *Indian Zool.*, p. 3. (Ceylon.)
- 1788. *Otus indica*, Gmelin, *Syst. Nat.* I, pt. 1, p. 289. (Ceylon.) New name for *Otus bakkamoena* Pennant.
- *1821. *Strix Lempiji*, Horsfield, *Trans. Linn. Soc. London*, XIII (1), p. 140. (Java.)
- *1836 (after September). *Scops lettia*, Hodgson, *Asiat. Res.* XIX, p. 176. ("Central and northern hills" of Nepal.)
- 1845. *Scops malabaricus*, Jerdon, *Madras J. Lit. & Sci.* XIII, pt. 2, p. 119. (Malabar, S. India.)
- 1845. *Scops griseus*, Jerdon, *Madras J. Lit. & Sci.* XIII, pt. 2, p. 119. (Western Ghats, S. India.)
- 1845 (January to June). *Strix lettoides*, Blyth (ex Jerdon MS.), *J. Asiat. Soc. Bengal* XIV, p. 182. ("Coromandel Coast", S. India.)
- *1869. *Ephialtes Plumipes*, Hume, *My Scrap-book or Rough Notes Indian Orn.*, p. 397. (Murree, Kotegarh and Garhwal; restricted to Murree, Punjab.) This date is given by many authors as 1870, but the date given on the reference present in Zoological Survey of India Library is 1869.
- 1870 (June). *Ephialtes jerdoni*, Walden, *Ann. Mag. nat. Hist.* (4) V, p. 417. ("Malabar" and "Western Ghats of India".)

- *1870 (August). *Ephialtes glabripes*, Swinhoe, *Ann. Mag. nat. Hist.* (4) VI, p. 152. (South China and Formosa.)
 *1922 (January 3). *Otus bakkamoena deserticolor*, Ticehurst, *Bull. Brit. orn. Cl.* XLII, p. 57. (Hyderabad, Sind, India.)
 *1922 (May 5). *Otus bakkamoena gangeticus*, Ticehurst, *Bull. Brit. orn. Cl.* XLII, p. 122, line 17. (Fatehgarh, United Provinces, India.)
 *1922 (May 5). *Otus bakkamoena marathae*, Ticehurst, *Bull. Brit. orn. Cl.* XLII, p. 122, line 26. (Raipur, Central Provinces, India.)
 1939. *Otus bakkamoena stewarti*, Koelz, *Proc. biol. Soc. Washington* LII, p. 80. (Bajinath, Kangra District, Punjab, India.)

Both Stuart Baker (1927, p. 427) and Peters (1940, p. 98) accept the range of *O. b. lettia* Hodgs. (type-locality Nepal) as: Eastern Himalayas from Nepal to eastern Assam, south to eastern Bengal; all of Burma and northern Siam. No fresh material has been available from Central Nepal since Hodgson's type-material was obtained about 1842. However, a comparison of recently (1947) collected fresh material from Central Nepal¹¹ with our fresh material from Manipur, clearly shows that the latter are definitely not *lettia*. The Nepal birds are smaller, have plenty of grey and much less of rufous, while the dark markings all over are much less extensive, whereas the Manipur birds are larger, and are very dark, with plenty of dark rufous, no grey and with the dark markings very extensive. The Manipur birds also differ from *O. b. bakkamoena* Penn. and *O. b. lempiji* (Horsf.). As no name is available for the Manipur specimens, we had to give a new one, *manipurensis*. In the absence of material, we cannot say whether Burmese specimens are *manipurensis*; if they are not, another new name would be necessary; and the same applies to so called *lettia* from Siam.¹²

The following key would separate the various Himalayan and other Indian subspecies, and including *O. b. lempiji* :—

- (A) Toes feathered to the subterminal phalanx. Size largest, wing ca. 162-186 mm. *plumipes* Hume.
 (B) Toes not feathered to the subterminal phalanx.
 (a) Size large, wing 161-175 mm. Feathers usually extending to base of toes or a little beyond.
 (aa) Very pale all over, with hardly any rufous. Wing 165-175 mm. *deserticolor* Ticeh.
 (bb) Less pale, with some grey and rufous. Wing 161-167, av. 163.3 mm. *lettia* Hodgs.
 (cc) Very dark, with plenty of dark brown above. Wing 169-174, av. 171.6 mm. *manipurensis* Roon. & Nath.
 (b) Size small; wing 135-167 mm.
 (aa) Size smallest, wing 135-157, av. ca. 148 mm. Dark with plenty of rufous and no grey. . . *bakkamoena* Penn., *lempiji* Horsf.
 (bb) Size larger, wing 151-167. Paler. . . *gangeticus* Ticeh., *marathae* Ticeh.

¹¹ Collected by Messrs. B. Biswas and P. N. Mitter of the Zoological Survey of India, June 1947, from "Forest at Phare Ghat west of Hitaura (and ca. 44 miles south of Kathmandu), Nepal Terai, ca. 2,000 ft."

¹² Since writing the above, we received a communication from Mr. B. Biswas who has kindly examined for us all the specimens of *Otus bakkamoena* from S. E. Asia available in the British Museum (Natural History), London. The specimens thus examined come from the following places :—Eastern Nepal Terai; Sikkim; Assam (Cachar, Sadiya, Naga Hills, Manipur); Burma (Lower Chindwin, Tounghoo); and Indo-China (Annam). He concludes that, on the whole, there is a distinct darkening of colour as we proceed from west to east, although exceptions do occur which make the separation into races difficult. Mr. Biswas did not measure his birds; we are convinced that had he done so, he would have noticed a clear difference between the smaller birds from Central Nepal and the larger ones from the eastern Himalayas. It must be remembered that the separation of subspecies here is somewhat complicated by the fact that two colour phases probably occur—a paler greyish one and a darker rufous one. It would appear that the paler phase is more common in the west (Nepal, etc.), and the darker one more common in the east (Assam, etc.).

We are quite unable to differentiate between *O. b. bakkamoena* from South India and *O. b. lempiji* from Malaya. This is evidently an example of the faunal similarity between the Malayan region and Peninsular India.

The Indian subspecies are arranged below in order of wing-length (in mm.) :—

1. *O. b. plumipes* (Hume).—171-186 (Hume, 1869, p. 397). 162-182 (Stuart Baker, 1927, p. 426). 173-176 (Hartert, 1913, *Vög. pal. Fauna* II, p. 977). SYN.—*O. b. stewarti* Koelz. Wing 163.
- 2 { 2a. *O. b. manipurensis* Roonwal & Nath.—169-174, average 171.6.
2b. *O. b. deserticolor* Ticeh.—165-175 (Ticehurst, 1922, p. 57).
3. *O. b. lettia* (Hodgs.) as restricted here.—161-167, average 163.3. (From type-locality, e.g., Central Nepal.)
4. *O. b. gangeticus* Ticeh.—153-167, mostly 155-162 (Ticehurst, 1922, p. 122).
5. *O. b. marathae* Ticeh.—151-159. 152-162, once 165 (Ticehurst, 1922, p. 122).
6. *O. b. bakkamoena* (Penn.).—143-153, average 147.3. 146-157 (Hartert, 1913, *Vög. pal. Fauna* II, p. 975). 135-152, once 154 (Stuart Baker, 1927, p. 423.) SYN.—*O. indica* Gm. ; *S. malabaricus* Jerd. ; *S. griseus* Jerd. ; *S. lettoides* Bly. ; *E. jerdoni* Wald.

Note.—*O. b. glabripes* (Swinh.) from S. China (wing 180-191, Hartert, 1913, *loc. cit.*, p. 977) is even larger than *O. b. plumipes*. *O. b. lempiji* (Horsf.) from Malaya (wing 147-156, average 151.5 ; and 153-165, Blanford, 1895, III, p. 299) is subequal in size to *O. b. bakkamoena*, and, as mentioned above, not separable from the latter, in our opinion.

Type-specimens of Otus bakkamoena lettia (Hodgs.).

Hodgson, who collected in Nepal, presented most of his birds to the British Museum, London, before 1846, which is the date of publication of *Catal. Specimens & Draw. Mam. Birds, etc. of Nepal & Tibet pres. by B. H. Hodgson to Brit. Mus.* (2nd ed. 1863). Hodgson did not designate type-specimens, but most of his type-material must be presumed to have gone to the British Museum. But Hodgson also presented or sold some birds to the *Asiatic Society of Bengal*, Calcutta, and such birds which were acquired by the Society prior to 1846 must be regarded as one of the type-series if they came from the type-locality of Hodgson ; these have exactly the same value as the British Museum specimens.

Blyth (*Catal. Birds Asiat. Soc. Bengal*, 1849, pp. 36-37, No. 148A, "*Scops lempiji*" Var. B.) listed two such birds (*G, H*) of Hodgson, viz., specimens :

"*G. H.* Two ditto [i. e., purchased] from Nepal. B. H. Hodgson, Esq. (1842)."

One of these birds (whether *G* or *H* is not mentioned on the label) is present in the collection of the Indian Museum (Zoological Survey of India), Calcutta, and bears the Indian Museum label : "148-A, B.", no doubt meaning No. 148A, var. B. of Blyth's *Catal.* On an old outer paper wrapper the following is written :

"148 (a)/A. S. B./Type/*Scops lettia* Hodgs./B. Neapl./B. H. Hodgson, Esq. 1842/See Godwin/MSS. . ."

On the same wrapper, but in another handwriting, is written : "*Scops lettia*. Nepal Hodgs. Not a type." This is evidently in Sclater's handwriting, as he had listed (1892) the types in the Indian Museum. But, like so many of Sclater's remarks in connection with Indian Museum types, this one was without foundation.

Sharpe (*Catal. Birds Brit. Mus.* II, *Striges*, 1875, p. 86) lists 4 Hodgson skins from Nepal, but no date of collection or acquirement is given. If they were collected prior to 1846, they constitute the type-series along with the two specimens of the A. S. B. But if they were collected after 1846, they cannot be regarded as belonging to the type-series, in which case the A. S. B. birds alone are the types.

70. *Otus sunia modestus* (Walden).

(The Burmese Scops Owl.)

1874. *Scops modestus* Walden, *Ann. Mag. nat. Hist.* (4) XIII, p. 123. (Port Blair, South Andamans.)
 1888. *Scops pennantus*, Hume, *Str. Feath.* XI, p. 21.
 1927. *Otus sunia modestus*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) IV, p. 437.

Specimen collected.—1♀ from Kanglatongbi area, 16 miles N. of Imphal on Dimapur Road, ca. 3,500 ft., 14th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—1♀: W 152; Tl. 71; Tr. 25; B. 20.

Colour of soft parts.—Iris bright yellow; bill, cere and claws horny; feet pale olivaceous; foot-pads dirty cream.

Field notes.—The ovary was in the non-breeding condition and measured 5×13 mm., with the largest ova about 1 mm. in diameter

Remarks.—Hume (1888, p. 21) recorded this owl from Manipur.

Systematic note.—The Manipur specimen seems to be hardly distinguishable from a specimen from Darjeeling and another from Simla, but in the absence of a series we cannot say whether *modestus* is really separable from typical *sunia* or not.

71. *Glaucidium cuculoides rufescens* Stuart Baker.

(The Burmese Barred Owlet.)

1888. *Glaucidium cuculoides*, Hume, *Str. Feath.* XI, p. 23.
 1926. *Glaucidium cuculoides rufescens* Stuart Baker, *Bull. Brit. orn. Cl.* XLVII p. 59. (Noong-zai-ban, Manipur.)
 1927. *Glaucidium cuculoides rufescens*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) IV, p. 445.

Specimen collected.—1♂ from Nanglea Atrow, 63 miles from Imphal on Silchar Road, ca. 3,250 ft. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♂: W 150; Tl. 101; Tr. 29; B. 18.

Remarks.—Hume (1888, p. 23) found this owl very common in the western hills of Manipur, but absent in the basin and the southern and eastern hills.

Ord. 3. ACCIPETRES.

Fam. 28. AEGYPTIDAE.

72. *Gyps himalayensis* Hume.

(The Himalayan Griffon.)

1869. *Gyps himalayensis* Hume, *Rough Notes Indian Oology & Orn.* I, pp. 12-18. (Himalayas; restricted to Simla, Punjab, by Stuart Baker, 1928, *infra*.)

1928. *Gyps himalayensis*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) V, p. 13.

Specimen collected.—1♀ from Imphal Valley, 6 miles north of Imphal on Dimapur Road, ca. 2,500 ft., 25th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—1♀: W 755; Tl. 370; Tr. 128; B. 73.

Colour of soft parts.—Iris brown; bill smoky, darker at edges; cere smoky, legs dirty greenish white; claws horny.

Field notes.—The ovaries were in the non-breeding condition and measured 9×20 mm., with the largest ova not more than 2 mm. in diameter.

Remarks.—Hume (1888) did not record the Griffon in his Manipur list. Stuart Baker (1928, p. 14) gave its distribution thus: "Throughout the Himalayas from Afghanistan to Western Assam and north to Turkestan and Tibet."

The present is evidently the first record from eastern Assam (Manipur) and from a rather lower altitude (2,500 ft.) than hitherto known.

Fam. 29. FALCONIDAE.

73. *Cerchneis tinnunculus interstinctus* (Horsfield).

(The Himalayan Kestrel.)

1839. *Falco interstinctus* Horsfield, *Proc. zool. Soc. London*, p. 154. (Assam.)

1888. *Cerchneis tinnunculus*, Hume, *Str. Feath.* XI, p. 4.

1928. *Cerchneis tinnunculus interstinctus*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) V, p. 62.

Specimens collected.—5 (3♀♀, 2♂♂) as follows:—

Imphal, 1♂, 3rd February 1936. (Naga Hills and Manipur Survey.)

Imphal Valley, 3♀♀, 20th and 26th November and 13th December 1945, ca. 2,500 ft.; 1♂, Kanglatongbi area, 16 miles north of Imphal on Dimapur Road, ca. 3,500 ft. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
2♂♂	239—252	161—181	40—45	14—19
3♀♀	247—255	171—186	40—44	15—17

Colour of soft parts.—Iris dark brown; cere and skin around eyes yellow; bill bluish grey, shading into yellow at base; legs and feet yellow; claws dark horny; pads dirty white.

Field notes.—This kestrel was met. with commonly, either soaring high or sitting on telegraph wires, and always singly.

The gonads were in the non-breeding condition. The ovary measured 7×10 mm., with the largest ova not more than 1 mm. in diameter; the testes measured 2×2 mm.

Remarks.—Hume (1888, p. 4) found this kestrel common in the Imphal Valley, but comparatively rare in the hills.

74. *Haliastur indus indus* (Boddaert).

(The Brahminy Kite.)

1783. *Falco indus* Boddaert, *Tabl. Pl. Enlum.*, p. 25, pl. 416. (Pondicherry, East Coast of India.)
 1888. *Haliastur indus*, Hume, *Str. Feath.* XI, p. 15.
 1928. *Haliastur indus indus*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) V, p. 118.

Specimen collected.—1♀ from Kanglatongbi area, 16 miles N. of Imphal on Dimapur Road, ca. 3,500 ft., 2nd December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—1♀: W 384; Tl. 223; Tr. 57; B. 36.

Colour of soft parts.—Iris hazel brown; bill greyish cream; cere and legs cream; claws horny black.

Field notes.—This kite was rare, and only one pair was seen in 6 months (July-December).

The ovaries were in the non-breeding condition and measured 9×17 mm., with the largest ova not more than 2 mm. in diameter.

Remarks.—Hume (1888, p. 15) also found it rare in Manipur.

75. *Milvus migrans govinda* Sykes.

(The Common Pariah Kite.)

1832. *Milvus govinda* Sykes, *Proc. zool. Soc. London*, p. 81. (Deccan.)
 1888. *Milvus affinis*, Hume, *Str. Feath.* XI, p. 15.
 1928. *Milvus migrans govinda*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) V, p. 122.

Specimens collected.—2 (1♂, 1♀) from Imphal Valley, ca. 2,500 ft.; and Kanglatongbi area, about 16 miles N. of Imphal on Dimapur road, ca. 3,500 ft., 20th and 21st November 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
1♂	438	251	54	34
1♀	431	265	58	34

Colour of soft parts.—Iris dark brown; bill and claws black cere greyish yellow; legs dirty cream.

Field notes.—This kite was common in the Imphal Valley but less common in the hills a few miles north of it where it was found at least upto 3,500 ft. This and the larger subspecies with the conspicuous white spot on the lower wing-coverts (*Milvus migrans lineatus*, see below) were both seen in this area during the winter months.

The gonads were in the non-breeding condition. The ovary measured 9×12 mm., and the testes 2×4 mm.

Remarks.—Hume (1888, p. 15) found this small kite fairly common in Manipur, but called it *affinis* and erroneously considered it as different from *govinda* Sykes.

76. *Milvus migrans lineatus* (Gray).

(The Black-eared or Large Indian Kite.)

1831. *Haliaeetus lineatus* Gray, in Hardwicke's *Illust. Ind. Zool.* I, pl. 18. (China.)

1888. *Milvus melanotis*, Hume, *Str. Feath.* XI, p. 15.

1928. *Milvus migrans lineatus*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) V, p. 124.

Specimens collected.—2 (1♂, 1♀) from Imphal Valley, ca. 2,500 ft., 21st November 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
1♂	497	333	62	36
1♀	431	281	60	27

Colour of soft parts.—Iris brown; bill and claws dark horny; cere cream; legs dirty white.

Field notes.—This large kite occurs in the Imphal Valley in winter, side by side with the subspecies *govinda* Sykes, and in about equal numbers.

The ovary of the female was moderately enlarged and measured 10×21 mm., with the largest ova about 5 mm. in diameter, suggesting proximity to breeding.

Remarks.—Hume (1888, p. 15) recorded it as uncommon in Manipur.

Systematic note.—The female listed here is rather too small for *lineatus*, but as it has a conspicuous white patch on the lower wing-coverts we have placed it here.

77. *Elanus coeruleus vociferus* (Latham).

(The Black-winged Kite.)

1790. *Falco vociferus* Latham, *Index Orn.* I, p. 46. (Coromandel Coast, India.)

1888. *Elanus coeruleus*, Hume, *Str. Feath.* XI, p. 17.

1928. *Elanus coeruleus vociferus*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) V, p. 125.

Specimens collected.—2 (1♀, 1 unsexed) from 11-16 miles N. of Imphal on Dimapur Road, ca. 3,000-3,500 ft., 19th and 26th November 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
1♂	273	123	37	23
1 (unsexed)	279	131	37	21

Colour of soft parts.—Iris orange red ; bill and claws black ; legs and feet yellow.

Field notes.—This kite was fairly common throughout July-December, at least upto 3,500 ft. It was always noticed soaring high up solitarily.

The ovary of the female collected on 26th November was enlarged and measured 13×17 mm., with the largest ova about 5 mm. in diameter, suggesting proximity to breeding.

Remarks.—Hume (1888, p. 17) recorded it as very common in the Imphal Valley and Kopum Thull, but “practically unknown” in the hills of Manipur.

Ord. 4. COLUMBAE.

Fam. 30. COLUMBIDAE.

78. *Ducula badia griseicapilla* Walden.

(The Grey-headed Imperial Pigeon.)

1875. *Ducula griseicapilla* Walden, *Ann. Mag. nat. Hist.* (4) XVI, p. 228. (Karen Hills, 4,000-4,200 ft., Burma.)

1888. *Carpophaga griseicapilla*, Hume, *Str. Feath.* XI, p. 295.

1928. *Ducula badia griseicapilla*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) V, p. 204.

1941. *Ducula badia griseicapilla*, Roonwal, *Rec. Indian Mus.* XLIII, p. 311.

Specimen collected.—1♂ from Nanglea Atrow, 63 miles W. of Imphal on Silchar Road, Manipur, 13th February 1936. (Naga Hills and Manipur Survey.) [This is No. 26466 recorded by Roonwal, 1941, p. 311.]

Measurements (mm.).—1♂ : W 244 ; Tl. 207 ; Tr. 31 ; B. 25.

Remarks.—Hume (1888, p. 295) recorded this pigeon from the Imphal Valley, while Higgins (1934a, p. 302) found it common there.

79. *Streptopelia orientalis agricola* (Tickell).

(The Indian Rufous Turtle Dove.)

1833. *Columba agricola* Tickell, *J. Asiat. Soc. Bengal* II, p. 581. (Jungles of Borabhum and Dholbhum, Bihar.)

1888. *Turtur meena*, Hume, *Str. Feath.* XI, p. 298.

1928. *Streptopelia orientalis meena*, Stuart Baker, *Fauna Brit. India Birds* (2nd ed.) V, p. 240.

1934. *Streptopelia orientalis meena*, Higgins, *J. Bombay nat. Hist. Soc.* XXXVII, p. 303.

1941. *Streptopelia orientalis agricola*, Roonwal, *Rec. Indian Mus.* XLIII, p. 331.

Specimens collected.—2♂♂ from Kanglatongbi area, 16-18 miles N. of Imphal on Dimapur Road, Manipur, ca. 3,500 ft., 11th December 1945 (Major M. L. Roonwal.)

Measurements (mm.).—2♂♂: W 175-185; Tl. 123-137; Tr. 23-25; B. 17-18.

Colour of soft parts.—Iris orange; bill purplish grey; front portion of legs and feet purple; back of legs and pads dirty white; claws pale horny.

Field notes.—This dove was met with frequently on the roadside and in and around oak scrub. It was less common in December than in October and November.

The testes in both the males were greatly enlarged and measured about 6×15 mm., suggesting proximity to breeding.

Remarks.—Hume (1888, p. 298) recorded it as rare in the western hills and basin of Manipur and absent in the eastern hills. Higgins (1934a, p. 303) found it fairly common in the Imphal Valley during the rains and stated that it begins to appear about the end of May.

Systematic note.—The birds recorded here have dark grey under tail-coverts and are, therefore, *agricola* Tickell (*vide* Roonwal, 1941, pp. 328-329).

80. *Streptopelia chinensis tigrina* Temminck.

(The Burmese Spotted Dove.)

1816. *Columba tigrina* Temminck, in Knip, *Les Pigeons I*, p. 94, pl. 43. (Timor and Batavia in E. Indies. However, according to Hartert, *Vög. paläarkt. Fauna II* (1920), p. 1491, the type-specimen in the Paris Museum is from Java.)

1928. *Streptopelia chinensis tigrina*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) V, p. 244.

1941. *Streptopelia chinensis tigrina*, Roonwal, *Rec. Indian Mus.* XLIII, p. 337.

Specimens collected.—3 (2♂♂, 1 unsexed) from Kanglatongbi area, 15-16 miles N. of Imphal on Dimapur Road, ca. 3,000 ft., and from Imphal Valley, ca. 2,600 ft., 6th November and 14th December, 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
2♂♂	138—145	136—144	22—25	17—18
1 (unsexed)	143	143	24	17

Colour of soft parts.—Iris greyish pink; bare skin below the eye pinkish ashy; edges of eye-lids purple; bill dark slaty; legs and feet purple; claws horny.

Field notes.—This dove was very common in the foot-hills near Kanglatongbi and in the Imphal Valley.

The testes were enlarged and measured 3×8 mm. and 4×9 mm. in the two males, suggesting proximity to breeding.

Remarks.—Hume (1888, p. 298) reported only *S. c. suratensis* (rare) from Manipur, and definitely stated that *S. c. tigrina*, although common in Burma, was absent in Manipur. Stuart Baker (1928, pp. 242-244) placed Manipur birds as intermediate between *suratensis* and *tigrina*. We, however, find the Manipur specimens very much closer to *tigrina* than to *suratensis*.

Higgins (1934a, p. 303) also found this dove very common in Manipur.

81. *Streptopelia decaocto decaocto* (Frivaldszky).

(The Indian Ring-Dove.)

1838. *Columba risoria* Linn., var. *decaocto* Frivaldszky, *K. magyar tudós Társaság Evkönyv* III, pt. 3, p. 183. ("Turkei".)
 1888. *Turtur risorius*, Hume, *Str. Feath.* XI, p. 299.
 1928. *Streptopelia decaocto decaocto*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) V, p. 248.
 1940. *Streptopelia decaocto decaocto*, Roonwal, *Rec. Indian Mus.* XLII (3), p. 440.

Specimens collected.—2♀♀ from Kanglatongbi area, 16 miles N. of Imphal on Dimapur Road, Manipur, ca. 3,500 ft., 13th November 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

2♀♀ : W 170-174 ; Tl. 131-136 ; Tr. 23-26 ; B. 17-18.

Colour of soft parts.—Bare orbital skin around eye pure grey, without any yellow tinge.

Field notes.—The Ring-Dove was uncommon and seen only occasionally. It was certainly far less common than other doves.

The ovaries, in the 2♀♀ examined, were enlarged and measured 7×17 and 10×16 mm., with the largest ova about 4 mm. in diameter, thus suggesting proximity to breeding.

Remarks.—Hume (1888, p. 299) found the Ring-Dove common in Manipur, although of course, he did not distinguish it from the subspecies *S. d. xanthocyclus* Newman. He wrote : " We saw this nowhere in the hills, but found it common in the Manipur basin."

The demarcation between *S. d. decaocto* and the Burmese subspecies, *S. d. xanthocyclus*, calls for some comments. Stuart Baker (1928, pp. 248-249) gave the eastern limit of *S. d. decaocto* in India simply as " North Eastern Himalayas ", and of *S. d. xanthocyclus* as " All Burma " and other eastern areas (Indo-China, etc.). Higgins (1934a, p. 303), however, identified the Manipur birds as *xanthocyclus*, and wrote : " This species is common in the Manipur Valley, especially near the foot-hills." In my review of the Ring-Doves (Roonwal, 1940) I had accepted Higgins's identification and included Manipur within the range of *xanthocyclus*.

The 5 or 6 specimens (including the 2♀♀ collected) that I examined in the field near Imphal, however, had pure grey orbital skins without any trace of yellow, and should, therefore, be considered as *S. d. decaocto*—a yellow orbital skin being characteristic of *S. d. xanthocyclus*¹³.

82. *Macropygia unchall tusalia* (Blyth).

(The Bar-tailed Cuckoo-Dove.)

1843. *Columba tusalia* Blyth (ex. Hodgson MS.), *J. Asiat. Soc. Bengal* XII, p. 936. (Darjeeling, N. Bengal.)
 1888. *Macropygia tusalia*, Hume, *Str. Feath.* XI, p. 297.
 1928. *Macropygia unchall tusalia*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) V, p. 253.
 1941. *Macropygia unchall tusalia*, Roonwal, *Rec. Indian Mus.* XLIII, p. 343.

¹³ Rarely, *S. d. decaocto* also may have the orbital skin yellowish, as noticed by one of us (Roonwal, 1943) in a male collected near Chittorgarh (Rajputana, W. India).

Specimen collected.—1♂ from Kanglatongbi area, 16 miles N. of Imphal on Dimapur Road, ca. 3,500 ft., 20th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—1♂ : W 178 ; Tl. 178 ; Tr. 20 ; B. 17

Colour of soft parts.—Iris pale violet, ashy on inner side and then, on the innermost side, with a thin ring of pale yellow. Bill dull horny black ; legs and feet vinous smoky, feet darker ; claws vinous horny

Field notes.—A single specimen was obtained from the forest near Imphal ; no others were seen.

The testes were in the non-breeding condition, measuring about 2×4 mm.

Remarks.—Hume (1888, p. 297) did not observe it in the western hills of Manipur but found it “ not uncommon ” in the eastern hills. Higgins (1934a, p. 303) found it rare in Manipur, having seen a single specimen “ in a glen off the Manipur Valley in the South West ”

Ord. 5. GALLINAE.

Sub-ord. ALECTOROPODES.

Fam. 31. PHASIANIDAE.

83. *Polyplectron bicalcaratum bakeri* Lowe.

(The Bhutan Peacock-Pheasant.)

1888. *Polyplectrum tibetanum*, Hume, *Str. Feath* XI, p. 300.

1925. *Polyplectron bicalcaratum bakeri* Lowe, *Ibid* (12) I, p. 477. (Bhutan Duars.)

1928. *Polyplectron bicalcaratum bakeri*, Stuart Baker, *Fauna, Brit. India, Birds* (2nd ed.) V, p. 291.

1934. *Polyplectron bicalcaratum bakeri*, Higgins, *J. Bombay nat. Hist. Soc.* XXXVII (1), p. 88.

Specimen collected.—1♂ from Ragailous Camp, ca. 3,250 ft., 11th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♂ : W 241 ; Tl. 410 ; Tr. 74 ; B. 22.

Remarks.—Hume (1888, p. 300) recorded it as common in the western hills of Manipur, but absent in the Valley and the eastern hills. Higgins (1934, p.88) found it fairly common in the hills, especially in the evergreen forests of western Manipur.

84. *Gennaeus horsfieldii horsfieldii* (G. R. Gray).

(The Black-breasted Kalij Pheasant.)

1848. *Gallophasis horsfieldii* G. R. Gray, *Genera Birds* III, p. 498, pl. cxxvi. (“ India ” ; restricted to Assam.)

1888. *Euplocamus horsfieldi*, Hume, *Str. Feath.* XI, p. 303.

1928. *Gennaeus horsfieldii horsfieldii*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) V, p. 324.

1934. *Gennaeus horsfieldii horsfieldii*, Higgins, *J. Bombay nat. Hist. Soc.* XXXVII (1), p. 89.

Specimen collected.—1♂ from Nanglea Atrow, 63 miles W of Imphal on Silchar Road, ca. 3,250 ft., 13th February 1936. (Naga Hills and Manipur Survey.)

Measurements (mm.).—1♂ : W. 256 ; Tl. 295 ; Tr. 84 ; B. 33.

Remarks.—Both Hume (1888, p. 303) and Higgins (1934, p. 89) found it common in Manipur. The latter author also recorded *G. h. williamsi* Oates from northern Manipur, viz., at Karong and in the Barak Valley.

85. *Bambusicola fytchii hopkinsoni* Godwin Austen.

(The Assam Bamboo-Partridge.)

1874. *Bambusicola hopkinsoni* Godwin Austen, *Proc. zool. Soc. London*, p. 44. (Khasia Hills, Assam.)
 1888. *Bambusicola fytchii*, Hume, *Str. Feath.* XI, p. 308.
 1928. *Bambusicola fytchii hopkinsoni*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) V, p. 366.
 1934. *Bambusicola fytchii hopkinsoni*, Higgins, *J. Bombay nat. Hist. Soc.* XXXVII (1), p. 94.

Specimens collected.—4 (3♂♂, 1♀) from Kanglatongbi area, 18 miles N. of Imphal on Dimapur Road, Manipur, ca. 3,500 ft., 7th November and 10th and 11th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.	•
3♂♂	138—150	100—115	44—46	20—24	
1♀	141	103	44	23	

Colour of soft parts.—Iris brown in ♂, hazel brown in ♀; bill horny; legs, feet and claws olivaceous horny.

Field notes.—This partridge was common in oak scrub and was usually seen in groups of twos or threes.

The gonads were in the non-breeding condition. The ovary measured 3×9 mm. and the testes 1.3×5.7 mm.

Remarks.—Hume (1888, p. 308) obtained it in the eastern hills of Manipur and remarked upon its rarity. Higgins (1934, p. 94) found it common throughout the Manipur Hills, upto 6,000 ft. He remarked that it occurs almost invariably in coveys, but I found them in twos and threes only. Higgins found them common in oak scrub in the Kanglatongbi area, the same locality where I obtained them.

86. *Arborophila atrogularis* (Blyth).

(The White-cheeked Hill-Partridge.)

1849. *Arboricola atrogularis* Blyth *J. Asiat. Soc. Bengal* XVIII, p. 819. ("Asám, Sylhet, and Arakan")
 1888. *Arboricola atrogularis*, Hume, *Str. Feath.* XI, p. 306.
 1928. *Arborophila atrogularis*, Stuart Baker *Fauna Brit. India, Birds* (2nd ed.) V, p. 393.
 1934. *Arborophila atrogularis*, Higgins, *J. Bombay nat. Hist. Soc.* XXXVII (1), p. 95.

Specimens collected.—2 (1♂, 1♀) from Regailous Camp, ca. 3,250 ft., and "Manipur" (= Imphal ca. 2,500 ft., 9th and 11th February 1936. (Naga Hills & Manipur Survey.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
1♂	145	65	37	20
1♀	131	60	36	20

Remarks.—Hume (1888, p. 306) found it very rare in Manipur, having met with only one specimen. Higgins (1934, p. 95) recorded it as “not uncommon” in the hills of Manipur, but wrote that it was very difficult to obtain.

Ord. 6. CHARADRIIFORMES.

Subord. LIMICOLAE.

Fam. 32. CHARADRIIDAE.

87. *Hoplopterus duvauceli* (Lesson).

(The Spur-Winged Plover.)

1826. *Charadrinus duvauceli* Lesson, in Levrault, *Dict. Sci. Nat.* XLIII, p. 38. (Calcutta.)
 1888. *Hoplopterus ventralis* Cuv. (=Wag.), Hume, *Str. Feath.* XI, p. 316.
 1929. *Hoplopterus ventralis* (Wag.), Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) VI, p. 184.
 1930. *Hoplopterus duvauceli*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) VIII, p. 696.

Specimens collected.—3 specimens, as follows :—

1♀ from Karong, 5th February 1936. (Naga Hills and Manipur Survey.)

2♂♂ from Kanglatongbi area, about 10-20 miles N. of Imphal on Dimapur Road, ca. 3,000-3,500 ft., 2nd and 8th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
2♂♂ . . .	193—196	93—99	64—66	81
1♀ . . .	194	100	66	28

Colour of soft parts.—Iris dark chocolate ; bill black ; legs, feet and claws horny black.

Field notes.—This plover was occasionally seen near water-courses.

The testes were in the non-breeding condition and measured 2×5 mm.

Remarks.—Hume (1888, p. 316) found this plover common in the central portion of Manipur. Higgins (1934, p. 82) reported it as resident and breeding there, but “not particularly common”.

88. *Lobivanellus indicus atronuchalis* Jerdon.

(The Burmese Red-wattled Lapwing.)

1864. *Lobivanellus atronuchalis* Jerdon (ex. Blyth MS.), *Birds of India* III. p. 648. (Burma.)
 1888. *Lobivanellus atronuchalis*, Hume, *Str. Feath.* XI, p. 316.
 1929. *Lobivanellus indicus atronuchalis*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) VI, p. 189.

Specimens collected.—2 (1♂, 1♀) from Imphal Valley, ca. 2,600 ft., 25th November 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

	W.	Tl.	Tr.	B.
1♂ . . .	220	118	77	33
1♀ . . .	222	117	79	36

Colour of soft parts.—Iris red, with yellow outer ring ; bill red, black at tip ; wattle yellowish grey ; claws horny.

Field notes.—This lapwing was not common. It was seen in the vicinity of water-pools.

Remarks.—Hume (1888, p. 316) found this lapwing rare in the Manipur basin and absent in the hills. Higgins (1934, p. 82) too found it rare in Manipur ; according to him, it breeds there.

In one specimen the white streak on one side of the neck extends to the breast (as in *L. indicus indicus*), but the other side is typical of *atronuchalis*.

Fam. 33. SCOLOPACIDAE.

89. *Tringa ochropus* Linnaeus.

(The Green Sandpiper.)

1758. *Tringa ochrophus* Linnaeus, *Syst. Nat.* (10th ed.) I, p. 149. (Sweden.).
 1888. *Totanus ochropus*, Hume, *Str. Feath.* XI, p. 324.
 1929. *Tringa ochropus*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) VI, p. 215.

Specimens collected.—2♀♀ from 6 miles north of Imphal on Dimapur Road, ca. 2,800 ft., 4th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—2♀♀: W 142-147 ; Tl. 61-66 ; Tr. 32-35 ; B. 37-40.

Colour of soft parts.—Iris dark chocolate ; bill olive green, dark smoky at tip ; legs and feet ashy olive green ; claws horny brown.

Field notes.—This sandpiper was occasionally seen near pools of rainwater and was distinctly uncommon.

The ovaries were in the non-breeding condition and measured about 4×7 mm.

Remarks.—Hume (1888, p. 324) found it very common in Manipur.

Ord. 7. HERODIONES.

Subord. ARDEAE.

Fam. 34. ARDAEIDAE.

90. *Bubulcus ibis coromandus* (Boddaert).

(The Cattle Egret.)

1783. *Cancroma coromanda* Boddaert, *Tabl. Pl. Enlum.*, p. 54, pl. 910. (Coromandel Coast, India.
 1888. *Bubulcus coromandus*, Hume, *Str. Feath.* XI, p. 333.
 1929. *Bubulcus ibis coromandus*, Stuart Baker, *Fauna Brit. India, Birds* (2nd ed.) VI, p. 349.

Specimens collected.—2 (unsexed) from Imphal Valley, ca. 2,600 ft., 5th November 1945. (Major M. L. Roonwal.)

Measurements (mm.).—2 (unsexed) : W 244-247 ; Tl. 83-92 ; Tr. 91-92 ; B. 56-60.

Colour of soft parts.—Iris, bare skin around eye, and bill yellow ; legs, feet and claws black.

Field notes.—The Cattle Egret was very common all over the Imphal Valley, both in the north (Kanglatongbi area) and in the south-east (Palel area).

Remarks.—Hume (1888, p. 333) also found it very common in meadows in Manipur. According to Higgins (1934, p. 86) it is resident and breeds there.

91. *Ardeola grayii* (Sykes).

(The Indian Pond Heron.)

1832. *Ardea grayii* Sykes, *Proc. zool. Soc. London*, p. 158. (Deccan.)

1888. *Ardeola grayii*, Hume, *Str. Feath.* XI, p. 334.

1929. *Ardeola grayii*, Stuart Baker, *Fauna Brit. India Birds* (2nd ed.) VI, p. 354.

Specimens collected.—2 (1♂, 1♀) from 6 miles north of Imphal on Dimapur Road, ca. 2,800 ft., 4th December 1945. (Major M. L. Roonwal.)

Measurements (mm.).—

		W.	Tl.	Tr.	B.
1♂		228	87	67	68
1♀		201	72	59	68

Colour of soft parts.—Iris golden yellow ; naked skin around eye and around base of bill bluish yellow. Upper bill ashy blue in ♂, smoky black in ♀ ; lower bill greyish yellow, tip smoky in ♀ and yellowish ashy in ♂. Legs, feet and pads bluish yellow ; claws horny.

Field notes.—The Pond Heron was common near water, but less so than the Cattle Egret.

The gonads were in the non-breeding condition. The ovary measured 6×15 mm., with the largest ova not more than 1 mm. in diameter ; the testes measured 2×5 mm.

Remarks.—Hume (1888, p. 334) found the Pond Heron sparsely distributed in the Manipur basin. Higgins (1934, p. 86), however, found it common, resident and breeding there.

III. REFERENCES.

(Those dealing either wholly or principally with Manipur are marked with an asterisk, *.)

- Allen, B. C., 1905. Naga Hills and Manipur. In *Assam District Gazetteers*, vol. IX, part 2, Manipur, pp. ii+151. Calcutta.
- Annandale, N., 1921. The aquatic and amphibious Mollusca of Manipur. Prefatory note; and Introduction. *Rec. Indian Mus.* XXII, pp. 529-538.
- Baker, E. C. Stuart, 1892. The bulbuls of North Cachar. Part I. *J. Bombay nat. Hist. Soc.* VII(1), pp. 1-12.
- 1892a. The bulbuls of North Cachar. Part II. *J. Bombay nat. Hist. Soc.* VII(2), pp. 125-131.
- 1892b. The bulbuls of North Cachar. Part III. *J. Bombay nat. Hist. Soc.* VII(3), pp. 263-268.
- 1892c. The bulbuls of North Cachar. Part IV. *J. Bombay nat. Hist. Soc.* VII(4), pp. 413-424.
- 1893. The bulbuls of North Cachar. Part V. *J. Bombay nat. Hist. Soc.* VIII(1), pp. 1-16.
- 1893a. The birds of North Cachar. A catalogue of the Passeriformes, Coraciiformes and the order Psittacii of the subclass Ciconiiformes. Part I. *J. Bombay nat. Hist. Soc.* VIII(2), pp. 162-211.
- 1894. The birds of North Cachar. Part II. *J. Bombay nat. Hist. Soc.* IX(1), pp. 1-24.
- 1894a. The birds of North Cachar. Part III. *J. Bombay nat. Hist. Soc.* IX(2), pp. 111-146.
- 1895. The birds of North Cachar. Part IV. *J. Bombay nat. Hist. Soc.* X(1), pp. 1-12.
- 1896. The birds of North Cachar. Part V. *J. Bombay nat. Hist. Soc.* X(2), pp. 161-168.
- 1896a. The birds of North Cachar. Part VI. *J. Bombay nat. Hist. Soc.* X(3), pp. 339-371.
- 1897. The birds of North Cachar. Part VII. *J. Bombay nat. Hist. Soc.* X(4), pp. 539-567.
- 1897a. The birds of North Cachar. Part VIII. *J. Bombay nat. Hist. Soc.* XI(2), pp. 222-233.
- 1898. The birds of North Cachar. Part IX. *J. Bombay nat. Hist. Soc.* XI(3), pp. 390-405.
- 1899. The birds of North Cachar. Part X. *J. Bombay nat. Hist. Soc.* XII(3), pp. 486-510.
- 1913. Zoological results of the Abor Expedition (1911-1912). Birds. *Rec. Indian Mus.* VIII(3), pp. 259-288.
- 1913a. On a small collection of birds from the Mismi Hills, North-East Frontier of India. *Rec. Indian Mus.* IX (5), pp. 251-254.

- Baker, E. C. Stuarts, 1913b. [On the occurrence of *Ithagenes cruentus kuseri*, in the Mishmi Hills.] *Bull. Brit. orn. Cl.* XXXIII, pp. 83-84.
- 1922-1930a. *The Fauna of British India, including Burma and Ceylon. Birds.* (2nd ed.) London. 8 vols., thus : vol. I (1922), II (1924), III (1926), IV (1927), V (1928), VI (1929), VII (1930), VIII (1930a).
- Blanford, W. T., 1895. *The Fauna of British India, including Burma and Ceylon. Birds.* III. London.
- 1898. Ditto. IV
- Blyth, E., 1849. *Catalogue of the Birds in the Museum of the Asiatic Society [of Bengal]*. Pp. xxxiv+403. Calcutta.
- *Gimson, C., 1934. Occurrence of the Mandarin Duck (*Aix galericulata* (Linn.)) in Manipur State. *J. Bombay nat. Hist. Soc.* XXXVII (2), pp. 490-491.
- Godwin Austen, H. H., 1870. A list of birds obtained in the Khasi and North Cachar Hills. *J. Asiat. Soc. Bengal* XXXIX(2), pp. 91-92.
- *————— 1870a. A second list of birds obtained in the Khasi and North Cachar Hill ranges, including the Garo Hills and country at their base in the Mymensing and Sylhet Districts. *J. Asiat. Soc. Bengal* XXXIX(3), pp. 264-275.
- *————— 1872. Third list of birds obtained in the Khasi and Garo Hill ranges, with some corrections and additions to the former list. *J. Asiat. Soc. Bengal* XLI(2), pp. 142-143.
- *————— 1874. Fourth list of birds principally from the Naga Hills and Manipur, including others from the Khasi, Garo and Tipperah Hills. *J. Asiat. Soc. Bengal* XLIII(3), pp. 151-180.
- *————— 1876. Description of supposed new birds from the Khasi-Naga Hill ranges south of Brahmaputra River, Assam. *Ann. Mag. Nat. Hist.* (4) XVIII, pp. 411-412.
- *————— 1876a. Fifth list of birds from the hill ranges of the North-East Frontier of India. *J. Asiat. Soc. Bengal* XLV(4), pp. 191-204.
- *————— 1882. On specimens of the male and female of *Phasianus humiae* from Manipur, with description of the latter. *Proc. zool. Soc. London*, pp. 115-118.
- *Godwin Austen, H. H. and Walden, A., 1875. Description of some supposed new species of birds. *Ibis* (3)V, pp. 250-253.
- Hartert, E., 1910. *Die Vögel der paläarktischen Fauna.* Bd. I, pp. 1-832. Berlin.
- 1912-21. Ditto. Bd. II, pp. 833-1764.
- 1921-22. Ditto. Bd. III, pp. 1765-2328.
- Hartert, E. and Steinbacher, F., 1932-38. Ditto. *Ergänzungsband*, pp. 1-602.
- *Higgins, J. C., 1913. Wood Duck (*Asarocornis scutulata*) in Manipur. *J. Bombay nat. Hist. Soc.* XXII(3), p. 632.

- *Higgins, J. C., 1914. The Chinese Francolin (*Francolinus chinensis*) in Manipur. *J. Bombay nat. Hist. Soc.* XXXIII(2), pp. 368-369.
- *——— 1933. The game birds and animals of the Manipur State, with notes on their numbers, migration and habits. Part I. *J. Bombay nat. Hist. Soc.* XXXVI(3), pp. 406-422.
- *——— 1933a. Ditto. Part II. *J. Bombay nat. Hist. Soc.* XXXVI(3), pp. 591-606.
- *——— 1933b. Ditto. Part III. *J. Bombay nat. Hist. Soc.* XXXVI(4), pp. 845-854.
- *——— 1934. Ditto. Part V. *J. Bombay nat. Hist. Soc.* XXXVII(1), pp. 81-95.
- *——— 1934a. Ditto. Part V. *J. Bombay nat. Hist. Soc.* XXXVII(2), pp. 298-309.
- Hume, A. O., 1877. A first list of birds of North-eastern Cachar. *Str. Feath.* V(1), pp. 1-47.
- 1880. A second list of birds of North-eastern Cachar. *Str. Feath.* IX(4), pp. 241-259.
- *——— 1888. The birds of Manipur, Assam, Sylhet and Cachar. *Str. Feath.* XI, pp. v+353.
- Oates, E. W., 1883. *A Handbook of the Birds of British Burmah, including those found in the adjoining State of Karennee*. I. London.
- 1883a. Ditto. II.
- 1889. *The Fauna of British India, including Ceylon and Burmah. Birds*. I. London.
- 1890. Ditto. II.
- *Ogilve-Grant, W. R., 1895. On a new species of *Proparus* from Manipur and the Naga Hills. *Bull. Brit. orn. Cl.* V, p. iii.
- *——— 1906. On a new species of *Proparus* from the Manipur Hills. *Bull. Brit. orn. Cl.* XVI, p. 123.
- Peters, J. L., 1931. *Check-list of Birds of the World*. I, pp. xviii+345. Cambridge, Mass.
- 1934. Ditto. II, pp. xvii+401.
- 1937. Ditto. III, pp. xiii+311.
- 1940. Ditto. IV, pp. xii+291.
- *Prater, S. H., 1925. Occurrence of Scaup Duck (*Fuligula marilla*) in Northern India. *J. Bombay nat. Hist. Soc.* XXX(3), p. 703.
- Roonwal, M. L., 1939. Report on a collection of birds from the Bengal Duars and the Tista Valley made in the winter of 1938, with notes on specimens in the Indian Museum. *Rec. Indian Mus.* XLI(3), pp. 281-307.
- 1940. On the subspecies of the Ring-Dove, *Streptopelia decussata* (Frivaldszky). *Rec. Indian Mus.* XLII(3), pp. 437-452.

- Roonwal, M. L., 1941. Catalogue of birds in the Indian Museum, Calcutta.
I. Columbæ (Pigeons and Doves). *Rec. Indian Mus.* XLIII (3), pp. 281-360.
- 1943. Note on the colour of the iris, of the bare orbital skin around the eyes and of the edges of the eyelids in the Indian Ring-Dove. *J. roy. Asiat. Soc. Bengal, Sci.* (N. S.) IX, p. 17
- *————— 1949. Contributions to the fauna of Manipur State, Assam. Part I. General Introduction. *Rec. Indian Mus.* XLVI [1948], pp. 123-126.
- Roonwal, M. L. and Nath, B., 1949. Critical remarks on the systematics of the White-browed Short-wing, *Heteroxenicus cruralis cruralis* (Blyth) [Aves : Turdidae]. *Rec. Indian Mus.* XLV(4) [1947], pp. 321-328.
- Ticehurst, C. B., 1926. New Indian birds from Naga Hills and N. W Himalayas. *Bull. Brit. orn. Cl.* XLVI, pp. 113-114.
- Sclater, W. L., 1892. On the Indian Museum and its collection of birds. *Ibis* (6) IV, pp. 65-87.

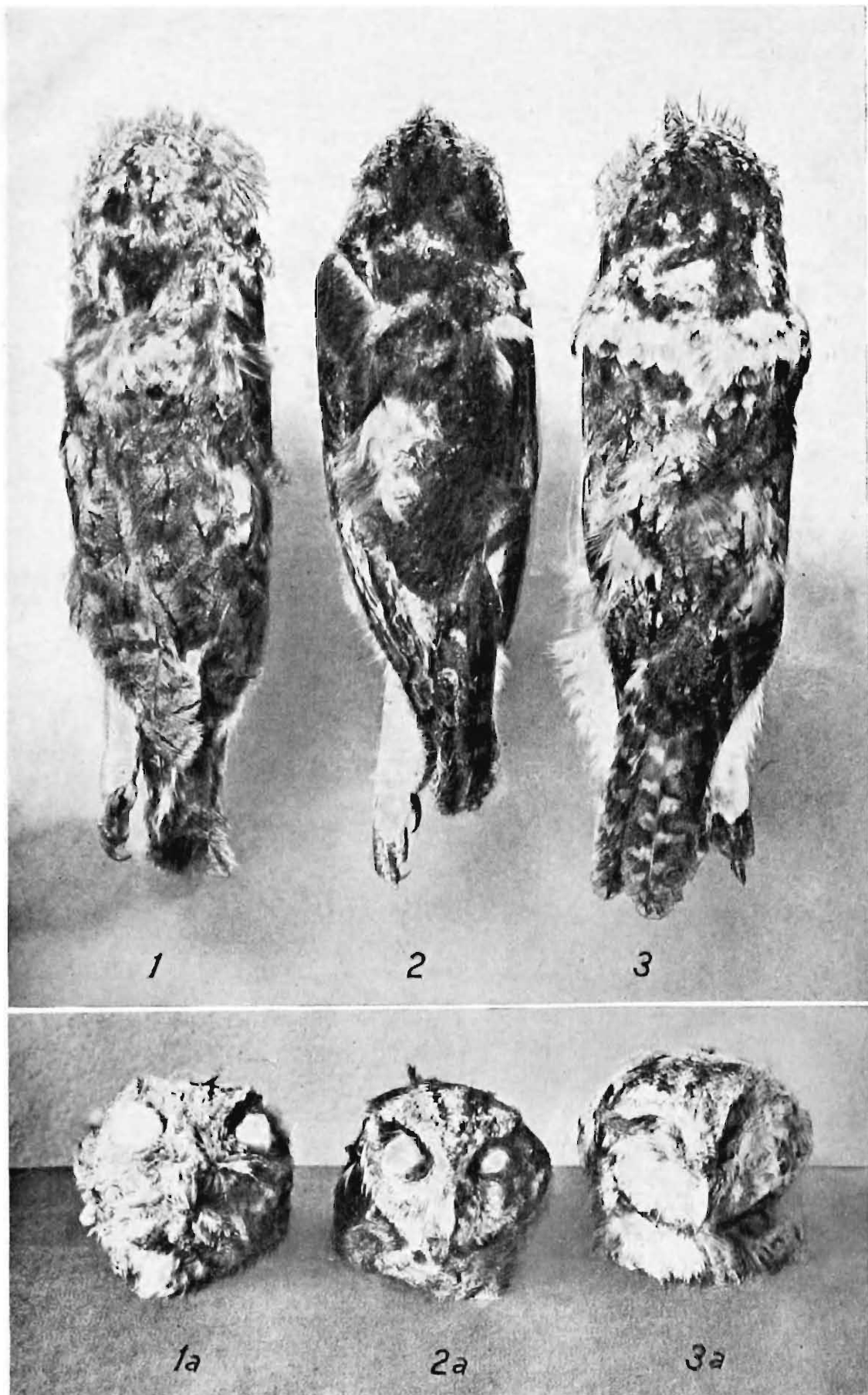
EXPLANATION OF PLATE V.

Otus bakkamoena. Dorsal views and front views of head. $\times$ circa 2/5ths.

FIGS. 1, 1a. *Otus bakkamoena lettia* (Hodgson). Z.S.I. Reg. No. 27087. ♀ from Forest of Phare Ghat, W of Hitaura (and ca. 44 miles south of Kathmandu), Nepal Terai, ca. 2,000 ft. Collected by P. N. Mitter, 11 June 1947.

FIGS. 2, 2a. *Otus bakkamoena manipurensis* subsp. nov. Z.S.I. Reg. No. 27082. ♂ from Imphal Valley, 6 miles north of Imphal, Manipur, Assam, ca. 2600 ft. Collected by Major M. L. Roonwal, 17 December 1945. HOLOTYPE.

FIGS. 3, 3a. Ditto. Z.S.I. Reg. No. 27083. Unsexed From 5 miles N. of Imphal. 27 December 1945. PARATYPE.



OTUS BAKKAMOENA (PENN.)

REVISION OF CYPRAEACEA IN THE COLLECTION OF THE ZOOLOGICAL SURVEY OF INDIA. PART I. THE FAMILIES TRIVIIDAE, ERATOIDAE AND PEDICULARIIDAE.

By HARISH CHANDRA RAY, M.Sc., Research Scholar, Zoological Survey of India, Calcutta.

INTRODUCTION.

Studies on the living Cypraeacea of the Indo-Pacific Region have made rapid strides within recent years. The monographs published by Schilder and Schilder provide valuable information concerning the nomenclature, synonymy, distribution and evolution of the various members of the different groups. Their scheme of classification, based on both anatomical and conchological characters, is a marked improvement on the earlier classifications suggested almost exclusively on the characters of the shells by Gray, Adams, Weinkauff, Jousseaume, Rochebrune, Roberts, Melvill and Paetel. Troschel first introduced a natural system of classification based on the radula, but his work was very limited. Vayssiere's work is also interesting, but it is confined to one section only, *i.e.*, the Triviidae. The well-illustrated works of Kiener, Reeve, Sowerby and Roberts are also valuable for the identification of the species. In so far as the list of references and distribution is concerned, Hidalgo's monograph is quite helpful.

At the instance of Dr. B. N. Chopra, Director, Zoological Survey of India, I took up a study of the Cypraeacea, with special reference to the Indo-Pacific forms available in the collection of the Zoological Survey of India. This work has not only resulted in a material improvement of the collection, but has afforded me sufficient scope and facilities to gain some knowledge and experience about the group.

In 1920, the late Mr. E. Vredenburg, Superintendent, Geological Survey of India, Indian Museum, Calcutta, attempted a classification of the recent and fossil Cypraeidae in the Indian Museum, Calcutta. He, no doubt, made an elaborate study of the subject, but while strongly criticizing Melvill's method, which he designated as the 'Circular System', as a 'Stop-gap', wrongly included the genera, such as, *Cypraea*, *Trivia*, *Erato*, etc., in the single family Cypraeidae. Moreover, his observations, in most cases, are not critical while the distribution and relationship of the species have not been fully discussed.

The specimens in the collection represent the families Triviidae, Eratoidae, Amphiperatidae, Pediculariidae and Cypraeidae. For convenience of study I have split up my work into two parts, the first deals with Triviidae, Eratoidae and Pediculariidae, while the second is devoted mainly to the study of the family Cypraeidae. The species of the family Amphiperatidae available in the collection have already been treated in my paper on the unnamed shells of Cypraeacea published in the *Journ. Roy. As. Soc. Bengal, Science*, IX, p. 40 (1945).

So far as the classification of the Cypraeacea is concerned, I fail to give my full support to the view expressed by Schilder. The retention of the families Triviidae and Eratoidae and the consequent adjustment of the subfamilies Triviinae and Eratoinae appears to me more reasonable than completely dropping the former family and placing both the subfamilies under the latter. - A detailed discussion on this important point will be made later in connection with the genus *Trivia*. Again, the erection of Tryon's family Pediculariidae (1885) for the accommodation of Swainson's genus *Pedicularia* (1840) appears to have been first accepted by Schilder with the inclusion of his new subfamily Pediculariinae into it for Swainson's species *P. sicula* from the Coast of Sicily. But afterwards he changed his decision and as a result the family Pediculariidae was totally dropped and the subfamily Pediculariinae placed under the family Amphiperatidae. Thiele, no doubt, partly supports Schilder's conclusion regarding the dropping of the family Pediculariidae, but differs from him in relegating the subfamily Pediculariinae together with Triviinae, Amphiperatinae, etc., to the single family Cypraeidae. Neither of the schemes, however, appears satisfactory. So, I think that the family Pediculariidae should be retained, as the characters displayed by the shells seem to be quite peculiar and interesting and may claim a separate family rank.

Jousseau's genera *Pusula*, *Niveriu*, *Triviella* and *Trivirostra* appear to have been deliberately merged by Cossmann (1903, p. 170) with the synonymy of *Trivia* with a view to reduce the number of groups. But this curtailed policy has not at all been supported by the subsequent workers in the field, as it causes a great deal of confusion. Thiele may be justified in his attempt to treat them as subgenera or sections of *Trivia*, but his recognition of only one family Cypraeidae even at this advanced state comprising all the groups, namely, *Trivia*, *Erato*, *Pedicularia*, *Amphiperas*, etc., is quite undesirable. Iredale's genera *Cleotrivia*, *Ellatrivia*, *Dolichupis* and *Fossatrivia*, which Schilder also ranks as distinct, cannot be said to have been erected on sufficient morphological grounds. So, I think it better to subordinate all these groups together with those of Jousseau to *Trivia* unless more detailed facts (both anatomical and conchological) are forthcoming. This view finds somewhat in agreement with that of Adam and Leloup and Thiele.

The collection before me is too poor to represent the families satisfactorily. In Triviidae there are only nine species, in Eratoidae only five and in Pediculariidae only one. However, a careful study of the collections has enabled me to bring the list of species and subspecies up-to-date as regards nomenclature, synonymy and classification. The distribution of the species has been discussed in detail and the range has been extended further in a few cases. The relationship among the species is also clearly indicated.

Lastly, I offer my cordial thanks to Dr. B. N. Chopra, for his kind suggestion of the problem and also for his unfailing help and advice throughout the work, to Dr. Bains Prasad, Fisheries Development Adviser, Government of India, for his trouble in correcting the manuscript as well as for useful criticisms.

Class GASTROPODA.

Subclass PROSOBRANCHIA.

Order MESOGASTROPODA.

Superfamily CYPRAEACEA.

Family TRIVIIDAE.

Subfamily TRIVIINAE.

Genus **Trivia** (Gray, 1832) Broderip, 1837.Type *Cypraea europea* Montagu.

1837. *Trivia*, Broderip, *Penny Cyclopaedia*, VIII, pp. 254-259.
 1840. *Trivea*, Swainson, *A Treatise on Malacology*, p. 325.
 1842. *Trivia*, Reeve, *Conch. Syst.* II, p. 262.
 1846. *Trivia*, Reeve, *Conch. Icon.* III.
 1846. *Trivia*, Sowerby, *Man. Conch.* ed. III, p. 279.
 1847. *Trivia*, Gray, *Proc. Zool. Soc. London*, Part XV, p. 142.
 1850. *Trivia*, Gray, *Figures of Moll. Anim.* IV, p. 75.
 1852. *Trivia*, Mörch, *Cat. Yoldi*, p. 118.
 1854. *Trivia*, H. & A. Adams, *Gen. Rec. Moll.* 1, p. 268.
 1857. *Trivia*, Gray, *Guide to Syst. Descr. Moll. Brit. Mus.* 1, p. 72.
 1863. *Trivia*, Troschel, *Das Gebiss der Schnecken*, 1, p. 214.
 1867. *Trivia*, Marrat, *Ann. & Mag. Nat. Hist.* (3) XX, p. 215.
 1868. *Trivia*, Stoliczka, *Cetaceous Fauna of Southern India*, II, pp. 49, 50, 55, 56, 499.
 1870. *Trivia*, Sowerby, *Thes. Conch.* IV, pp. 2, 4, 42.
 1870. *Trivia*, Roberts, *Amer. Journ. Conch.* V, p. 204.
 1872. *Trivia*, Brazier, *Proc. Zool. Soc. London*, p. 86.
 1878. *Trivia*, Sars, *Moll. Reg. Arcticae Norvegiae*, 1, p. 154.
 1882. *Trivia*, Tryon, *An Introduction to the Study of Moll.*, 1, p. 198.
 1883. *Trivia*, Dautzenberg, *Les Moll. Mar. du Roussillon*, 1 (3), p. 127.
 1883. *Trivia*, Daniel, *Journ. de Conchyliol.* XXXI, p. 355.
 1884. *Trivia*, Jousseaume, *Bull. Soc. Zool. France*, IX, pp. 99, 100.
 1885. *Trivia*, Roberts, in Tryon's *Man. Conch.* VII, pp. 161, 163, 198.
 1888. *Trivia*, Paetel, *Cat. der Conchyl.—Samml.* 1, p. 322.
 1888. *Trivia*, Melvill, *Mem. and Proc. Manchest. Lit. & Phil. Soc.* (4) I, pp. 185, 193, 245.
 1900. *Trivia*, Pritchard and Gatliff, *Proc. Roy. Soc. Victoria*, (N.S.), XII p. 187.
 1903. *Trivia*, Cossmann, *Ess. de Paleoconch. Comp.* V, pp. 170, 171.
 1909. *Trivia*, Shaw, *Proc. Malac. Soc. London*, VIII, pp. 288-292.
 1915. *Trivia*, Bartsch, *Bull. Smiths. Inst. U. S. Nat. Mus.* XCI, p. 98.
 1915. *Trivia*, Iredale, *Proc. Malac. Soc. London*, XI, p. 133.
 1916. *Trivia*, Iredale, *Proc. Malac. Soc. London*, XII, pp. 34, 35.
 1920. *Trivia*, Vredenburg, *Rec. Geol. Surv. Ind.* LI (2), pp. 71, 73, 74, 84, 129-135.
 1922. *Trivia*, Schilder, *Proc. Malac. Soc. London*, XV, p. 98.
 1923. *Trivia*, Vayssiere, *Ann. Mus. Hist. Nat. Marseille-Zool.* XVIII, p. 82.
 1925. *Trivia*, Oostingh, *Rept. on a Collection of Rec. Shells from Obi and Halmahera (Moluccas)*, p. 112.
 1926. *Trivia*, Schilder, *Rec. Geol. Surv. Ind.* LVIII (4), pp. 360, 373, 374, 376.
 1927. *Trivia*, Schilder, *Archiv f. Naturges.* XCIA, p. 62.
 1928. *Trivia*, Faustino, *Summary of Philippine Marine and Freshwater Moll.*, p. 220.
 1929. *Trivia*, Dautzenberg, *Faune de Col. Franc.* III, p. 465.
 1929. *Trivia*, Thiele, *Handb. der Syst. Weichtierk.* 1, p. 268.
 1930. *Trivia*, Iredale, *Mem. Queensl. Mus.* X, p. 83.
 1931. *Trivia*, Schilder, *Zool. Anz.* XCVI, p. 69.

1932. *Trivia*, Dautzenberg, *Journ. de Conchyliol.* LXXVI, p. 53.
 1933. *Trivia*, Schilder, *Proc. Malac. Soc. London*, XX, pp. 244, 274.
 1934. *Trivia*, Tomlin and Schilder, *Ann. S. Afric. Mus.* XXX (3), p. 478.
 1935. *Trivia*, Schilder, *Proc. Malac. Soc. London*, XXI, p. 232.
 1936. *Trivia*, Schilder, *Proc. Malac. Soc. London*, XXII, p. 79.
 1937. *Trivia*, Viader, *Maur. Inst. Bull.* 1 (2), p. 39.
 1946. *Trivia*, Fretter, *Journ. Mar. Biol. Ass. U. K.* XXVI (3), pp. 326, 348.

Genus *Trivia* was proposed by Gray, in 1832, in his "Descr. Cat. of Shells" to separate the smaller sulcated shells, the nuns, from the real cowries designated by the generic name *Cypraea* Linn. But as his manuscript remains unpublished the genus is ascribed to Broderip who in his monograph on Cypraeidae discussed Gray's account in detail. Some workers, namely, Pritchard and Gatliff, Watson, Melvill, Sowerby, Dautzenberg, Weinkauff, Roberts, Jones and Preston and Gould, seem to consider *Trivia* as a subgenus of *Cypraea* and place it under the family Cypraeidae Fleming (1828). Troschel's valuable study of the radula, on the other hand, led to the creation of a new family Triviacea for *Trivia* and *Erato* Risso (1826) which, as stated by Schilder, may be a synonym of Triviinae Vredenburg (1920). Jousseume follows Troschel's new method of arrangement, and Shaw's researches on the nervous system of *Trivia* and *Erato* also uphold the same conclusion. Dall, on the other hand, erected a separate family Triviidae for them. His conclusion has been accepted by Bartsch, Iredale, Ludbrook, Schilder and Tomlin and Schilder. The latter again proceeds a step further to suggest a division of the group into two subfamilies, Triviinae and Eratoinae for *Trivia* and *Erato* respectively. But it is quite surprising that he later dropped the family Triviidae in favour of his newly proposed family Eratoidae and relegated the above subfamilies to the latter. This change, however, is in no way an improvement in the further study of the subject, but, on the contrary, may cause a great deal of confusion. So, I am strongly in favour of the retention of both the families which may ensure better understanding and arrangements, *i.e.*, all the Triviids should be included into Triviinae of the family Triviidae, while the Eratoids into Eratoinae of the family Eratoidae. The differences in shape, size, form, colouration and sculpture of the shells between *Trivia* and *Erato* also warrant such a distinction.

Trivia comprises small marine shells of globular or subglobular form and of a whitish, pinkish or pinkish-brown colour. They are finely transversely sulcated on the surface, the ribs generally being interrupted in the middle by a narrow longitudinal groove which may be long or short, deep or shallow or entirely obsolete, in which case the ribs run smoothly from side to side. The latter in some cases become nodulous while terminating at the sulcus. The ribs are nothing but mere prolongations of the apertural denticulations, and this character at once distinguishes this group from the real cowries placed in the family Cypraeidae. The extremities of the shells may be short or produced, while the front part of the columella is internally concave and ribbed.

The genus is widely distributed in Europe, Africa, America and Asia. It is also known in the fossil state in Eocene, Miocene, Oligocene, Pliocene, Pleistocene and Cretaceous times.

Subgenus **Ellatrivia** Iredale, 1931.

Type *Triviella merces* Iredale, 1924.

- 1931. *Ellatrivia*, Iredale, *Rec. Austr. Mus.* XVIII (4), p. 221.
- 1932. *Ellatrivia*, Iredale, *Zool. Anz.* C, p. 166.
- 1933. *Ellatrivia*, Schilder, *Sitzungs. der Gesell. Naturf. Fr. Berlin*, pp. V and 256.
- 1935. *Ellatrivia*, Schilder, *Proc. Malac. Soc. London*, XXI, pp. 332, 334, 335.
- 1936. *Ellatrivia*, Schilder, *Proc. Malac. Soc. London*, XXII, pp. 80, 109.
- 1941. *Ellatrivia*, Ludbrook, *Trans. Roy. Soc. South Australia*, LXV (1), p. 94.

In 1931 Iredale introduced the name *Ellatrivia* as a genus for the deep-water *merces*-series having large and peculiarly sculptured shells, with *Triviella merces* as its genotype. But Schilder at first subordinated it to *Triviella*, secondly to *Pusula* and finally considered it as distinct.

Trivia merces (Iredale, 1924).

- 1822. *Cypraea australis*, Lamarck, *Hist. Nat. Anim. Sans Verteb.* VII, p. 404.
- 1828. *Cypraea australis*, Gray, *Zool. Journ.* III, pp. 570, 571, No. 108.
- 1828. *Cypraea rosea*, Wood, *Index Test. Suppl.*, p. 9.
- 1832. *Trivia australis*, Gray, *Descr. Cat. of Shells*, p. 13, No. 110.
- 1832. *Cypraea australis*, Sowerby, *Conch. Illustr.*, sp. 112, fig. 29.
- 1834. *Cypraea australis*, Quoy et Gaimard, *Voy. de 'Astrolabe'*, *Zool.* III, p. 48, pl. xlviii, figs. 19-26.
- 1838. *Cypraea rosea*, Pot. and Mich., *Gal. des Moll. Douai*, 1, p. 477, No. 9.
- 1839. *Cypraea australis*, Anton, *Verz. Conchyl.*, p. 98, No. 3133.
- 1843. *Cypraea australis*, Menke, *Spec. Moll. Novae Hollandiae*, p. 30, No. 162.
- 1843. *Cypraea australis* and *C. rosea*, Kiener, *Icon. Coq. Viv.*, pp. 136-139, pl. xlviii, fig. 2, pl. xlvii, fig. 4.
- 1844. *Cypraea australis*, Lamarck, *Hist. Nat. Anim. Sans Verteb.* (ed. Deshayes) X, p. 545.
- 1845. *Cypraea australis*, Catlow, *Conchologist's Nomenclator*, p. 308.
- 1846. *Cypraea australis*, Reeve, *Conch. Icon.* III, pl. xxiv, fig. 38.
- 1850. *Trivia australis*, Gray, *Figures of Moll. Anim.* IV, p. 75.
- 1850. *Cypraea australis*, Jay, *Cat. of the Shells*, p. 387, No. 1091.
- 1854. *Trivia australis*, H. & A. Adams, *Gen. Rec. Moll.* 1, p. 268.
- 1857. *Trivia australis*, Gray, *Guide to Syst. Descr. Moll. Brit. Mus.* 1, p. 72, pl. xxxiv, fig. 7.
- 1867. *Trivia australis*, MacCoy, *Ann. & Mag. Nat. Hist.* (3) XX, p. 437.
- 1867. *Trivia australis*, Angas, *Proc. Zool. Soc. London*, pp. 206, 207, No. 127.
- 1870. *Cypraea (Trivia) australis*, Sowerby, *Thes. Conch.* IV, p. 45, No. 159, pl. cccxxv, figs. 439, 440.
- 1870. *Trivia australis*, Roberts, *Amer. Journ. Conch.* V, p. 205.
- 1872. *Trivia australis*, Brazier, *Proc. Zool. Soc. London*, p. 86.
- 1878. *Trivia australis*, Hutton, *Journ. de Conchyliol.* XXVI, p. 25.
- 1878. *Trivia australis*, Angas, *Proc. Zool. Soc. London*, p. 867.
- 1880. *Cypraea australis*, von Martens, in *Möbius's Beiträge zur Meeresfauna der Insel Mauritius und der Seychellen*, p. 274.
- 1880. *Trivia australis*, Hutton, *Man. New Zealand Moll. Wellington*, p. 67.
- 1881. *Cypraea australis*, Weinkauff, in *Martini and Chemnitz's Syst. Conch.* Cab. V, Abth. 3, p. 142, No. 158, pl. xxxix, figs. 14, 15.
- 1883. *Cypraea (Trivia) australis*, Dautzenberg, *Les Moll. Mar. du Roussillon*, 1, p. 127.
- 1884. *Triviella australis*, Jousseaume, *Bull. Soc. Zool. France*, IX, pp. 82, 99.
- 1885. *Cypraea (Trivia) australis*, Roberts, in *Tryon's Man. Conch.* VII, p. 206, pl. xxiii, figs. 53, 54.
- 1885. *Cypraea (Trivia) australis*, Watson, *Zool. Chall. Exped.* XV, Part XLI pp. 421, 427, 704.
- 1888. *Trivia (Trivia) australis*, Paetel, *Cat. der Conchyl.-Samml.* 1, p. 332.
- 1888. *Cypraea (Trivia) australis*, Melvill, *Mém. and Proc. Manchest. Lit. & Phil. Soc.* (4) 1, p. 246, No. 116.
- 1890. *Trivia australis*, Tate, *Trans. Roy. Soc. South Austr.* XII (2), p. 213.
- 1896. *Trivia australis*, Kenyon, *Proc. Linn. Soc. New S. Wales*, XXI, p. 27.
- 1898. *Trivia australis*, Beddome, *Proc. Linn. Soc. New S. Wales*, XXII (3), p. 576, pl. xxi, fig. 19.

1900. *Cypraea (Trivia) australis*, Pritchard and Gatliff, *Proc. Roy. Soc. Victoria, (N.S.)*, XII, pp. 187, 188.
1901. *Trivia australis*, Tate, *Revised Census of the Mar. Moll. Tasmania, Sydney*, p. 374.
- 1906-1907. *Cypraea australis*, Hidalgo, *Mém. de la Real Acad. de Cienc. Madrid*, XXV, pp. 136, 188, 276, 277.
1917. *Trivia australis*, Odhner, *K. Svenska Vetenskap. Handl.* II, No. 16, p. 53.
1920. *Trivia (Trivia) australis*, Vredenburg, *Rec. Geol. Surv. Ind.* LI (2), p. 133.
1923. *Trivia australis*, Vayssiere, *Ann. Mus. Hist. Nat. Marseille-Zool.* XVIII, pp. 83, 84, pl. ix, figs. 122-126 (anatomy).
1924. *Triviella merces*, Iredale, *Proc. Linn. Soc. New S. Wales*, XLIX, Part III, pp. 183, 257, pl. xxxv, figs. 16, 17.
1924. *Trivia australis*, Fulton, *Shells of Rec. Moll.*, p. 37.
1927. *Triviella (Semitrivia) merces*, Schilder, *Archivf. Naturges.* XCIA, p. 60.
1929. *Trivia (Semitrivia) merces*, Thiele, *Handb. der Syst. Weichtierk.* 1, p. 268.
1930. *Triviella merces*, Schilder, *Zool. Anz.* CXII, p. 71.
1931. *Ellatrivia merces*, Schilder, *Rec. Austr. Mus.* XVIII (4), p. 221.
1932. *Pusula (Ellatrivia) merces*, Schilder, *Zool. Anz.* C, p. 166.
1935. *Ellatrivia merces*, Schilder, *Proc. Malac. Soc. London*, XXI, p. 332.
1936. *Ellatrivia merces*, Schilder, *Proc. Malac. Soc. London*, XXII, p. 80.
1937. *Trivia australis*, Viader, *Maur. Inst. Bull.* 1 (2), p. 39.
1941. *Ellatrivia merces*, Ludbrook, *Trans. Roy. Soc. South Austr.* LXV (1), p. 94.

Lamarck's *Cypraea australis* was originally described from New Holland and is commonly known as the 'New Holland Cowry'. But as this appellation appears to have been anticipated by Schroeter (1804)¹ and Duclos's *rosea* also being cited by Pot. and Mich. as a synonym of *australis* Iredale has suggested the new name *merces* for the species. Wood's *C. rosea*, as stated by the latter, is also a synonym. In 1931 Iredale selected *merces* as the type of his new genus *Ellatrivia*. Viader, on the other hand, ignores all these important changes in nomenclature and maintains Lamarck's name *australis* for the species.

Characters :—A good description of this pretty species is given by Gray, to which I have very little to add. It can easily be distinguished from all other Triviids by its large, thin, white, oblong-ovate shell (though not so large as that of *Trivellona excelsa* Iredale, 1931) variegated with irregular squarish liver-coloured blotches on its surface (the middle one on the right side of the sulcus is the largest of all) and rose-tinted extremities. *T. merces* is closely allied to *T. excelsa* from off Montagu Island, Australia, and Kiener's *C. formosa* (nec Gaskoin). Ludbrook indicates the close affinities of this form with his new species *Ellatrivia wirrata* from Adelaide, S. Australia, while MacCoy points out that his *Trivia avellanoides* from the Eocene of Australasia, which is the largest representative of the genus and is still found living, is also allied to *T. merces*; it is, however, much more globose and has fewer but more distant ribs. An account of the anatomy of the soft parts of this species is given by Vayssi re in the paper cited.

There is a series of specimens of *T. merces* in the collection from Port Jackson and Victoria, which are labelled as *T. australis* (Lam.). In the young shells where the sulcus is not formed the blotches of either side (especially the middle ones) unite with one another in the middle forming a single large blotch. The largest shell is from Philippi's Bay, Victoria, which is 16 mm. in length and 11 mm. in breadth.

¹ Schroeter, J. S. *Archiv Zool.* (Wiedemann) IV, Part I, p. 10 (1804).

Distribution :— *Trivia* (*Ellatrivia*) *merces* (Iredale) is known to be very common on the shores of Tasmania and Australia as also in Victoria, Queensland and New South Wales (shark and Clark Islands, Watson's Bay; Bottle and Glass Rocks, Port Jackson; Port Stephens; Port Macquarie; Macleay, Nambucera, Bellinger, Redbank, and Clarence Rivers). But records are also known from Cargados, Sandwich Islands, Mauritius, New Zealand and Malacca.

Type-locality. East Coast of New Holland.

Type. Brit. Mus. (Nat. Hist.).

Subgenus ***Pusula*** Jousseaume, 1884.

Type *Cypraea radians* Linnaeus.

- 1884. *Pusula*, Jousseaume, *Bull. Soc. Zool. France*, IX, p. 99.
- 1903. *Pusula*, Cossmann, *Ess. de Paleoconch. Comp.* V, p. 170.
- 1927. *Pusula*, Schilder, *Archiv f. Naturges.* XCIA, p. 61.
- 1929. *Pusula*, Thiele, *Handb. der Syst. Weichtierk.* I, p. 268.
- 1931. *Pusula*, Schilder, *Zool. Anz.* XCVI, p. 69.
- 1932. *Pusula*, Schilder, *Zool. Anz.* C, p. 166.
- 1936. *Pusula*, Schilder, *Proc. Malac. Soc. London*, XXII, pp. 80, 109.

Jousseaume erected *Pusula* as a genus, with *Cypraea radians* Linnaeus as its type-species. Cossmann, on the other hand, included it into the synonymy of *Trivia*. Schilder seems to follow Jousseaume, but Thiele subordinates it to *Trivia*. I follow the latter.

Trivia quadripunctata (Gray, 1827).

- 1827. *Cypraea quadripunctata*, Gray, *Zool. Journ.* III, pp. 368, 369.
- 1832. *Trivia quadripunctata*, Gray, *Descr. Cat. of Shells*, p. 14.
- 1832. *Cypraea quadripunctata*, Sowerby, *Conch. Illustr.*, sp. 116, fig. 33.
- 1839. *Cypraea quadripunctata*, Anton, *Verz. Conchyl.*, p. 98, No. 3130.
- 1840. *Cypraea quadripunctata*, Pfeiffer, in *Weigmann's Archiv f. Naturges.* VI, p. 259.
- 1843. *Cypraea rotunda*, Kiener, *Icon. Coq. Viv.*, p. 141, pl. III, fig. 2.
- 1844. *Cypraea quadripunctata*, Lamarck, *Hist. Nat. Anim. Sans Verteb.* (ed. Deshayes) X, p. 569, No. 101.
- 1845. *Cypraea quadripunctata*, Catlow, *Conchologist's Nomenclator*, p. 312.
- 1846. *Cypraea quadripunctata*, Reeve, *Conch. Icon.* III, pl. xxv, fig. 146.
- 1847. *Cypraea quadripunctata*, Chenu, *Hist. Nat. des Anim.*, pl. x, fig. 8.
- 1850. *Cypraea quadripunctata*, Jay, *Cat. of the Shells*, p. 392.
- 1851. *Cypraea quadripunctata*, Beau, *Journ. de Conchyliol.* II, p. 430.
- 1860. *Trivia quadripunctata*, Tristram, *Proc. Zool. Soc. London*, p. 404.
- 1867. *Cypraea rotunda*, Krebs, *Ann. Lyceum Nat. Hist. New York*, VIII, p. 429.
- 1869. *Cypraea quadripunctata*, Schramm, *Cat. Coq. et Crust. Guadeloupe Basse-Terre*, p. 40.
- 1870. *Cypraea* (*Trivia*) *quadripunctata*, Sowerby, *Thes. Conch.* IV, p. 45, No. 157, pl. cccxxvi, figs. 460-463.
- 1870. *Trivia quadripunctata*, Roberts, *Amer. Journ. Conch.* V, p. 207, No. 30.
- 1873. *Trivia quadripunctata*, Tryon, *Amer. Mar. Conch. Philadelphia*, p. 55.
- 1877. *Trivia quadripunctata*, Mörch, *Malakozool. Blätt.* XXIV, p. 49, No. 402.
- 1880. *Cypraea quadripunctata*, von Martens, in *Möbius's Beiträge zur Meeres-fauna der Insel Mauritius und der Seychellen*, p. 274.
- 1881. *Cypraea quadripunctata*, Weinkauff, in *Martini and Chemnitz's Syst. Conch-Cab.* V, Abth. 3, p. 151, pl. xli, figs. 6, 7.
- 1882. *Trivia quadripunctata*, Tryon, *An Introduction to the study of Moll.* I, p. 198, pl. lxi, figs. 6, 7.
- 1883. *Cypraea* (*Trivia*) *quadripunctata*, Dautzenberg, *Les Moll. Mar. du Roussillon*, I, Fasc. 3, p. 128.

1884. *Pusula quadripunctata*, Jousseaume, *Bull. Soc. Zool. France*, IX, p. 99.
 1885. *Cypraea (Trivia) quadripunctata*, Roberts, in *Tryon's Man. Conch.* VII, pp. 201, 202, pl. xxii, figs. 5, 6.
 1888. *Trivia (Trivia) quadripunctata*, Paetel, *Cat. der Conchyl.-Samml.* 1, p. 324.
 1888. *Cypraea (Trivia) quadripunctata*, Melvill, *Mém. and Proc. Manchest. Lit. & Phil. Soc.* (4) I, p. 245.
 1889. *Trivia quadripunctata*, Dall, *Preliminary Cat. of Shell-bearing Mar. Moll. S. E. Coast of U. States, Washington*, p. 138.
 1889. *Trivia quadripunctata* var. *rotunda*, Dall, *Rept. On the Results of Dredging in the Gulf of Mexico*, Part II, p. 241.
 1897. *Trivia quadripunctata*, Sowerby, *Marine Shells of South Africa*, p. 16.
 1900. *Trivia quadripunctata*, Dauterberg, *Crois du yacht chaz dans l'Atlantique Moll.*, p. 50.
 1903. *Trivia quadripunctata*, Baker, *Nautilus*, XIII, p. 57.
 1905. *Cypraea quadripunctata*, Hidalgo, *Cat. Moll. Test. Filipinas*, P. 150.
 1906-1907. *Cypraea quadripunctata*, Hidalgo, *Mém. de la Real Acad. de Cienc. Madrid*, XXV, pp. 219, 495, 496.
 1920. *Trivia (Trivia) quadripunctata*, Vredenburg, *Rec. Geol. Surv. Ind.* LI (2), p. 133.
 1924. *Trivia quadripunctata*, Peile, *Proc. Malac. Soc. London*, XVI, p. 197.
 1924. *Trivia quadripunctata*, Fulton, *shells of Rec. Moll.*, p. 38.
 1927. *Pusula (Niveria) quadripunctata*, Schilder, *Archiv f. Naturges.* XCIA, p. 62.
 1928. *Trivia quadripunctata*, Faustino, *Summary of Philippine Mar. and Freshw. Moll.*, p. 220.
 1930. *Niveria quadripunctata*, Schilder, *Zool. Anz.* CXII, p. 68.
 1937. *Trivia quadripunctata*, Viader, *Maur. Inst. Bull.* 1 (2), p. 39.

Gray's *Cypraea quadripunctata* or the 'Four-dotted Cowry', as it is usually called, was described from an unknown habitat. Kiener's *Cypraea rotunda* from Antillas, which is the young shell of this species with purplish red colour, appears to have been wrongly treated by Dall as its variety. MacCoy is wrong in stating "Duclos's *tremeza* is a synonym of this species" Vredenburg includes this species into his sub-Group *Trivia quadripunctata* of the Group *Trivia europaea*, because of its oval shell and distinct dorsal groove.

Characters :—Shell rotundately-ovate, ventricose, rose-coloured (young shells more brightly coloured than the adult ones), ornamented with four conspicuous reddish-brown dots on the back and, hence, the name 'Four-dotted Cowry', two of which are placed in the middle line (one being slightly anterior to the other on either side of the dorsal sulcus) and of the other two—one at each end of the sulcus, the latter appearing deep and narrow, finally transversely ribbed throughout, ribs becoming smooth and close-set; extremities blunt, but slightly thickened; right side thickened and well-margined; base convex; aperture wide, linear, and much curved posteriorly; teeth small. The four dots, so characteristic of the species, may be pale or entirely obsolete in some cases.

As stated by Peile, this pink species, like *Cyphoma gibbosum* (Linn.) and *Ovula acicularis* (Lamk.), has the remarkable habit of harmonizing itself with the colour of the organism on which it lives.

This species is represented in the collection by twenty-seven specimens obtained from West Indies and Ceylon, of which the largest one from West Indies measures 13 mm. in length and 5.5 mm. in breadth.

Distribution :—*Trivia (Pusula) quadripunctata* (Gray) is quite common in West Indies, but also occurs in North Caroline, Mauritius,

¹ Schroeter, J. S. *Archiv Zool.* (Wiedemann) IV, Part I, p. 10 (1804).

Pondoland (S. Africa), Australia and the Philippines. I have found one typical shell of this species in the collection associated with the shells of *T. rubinicolor* (Gaskoin) from Ceylon. This appears to be rather a new record.

Subgenus **Cleotrivia** Iredale, 1930.

Type *Cypraea pilula* Kiener, 1845.

- 1930. *Cleotrivia*, Iredale, *Mém. Queensl. Mus.* X, p. 83.
- 1931. *Cleotrivia*, Iredale, *Rec. Austr. Mus.* XVIII, p. 221.
- 1931. *Cleotrivia*, Thiele, *Handb. der Syst. Weichtierk.* 1, p. 739.
- 1931. *Cleotrivia*, Schilder, *Zool. Anz.* XCVI, p. 69.
- 1932. *Cleotrivia*, Schilder, *Zool. Anz. C*, p. 166.
- 1933. *Cleotrivia*, Schilder, *Occ. Pap. B. P. Bishop Mus. Honolulu*, X(3), p. 5.
- 1935. *Cleotrivia*, Schilder, *Proc. Malac. Soc. London*, XXI, pp. 332, 333.
- 1936. *Cleotrivia*, Schilder, *Proc. Malac. Soc. London*, XXII, p. 109.
- 1937. *Cleotrivia*, Schilder, *De Mijneningenieur*, IV(11), p. 4.
- 1940. *Cleotrivia*, Winckworth, *Proc. Malac. Soc. London*, XXIV, p. 21.

Iredale established *Cleotrivia* as a genus for the small globular Trivias and selected *Cypraea pilula* Kiener as its genotype. Schilder seems to be quite inconsistent in his treatment of *Cleotrivia*, as he at first subordinates it to *Pusula* (1931, p. 69), later to *Trivia* (1932, p. 166) and finally ranks it as distinct (1933, p. 5; 1935, p. 332). I have already given reasons to treat this as a subgenus. I think Thiele's '*Cleovitrea*' is a misprint for *Cleotrivia*.

Trivia pilula (Kiener, 1843).

- 1767. *Cypraea globosa*, Adanson, *Hist. Nat. du Senegal Cog.*, p. 74.
- 1832. *Trivia globosa*, Gray, *Descr. Cat. of Shells*, p. 14.
- 1832. *Cypraea globosa*, Sowerby, *Conch. Illustr.*, sp. 117, fig. 34.
- 1839. *Cypraea globosa*, Anton, *Verz. Conchyl.*, p. 98, no. 3131.
- 1843. *Cypraea pilula*, Kiener, *Icon. Cog. Viv.*, pp. 151, 152, pl. liv. figs. 2, 2a.
- 1845. *Cypraea sphaerula*, Mighels, *Proc. Bost. Soc. Nat. Hist.* II, pp. 24, 25.
- 1845. *Cypraea globosa*, Catlow, *Conchologist's Nomenclator*, p. 310, no. 56.
- 1846. *Cypraea globosa*, Reeve, *Conch. Icon.* III, pl. XXVI, fig. 152.
- 1850. *Cypraea globosa*, Jay, *Cat. of the Shells*, pp. 389, 391.
- 1852. *Trivia globosa* and *T. pilula*, Mörch, *Cat. Yoldi*, p. 118.
- 1854. *Trivia globosa* and *T. pilula*, H. & A. Adams, *Gen. Rec. Moll.* 1, p. 269.
- 1867. *Cypraea pilula*, Krebs, *Cat. Mar. Moll. Collected in Bahama Islands*, p. 41.
- 1868. *Trivia globosa*, Pease, *Amer. Journ. Conch.* IV, pp. 126, 127.
- 1869. *Cypraea globosa*, Schramm, *Cat. Cog. et Crust. Guadeloupe Basse-Terre*, p. 40.
- 1870. *Trivia globosa*, Roberts, *Amer. Journ. Conch.* V, p. 206, no. 16.
- 1871. *Trivia globosa*, Angas, *Proc. Zool. Soc. London*, p. 94, no. 59.
- 1872. *Cypraea globosa*, Brazier, *Proc. Zool. Soc. London*, p. 86.
- 1874. *Cypraea (Trivia) globosa*, Langdon, *Journ. Conch.* 1, p. 75.
- 1879. *Trivia sphaerula*, Garrett, *Journ. Conch.* II, pp. 107, 126, no. 74.
- 1881. *Cypraea globosa* and *C. pilula*, Weinkauff, in *Martini and Chemnitz's Syst. Conch.-Cat.* V, Abth. 3, pp. 151, 152, pl. xli, figs. 9, 12, pp. 159, 160, pl. xlii, figs. 13, 16.
- 1882. *Cypraea globosa*, Dunker, *Index Moll. Maris Japonici*, p. 101.
- 1884. *Niveria globosa* and *N. brevissima*, Jousseaume, *Bull. Soc. Zool. France*, IX, p. 100.
- 1885. *Cypraea (Trivia) globosa* and *C. (T.) brevissima*, Roberts, in *Tryon's Man. Conch.* VII, pp. 200, 201, pl. xxi, figs. 90-93.
- 1888. *Trivia globosa*, *T. brevissima*, *T. pilula* and *T. sphaerula*, Paetel, *Cat. der Conchyl.—Samml.* 1, pp. 322-324.
- 1888. *Cypraea (Trivia) globosa*, and *C. (T.) brevissima*, Melvill, *Mém. and Proc. Manchest. Lit. & Phil. Soc.* (4)I, p. 247, Nos. 125 and 127.
- 1889. *Trivia globosa*, Dall, *Preliminary Cat. of the Shell-bearing Mar. Moll. S. E. Coast of U. States, Washington*, p. 136.
- 1891. *Cypraea globosa*, Fischer, *Cat. Moll. Indo-China*, p. 158.

1897. *Trivia globosa*, Melvill and Standen, *Journ. Conch.* VIII, p. 408.
 1898. *Trivia sphaerula*, Baldwin, *Nautilus*, XI, p. 123.
 1901. *Trivia globosa*, Melvill and Standen, *Proc. Zool. Soc. London*, II, p. 384.
 1902. *Cypraea (Trivia) globosa* and *C. (T.) pilula*, Dautzenberg, *Journ. de Conchyliol.* L, pp. 382, 383.
 1904. *Trivia globosa*, Melvill and Standen, *Journ. Conch.* XI(4), p. 122.
 1905. *Trivia globosa*, Hidalgo, *Cat. Moll. Test. Filipinas*, p. 143.
 1906—1907. *Cypraea globosa*, *C. brevissima* and *C. pilula*, Hidalgo, *Mém. de la Real Acad. de Cienc. Madrid*, XXV, pp. 136, 139, 141, 188, 201, 216, 282, 369, 469.
 1909. *Trivia globosa*, Shaw, *Proc. Malac. Soc. London*, VIII, pp. 308, 310.
 1909. *Trivia globosa* and *T. brevissima*, Schepman, *Prosoobr. Siboga Exped. Monogr.* XLIX^{1b}, p. 138.
 1920. *Trivia globosa*, *T. pilula* and *T. brevissima*, Vredenburg, *Rec. Geol. Surv. Ind.* LI(2), p. 133.
 1922. *Trivia globosa*, Schilder, *Proc. Malac. Soc. London*, XV, p. 105.
 1923. *Trivia globosa*, Vayssiere, *Ann. Mus. Hist. Nat. Marseille-Zool.* XVIII, p. 36.
 1924. *Trivia globosa*, Fulton, *Shells of Rec. Moll.*, p. 37.
 1927. *Trivia (Trivirostra) pilula* and *T. (Trivia) brevissima*, Schilder, *Archiv f. Naturges.* XCIA, pp. 63, 64.
 1928. *Trivia globosa*, Faustino, *Summary of Philippine Mar. and Freshw. Moll.*, p. 220.
 1930. *Cleotrivia pilula*, Iredale, *Mem. Queensl. Mus.* X, p. 83.
 1931. *Cleotrivia pilula*, Iredale, *Rec. Austr. Mus.* XVIII(4), p. 221.
 1931. *Trivia globosa*, Schilder, *Zool. Anz.* XCVI, p. 71.
 1931. *Cleovitrea pilula*, Thiele, *Handb. der Syst. Weichtierk.* 1, 739.
 1932. *Trivia pilula*, Dautzenberg, *Journ. de Conchyliol.* LXXVI, p. 53.
 1933. *Cleotrivia pilula*, Schilder, *Occ. Pap. B. P. Bishop Mus. Honolulu*, X(3), pp. 5, 7, 8.
 1935. *Cleotrivia globosa*, Schilder, *Proc. Malac. Soc. London*, XXI (6), p. 333.
 1936. *Cleotrivia pilula*, Schilder, *Proc. Malac. Soc. London*, XXII, pp. 80, 95, 96 and 97 (foot note).
 1937. *Trivia globosa* and *T. brevissima*, Viader, *Maur. Inst. Bull.* 1(2), p. 39.

Kiener's *Cypraea pilula* was described from an unknown habitat. Gray in his *Descr. Cat.* mentions China as the type-locality of his new species *T. globosa*. Dujardin (1837) unknowingly proposed this very name to a fossil species, the type of which was obtained in some parts of France. Shaw has, however, substituted a new name *hoernesiana* for Dujardin's species.

Gray's *globosa* has, no doubt, priority over Kiener's *pilula*, but as Iredale has selected the latter as the type of his new genus *Cleotrivia*, this name, therefore, must stand. The resemblances between *T. pilula*, Sowerby's *C. brevissima* and Mighels's *T. sphaerula* appear to be so close as regards shape, size and sculpture of the shells that they can safely be considered as identical. Pease was right so long as he treated *globosa* as inseparable from the above species, but a mistake was made in his concluding remark, "It will probably prove to be a variety of *Oryza*, Lam." Weinkauff appears to have made vain attempts to separate *pilula* from *globosa* mainly on geographical ground, i.e., he restricted the name *pilula* to the shells occupying the Pacific Region, and retained *globosa* for the West Indian forms, but he rightly combined Kenyon's *Trivia acutisulcata* (fig. 2)¹ with *globosa*. Shaw's remark on Weinkauff's statement appears to be quite satisfactory, "With regard to geographical distribution, *T. globosa* is supposed to be a West Indian form, though Gray in his "Descriptive Catalogue" gave China as the locality of his type. *T. pilula* is reported from the Persian Gulf, Siam,

¹ Kenyon, A. F. *Proc. Malac. Soc. London*, IV, pp. 68, 69 (1900).

Japan, Philippines, New Caledonia, Sandwich Islands, and New South Wales. Even if *globosa* was incorrectly cited from China and is strictly a West Indian shell (which I think very improbable) there is not the slightest conchological reason for separation." He has also rightly criticized the view expressed by Hidalgo as follows, "After having carefully compared the description, figure, and specimens of *T. globosa* with those of *T. pilula*, Kiener, I fail to see why Hidalgo has separated them. *T. pilula* has generally been accepted as a synonym of *T. globosa*, and I cannot see the slightest ground for Keeping them apart." Vredenberg unfortunately follows Dautzenberg, Paetel and Sowerby in the separation of *pilula* from *globosa*, while Schepman retains *globosa* apart from *brevissima* simply on the character of the dorsal sulcus, which is deep in one case and shallow in the other. Jousseaume, no doubt, supports Weinkauff and Hidalgo, but he relegates both the species to his new genus *Niveria*. Mörch and Roberts unite Krebs's *Cypraea subrostrata* var. *alba*. with *pilula*.

Characters.—The most remarkable feature of this species is the globular pea-like form of its shell by which it can readily be separated from all other species of *Trivia*. The shell is snow-white in colour and the dorsal sulcus is deeply impressed and extremely long (recalling that of *T. pisum*) extending between the extremities which are only slightly beaked. The aperture is wide, but slightly curved posteriorly, while the teeth are small, equal and snow-white in colour. Schilder says that the teeth in the Hawaiian specimens are smaller and less numerous on both the lips than in those from the South Pacific.

There are about eighteen shells of different size and growth in the collection bearing the locality-label 'Ceylon' (Reg. No. 2871). Vredenburg has identified them as *T. globosa* Gr. They appear to be quite typical of the species. Another specimen named *Cypraea globosa* Duj. has recently been received (Reg. No. M15446/2) as exchange from Rev. W. R. Stedman with a locality-label 'Fiji Islands' But a careful examination reveals it to be identical with *T. oryza* (Lam.).

Distribution.—The range of *Trivia* (*Cleotrivia*) *pilula* (Kiener) is very wide, having been recorded from Guadeloupe, Antigua, Antillas, Jamaica, Cuba, St. Bartheloma, St. Cruz, St. Martin, St. Johns, Anquilla, Persian Gulf, Gulf of Oman, Malcolm Inlet, Coast of Continental India from east of River Hab. abutting on Karachi to Panjim, Mauritius, Madagascar, Chagos, Cargados, Rodriguez, Seychelles, Ceylon, Gulf of Siam, Lombok, New Caledonia, Australia, New South Wales (Cook's Landing Place, Botany Bay; Little Bay between Port Jackson Heads and Botany), the Philippines, Japan, Lifu, Sandwich, Paumotus, Loyalty, Society and Hawaii. Melvill and Standen (1897, p. 408) state "It may almost be deemed cosmopolitan within the tropics"

***Trivia pisum* (Gaskoin, 1846).**

1846. *Cypraea pisum*, Gaskoin, *Proc. Zool. Soc. London*, p. 24.

1846. *Cypraea pisum*, Reeve, *Conch. Icon.* III, pl. xxvi, fig. 154.

1850. *Cypraea pisum*, Jay, *Cat. of the Shells*, p. 391.

1870. *Cypraea* (*Trivia*) *pisum*, Sowerby, *Thes. Conch.* IV, p. 44, no. 152. pl. cccxxvi, figs. 448, 449.

1870. *Cypraea pisum*, Roberts, *Amer. Journ. Conch.* V, p. 207.
 1881. *Cypraea pisum*, Weinkauff, in *Martini and Chemnitz's Syst. Conch.*—*Cab.* V, Abth. 3, pp. 146, 147, pl. xl, figs. 9, 12.
 1885. *Cypraea (Trivia) pisum*, Roberts, in *Tryon's Man. Conch.* VII, p. 207, pl. xxii, figs. 29, 30.
 1888. *Trivia (Trivia) pisum*, Paetel, *Cat. der Conchyl.*—*Samml.* 1, p. 324.
 1888. *Cypraea (Trivia) pisum*, Melvill, *Mém. and Proc. Manchest. Lit. and Phil. Soc.* (4)I, p. 245, no. 99.
 1904. *Trivia pisum*, Smith, *Ann. & Mag. Nat. Hist.* (7)XIII, p. 471.
 1906—1907. *Cypraea pisum*, Hidalgo, *Mém. de la Real Acad. de Cienc. Madrid*, XXV, pp. 141, 216, 471, 472.
 1920. *Trivia pisum*, Vredenburg, *Rec. Geol. Surv. Ind.* LI (2), p. 133.
 1927. *Trivia (Trivirostra) pisum*, Schilder, *Archiv f. Naturges.* XCI, p. 63.
 1931. *Trivia pisum*, Schilder, *Zool. Anz.* XCVI, p. 71.
 1940. *Cleotrivia pisum*, Winckworth, *Proc. Malac. Soc. London*, XXIV, p. 21.

Gaskoin's *Cypraea pisum* or the "Pea-Cowry", as it is generally known, appears to be based on an immature specimen. The author in his description says that each of the ribs tapers gradually before it terminates dorsally into the longitudinal sulcus. But this condition appears to exist only in the juvenile shells; in the adult shells the ribs are more or less equal throughout.

Characters.—This unique species is characterized by its sphaeroidal shell having a long and deeply impressed sulcus reaching the extremities (as in *T. pilula*) which are obtuse and thick. The colour is light fawn and the ribs are quite large and prominent. The aperture is more or less like that of *pilula*.

Out of twenty-three shells in the collection, twenty-two are from Ceylon (Reg. No. 2856) and agree with the description of the typical form, while the other (a juvenile shell—Reg. No. 2948) is from off the coast of Ceylon. It is sky-blue in colour and lacking entirely in dorsal sulcus. The ribs are seen gradually tapering as they pass on to the dorsal side and terminating abruptly in the middle. The largest shell from Ceylon measures 8.5 mm. in length and 6.5 mm. in breadth.

Distribution.—*Trivia (Cleotrivia) pisum* (Gaskoin) was originally recorded from East Indies, but subsequently its range has been extended to India (Coromandel) and Ceylon.

Type-locality. East Indies.

Subgenus **Dolichupis** Iredale, 1930.

Type *Cypraea producta* Gaskoin, 1836.

1930. *Dolichupis*, Iredale, *Mém. Queensl. Mus.* X, p. 83.
 1931. *Dolichupis*, Iredale, *Rec. Austr. Mus.* XVIII(4), p. 221.
 1931. *Dolichupis*, Thiele, *Handb. der Syst. Weichtierk.* 1, p. 739.
 1931. *Dolichupis*, Schilder, *Zool. Anz.* XCVI, p. 69.
 1932. *Dolichupis*, Schilder, *Zool. Anz.* C, p. 116.
 1936. *Dolichupis*, Schilder, *Proc. Malac. Soc. London*, XXII, pp. 80, 109.
 1940. *Dolichupis*, Winckworth, *Proc. Malac. Soc. London*, XXIV, p. 21.

Iredale established *Dolichupis* as a genus to include certain forms of *Trivia* with produced extremities and selected Gaskoin's *Cypraea producta* as its genotype. Schilder first treated it as a subgenus of *Pusula* Jousseaume, but afterwards ranked it as distinct. Winckworth, on the other hand, in his systematic list of Investigator Mollusca has subordinated *Dolichupis* to *Cleotrivia*.

Trivia producta (Gaskoin, 1836).

1836. *Cypraea producta*, Gaskoin, *Proc. Zool. Soc. London*, p. 200.
 1843. *Cypraea producta*, Kiener, *Icon. Cog. Viv.*, p. 153, pl. liii, fig. 5.
 1845. *Cypraea producta*, Catlow, *Conchologist's Nomenclator*, p. 212.
 1846. *Cypraea producta*, Reeve, *Conch. Icon.* III, pl. xxiv, figs. 37a, 37b.
 1848. *Cypraea producta*, Gaskoin, *Proc. Zool. Soc. London*, p. 98.
 1850. *Cypraea producta*, Jay, *Cat. of the Shells*, p. 391.
 1854. *Trivia producta*, H. & A. Adams, *Gen. Rec. Moll.* I, p. 269.
 1858. *Cypraea producta*, Drouet, *Mém. Soc. d'Agric. des Sc. et Bells—lettres du dép. de l'Aube*, IX, p. 37.
 1861. *Cypraea producta*, Petit, *Journ. de Conchyliol.* IX, p. 39.
 1870. *Trivia producta*, Roberts, *Amer. Journ. Conch.* V, p. 207, no. 27.
 1870. *Cypraea (Trivia) producta*, Sowerby, *Thes. Conch.* IV, p. 49, pl. cccxxiii, figs. 495, 496.
 1871. *Cypraea producta*, von Martens and Langkavel, *Donum Bismarck.*, p. 35.
 1881. *Cypraea producta*, Weinkauff, in *Martini and Chemnitz's Syst. Conch.*—*Cab.* V, Abth. 3, pp. 158, 161, 162, 166, pl. xliii, figs. 2, 3.
 1884. *Cypraea producta*, Jickeli, *Jahrb. Deutsch. Malakozool. Ges.* XI, p. 212.
 1885. *Cypraea (Trivia) producta*, Roberts, in *Tryon's Man. Conch.* VII, p. 207, pl. xxii, figs. 25, 26.
 1888. *Cypraea (Trivia) producta*, Melvill, *Mém. and Proc. Manchest. Lit. & Phil. Soc.* (4)I, p. 246, no. 108.
 1888. *Trivia (Trivia) producta*, Paetel, *Cat. der Conchyl.*—*Samml.* 1, p. 324.
 1889. *Trivia producta*, Dautzenberg, *Albert 1er Prince de Monaco, Camp. Scient.*, p. 40.
 1897. *Trivia producta*, Sowerby, *Marine Shells of South Africa*, p. 16.
 1904. *Trivia producta*, Smith, *Ann. & Mag. Nat. Hist.* (7)XIII, p. 471.
 1905. *Cypraea producta*, Hidalgo, *Cat. Moll. Test. Filipinas*, p. 150.
 1906—1907. *Cypraea producta*, Hidalgo, *Mém. de la Real Acad. de Cienc. Madrid*, XXV, pp. 217, 475, 476, 504.
 1920. *Trivia (Trivia) producta*, Vredenburg, *Rec. Geol. Surv. Ind.* LI(2), p. 135.
 1923. *Trivia producta*, Vayssiere, *Ann. Mus. Hist. Nat. Marseille-Zool.* XVIII, pp. 88, 89, pl. ix, figs. 115—120 (anatomy), 121 (shell).
 1925. *Trivia producta*, Thiele, *Wiss. Ergeb. der Deuts. Tiefsee-Exped. Gastropoda*, Part II, pp. 73, 107.
 1927. *Trivia (Trivia) producta*, Schilder, *Archiv f. Naturges.* XCIA, pp. 62, 64.
 1930. *Dolichupis producta*, Iredale, *Mem. Queensl. Mus.* X, p. 83.
 1931. *Dolichupis producta*, Thiele, *Handb. der Syst. Weichtierk.* 1, p. 739.
 1936. *Dolichupis producta*, Schilder, *Proc. Malac. Soc. London*, XXII, p. 80.
 1940. *Cleotrivia (Dolichupis) producta*, Winckworth, *Proc. Malac. Soc. London*, XXIV, p. 21.

Gaskoin's *Cypraea producta* is a peculiar form of dull-white colour, the type-shell of which is well-illustrated in Sowerby's *Conchological Illustrations*, fig. 155. The exact locality of the species is not given by Gaskoin in his paper. But it is said by Adams and Reeve to have been described from a single worn specimen obtained from Unsang, east coast of Borneo, from coral reefs.

Characters.—Shell ovate, ventricose, slightly humped, emarginate, finely transversely ribbed throughout, ribs large, prominent, smooth, distant and less in number, but their arrangement appearing quite peculiar—a few terminating on the side of the shell at various distances from the middle of the back, a few passing over the middle of the back to the opposite side, while the rest terminating in the centre of the dorsum between each other; extremities peculiarly produced and flattened; dorsal groove entirely absent; teeth prominent, strong, even, distant, but their number is not so constant as mentioned by Gaskoin.

This white-shelled species approximates more nearly to the blood-stained *sauguinea* of Gray than to *scabriuscula* in the converging character of the dorsal ribs and the entire absence of the longitudinal groove. For a detailed account of the anatomy of its soft parts (including the

radula and genitalia) reference may be made to Vayssi  re's paper cited above.

A typical shell of dirty-white colour from off the Coromandel Coast, 41 fathoms (Reg. No. 2957), represents the species in the collection. It is 9 mm. in length and 6.5 mm. in breadth.

Distribution.—*Trivia (Dolichupis) producta* (Gaskoin) has so far been known to occur in the Red Sea, Gulf of Suez, Agulhas Bank in South Africa, Tuticorin, off the Coromandel Coast, Australia, the Philippines, Society and Paumotu Islands.

***Trivia insecta* (Mighels, 1945).**

1843. *Cypraea hordacea*, Kiener, *Icon. Cog. Viv.* III, p. 149, pl. iv, figs. 5, 5a.
1845. *Cypraea insecta*, Mighels, *Proc. Bost. Soc. Nat. Hist.* II, p. 24.
1850. *Cypraea insecta* and *C. hordacea*, Jay, *Cat. of the Shells*, p. 389.
1854. *Trivia hordacea*, H. & A. Adams, *Gen. Rec. Moll.* 1, p. 269.
1863. *Cypraea hordacea*, Deshayes, *Cat. Moll. Reunion*, p. 138, no. 548.
1867. *Trivia insecta*, Marrat, *Ann. & Mag. Nat. Hist.* (3)XX, p. 215.
1868. *Trivia insecta*, Pease, *Amer. Journ. Conch.* IV, p. 127.
1870. *Cypraea (Trivia) insecta*, Sowerby, *Thes. Conch.* IV, p. 46, pl. XXXV, figs. 477-479.
1870. *Trivia insecta*, Roberts, *Amer. Journ. Conch.* V, p. 206, No. 18.
1871. *Cypraea (Trivia) insecta*, von Martens and Langkavel, *Donum Bismarck.*, p. 34.
1872. *Trivia insecta*, Brazier, *Proc. Zool. Soc. London*, p. 86.
1879. *Trivia insecta*, Garrett, *Journ. Conch.* II, pp. 123, 127, No. 67.
1880. *Cypraea (Trivia) hordacea*, von Martens, in *M  bius's Beitr  ge zur Meeresfauna der Insel Mauritius und der Seychellen*, p. 274.
1881. *Trivia insecta*, Angas, *Proc. Zool. Soc. London*, p. 94, No. 60.
1881. *Cypraea hordacea*, Weinkauff, in *Martini and Chemnitz's Syst. Conch.*—*Cab.* V, Abth. 3, pp. 162, 163, pl. xliii, figs. 5, 8.
1884. *Trivirostra insecta*, Jousseaume, *Bull. Soc. Zool. France*, IX, p. 100.
1588. *Cypraea (Trivia) hordacea*, Watson, *Zool. Chall. Exped.* XV, Part. XLII, p. 428.
1888. *Trivia (Trivia) insecta*, Paetel, *Cat. der Conchyl.*—*Samml.* 1, p. 323.
1888. *Cypraea (Trivia) insecta*, Melvill, *M  m. and Proc. Manchest. Lit. & Phil. Soc.* (4)1, p. 247, No. 132.
1895. *Trivia insecta*, Melvill and Standen, *Journ. Conch.* XIII, p. 113.
1897. *Trivia insecta*, Sowerby, *Marine Shells of South Africa*, p. 16.
1898. *Trivia insecta*, Baldwin, *Nautilus*, XI, p. 123.
1902. *Cypraea (Trivia) insecta*, Dautzenberg, *Journ. de Conchyliol.* L, p. 381.
1906. *Trivia hordacea*, Vayssi  re, *Bull. Mus. Nat. Hist. Paris*, XII, p. 118.
- 1906—1907. *Cypraea insecta*, Hidalgo, *M  m. de la Real Acad. de Cienc. Madrid*, XXV, pp. 139, 154, 203, 204, 385, 386.
1909. *Trivia insecta*, Schepman, *Prosobr. Siboga Exped. Monogr.* XLIX^{1b}, p. 138.
1909. *Trivia insecta*, Shaw, *Proc. Malac. Soc. London*, VIII, p. 308.
1909. *Cypraea (Trivia) insecta*, Melvill, *Trans. Linn. Soc. (Zool.)* (2)XIII, p. 135.
1920. *Trivia (Trivia) insecta*, Vredenburg, *Rec. Geol. Surv. Ind.* LI(2), p. 135.
1922. *Trivia insecta*, Schilder, *Proc. Malac. Soc. London*, XV, p. 100.
1923. *Trivia insecta*, Dautzenberg, *Journ. de Conchyliol.* LXVIII, p. 44.
1924. *Trivia insecta*, Fulton, *Shells of Rec. Moll.* p. 38.
1927. *Trivia (Trivirostra) insecta*, Schilder, *Archiv f. Naturges.* XCIA, p. 63.
1928. *Trivia insecta*, Faustino, *Summary of the Philippine Mar. and Freshw. Moll.*, p. 220.
1929. *Trivia insecta*, Dautzenberg, *Faune des Col. Franc.* III, p. 259.
1931. *Dolichupis insecta*, Iredale, *Rec. Austr. Mus.* XVIII(4), p. 221.
1932. *Trivia insecta*, Dautzenberg, *Journ. de Conchyliol.* LXXVI, p. 53.
1932. *Trivirostra hordacea*, Schilder, *Zool. Anz.* C, pp. 166, 169, fig. 2 (radular teeth).
1933. *Trivirostra hordacea*, Schilder, *Occ. Pap. B. P. Bishop Mus. Honolulu*, X(3), pp. 5, 7, 8.
1933. *Trivirostra hordacea* and *T. insecta*, Schilder, *Zool. Anz.* CII, pp. 290-294, fig. 14.
1937. *Trivia insecta*, Viader, *Maur. Inst. Bull.* 1(2), p. 39.

Mighels gives only the description, though not the figure, of his new species *Cypraea insecta* which he recorded from Oahu. Kiener's well-illustrated *C. hordacea* from an unknown habitat cannot claim priority over Mighels's *insecta* and, as such, should be treated as its synonym. But some authors give preference to *hordacea* and some even do not hesitate to rank both as distinct species. Reeve wrongly includes this species into the synonymy of *Cypraea oryza* and Paetel also perpetuates the same mistake. Jay's contention that *Cypraea hordacea* "is *C. oryza* Lam." is also incorrect.

Characters.—The shell of *insecta* is very small, white, slender, looking more or less like an insect and, hence, the name *insecta* possibly given to it by the author. The ribs are fine, equal, numerous, and are interrupted, in most cases, in the middle by the long narrow impressed sulcus or in some cases they pass freely from side to side when the latter becomes obsolete (only rarely). The extremities, in some cases, appear to be blunt with the hind top of the inner lip abruptly cut out, so that the posterior outlet becomes more pronounced, while in others subrostrate with the inner lip acuminate produced posteriorly in a way recalling that of *Trivia edgari*. The aperture is narrow, slightly dilated in front, but curved posteriorly, while the teeth are very small white and even.

Marrat in his description of *T. affinis* writes, "It resembles a large *T. insecta* Mighels, but may at once be known by its coarse ribs and obsolete dorsal groove"

There is a fairly good series of specimens of *T. insecta* in the collection with the locality labels Indian Seas (Reg. No. 2839—20 sp.), South Sea Islands (Reg. No. 2836—22 sp.), Singapore (Reg. No. 2838—3sp.), Ceylon (Reg. No. 2837—31 sp.). There is only one specimen from an unknown locality. The largest specimen in the lot is from Singapore which measures 5.5 mm. in length and 4 mm. in breadth.

Distribution.—*Trivia (Dolichupis) insecta* (Mighels) is a widely distributed species and occurs in Mauritius, Madagascar, Seychelles, Reunion, Cargados, Chagos, Persian Gulf, India, Ceylon, Singapore, Australia, Pasir Pandjang on the west coast of Binongka, New Caledonia, Loyalty, Cook, Society, Samoa, Paumotu, Sandwich, Kingsmill and Caroline. Although the range of the species extends from Mauritius to the Pacific, no record of its existence has hitherto been known from Andamans. One typical example of this species is found in the collection associated with the shells of *T. oryza* from Andamans which may serve as a missing link in the chain of distribution.

Type-locality. Oahu in the Hawaii Islands, North Pacific.

***Trivia rubinicolor* (Gaskoin, 1836).**

- 1836. *Cypraea rubinicolor*, Gaskoin, *Proc. Zool. Soc. London*, pp. 199, 200.
- 1841. *Cypraea rubinicolor*, Sowerby, *Conch. Illustr.*, fig. 150.
- 1845. *Cypraea rubinicolor*, Catlow, *Conchologist's Nomenclator*, p. 312.
- 1846. *Cypraea rubinicolor*, Reeve, *Conch. Icon.* III, pl. XXV, figs. 145a, 145b.
- 1850. *Cypraea rubinicolor*, Adams and Reeve, *Voy. H. M. S. 'Samarang', Moll.*, p. 24.

1854. *Trivia rubinicolor*, H. & A. Adams, *Gen. Rec. Moll.* 1, p. 269.
 1870. *Trivia rubinicolor*, Roberts, *Amer. Journ. Conch.* V, p. 207, no. 33.
 1870. *Cypraea (Trivia) rubinicolor*, Sowerby, *Thes. Conch.* IV, pp. 48, 79, no. 173, pl. cccxxviii, figs. 500, 501.
 1881. *Cypraea rubinicolor*, Weinkauff, in *Martini and Chemnitz's Syst. Conch.*—*Cab.* V, Abth. 3, p. 164, pl. xliii, figs. 10, 11.
 1885. *Cypraea (Trivia) rubinicolor*, Roberts, in *Tryon's Man. Conch.* VII, p. 204, pl. xxii, figs. 27, 28.
 1888. *Cypraea (Trivia) rubinicolor*, Melvill, *Mém. and Proc. Manchest. Lit. & Phil. Soc.* (4)I, p. 246, no. 110.
 1888. *Trivia (Trivia) rubinicolor*, Paetel, *Cat. der Conchyl.*—*Samml.* 1, p. 324.
 1906—1907. *Cypraea rubinicolor*, Hidalgo, *Mém. de la Real Acad. de Cienc. Madrid*, XXV, pp. 220, 504.
 1920. *Trivia (Trivia) rubinicolor*, Vredenburg, *Rec. Geol. Surv. Ind.* LI(2), p. 135.
 1924. *Trivia rubinicolor*, Fulton, *Shells of Rec. Moll.* p. 28.
 1927. *Trivia (Trivia) rubinicolor*, Schilder, *Archiv f. Naturges.* XCIA, p. 64.

Gaskoin's *Cypraea rubinicolor* is said to have been first described from specimens obtained at Unsang, east coast of Borneo, on coral reefs in association with the specimen of *Cypraea producta* Gask. Vredenburg placed this species into his Group of *Trivia producta* characterized by the produced extremities of the shells, which essentially corresponds to Iredale's genus *Dolichupis*.

Characters.—Shell ovato-globose, ventricose, emarginate, light red or pinkish in colour; transversely ribbed, ribs fine, prominent, smooth, passing uninterruptedly over the back in the total absence of the longitudinal groove and terminating on both the sides in teeth at the edge of the aperture (very rarely one or two such ribs are found ending either at the sides or in the middle line); extremities bluntly produced, but tinged with rose; aperture narrow but slightly curved only posteriorly, sides thickened and well-margined (the right side more than the left); teeth numerous and equal.

T. rubinicolor resembles *T. sanguinea*, but differs from it in colouration and in the greater number of teeth which are more even. It also approaches *T. producta* in the character of its produced extremities.

There are twenty-six specimens in the collection bearing the locality-labels Ceylon (Reg. No. 2867-25 sp.) and Port Jackson —1 sp. All of them seem to agree with the description of the typical form. The largest shell is from Ceylon which measures 13 mm. in length and 6 mm. breadth.

Distribution.—This pretty species appears to have a very limited range extending to Borneo and Ceylon. But the existence of a typical example in the collection associated with the shells of *Trivia merces* (Iredale) from Port Jackson in Australia certainly extends its range further eastwards.

Subgenus **Trivirostra** Jousseaume, 1884.

Type. *Cypraea Oryza* Lamarck, 1810.

1884. *Trivirostra*, Jousseaume, *Bull. Soc. Zool. France*, IX, p. 100.
 1903. *Trivirostra*, Cossmann, *Ess. de Paleoconch. Comp.* V, p. 171.
 1920. *Trivirostra*, Vredenburg, *Rec. Geol. Surv. Ind.* LI(2), p. 134.
 1926. *Trivirostra*, Schilder, *Rec. Geol. Surv. Ind.* LVIII(4), p. 376.
 1927. *Trivirostra*, Schilder, *Archiv f. Naturges.* XCIA, p. 62.

1929. *Trivirostra*, Thiele, *Handb. der Syst. Weichtierk.* 1, p. 268.
 1930. *Trivirostra*, Iredale, *Mém. Queensl. Mus.* X, p. 83.
 1931. *Trivirostra*, Iredale, *Rec. Austr. Mus.* XVIII (4), p. 221.
 1931. *Trivirostra*, Schilder, *Zool. Anz.* XCVI, p. 69.
 1932. *Trivirostra*, Schilder, *Zool. Anz.* C, p. 166.
 1933. *Trivirostra*, Schilder, *Zool. Anz.* CII, p. 288.
 1933. *Trivirostra*, Schilder, *Occ. Pap. B. P. Bishop Mus. Honolulu*, X(3), p. 5.
 1934. *Trivirostra*, Tomlin and Schilder, *Ann. S. Afric. Mus.* XXX (3), p. 478.
 1935. *Trivirostra*, Schilder, *Proc. Malac. Soc. London*, XXI, p. 332.
 1936. *Trivirostra*, Schilder, *Proc. Malac. Soc. London*, XXII, p. 80.
 1938. *Trivirostra*, Adam et Leloup, *Mém. Mus. Roy. Hist. Nat. Belg.* II, Fasc. 19, p. 122.
 1942. *Trivirostra*, Yen, *Proc. Malac. Soc. London*, XXIV, p. 212.

The name *Trivirostra* was employed by Jousseaume in a generic sense, with *Cypraea scabriuscula* Gray (1827) as its genotype. Cossmann, on the other hand, merged it with *Trivia*. Schilder at first included *Trivirostra* in the synonymy of the subgenus *Trivia* S. S., later subordinated it to *Trivia*, and finally ranked it as distinct. His last view seems to have been upheld by Iredale and Yen, while the second one by Thiele and Adam and Leloup, which I also follow in this paper. Vredenburg states that his Group of *Trivia europaea* corresponds essentially to this group. Regarding the selection of the type-species, Schilder first followed Jousseaume, but later preferred Lamarck's *Cypraea oryza* (1810) not only on the ground of its priority over Gray's *scabriuscula* from Madagascar, but because it has essentially the same colouration, shape and structure as the latter.

***Trivia oryza* (Lamarck, 1810).**

1810. *Cypraea oryza*, Lamarck, *Ann. du Mus.* XVI, p. 104.
 1817. *Cypraea nivea* (Solander MSS.), Dillwyn, *Descr. Cat. Rec. Shells*, 1, p. 466.
 1822. *Cypraea oryza*, Lamarck, *Hist. Nat. Anim. Sans Vertéb.* VII, p. 403.
 1827. *Cypraea scabriuscula* and *C. oryza*, Gray, *Zool. Journ.* III, p. 364, no. 93, pp. 369, 370, no. 99.
 1828. *Cypraea oryza*, Menke, *Synop. Method. Molluscor.*, p. 49.
 1832. *Trivia oryza*, Gray, *Descr. Cat. of Shells*, p. 15, no. 126.
 1832. *Cypraea oryza*, Sowerby, *Conch. Illustr.*, fig. 38.
 1836. *Cypraea scabriuscula*, Gaskoin, *Proc. Zool. Soc. London*, p. 200.
 1838. *Cypraea oryza*, Pot. and Mich., *Gal. de Moll. Douai*, t. p. 480 no. 21.
 1839. *Cypraea oryza*, Anton, *Verz. Conchyl.*, p. 98, no. 3132.
 1843. *Cypraea scabriuscula*, *C. oryza* and *C. intermedia*, Kiener, *Icon. Cog. Viv.*, p. 133, pl. xliii, fig. 3, p. 143, pl. lii, figs. 2, 2a, p. 145, pl. liv, fig. 1.
 1844. *Cypraea oryza*, Lamarck, *Hist. Nat. Anim. Sans Vertéb.* (ed. Deshayes) X, pp. 543, 544.
 1845. *Cypraea oryza* and *C. scabriuscula*, Catlow, *Conchologist's Nomenclator*, p. 311, no. 96, p. 312, no. 124.
 1845. *Cypraea oryza*, Reeve, *Conch. Icon.* III, pl. xxiv, fig. 140.
 1850. *Cypraea oryza* and *C. scabriuscula*, Jay, *Cat. of the shells*, pp. 391, 392.
 1854. *Trivia oryza*, H. & A. Adams, *Gen. Rec. Moll.* 1, p. 269.
 1863. *Cypraea oryza*, Deshayes, *Cat. Moll. Reunian*, p. 138.
 1868. *Trivia oryza*, Pease, *Amer. Journ. Conch.* IV(3), p. 127.
 1869. *Cypraea (Coccinelliformes) oryza*, Crosse, *Journ. de Conchyliol.* XVII, p. 49.
 1870. *Trivia oryza*, MacAndrew, *Ann. & Mag. Nat. Hist.* (4)VI, p. 441.
 1870. *Cypraea (Trivia) oryza* and *C. (T.) scabriuscula*, Sowerby, *Thes. Conch.* IV, p. 46, No. 162, pl. cccxxvi, figs. 474-476, No. 163, pl. cccxxvi, figs. 472, 473.
 1870. *Trivia scabriuscula*, Roberts, *Amer. Journ. Conch.* V(3), p. 207.
 1871. *Cypraea (Trivia) oryza*, von Martens and Langkavel, *Donum Bismarck.*, p. 34.
 1877. *Trivia oryza*, Pagenstecher, *Ueber die von Dr. Kossmann am rothen meere gesammelten Moll.* Leipzig, p. 48.

1877. *Cypraea oryza*, Man, *Faune de Madagascar*, Part 5, Liv. 3, p. 41.
 1879. *Trivia oryza*, Garrett, *Journ. Conch.* II, pp. 107, 126, 127.
 1880. *Cypraea (Trivia) oryza*, von Martens, in *Möbius's Beiträge zur Meeres-fauna der Insel Mauritius und der Seychellen*, p. 274.
 1881. *Cypraea scabriuscula* and *C. oryza*, Weinkauff, in *Martini and Chemnitz's Syst. Conch.*—Cab. V, Abth. 3, p. 152, pl. xli. figs. 10, 11, p. 153, pl. V, figs. 12, 13; pl. xli, figs. 13-16.
 1882. *Trivia oryza*, Rossiter, *Proc. Linn. Soc. N. S. Wales*, p. 831.
 1884. *Trivirostra scabriuscula* and *T. oryza*, Jousseau, *Bull. Soc. Zool. France*, IX, p. 100.
 1884. *Trivia scabriuscula*, Smith, *Zool. Coll. Voy. H. M. S. 'Alert'*, Moll., p. 500.
 1884. *Cypraea oryza*, Jickeli, *Jahrb. Deuts. Malakozool. Ges.* XI, p. 212.
 1885. *Trivia oryza*, Roberts, in *Tryon's Man. Conch.* VII, p. 200, pl. xxi, figé. 79, 82, 83, 86, 87.
 1886. *Trivia oryza*, Cooke, *Ann. & Mag. Nat. Hist.* (5) XVIII, p. 384.
 1888. *Trivia (Trivia) oryza* vars. *intermedia* and *scabriuscula*, Paetel, *Cat. der Conchyl.*—Samml. 1, p. 324.
 1888. *Cypraea (Trivia) oryza* and *C. (T.) scabriuscula*, Melvill, *Mém. and Proc. Manchest. Lit. & Phil. Soc.* (4) 1, p. 247, Nos. 130 and 134.
 1892. *Trivia oryza*, Baker, *Proc. Rockester Acad. Sci.*, p. 31.
 1892. *Cypraea scabriuscula*, Smith, *Ann. & Mag. Nat. Hist.* (4) IX, p. 129.
 1895. *Trivia oryza*, Melvill and Standen, *Journ. Conch.* VIII, p. 113.
 1895. *Cypraea (Trivia) oryza*, Thurston, *Bull. Mad. Govt. Mus.* III, p. 125.
 1897. *Trivia oryza*, Sowerby, *Marine Shells of S. Africa*, p. 16.
 1898. *Trivia oryza*, Baldwin, *Nautilus*, XI, p. 123.
 1899. *Trivia oryza*, Hedley, *Moll. of Funafuti*, p. 455.
 1900. *Trivia oryza*, Pritchard and Gatliff, *Proc. Roy. Soc. Victoria, (N. S.)* XII, p. 188.
 1901. *Trivia scabriuscula*, Melvill and Standen, *Proc. Zool. Soc. London*, II, p. 284.
 1902. *Cypraea (Trivia) oryza*, Dautzenberg, *Journ. de Conchyliol.* L, pp. 380, 381.
 1904. *Cypraea (Trivia) scabriuscula*, Jones and Preston, *Proc. Malac. Soc. London*, VI, p. 144.
 1904. *Trivia oryza* and *T. scabriuscula*, Melvill and Standen, *Journ. Conch.* XI (4), p. 122.
 1905. *Cypraea oryza* and *C. scabriuscula*, Hidalgo, *Cat. Moll. Test. Filipinas*, pp. 146, 147.
 1906-1907. *Cypraea oryza*, *C. intermedia* and *C. scabriuscula*, Hidalgo, *Mém. de la Real Acad. de Cienc. Madrid*, XXV, pp. 140, 142, 213, 214, 454, 455, pp. 204, 386, pp. 221, 508, 509.
 1908. *Trivia oryza*, Bergh, in *Semper's Reise Archipel der Philippinen*, IX, p. 144, pl. xi, figs. 27-37 (anatomy).
 1909. *Trivia oryza*, Shaw, *Proc. Malac. Soc. London*, VIII, p. 308.
 1909. *Trivia oryza* f. *minor* and var. *scabriuscula*, Schepman, *Prosobr. 'Siboga Exped.' Monogr.* XLIX^b, pp. 137, 138.
 1909. *Cypraea (Trivia) oryza*, Melvill, *Trans. Linn. Soc. Zool.* (2) XIII, p. 98, No. 158.
 1917. *Trivia oryza*, Odhner, *K. Svenska Vetenskap. Handl.* LII(16), p. 53, pl. ii, figs. 52, 53 (shell), Text-fig. 12 (radular teeth).
 1920. *Trivia (Trivirostra) oryza*, *T. (T.) scabriuscula* and *T. (T.) intermedia*, Vredenburg, *Rec. Geol. Surv. Ind.* LI(2), pp. 134, 135.
 1922. *Trivia scabriuscula*, Schilder, *Proc. Malac. Soc. London*, XV, p. 111.
 1923. *Trivia oryza*, Dautzenberg, *Journ. de Conchyliol.* LXVIII, p. 44.
 1924. *Trivia oryza*, Fulton, *Shells of Rec. Moll.*, p. 38.
 1925. *Trivia oryza*, Oostingh, *Rept. on a Coll. of Rec. Shells from Obi and Hal-mahera (Moluccas)*, p. 112, No. 114.
 1926. *Trivia (Trivia) scabriuscula*, Schilder, *Rec. Geol. Surv. Ind.* LVIII(4), p. 376.
 1927. *Trivia (Trivirostra) oryza*, *T. (T.) intermedia* and *T. (T.) scabriuscula*, Schilder, *Archiv f. Naturges.* XCIA, p. 63.
 1928. *Trivia oryza* and *T. scabriuscula*, Faustino, *Summary of Philippine Marine and Freshwater Moll.* p. 220.
 1928. *Trivia scabriuscula*, Melvill, *Proc. Malac. Soc. London*, XVIII, p. 103.
 1929. *Trivia oryza*, Dautzenberg, *Faune des Col. Franc.* III, p. 260.
 1929. *Trivia (Trivirostra) scabriuscula*, Thiele, *Handb. der Syst. Weichtierk.* 1, p. 268.
 1930. *Trivirostra scabriuscula*, Iredale, *Mém. Queensl. Mus.* X, p. 83.
 1931. *Trivirostra scabriuscula*, Iredale, *Rec. Austr. Mus.* XVIII (4), p. 221.

1932. *Trivia oryza*, Dautzenberg, *Journ. de Conchyliol.* LXXVI, p. 53.
 1932. *Trivirostra oryza*, Schilder, *Zool. Anz.* C, p. 166.
 1933. *Trivirostra oryza oryza* and *T. oryza scabriuscula*, Schilder, *Zool. Anz.* CII, pp. 290, 291, 294.
 1936. *Trivirostra oryza*, Schilder, *Proc. Malac. Soc. London*, XXII, p. 80.
 1937. *Trivia oryza* and *T. scabriuscula*, Viader, *Maur. Inst. Bull.* 1(2), p. 39.
 1938. *Trivia (Trivirostra) oryza*, Adam et Leloup, *Mém. Mus. Roy. Hist. Nat. Belg.* II, Fasc. 19, p. 122.

Lamarck's *Cypraea oryza* or the 'Rice-Cowry', as the species is commonly known, is remarkable for the great variability of its shell characters. Koenen¹ unknowingly applied Gray's name *scabriuscula* to a small shell of *Trivia* from the German Oligocene, which appears to approach the living *Cypraea childreni*, Gray. Schilder (1922, p. 111) has, however, substituted a new name *litiputana* for Koenen's species *T. scabriuscula*, while Vredenburg (p. 114) has established the new genus *Cypraeogemmula* for its inclusion.

T. oryza is a very common species and much confusions seem to prevail over its synonymy. Roberts's attempt in removing the confusion is not at all satisfactory as would be evident from his statement "The shell *C. nivea*, figured by Reeve, *C. Ic.* pl. 24, sp. 136, is the *C. oryza*, Lam., which is *T. pediculus*, Rumph. The *C. oryza*, figured by Reeve, *C. Ic.* pl. 24, sp. 140, is the *T. scabriuscula*, Gray. The same error occurs in Sowerby's *Conch. Illustr.* M. Kiener has confounded the two species *T. scabriuscula*, Gray (*Cog. Viv.* pl. 43, fig. 3), and *T. oryza*, Lam. (*Cog. Viv.* pl. 52, fig. 2); the figures should be reversed. The true *C. nivea*, Gray (*Zool. Journ.* 1, p. 511), is a white variety of *C. turdus*, Lam., and has been placed into the synonymy of the latter species" Sowerby maintains that Gray's *nivea* may possibly be allied to *oryza*, but it is rough ribbed. The opinion expressed by Shaw (p. 308) appears to be more reasonable, "With regard to *T. oryza*, Lam., and *T. scabriuscula*, Gray, they agree in size, sculpture, shape, colour, and in the extremities being produced, and in fact *scabriuscula* is only a synonym of *T. oryza*, Lam., to which it has been united by Mr. E. A. Smith in the British Museum" He also unites Kiener's *intermedia* and Sowerby's *sandwichensis* with *oryza*. His conclusion has been upheld by Oostingh. Hidalgo, on the other hand, seems to have cared very little about the synonymy and treated all these species as distinct. This view finds somewhat in agreement with that of Weinkauff and Faustino. Schepman erroneously separates *scabriuscula* from *oryza* as a variety mainly on the basis of the dorsal sulcus becoming deep in one case or shallow in the other. He also creates a new form of *oryza* named 'minor' resting on quite an uncertain fact. Vredenburg followed Hidalgo with the exception of the species *intermedia* which he united with *oryza*. Schilder at first followed this arrangement, but later distinguished two races or subspecies of *oryza*, namely, *T. oryza oryza* and *T. oryza scabriuscula*; I fail to agree with him in this respect.

Cypraea pediculus figured by Petiver (1713—*Ag. Anim. Amboina*) in pl. xvi, no. 22, by Gualtieri (1742—*Index Test. Conchyl.*) in pl. xiv, nos. O. & P. and by Adanson (1757—*Hist. Nat. du Senegal Coq.*) in pl. v,

¹ von Koenen, A. *Abhandl. z. geol. Spezialk. v. Preussen*, X, Part II, p. 565(1890).

no. 3, appears to be quite identical with *T. oryza*. Odhner's *T. bipunctata* from Australia comes very near to this species, though it differs slightly in being narrower in form and reddish in colour. Juvenile shells of *oryza* appear to be much more globular in form with less produced extremities and somewhat resemble Gaskoin's *grando* from Manila. Bergh and Odhner in their paper cited above have dealt in detail with the anatomy of the soft parts of *T. oryza*.

Characters.—This well-known species can readily be distinguished by its globular form, pure snow-white colour and peculiar roughish interstices of its ribs. The extremities may be more produced in some or less produced in others and the dorsal sulcus may be either long or short, deep or shallow, or entirely obsolete (in rare case only). These characters are not at all constant and seem to vary even amongst individuals of the same size and locality. Garrett remarks, "The Polynesian shells, which are not uncommon, are smaller than the East Indian examples."

This species has the largest number of specimens in the collection having the locality labels Andamans (Reg. No. 2880—16 sp.), Nicobars (Reg. No. 2881—2 sp.), Ceylon—2 sp., Indian Seas (Reg. No. 2848—12 sp., Reg. No. 2879—25 sp.), Roweiah (Reg. No. 2882—1 sp.), Massana (Red Sea—2 sp.), Provenance unknown—2 sp. They are labelled as *Trivia oryza* Lam., *T. oryza* var. *intermedia* Kiener and *T. scabriuscula* Gray. Besides these, there are eight more specimens, of which seven are from the Sandwich Islands (Reg. No. 2872) and labelled as *T. globosa*, while the last is from the Indian Seas and labelled as *T. pellucidula*. The largest shell in the collection measures 13 mm. in length and 9 mm. in breadth.

Distribution.—*Trivia (Trivirostra) oryza* (Lamarck) was originally described from the coast of Timor in the Malay Archipelago. But later on its range has been extended into the Persian Gulf, Gulf of Oman, Malcolm Inlet, Natal, Madagascar, Mauritius, Seychelles, Reunion, Durban, Amirantes, West India, Ceylon, Andamans, Nicobars, Java, North Borneo, Celebes, Moluccas, Flores, Aru, Labuan, Banda Neira, Halmahera, Sorong, Port Jackson, Sydney, Victoria, Torres Straits, China Sea, the Philippines (Manila, Luzon, Ticao, Moron, Balauan and Saguisi, Bolinao, Zambales, Luban, Mindoro and Marinduque, Mindanao, Samar, Cebu, Cap Surigao and Zamboanga, Calamianes Is. and Ulugan), Samoa, Viti, Funafuti Lagoon, Cook, Paumotu, Lifu, Society, Sandwich, Loyalty, Tonga, Hawaii, New Caledonia, New Carolines, New Hebrides and Kingsmill. It is also recorded from the Red Sea and Suez.

***Trivia exigua exigua* (Gray, 1832).**

- 1832. *Trivia exigua*, Gray, *Descr. Cat. of Shells*, p. 15, no. 123.
- 1833. *Cypraea tremeza*, Duclos, in *Guerin's Mag. de Zool.*, pl. xxv.
- 1836. *Cypraea exigua*, Gaskoin, *Proc. Zool. Soc. London*, p. 202.
- 1841. *Cypraea exigua*, Sowerby, *Conch. Illustr.*, fig. 35.
- 1843. *Cypraea tremeza*, Kiener, *Icon. Cog. Viv.*, p. 154, pl. liii, fig. 4.
- 1845. *Cypraea gemmula*, Gould, *Proc. Bost. Soc. Nat. Hist.* II, p. 27.
- 1845. *Cypraea tremeza* and *C. exigua*, Catlow, *Conchologist's Nomenclator*, pp. 310, 313.
- 1846. *Cypraea exigua*, Gaskoin, *Proc. Zool. Soc. London*, p. 24.
- 1846. *Cypraea tremeza*, Reeve, *Conch. Icon.* III, pl. xxvi, fig. 148.

1850. *Cypraea tremeza*, Jay, *Cat. of the Shells*, p. 394.
 1854. *Trivia tremeza*, H. & A. Adams, *Gen. Rec. Moll.* 1, p. 269.
 1862. *Cypraea (Trivia) gemmula* and *C. tremeza*, Gould, *Otia Conch.*, p. 195.
 1863. *Cypraea tremeza*, Deshayes, *Cat. Moll. Reunion*, p. 139.
 1868. *Trivia gemmula*, Pease, *Amer. Journ. Conch.* IV, p. 96.
 1869. *Cypraea (Coccinelliformes) tremeza*, Crosse, *Journ. de Conchyliol.* XVII, p. 49.
 1870. *Trivia exigua*, Roberts, *Amer. Journ. Conch.* V, p. 205.
 1870. *Cypraea (Trivia) tremeza*, Sowerby, *Thes. Conch.* IV, p. 49, no. 176 pl. cccxxvii, figs. 510, 511.
 1870. *Trivia tremeza*, MacAndrew, *Ann. & Mag. Nat. Hist.* (4)VI, p. 441.
 1871. *Cypraea (Trivia) tremeza*, von Martens and Langkavel, *Donum: Bismarck.*, p. 35.
 1879. *Trivia exigua*, Garrett, *Journ. Conch.* II, pp. 123, 127, no. 65.
 1880. *Cypraea (Trivia) tremeza*, von Martens, in Möbius's *Beiträge zur Meeresfauna der Insel Mauritius und der Seychellen*, p. 274.
 1881. *Cypraea tremeza*, Weinkauff, in Martini and Chemnitz's *Syst. Conch.*—*Cab.* V, Abth. 3, pp. 163, 164, 166, pl. xliii, figs. 9, 12.
 1882. *Cypraea exigua*, Rossitor, *Proc. Linn. Soc. New South Wales*, p. 831.
 1884. *Cypraea tremeza*, Jickeli, *Jahrb. Deuts. Malakozool. Ges.* XI, p. 212.
 1884. *Trivirostra tremeza*, Jousseau, *Bull. Soc. Zool. France*, IX, p. 100.
 1885. *Trivia exigua*, Roberts, in Tryon's *Man. Conch.* VII, p. 202, pl. xxii, figs. 9, 10, 17.
 1886. *Trivia tremeza*, Cooke, *Ann. & Mag. Nat. Hist.* (5) XVIII, p. 384.
 1888. *Trivia (Trivia) exigua*, Paetel, *Cat. der Conchyl.-Samml.* 1, p. 323.
 1888. *Cypraea (Trivia) exigua*, Melvill, *Mém. and Proc. Manchestr. Lit & Phil. Soc.* (4)I, p. 245, no. 105.
 1892. *Trivia tremeza*, Baker, *Proc. Rockester Acad. Sci.*, p. 31.
 1897. *Trivia exigua*, Melvill and Standen, *Journ. Conch.* VIII, p. 408.
 1898. *Trivia exigua*, Baldwin, *Nautilus*, XI, p. 123.
 1902. *Cypraea (Trivia) exigua*, Dautzenberg, *Journ. de Conchyliol.* L, pp. 383, 384.
 1906. *Trivia tremeza*, Vayssiére, *Bull. Mus. Hist. Nat. Paris*, XII, p. 118.
 1906—1907. *Cypraea exigua*, Hidalgo, *Mém. de la Real Acad. de Cienc. Madrid*, XXV, pp. 138, 198, 348, 349.
 1920. *Trivia exigua*, Vredenburg, *Rec. Geol. Surv. Ind.* LI(2), p. 135.
 1922. *Trivia exigua*, Schilder, *Proc. Malac. Soc. London*, XV, p. 105.
 1923. *Trivia exigua*, Vayssiére, *Ann. Mus. Hist. Nat. Marseille-Zool.* XVIII, pp. 86, 87, pl. xiv, figs. 209-212 (anatomy).
 1924. *Trivia exigua*, Fulton, *Shells of Rec. Moll.*, p. 37.
 1927. *Trivia (Trivirostra) exigua*, Schilder, *Archiv f. Naturges.* XCIA, p. 63.
 1932. *Trivirostra exigua*, Schilder, *Zool. Anz. C.* p. 166.
 1932. *Trivirostra exigua*, Schilder, *Occ. Pap. B.P. Bishop Mus. Honolulu*, X(3), pp. 5, 7, 8.
 1933. *Trivirostra exigua exigua*, Schilder and Schilder, *Zool. Anz.* CII, pp. 289, 290, 292, figs. 13, 292, figs. 13, 16.
 1937. *Trivia exigua*, Viader, *Maur. Inst. Bull.* 1(2), p. 39.

Authorities differ regarding the use of the name *exigua* Gray (1832) for the species in preference to *tremeza* Duclos (1833) or vice versa. Some even treat both as distinct species. But as the former antedates the latter, there seems no reason for violating the rules of priority. Gould's *Cypraea gemmula* also has to be treated as a synonym. Weinkauff through oversight had applied the same name to another species closely resembling the West American *Cypraea arabicula*. Schilder has, however, suggested the new name *massauensis* for that species inhabiting the Red Sea and the Western part of the Indian Ocean. I also agree with Schilder in his recognition of two distinct races or subspecies of *T. exigua*, namely, *T. ex. exigua* and *T. ex. corrugata*.

Characters.—This race is remarkable for its shell being stained and variegated with irregular blotches of pink on the dorsum. The extremities are somewhat attenuated and beaked. The longitudinal groove, though not very prominent, appears to vary considerably, i.e., in some it is nearly crossed by all the ribs, while in others it is the point at which

they cease terminating in tubercles. In rare cases the groove may also be absent. The right side is hardly margined and the teeth are minute. The shells recorded by Schilder from the French Fregates Shoal are said to be more humped than those from the Pearl and Hermes Reef, but the differences in the number of their teeth are considered as "probably only accidental"

T. exigua exigua approaches *C. acutidentata* Gaskoin in its shape as also in the number of ribs terminating on the back. Vayssi re in his paper cited above has worked out its detailed anatomy.

There are twelve specimens of this race in the collection bearing the locality—label Indian Sea (Reg. No. 2859) and identified as *T. tremeza* Duclos.

Distribution.—This elegant race was first described from West Indies, but subsequently known from the Red Sea, Gulf of Suez, Mauritius, Reunion, Ceylon, New South Wales, the Philippines, Noumea, Lifu, New Caledonia, Cook, Society, Sandwich, Paumotus, Loyalty, Viti, Samoa, New Carolines, New Hebrides and Hawaii.

Type-locality. West Indies.

***Trivia exigua corrugata* (Pease, 1868).**

- 1868. *Trivia corrugata*, Pease, *Amer. Journ. Conch.* IV, pp. 94, 95, pl. xi, figs. 14, 15.
- 1870. *Trivia corrugata*, Roberts, *Amer. Journ. Conch.* V, p. 205.
- 1871. *Cypraea (Trivia) corrugata*, von Martens and Langkavel, *Donum Bismarck.*, pp. 34, 35.
- 1879. *Trivia corrugata*, Garrett, *Journ. Conch.* II, pp. 107, 122, 127.
- 1881. *Cypraea (Trivia) corrugata*, Weinkauff, in *Martini and Chemnitz's Syst. Conch.*—*Cab.* V, Abth. 3, p. 166.
- 1885. *Trivia corrugata*, Roberts, in *Tryon's Man. Conch.* VII, p. 202, pl. xxii, fig. 17.
- 1888. *Trivia (Trivia) corrugata*, Paet l, *Cat. der Conchyl.*—*Samml.* 1, p. 323.
- 1888. *Cypraea (Trivia) exigua* var. *corrugata*, Melvill, *M m. and Proc. Manch. Lit. & Phil. Soc.* (4)I, p. 245, no. 105.
- 1906—1907. *Cypraea corrugata*, Hidalgo, *M m. de la Real Acad. de Cienc. Madrid*, XXV, pp. 137, 194, 318, 319.
- 1927. *Trivia (Trivirostra) corrugata*, Schilder, *Archiv f. Naturges.* XCIA, p. 63.
- 1933. *Trivia exigua corrugata*, Schilder, *Zool. Anz.* CII, pp. 290-292.
- 1937. *Trivia corrugata*, Viader, *Maur. Inst. Bull.* 1(2), p. 39.

Corrugata was first described by Pease from Paumotus in Eastern Polynesia as a distinct species, but Roberts included it in the synonymy of *T. exigua* Gray. Viader in his *Catalogue of Mauritius Mollusca* also treats it as distinct, while Schilder combines it with *exigua* as a race or subspecies. In general appearance the shell is like that of *exigua*, but differs from it in having strong and flexuous ribs and also in having a pinkish colour.

Characters.—Shell ovately-globose, shining, whitish or variegated with blotches of pink; ribs short, strong and flexuous, less in number, sometimes end abruptly on the sides or bifurcate, slightly nodulous at the dorsal sulcus which is not much impressed; columella angulate at its edge; aperture somewhat flexuous and widened at the extremities which are only slightly produced.

The race *corrugata* is represented in the collection by only three specimens from Paumotu (Reg. No. 2858) which are labelled as *T. corrugata*. They appear to be quite typical. The largest shell is 5 mm. in length and 3.5 mm. in breadth.

Distribution.—The range of this race was so long confined to the Pacific only, occurring in Paumotu and Society Islands. But recently Viader has reported this from Mauritius, a record which needs confirmation.

Family ERATOIDAE.

Subfamily ERATOINAE.

Genus **Proterato** Schilder, 1927.

Type. *Erato neozelanica* Suter.

- 1927. *Proterato*, Schilder, *Archiv f. Naturges.* XCIA, p. 57.
- 1929. *Proterato*, Thiele, *Handb. der Syst. Weichtierk.* 1, p. 268.
- 1933. *Proterato*, Schilder, *Proc. Malac. Soc. London*, XX, pp. 246, 248, 263, 255, 257, 260, 262, 265, 275.
- 1935. *Proterato*, Schilder, *Proc. Malac. Soc. London*, XXI, p. 329.

Schilder first established *Proterato* as a subgenus of *Erato* Risso (1826)¹, but later on he gave it a generic rank. Thiele, however, follows the original view of Schilder. The distinctive features and the phylogeny of this genus are discussed by Schilder in his paper cited above.

Subgenus **Proterato** S. S.

Proterato callosa (Adams and Reeve, 1850).

- 1850. *Erato callosa*, Adams and Reeve, *Zool. Voy. H. M. S. 'Samarang'*, *Moll.*, p. 25, pl. X, figs. 32a, 32b.
- 1853. *Erato callosa*, H. & A. Adams, *Gen. Rec. Moll.* 1, p. 190.
- 1859. *Erato lachryma* and *E. callosa*, Sowerby, *Thes. Conch.* III, p. 82, no. 5, pl. ccixx, figs. 4-6 and 35-37.
- 1863. *Erato callosa*, Troschel, *Das Gebiss der Schnecken*, 1, p. 216, pl. xviii, fig. 5 (radular teeth).
- 1865. *Erato callosa*, Reeve, *Conch. Icon.* XV, pl. i, fig. 2a-b.
- 1871. *Erato callosa*, Lischke, *Jap. Meeres-Conchyl.* II, p. 68.
- 1871. *Erato callosa*, Redfield, *Amer. Journ. Conch.* VI, p. 216, no. 3.
- 1879. *Erato callosa*, Weinkauff, in *Martini and Chemnitz's Syst. Conch.*—*Cab.* IV, pp. 146, 147, pl. XXV, figs. 2, 3.
- 1882. *Erato callosa*, Dunker, *Index Moll. Maris Japonici*, II, p. 56.
- 1883. *Erato callosa*, Tryon, *Man. Conch.* V, p. 9, pl. iv, figs. 38, 39, pl. ii, fig. 7 (radular teeth).
- 1888. *Erato (Eratopsis) callosa*, Paetel, *Cat. der Conchyl.*—*Samml.* 1, p. 198.
- 1910. *Erato lachryma* var. *callosa*, Smith, *Proc. Malac. Soc. London*, IX, pp. 17, 18.
- 1920. *Erato (Erato) callosa*, Vredenburg, *Rec. Geol. Surv. Ind.* LI(2), p. 137, no. 3.
- 1924. *Erato callosa*, Fulton, *Shells of Rec. Moll.*, p. 38.
- 1927. *Erato (Erato) callosa*, Schilder, *Archiv f. Naturges.* XCIA, p. 58.
- 1932. *Erato (Proterato) callosa*, Schilder, *Zool. Anz. C.*, p. 166.
- 1933. *Proterato (Proterato) callosa*, Schilder, *Proc. Malac. Soc. London*, XX, pp. 248, 257, 261, 266, figs. 15-17.

¹ Risso, A. *Hist. Nat. Eur. Merid.* IV, p. 240 (1826).

A great deal of confusion seems to exist in literature regarding the nomenclature of Adams and Reeve's *Erato callosa* owing to its close similarity with *E. lachryma* Sowerby (1832). Smith, no doubt, erroneously combines *callosa* with *lachryma* as a variety and treats Sowerby's *sulcifera* (figs. 1-3) as *callosa* and a cotype of *panamensis*, but his interpretation of Reeve's *sulcifera* (fig. 14a-b) and Tryon's *lachryma* (fig. 37) as *callosa* appears agreeable to me, though Schilder regards them as real *lachryma*. I believe that *sulcifera* of Weinkauff (pl. xxvi, figs. 11, 12) is also identical with *sulcifera* of Reeve and, as such, should be treated as synonymous with *callosa*. Recently Schilder has united Weinkauff's *lachryma* (pl. xxvi, figs. 9, 10) with *callosa*, but I fail to support him. Smith also harboured some doubt about it as is evident from his remark, "the figures given by Weinkauff (pl. xxvi, figs. 9, 10) are very unsatisfactory, both as regards colour and denticulation of the outer lip" Schilder seems to have rightly followed Smith in accepting Sowerby's *lachryma* as *callosa*. Dunker mentions the closeness of *lachryma* to *callosa*.

Characters.—Shell conically pyriform, more or less callous (and, hence the name '*callosa*' possibly given to this species by the authors), livid-white, tinged with rose or in some ornamented with conspicuous flesh colour bands (one in each whorl, excepting the last one where there are two, the terminal one of which appears to be the largest of all); whorls swollen round the upper part; spire short, obtuse, rather exserted; extremities tinged with pinkish-brown (excepting rare cases); outer lip thickened, prominently angled at the upper part and denticulated throughout, inner lip crenated excepting the anteriormost part where only a few denticulations occur; aperture linear, slightly wide but curved in the middle.

Callosa differs from *lachryma* in having its base slightly more constricted, the angulation at the upper part of the outer lip distinctly more prominent, the outer lip less curved and its denticulations less stronger and less extended and the inner lip crenated throughout. The radular teeth of this species have been studied by Troschel and Tryon.

Out of eight specimens of this species in the collection, only six are in good condition (though four of them are young) and the other two partly broken. They bear the locality-labels 'China' (Reg. No. 2817—2 sp., Reg. No. 2826—1 sp.) and 'Galle' (1+4=5 sp.). But unfortunately six of them are labelled as *Erato lachryma* and two as *E. guttula*. Moreover, three shells from the Sandwich Islands (which should be referred to the species *sandwichensis* Pease) also appear to have been wrongly determined as *lachryma*.

In two of the young shells the colour is perfectly white, while in the other two pale fleshy. The callousness at the upper part of the outer lip is not properly developed in any case, but the extremities appear to be slightly tinged with pinkish-brown. The adult ones seem to agree in their characters with the figures given by Schilder, but the crenations on the inner lip are only developed in one or two cases. The largest specimen in the collection is 7 mm. in length and 4.5 mm. in breadth, but its apex is slightly broken.

Distribution.—The range of *Proterato* (*Proterato*) *callosa* (Adams and Reeve), according to Schilder, extends from "China Sea to Japan" But the occurrence of specimens in the collection from Galle in Ceylon extends the distribution of the species to the Indian Ocean.

Type-locality. China Sea.

***Proterato sulcifera sulcifera* (Sowerby, 1832).**

- 1832. *Erato sulcifera*, Gray, *Descr. Cat. of Shells*, p. 16.
- 1832. *Erato sulcifera*, Sowerby, *Conch. Illustr.*, p. 97, fig. 46.
- 1841. *Erato sulcifera*, Sowerby, *Conch. Illustr.*, p. 15, fig. 46.
- 1845. *Erato sulcifera*, Catlow, *Conchologist's Nomenclator*, p. 308.
- 1859. *Erato sulcifera*, Sowerby, *Thes. Conch.* III, p. 81, no. 3, pl. cexix, figs. 1-3.
- 1871. *Erato sulcifera*, Redfield, *Amer. Journ. Conch.* VI, p. 219, no. 19.
- 1883. *Erato* (*Eratopsis*) *sulfifera*, Tryon, *Man. Conch.* V, p. 11, pl. iv, fig. 51.
- 1888. *Erato sulcifera*, Paetel, *Cat. der Conchyl.—Samml.* I, p. 198.
- 1910. *Erato sulcifera*, Smith, *Proc. Malac. Soc. London*, IX, pp. 19, 20.
- 1920. *Erato* (*Eratopsis*) *sulfifera*, Vredenburg, *Rec. Geol. Surv. Ind.* LI(2) p. 138.
- 1927. *Erato* (*Erato*) *sulfifera*, Schilder, *Archiv f. Naturges.* XCIA, p. 58.
- 1932. *Erato sulcifera*, Schilder, *Zool. Anz.* C, p. 166.
- 1933. *Erato sulcifera*, Schilder, *Zool. Anz.* CII, p. 294.
- 1933. *Proterato* (*Proterato*) *sulfifera sulcifera*, Schilder, *Proc. Malac. Soc. London*, XX, pp. 248, 253, 257, 262, 263, figs. 20, 21.
- 1937. *Erato sulcifera*, Viader, *Maur. Inst. Bull.* 1(2), p. 40.

Like *P. callosa*, the synonymy of *sulfifera* also lies in a state of confusion. The extremely variable nature of its shell perhaps led Smith to think that Duclos's *Erato nana* and Hinds's *E. corrugatum* are synonymous with *sulfifera*. But as has been rightly pointed out by Schilder, *nana* and *corrugatum* are quite identical (the former being a synonym of the latter) and differ markedly from *sulfifera* and, as such, should not be included in the synonymy of the latter. I have already mentioned above that *sulfifera* of Weinkauff and *sulfifera* of Reeve are not the true *sulfifera* of Sowerby, but mere synonyms of *callosa* Ad. and Rv. Crosse's *E. schmelziana*¹ from Viti is a synonym of *sulfifera*. Sowerby's *sulfifera* which Smith regards as *callosa* and a co-type of *panamensis* is, as stated by Schilder, also a real *sulfifera*.

Schilder distinguishes five races or subspecies of *sulfifera*, namely, *P. sulcifera sulcifera*, *P. s. corrugatum*, *P. s. capensis*, *P. s. schneideri* and *P. s. smithi*, only the first and last are represented in the present collection.

There is a fairly good series of specimens in the collection with the locality labels yenosshima, Japan (Reg. No. 4249—3 sp.), Singapore (Reg. No. 2832—13 sp.), Natal (2 sp.), Andamans (Reg. No. 2830—8 sp.), Ceylon (Reg. No. 2831—8 sp.) and Mauritius (Reg. No. 2829—many sp.). But unfortunately all of them appear to have been identified by Vredenburg as *Erato corrugatus*, excepting those from Japan as *E. callosa*.

Characters.—Shell ovately or triangularly pyriform, dull-white or pale greenish, obscurely banded in some cases, finely granulated throughout; spire conical, but not so much as in *smithi*; dorsal sulcus deep and long or may be absent in rare cases; extremities tinged with pink,

¹ Crosse, H. *Journ. de Conchyliol.* XV, p. 301, pl. xi, fig. 5 (1867).

but in rare cases only one or none ; aperture narrow ; inner lip distinctly crenated throughout, but denticulations are also present only at the base, outer lip swollen and denticulated at its whole length.

Distribution.—*Proterato* (*P.*) *sulcifera sulcifera* (Sowb.), which was stated by Gray to have been first described from the Cape of Good Hope, appears to be widely distributed from South Africa to Hawaii, having been recorded from Durban, Port Shepstone, Zanzibar, Natal, Mauritius, Madagascar, Seychelles, Amirantes, Ceylon, Andamans, Singapore, New Guinea, Port Jackson, New Caledonia, Kermadec, Sunday Island, Mindoro and Fiji in the Philippines, Japan, Samoa, Viti, Loyalty and Paumotus. But its range also extends as far as New Britain, Guadalcanar and the Red Sea.

***Proterato sulcifera smithi* Schilder, 1933.**

- 1859. *Erato guttata*, Sowerby, *Thes. Conch.* III, p. 82, pl. ccxix, figs. 29, 30.
- 1865. *Erato guttata*, Reeve, *Conch. Icon.* XV, figs. 15.
- 1883. *Erato guttula*, Tryon, *Man. Conch.* V, p. 9, pl. iv, figs. 33, 34.
- 1920. *Erato* (*Eratopsis*) *guttula*, Vredenburg, *Rec. Geol. Surv. Ind.* LI(2), p. 138.
- 1933. *Proterato* (*Proterato*) *sulcifera smithi*, Schilder, *Proc. Malac. Soc. London*, XX, pp. 248, 253, 255, 257, 265, 271, 273, fig. 24.
- 1937. *Erato guttula*, Viader, *Maur. Inst. Bull.* 1(2), p. 40.

Erato guttata is, as stated by Schilder, a misprint for *guttula*. But in view of Sowerby's *guttula* (1832—*Conch. Illustr.*) from Mauritius having been proved to be a *Marginella* by Smith (1910) he has proposed the new name *smithi* for Sowerby's species *guttata* (1859). Tryon's figure of *guttula* (copied from Sowerby) and Vredenburg's species are also regarded by Schilder as *smithi*.

The race *smithi* differs from the race *sulcifera* in having the granules slightly smaller and confined to the posterior extremity and the spire, the angulation at the posterior extremity of the outer lip more pronounced, the anterior extremity unspotted and the dorsal sulcus entirely absent.

There is a series of specimens in the collection bearing the locality labels Omar and Tumb Is. (Reg. No. 2814—3 sp., of which one is broken), Ceylon (Reg. No. 2813—7 sp.) and Mauritius (Reg. No. 2812—13 sp.). But all of them appear to have been identified as *Erato guttata* Sowerby. On a careful examination of the shells I find that they represent the race *smithi*, but present certain interesting features which are not mentioned by Schilder. These are : faint trace of a dorsal sulcus (in one); presence of a few granules in between the posterior extremity and the spire (in one), presence of purplish-brown spots on both the extremities and colouration pale greenish (in some). Besides, some of the shells are found to be obscurely fasciated with dark-brown appearing more or less like that of *P. sandwichensis* (Sowb.) from the Sandwich Islands. The largest specimen in the collection is 5 mm. in length and 3mm. in breadth.

Distribution.—This race, which is very common in Mauritius, also occurs at Bombay. Its existence in Ceylon, Omar and Tumb Is. is really interesting.

Proterato sandwichensis (Sowerby, 1859).

1859. *Erato sandwichensis*, Sowerby, *Thes. Conch.* III, p. 82, pl. cexix, figs. 21, 22.
 1860. *Erato sandwichensis*, Pease, *Proc. Zool. Soc. London*, pp. 146, 147.
 1865. *Erato sandwichensis*, Reeve, *Conch. Icon.* XV, pl. iii, fig. 17 a-b.
 1871. *Erato sandwichensis*, Redfield, *Amer. Journ. Conch.* VI, p. 218, no. 16.
 1871. *Erato sandwichensis*, von Martens and Langkavel, *Donum Bismarck.*, p. 20.
 1879. *Erato sandwichensis*, Weinkauff, in *Martini and Chemnitz's Syst. Conch. Cab.* V, Abth. 4, pp. 154, 155, pl. xxvi, figs. 14, 15.
 1883. *Erato sandwichensis*, Tryon, *Man. Conch.* V, p. 9, pl. iv, fig. 35.
 1888. *Erato (Eratopsis) sandwichiensis*, Paetel, *Cat. der Conchyl.—Samml.* 1, p. 198.
 1910. *Erato sandwichensis*, Smith, *Proc. Malac. Soc. London*, IX, pp. 18, 19.
 1927. *Erato (Erato) sandwichensis*, Schilder, *Archiv f. Naturges.* XCIA, p. 58.
 1933. *Proterato (Proterato) sandwichensis*, Schilder, *Proc. Malac. Soc. London*, XX, pp. 248, 257, 271, fig. 26.

Although all workers are more or less unanimous in regarding *Erato sandwichensis* Sowerby as identical with *E. sandwichensis* Pease from the same locality, still most of them are inclined to prefer Pease's name *sandwicensis* for the species. Sowerby's description is quite accurate and his spelling is also more accurate than that of Pease. I, therefore, follow Schilder in using the name *sandwichensis* for the species. Tryon erroneously combines *E. pellucida* Reeve (which is a synonym of *E. angistoma* Sowerby) with *sandwichensis*.

Characters.—Shell somewhat elongately pyriform, pale rosy white, ornamented with three distinct broad dark-brown bands; whorls obtusely angled round the upper part; spire conically exserted; extremities spotted with pinkish brown; outer lip slightly narrow, less elevated and denticulated along its whole length, inner lip provided with a few denticulations only at the base, while the rest is crenated, though crenations may tend to disappear gradually towards the posterior part; aperture narrow and linear.

There are six specimens of *sandwichensis* in the collection from the Sandwich Islands which are kept separately under the Reg. Nos. 2823—3 sp. and 4253—3 sp. respectively. The first three were determined by Vredenburg as *Erato lachryma* Gray. The shells, though mostly worn, appear to agree with the description of the typical form. In one case only I found a faint trace of the longitudinal groove which is entirely absent in this species. The largest shell in the collection is 5 mm. in length and 3 mm. in breadth.

Distribution.—*Proterato (Proterato) sandwichensis* (Sowb.) has not been known to occur anywhere beyond the Sandwich Islands and Hawaii.

Type-locality. Sandwich Is.

Subgenus Cypraeerato Schilder, 1932.

1932. *Cypraeerato*, Schilder, *Foss. Cat.* 1/55, p. 86.
 1933. *Cypraeerato*, Schilder, *Proc. Malac. Soc. London*, XX, pp. 246, 248, 257, 275.
 1925. *Cypraeerato*, Schilder, *Proc. Malac. Soc. London*, XXI, p. 329.

This subgenus, as stated by Schilder, is the most specialized of *Eratoinae* which originated in Australia.

Proterato angistoma angistoma (Sowerby, 1832).

1832. *Erato angistoma*, Sowerby, *Conch. Illustr.*, fig. 51.
 1842. *Erato angistoma*, Reeve, *Conch. Syst.* II, p. 260, pl. cclxxxv, fig. 1.
 1845. *Erato angistoma*, Catlow, *Conchologist's Nomenclator*, p. 308.
 1859. *Erato angystoma*, Sowerby, *Thes. Conch.* III, p. 83, no. 13, pl. ccxix, figs. 19, 20, 23, 24.
 1865. *Erato angistoma* and *E. pellucida*, Reeve, *Conch. Icon.* XV, pl. iii, figs. 13, 16.
 1871. *Erato angistoma*, Redfield, *Amer. Journ. Conch.* VI, p. 216.
 1879. *Erato angistoma* and *E. pellucida*, Weinkauff, in *Martini and Chemnitz's Syst. Conch.*—*Cab.* V, Abth. 4, pp. 151, 152, 154, pl. xxvi, figs. 3, 4, 13.
 1880. *Erato angistoma* and *E. pellucida*, Weinkauff, *Jahrb. Deutsch. Malakozool. Ges.* VII, p. 108, nos. 10 and 15.
 1883. *Erato angistoma*, Tryon, *Man. Conch.* V, p. 10, pl. iv, fig. 44.
 1888. *Erato (Eratopsis) angistoma*, Paetel, *Cat. der Conchyl.*—*Samml.* 1, p. 198.
 1893. *Erato pellucida*, Melvill and Abercrombie, *Mém. Manchest. Lit. & Phil. Soc.* (4)VIII, p. 32.
 1895. *Erato angistoma*, Thurston, *Bull. Mad. Govt. Mus.* III, p. 123.
 1898. *Erato pellucida*, Melvill and Standen, *Journ. Conch.* IX, p. 45.
 1901. *Erato pellucida*, Melvill and Standen, *Proc. Zool. Soc. London*, II, p. 385.
 1910. *Erato angistoma*, Smith, *Proc. Malac. Soc. London*, IX, p. 21.
 1920. *Erato (Erato) angystoma*, Vredenburg, *Rec. Geol. Surv. Ind.* LI(2), p. 137.
 1927. *Erato (Erato) angystoma*, Schilder, *Archiv f. Naturges.* XCIA, p. 58.
 1933. *Proterato (Cypræerato) angistoma angistoma*, Schilder, *Proc. Malac. Soc. London*, XX, pp. 248, 257, 260, 278, fig. 36.

Sowerby first used the name *angistoma* for a species described by him from East Indies (exact locality not mentioned), but later he changed it to *angystoma* without giving any reasons. Paetel, on the other hand, has wrongly quoted the name as '*angiostoma*', while Vredenburg as '*angystoma*'. Schilder has restored Sowerby's original name *angistoma* which most of the workers have used. He has distinguished two races of *angistoma*, namely, *P. a. angistoma* and *P. a. angulifera*.

Characters.—Shell globosely pyriform, livid-white, semi-pellucid, shining, finely granulated; whorls rounded; spire short; the posterior elevation of the outer lip forming a prominent angle at its extremity nearly as high as the spire and the great constriction at the base of the shell are the chief diagnostic features of this race; outer lip thickened, wide and denticulated throughout, inner lip crenated except at the base where a few folds occur; aperture narrow, as long as the shell; extremities tipped with brown.

There are sixteen specimens in the collection, of which seven are from Hong Kong and labelled as *Erato angystoma*, two from Natal and labelled as *E. angystoma*, while the rest from the Persian Gulf, Gulf of Oman, Ceylon and Mauritius and labelled as *E. angulifera*. The shells are worn, smooth and dull-white, but three of them only appear slightly creamy and shining with the anterior extremity only spotted with brown. Moreover, the crenations on the columella appear, in most cases, to be restricted to the lower part only, though not continued over its entire length as stated by Schilder. The largest specimen in the collection is from Hong Kong which measures 4.5 mm. in length and 3 mm. in breadth.

The race *angistoma* can easily be distinguished from *angulifera* by the less produced posterior angle of its outer lip, extremely fine granula-

tions on the spire, the labial teeth less numerous, but slightly more prominent and extensive, and the apex distinctly less obtuse.

Distribution.—Schilder gives the range of *P. (C.) angistoma angistoma* (Sowerby) as "Omar to Ceylon" But it probably extends from Mauritius to the Philippines.

Type-locality. East Indies (exact locality not stated).

Proterato gallinacea (Hinds, 1844).

- 1844. *Ovulum gallinaceum*, Hinds, *Zool. Voy. H. M. S. 'Sulphur'*, *Moll.* II, p. 47, no. 193, pl. xvi, figs. 1, 2.
- 1859. *Erato gallinaceum*, Sowerby, *Thes. Conch.* III, p. 83, no. 14, pl. ccxix, figs. 33, 34.
- 1865. *Erato gallinacea*, Reeve, *Conch. Icon.* XV, pl. ii, fig. 7a-b.
- 1871. *Erato gallinacea*, Redfield, *Amer. Journ. Conch.* VI, p. 216.
- 1879. *Erato gallinacea*, Weinkauff, in *Martini and Chemnitz's Syst. Conch.*—*Cab.* V, Abth. 4, p. 150, pl. XXV, figs. 14, 15,
- 1880. *Erato gallinacea*, Weinkauff, *Jahrb. Deutsch. Malakozool. Ges.* VII, p. 107, no. 7.
- 1883. *Erato gallinacea*, Tryon, *Man. Conch.* V, p. 10, pl. IV, fig. 46.
- 1888. *Erato (Eratopsis) gallinacea*, Paetel, *Cat. der Conchyl.*—*Samml.* 1, p. 198.
- 1909. *Erato gallinacea*, Schepman, *Proc. Siboga Exped. Monogr.* XLIX^{1b}, p. 140.
- 1910. *Erato gallinacea*, Smith, *Proc. Malac. Soc. London*, IX, p. 20.
- 1920. *Erato (Erato) gallinacea*, Vredenburg, *Rec. Geol. Surv. Ind.* LI(2), p. 13.
- 1927. *Erato (Erato) gallinacea*, Schilder, *Archiv f. Naturges.* XCIA, p. 58.
- 1928. *Erato gallinacea*, Melvill, *Proc. Malac. Soc. London*, XVIII, p. 103.
- 1933. *Proterato (Cypraeerato) gallinacea*, Schilder, *Proc. Malac. Soc. London*, XX, pp. 248, 254, 255, 257, 260, 264, 265, 269, figs. 38-40.

Hinds placed his species *gallinaceum* from New Guinea in the genus *Ovulum* Bruguière, while Sowerby and others relegated it to *Erato* Risso. But its true systematic position was not known until 1932, when Schilder carefully studied the species and correctly assigned it to his new genus *Proterato*. All workers seem to agree that *P. gallinacea* is distinct from *E. angulifera* Sowerby, but Smith treats the two as synonymous. The name of the species, says Tryon, is perhaps derived from "its fancied resemblances to a trussed hen"

Characters.—Shell triangularly pyriform, dull-white, pellucid, shining, greatly callous when fully formed, ornamented with one prominent reddish-brown transverse band on the dorsum about the angle of the last whorl; whorls angled round the upper part, constricted and beaked at the lower; spire conical, minutely granulated; apex obtuse; labrum thick, broad, swollen, conspicuously angled posteriorly and elevated above the apex, the lirae extend almost across it and similar lirae also occur at the anterior part of the inner lip which is crenated; aperture narrow and linear; extremities and the tip of the angle of the outer lip spotted with brown. This very character was first observed by Smith in this species.

Gallinacea seems to differ markedly from *angulifera* in having a triangularly pyriform shell adorned with two transverse colour bands, the lirae on the thickened labrum as well as on the lower part of the columella more prominent and extensive, the angle of the outer lip more elevated and the apex distinctly less obtuse.

There are three specimens of *gallinacea* in the collection which appear to represent three very interesting stages of development. Of these, two are from Andamans and Ceylon (Reg. No. 2827) and in a perfectly good condition, but labelled as *Erato angulifera* Sowerby, while the third one is from Galle (Reg. No. 4250). It is worn and callous with the apex greatly blunt and labelled as *Erato sulcifera* var. *minor*. Among the first two shells, one (5 mm. in length and 3.5 mm. in breadth) appears quite typical of the species as regards form, shape and structure and agrees with Hinds's figs. 1 and 2, Tryon's fig. 46, Reeve's figs. 7a and 7b and Sowerby's figs. 33 and 34, the only difference being that it has an additional colour band on the penultimate whorl—a feature hitherto unknown in this species. The large band in this case appears to extend across the inner lip as far as the aperture. In the second specimen (nearly 5 mm. in length and 3.5 mm. in breadth), however, a callous layer appears to develop on the outer side of either lip, gradually extend over the back of the shell and more or less conceal the spire and the base. The more the shell grows the more the layers develop, with the result that the entire spire, the base and the angular process of the outer lip all become burried and a small space is only left in the middle of the back where only the prominent colour band is partially visible. Consequently, the shell looks more or less short with the apex very blunt, the outer lip much thickened and swollen and the aperture much narrowed. This last stage is represented by the worn and callous shell in the collection (4.5 mm. in length and 3 mm. in breadth) from Galle which more or less agrees with Schilder's fig. 40.

Distribution.—Schilder gives the range of *P. (C.) gallinacea* (Hinds) as "Malaysia to Zanzibar and Oman", and adds that the specimens from Oman are mostly of a dwarf form.

Type-locality. New Guinea.

Family *PEDICULARINAE*.

Subfamily *PEDICULARIINAE*.

Genus *Pediculariella* Thiele, 1925.

Type. *Pedicularia californica* Newcomb, 1864.

- 1925. *Pediculariella*, Thiele, in *Kükenthal Handb. d. Zool.* V(1), p. 88.
- 1927. *Pediculariella*, Schilder, *Archiv f. Naturges.* XCIA, p. 66.
- 1929. *Pediculariella*, Thiele, *Handb. der Syst. Weichtierk.* 1, p. 270.
- 1931. *Pediculariella*, Schilder, *Journ. Conch.* XIX(6), p. 167.
- 1936. *Pediculariella*, Schilder, *Proc. Malac. Soc. London*, XXII, p. 81.

Thiele erected *Pediculariella* as a genus, with *Pedicularia californica* Newcomb as its type-species, and included it in the subfamily Jenneriinae of the family Cypraeidae. Schilder (1927) while subordinating *Pediculariella* to *Pedicularia* Swainson (1840) placed it under Pediculariinae of the family Pediculariidae Tryon. But subsequently he (1931) ranked it as distinct and relegated it to the family Amphiperatidae on the basis of the radular character, which view I am not inclined to accept. Radula,

no doubt, plays an important rôle in the identification of some molluscs but there are other characters too, such as, shape, size, form and sculpture of the shells, which are none the less important. The specimens of the genera *Pedicularia* and *Pediculariella* which are limpet-like in form and found parasitic on corals differ so markedly in their shell characters from those of the family Amphiperaidae that they can claim a separate family rank.

***Pediculariella pacifica* (Pease, 1868).**

1868. *Pedicularia pacifica*, Pease, *Amer. Journ. Conch.* IV, p. 96, pl. xi, figs. 17, 18.
1872. *Pedicularia pacifica*, Dall, *Amer. Journ. Conch.* VII, p. 121.
1885. *Pedicularia pacifica*, Tryon, *Man. Conch.* VII, p. 242, pl. 1, figs. 6, 7.
1888. *Pedicularia pacifica*, Paetel, *Cat. der Conchyl.—Samml.* 1, p. 328.
1920. *Pedicularia pacifica*, Vredenburg, *Rec. Geol. Surv. Ind.* LI(2), p. 140.
1924. *Pedicularia pacifica*, Fulton, *Shells of Rec. Moll.*, p. 36.
1927. *Pedicularia (Pediculariella) pacifica*, Schilder, *Archiv f. Naturges.* XCIA, p. 66.
1931. *Pediculariella pacifica*, Schilder, *Journ. Conch.* XIX(6), p. 167.
1937. *Pedicularia pacifica*, Viader, *Maur. Inst. Bull.* 1(2), p. 36.

Characters.—This species can easily be recognized by its small, irregular, pinkish, oblong-ovate shell which is limpet-like in form, but much constricted in the middle. It is ornamented with fine conspicuous radial striae which are decussated with regular concentric striae. The apex is involute, lateral and prominent, while the aperture is wide and subcanaliculate in front.

It is closely allied to *Pedicularia elegantissima* Deshayes (1863) from the isle of Reunion.

There are three shells in the collection from the Viti Islands which agree with the description of the typical form. The largest shell (Reg. No. 2946) is 8 mm. in length and 4 mm. in breadth, while the smallest one is 5.5 mm. in length and 3.5 mm. in breadth.

Distribution.—*P. pacifica* (Pease) was originally known from the Ins. Apaian in Polynesia. But its occurrence in Mauritius as recorded by Viader extends its range westwards.

Type-locality. Insl. Apaian in Polynesia.