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AND THE ADJACENT COUNTRIES

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PLATYHELMINTHES

Vol. I

TREMATODA

by

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(with a seperate supplement)



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CONTENTS

	Page
EDITOR'S PREFACE	v
SYSTEMATIC CONTENTS	vii
INTRODUCTION	1
MORPHOLOGY	3
METHODS OF EXAMINATION AND TECHNIQUE	27
EXAMINATION METHODS AND TECHNIQUE FOR CERCARIAE ...	30
HISTORY OF CLASSIFICATION OF TREMATODA ...	31
CLASSIFICATION OF SUBCLASS DIGENEA ...	52
SYSTEMATIC ACCOUNTS	54
REFERENCES	400
ALPHABETICAL INDEX	409

EDITOR'S PREFACE

Trematodes form an important constituent of the endoparasitic fauna of vertebrates in which they infest practically every organ system. Their notoriety as causal organisms of serious diseases of domestic animals and man are well known and they play a vital role in veterinary and human parasitological and medical research.

Because of their medical importance trematodes have received considerable attention from specialists since the days of Francisco Redi in the 17th Century and since 1860 studies on Indian trematodes got a start with the work of Cobbald and other European helminthologists who identified material sent from India. By the middle of the present century several hundred species of trematodes were recorded from India and it became necessary to bring all the knowledge about this group together in the prestigious Fauna of India series. The task was first assigned to the late Dr. G. D. Bhalerao in 1938, but his death in 1948 necessitated the reassignment of the authorship of the volume to some other well known specialist on trematodes and the choice fell on Prof. H. R. Mehra whose international reputation as an expert on this group was well known in helminthological circles.

In the present volume Professor Mehra has recognised Monogenea as a taxon at the level of *class*, rejecting the earlier classifications in which Monogenea was treated as an order or subclass of the class Trematoda. In the class Trematoda he has recognised two subclasses, *viz.*, Digenea and Aspidobothrea, and the subclass Digenea has been subdivided into five orders, *viz.*, Strigeatoidea, Fasciolatoidea, Azygatoidea, Hemiruratoidea and Gorgoderida, the last three being erected by Prof. Mehra in 1957 and 1958.

The present volume deals with Order Fasciolatoidea in which Professor Mehra has recognised six suborders—Echinostomata, Paramphistomata, Fellodistomata, Cyclocoelata, Opisthorchia a and Plagiorchiata. All the Indian species, known till about 1963, except those of the suborder Plagiorchiata, have been described in the present work.

Because of a long, but unavoidable, time lag between the submission of the manuscript and its publication, several new taxa have been added to the Indian trematode fauna and untimely death of Prof. Mehra soon after he submitted the manuscript, the volume could not be made uptodate by him.

In order to cover this lacuna, Dr. C. B. Srivastava, was requested to prepare an addendum which will be published as a supplement to this volume. Dr. Srivastava has also critically gone through the manuscript to eliminate typographical and other errors and thanks are due to him for this assistance.

T. N. ANANTHAKRISNNAN
Director
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SYSTEMATIC CONTENTS

(Class TREMATODA Rudolphi, 1808
Syn. Digenea Beneden, 1858 Vol. I)

	Page
Order FACIOLATOIDEA Szidat	54
I. Suborder ECHINOSTOMATA Szidet	55
A. Superfamily ECHINOSTOMOTOIDEA Faust	55
I. Family ECHINOSTOMATIDAE Poche	56
I. Subfamily ECHINOSTOMATINAE Faust	58
Genus 1. *Echinostoma* Rudolphi	59
1. *revolutum* (Froelich)	60
2. *govindum* Moghe	62
3. *battacharyai* Verma	62
4. *chasma* Lal	54
Genus 2. *Echinoparyphium* Dietz	64
5. *recurvatum* (V. Linst).	66
6. *longicirrus* Verma	66
7. *gizzardai* Verma	67
8. *dollfusi* Agarval	67
9. *indicum* Rai	69
10. *clerci* Skrjabin	70
Genus 3. *Euparyphium* Dietz	71
11. *longitestis* Verma	71
Genus 4. *Paryphostomum* Dietz	72
12. *radiatum* (Duj.)	73
13. *testitrifolium* Gogate	74
14. *pentalobum* Verma	75
15. *horai* Baugh	75
16. *dollfusi* Agarwal	77
17. *giganticum* Rai and Agarwal	78
Genus 5. *Artyfechinostomum* Lane	79
18. *sufrartyfex* Lane	80
19. *indicum* (Bhalerao)	81
Genus 6. *Pseudoechinochasmus* Verma	83
20. *satjivani* Verma	83
II. Subfamily HYPODERAEINAE Skrjabin at Baschkirova	84
Genus 7. *Hypoderaeum* Dietz	84
21. *conoideum* (Bloch)	85
22. *magnocirrusa* Verma	86
23. *microspina* (Singh)	86
III. Subfamily PSILORCHINAE n. subf.	88
Genus. 8. *Psilorchis* Thapar and Lal	89
24. *indicus* Thapar and Lal	89
IV. Subfamily PSEUDECHINOSTOMINAE n. subf.	91
Genus 9. *Pseudechinostomum* Odhner	92
25. *indicus* Mehra	92
V. Subfamily PARALLELOIESTISHNAE n. subf.	94
Genus 10. *Parallelotestis* Belopolskeina	95
26. *tarai* (O. N. Srivastava)	95
VI. Subfamily NEPHROSTOMINAE Mendheim	96
Census 11. *Nephrostomum* Dietz	
27. *ramosum* (Sonsino)	97
Genus 12. *Patagifer* Dietz	99
28. *wesleyi* Verma	99
29. *simerai* Nigam	100
VII Subfamily PEGOSOMINAE Mendheim	101
Genus 11. *Pegosomum* Ratz	100
30. *egretti* Srivastava	102
VIII. Subfamily PATASIGERINAE Mendheim	102
Genus 14. *Petasiger* Dietz	104
31. *nicolli* Pande	104
32. *antigonus* Nigam	105
IX. Subfamily CHAUNOCAPHALINAE Travassos	106

	Page
Genus 15. *Chaunocephalus* (Rud)	108
33. *ferox* (Rud.)	109
34. *leucocephalus* Vedvrat	110
35. *travassosi* Vedvrat	110
36. *adhneri* Vedvrat	113
37. *kirati* Vedvrat	115
38. *elongatus* Vedvrat	115
X. Subfamily SINGHIINAE Yamaguti	118
Genus 16. *Singhia* Yamaguti	118
39. *thapari* (Singh)	118
XI. Subfamily MICROPARYPHIINAE Mendhiem	120
Genus 17. *Microparyphium* Dietz	120
40. *montei* Verma	120
XII. Subfamily SINGHIATRAMATINAE n. subf.	121
Genus 18. *Singhiatrama* Simha	122
41. *singhia* Simha	122
42. *longifurca* Simha	122
43. *hyderabadensis* Simha	122
XIII. Subfamily ECHINOCHASMINAE Odhner	124
Genus 19. *Echinochasmus* Dietz	125
44. *antigonus* Gupta	126
45. *bagulai* Verma	127
46. *ruficapensis* Verma	128
47. *mengovitellus* Lal	130
48. *narayani* Mudaliar	130
49. *perfoliatus* (V. Ratz)	131
50. *famelicus* Odhner	132
Genus 20. *Episthmium* Luhe	134
51. *bursicola* (Creplin)	134
52. *corvus* (Bhalerao)	136
Genus 21. *Saakotrema* (Saskova)	139
53. *metatestis* (Saakova)	139
Genus 22. *Dissurus* Verma	139
54. *farrukhabadi* Verma	141
Genus 23. *Stephanoprora* Odhner	141
55. *pennanti* Verma	142
56. *reynoldi* Bhalerao	143
57. *fusca* Lal	143
58. *gigantica* Gupta	145
59. *nigerica* Gupta	145
Genus 24. *Ignavia* Freites	148
60. *treviovarica* Gupta	148
XIV Subfamily PARORCHIINAE Lal	150
Genus. 25. *Parorchis* Nicoll	151
61. *snipis* Lal	151
XV. Subfamily MEHRASTOMUMNAE Saksena	153
Genus 26. *Mehrastomum*, Saksena	153
62. *minutum* Saksena	154
II. Family PHILOPHATHALMIDAE Travassos	156
XVI. Subfamily PHILOPTHALMINAE Looss	157
Genus 20. *Philothalmus* Looss	157
63. *gralli* Mathis et Leger	158
III. Family OMMATOBREPHIDAE Poche	161
Genus 28. *Ommatobrephus* Nicoll	161
54. *lobatum* Mehra	162
65. *megacetabulus* Simha	162
IV. Family PSILOSTOMIDAE Odhner	164
XVII. Subfamily PSILOSTOMINAE Luhe	164
Genus 29. *Psilochasmus* Luhe	165
66. *Psyurus* (Creplin)	165
Genus 30. *Psilocolaris* K. S. Singh	166
67. *indicus* K. S. Singh	167
Genus 31. *Mehlisia* Johnson	169
68. *gatesi* Sharma	169
V. Family CATHEMASIIDAE Fuhrmann	171
XVIII. Subfamily CATHAEMASSINAE Dollfus	171
Genus 32. *Cathaemasia* Looss	171
69. *orientalis* Wesley	172
70. *indicus* Wesley	173
71. *mehrai* Wesley	175
VI. Family FASCIOLIDAE Railliet	175
XIX. Subfamily FASCIOLINAE Stiles and Hassall	176
Genus 33. *Fasciola* Linnaeus	177
72. *hepatica* Linnaeus	177
73. *gigantica* Cobbold	178
74. *jacksoni* Cobbold	179
XX. Subfamily FASCIOLOPSINAE Odhner	181

	Page
Genus 34. *Fasciolopsis* Looss	181
75. *buski* (Lankastar)	181
B. Superfamily HAPLOPROIDEA Nicoll	183
VII. Family HAPLOSPLANCHNIDAE Poche	183
Genus 35. *Haplosplanchaus* Looss	184
76. *pachysomus* Eysenhardt	185
77. *caudata* (Srivastava)	187
VIII. Family HAPLOPORIDAE Nicoll	188
XXI. Sub family WARETREMATINAE Belcuss	189
Genus 36. *Waretrema* Srivastava	189
78. *piscicola* Srivastava	190
II. Suborder PARAMPHISTOMA Szidat ..	191
C. Superfamily PARAMPHISTOMOIDEA Stiles and Goldberger	192
IX. Family PARAMPHISTOMIDAE Fischoeder	192
XXII. Subfamily PARAMPHISTOMINAE Fischoeder	194
Genus 37. PARAMPHISTOMUM Fischoeder	195
79. *cervi* (Zeder)	196
80. *explanatum* (Creplin)	198
81. *gotoi* Fukui	999
Genus 38. *Calicophoron* Nasmark	200
82. *calicophorum* (Fischoeder) ..	200
83. *crassum* (Stiles and Goldberger) .	201
84. *cauliorchis* (Stiles and Goldberger) .	201
85. *papillosum* (Stiles and Goldberger) .	202
Genus 30. *Cotylophoron* Stiles and Goldberger .	203
86. *cotylophorum* (Fischoeder)	204
87. *indicum* Stiles and Goldberger	205
88. *ovatum* Harshe	206
89. *orientalis* Harshe	206
90. *elongatum* Harshe	208
Genus 40. *Ceylonocotyle* Nasmark ..	208
91. *scoliocoelium* (Fischoeder)	209
92. *dicrocoelium* (Fischoeder)	211
93. *streptocoelium* (Fischoeder)	211
94. *orthocoelium* (Fischoeder)	211
95. *nasmarki* Mukherjee .	212
Genus 41. *Paramphistomoides* Yamaguti	212
96. *maplestonei* (Bhalerao) .	213
Genus 42. *Pseudoparamphistoma* Yamaguti	214
97. *cuonum* (Bhalerao)	215
Genus 43. *Paramphiatomacotyle* n. gen.	217
98. *spinicephalus* (Tandon)	217
XXIII. Subfamily GASTROTHYLACINAE Stiles and Goldberger	219
Genus 44. *Gastrothylax* Poirier	228
99. *crumenifer* (Creplin)	220
Genus 45. *Fischoederies* Stiles and Goldberger	222
100. *elongatus* (Porrier)	222
101. *cobboldi* (Porrier)	224
102. *gregarsus* (Looss)	225
103. *spatiorus* (Brandes)	225
XXIV. Subfamily GASTRODISCINAE Monticelli	226
Genus 47. *Gastrodiscus* Leukart	226
104. *egypticus* (Cobbold)	227
105. *secundus* (Looss)	227
Genus 48. *Gastrodisocoides* Leiper .	228
106. *hominis* (Lemis and McConnel) .	229
Genus 49. *Homalogaster* Poirier	230
107. *paloniae* Poirier	231
XXV. Subfamily PSEUDODISCINAE Nasmark	232
Genus 50. *Pseudodiscus* Sonsino	232
108. *collinsi* (Cobbold) .	233
Genus 51. *Watsonius* Stiles and Goldberger	234
109. *watsoni* (Conyngham)	235
XXVI. Subfamily CLADORCHIINAE Luhe .	236
Genus 52. *Olveria* Thapar and Sinha .	236
110. *indica* Thapar and Sinha	237
111. *bosi* Tandon	238

	Page
Genus 53. *Pfenderius* Stiles and Goldherger	239
112. *papillatus* (Cobb.)	240
113. *birmanicus* Bhalerao	240
XXVII. Subfamily Zygocotylinae Ward	241
Genus 54. *Stunkardia* Bhalerao	241
114. *dilymphosa* Bhalerao	242
XXVIII. Subfamily Diplodiscinae Cohn	243
Genus 55. *Diplodiscus* Diesing	243
115. *amphichrus* Tubengui	244
116. *mehrai* Pande	244
XXIX. Subfamily Pseudochiorchiinae Yamaguti ..	245
Genus 56. *Pseudochiorchis* Yamaguti	247
117. *burti* (Prudhoe)	247
XXX. Subfamily Dadaytrematinae Yamaguti .	248
Genus 57. *Orientodiscus* Srivastava	249
118. *lobatum* Srivastava	250
119. *jumnai* Srivastava ..	250
Genus 58. *Protocladorchis* Willey	251
120. *burmanica* (Chaterji)	251
XXXI. Subfamily Nicollodiscinae Skrjabin	252
Genus 59. *Nicollodiscus* Srivastava	254
121. *gangeticus* Srivastava	254
XXXII. Subfamily Helostomatinae Skrjabin .	254
Genus 60. *Helostomatis* (Fukui)	255
122. *sakrei* Bhalerao	255
XXXIII. Subfamily Cleptodiscinae Skrjabin	256
Genus 61. *Cleptodiscus* Linson	257
123. *poonensis* (Bhalerao)	257
XXXIV. Subfamily Solenorchiinae Hilmy .	258
Genus 62. *Indosolenorchis* Crusz	259
124. *hirudinacaus* Crusz	260
D. Superfamily NOTOCOLOIDEA La Rue ..	650
X. Family Notocotylidae Luhe	262
Genus 63. *Notocotyles* Diesing	263
1. Subgenus *Notocotylus* Dubois	254
2. Subgenus *Hindia* Lal	265
125. *attenuatus* (Rud)	265
126. *babai* (Bhalerao)	265
127. *imbaricatus* Lal (Looss)	267
128. *parvivatus* Yamaguti .	267
129. *gibbus* (Mehlis in Creplin)	268
130. *orientalis* Harshe	268
131. *indicus* Srivastava	270
Genus 65. *Paramonostomum* Luhe	271
132. *microstomum* Moghe	272
133. *querquedulum* Lal	273
134. *fulicai* Baugh	274
XXXV. Subfamily Ogmocotylinae Skrjabin	274
Genus 66. *Ogmocotyle* Skrjabin and Schulz	275
135. *indica* (Bhalerao)	276
XI. Family Pronocephalidae Looss	277
XXXVI. Subfamily Pronocephalinae Looss	278
Genus 67. *Pronocephalus* Looss	279
136. *obliquus* Looss	280
Genus 68. *Pleurogonius* Looss	280
137. *karachii* R. K. Mehra	282
138. *sindhii* R. K. Mehra	283
139. *keamerii* R. K. Mehra	283
140. *mehrai* (R. K. Mehra) .	285
Genus 69. *Renigonius* R. K. Mehra	285
141. *orientalis* R. K. Mehra	287
XXXVII. Subfamily Charaxicephalinae Price .	287
Genus 70. *Charaxicephalus* Looss ..	289
142. *loossi* R. K. Mehra ..	290
Genus 71. *Dischistorchis* Johnston	290
143. *gastricus* H. R. Mehra	292
XXXVIII. Subfamily Neopronocephalinae H. R. Mehra	292
	294

	Page
Genus 72. *Neopronocephalus* H. R. Mehra	294
144. *triangularis* H. R. Mehra	295
145. *gangeticus* H. R. Mehra	296
146. *mehrai* Chatterji	296
XII. Family RHABDIOPOEIDAE Poche	298
XXXIX. Subfamily TAPROBANELLINAE Yamaguti	298
Genus. 73. *Taprobanella* Crusz and Fernand	299
147. *bicaudata* Crusz and Fernand	299
XIII. Family OPISTHOTREMATIDAE Puche	301
XL. Subfamily LANKATREMATINAE Yamaguti	301
Genus 74. *Lankatrema* Crusz and Farnand	301
148. *mannarensis* Crusz and Fernand	382
III. Suborder FELLODISTOMATA Singh	302
E. Superfamily FELLODISTOMOIDEA MeCra	304
XIV. Family FELLODISTOMIDAE Woolcock	304
XLI. Subfamily FELLODISTOMINAE Nitoll	305
Genus 75. *Fellodistomum* Stafford	305
149. *lethrini* (N. K. Gupta)	306
Genus 76. *Pseudodiscogastrides* S. P. Gupta	307
150. *indicus* Srivastava	308
151. *cranxi* (Srivastava)	309
Genus 77. *Yamagutia* Srivastava	210
152. *lateroporus* Srivastava	310
XLII. Subfamily ANTHORCHIINAE Yamaguti	312
Genus 78. *Fastula* Poche	312
153. *brevichrus* Srivastava	313
154. *gangeticus* (Srivastava)	315
155. *ilishi* (Srivastava)	315
156. *clupii* (Srivastava)	315
XLIII. Subfamily MONASCINAE Yamaguti	316
Genus 79. *Monascus* Looss	316
157. *orientalis* (Srivastava)	317
XV. Family MONODHELMINTHIDAE Dollfus	317
XLV. Subfamily MEHRATREMATINAE Srivastava	318
Genus 80. *Mehratrema* Srivastava	319
158. *dollfusi* Srivastava	319
Genus 81. *Buckleytrema* N. K. Gupta	321
159. *indica* N. K. Gupta	322
IV. Suborder CYCLOCOELATA La Rue	323
F. Superfamily CYCLOCOCLOIDEA Nicoll	323
XVI. Family CYCLOCOELIDAE Kossack	324
XLV. Subfamily CYCLOCOELINAE Stossich	326
Genus. 82. *Cyclocoelum* Brandes	326
3. Subgenus *Cyclocoelum* Winterberg	326
160. *mutabile* (Zeder)	326
161. *obscurum* (Leidy)	327
162. *ovipunctatum* Stossich	328
163. *odeningi* Dubois	330
4. Subgenus *Haematotrephus* Stossich	331
164. *vanelli* (Rudolphi)	331
165. *kossacki* (Witenberg)	334
5. Subgenus *Hyptiasmus* Kossack	335
166. *elongatum* Harrah	335
XLVI. Subfamily TYPHLOCOELINAE Harrah	337
Genus 83. *Typhlocoelum* Stossich	338
167. *cucumerinum* (Rudolphi)	338
168. *shovellus* Lal	339
G. Superfamily EUCOTYLOIDEA n. supf.	340
XVII. Family EUCOTYLIDAE Skrjabin	340
Genus. 84. *Tanaisia* Skrjabin	341
169. *indica* K. S. Singh	341
V. Suborder OPISTHORCHIATA La Rue	343
H. Superfamily OPISTHORCHIOIDEA (Faust)	343

	Page
XVIII. Family Opisthorchiidae Braun	344
XLVII. Subfamily Opisthorchiinae Looss	345
Genus 85. *Opisthorchis* Blanchard	345
170. *noverca* Braun	348
171. *sinensis* (Cobbold) ..	350
172. *gemius* (Looss)	350
173. *dantriticus* (Morgan)	352
174. *giddhis* Lal	352
175. *allahabadii* Mehra	354
176. *anhingi* Mehra	355
177. *obsequens* Nicoll	355
178. *pelicani* Mehra	356
179. *pedicellata* Verma	358
180. *pedicellata* var. *minuta* Mehra	358
181. *gomtii* Thapar	359
182. *meharai* Agarwal	360
183. *mehrai* Gupta	360
6. *Subgenus Nigerina* (Baugh)	361
184. *hardoiensis* (Baugh)	361
Genus 86. *Cyclorchis* Luhe	363
185. *campula* (Cobbold)	363
XLVIII. Subfamily Metorchiinae Luhe	365
Genus 87. *Metorchis* Looss	365
186. *xanthosomun* (Crepl.)	365
XLIX. Subfamily Pachytrematimnae Ejsmont	367
Genus 88. *Pachytrema* Looss	367
187. *hewletti* (Phadke and Gulati)	368
XIX. Family Acanthostomidae Poche	369
L. Subfamily Acanthostominae Nicoll	370
Genus 89. *Acanthostomum* Looss	370
188. *indicum* Sinha ..	370
189. *burminis* (Bhalerao) ..	371
XX. Family Heterophyidae Odhner	374
LI. Subfamily Heterophyinae Ciurea ..	374
Genus 90. *Heterophyes* Cobbold	375
190. *indica* Rao and Ayyar	375
LII. Subfamily Ascocotylinae Yamaguti	376
Genus 91. *Ascocotyle* Looss	377
191. *intermedius* Srivastava	377
LIII. Subfamily Haplorchiinae Looss	380
Genus 92. *Haplorchis* Looss	381
192. *taichui* Nishigori	382
193. *yokogawai* (Katsutal)	384
Genus 93. *Haplorchoides* Chen	387
194. *attenuatum* (Srivastava)	389
195. *piscicola* (Srivastava) ..	391
XXI. Family Cryptogonimidae Ciurea	393
LIV. Subfamily Cryptogonminae Ward	393
Genus 94. *Mehracola* (Srivastava)	394
196. *ovocaudatum* Srivastava	394
LV. Subfamily Polyorchitrematinae Srivastava .	396
Genus 95. *Polyorchitrema* Srivastava	396
197. *piscicola* Srivastava .	397
198. *eutropicthis* Chatterji ..	397

TREMATODA

Introduction

The volume on Trematoda in Fauna of India series has been long due on account of Dr. G. D. Bhalerao's death in December 1948 whom it was first assigned in 1938. Trematoda has engaged the attention of large number of researchers in India but the sustained work has been done by a small number.

The class Trematoda which according to Faust and Tang (1936) was divided into three subclasses : (1) Monogenea Beneden, 1858 and Carus, 1863 syn. Heterocotylea Monticelli, 1892; (2) Digenea Beneden, 1858 and Carus, 1863 syn. Malacocotylea Monticelli, 1892 and (3) Aspidobothrea Burmeister, 1856 syn. Aspidocotylea Monticelli, 1892 syn. Aspidogastrea Faust and Tang, 1936 is now split up into two classes : (1) Class Monogenea Beneden 1858 (Baer and Euzet, 1961) and (2) Class Trematoda Rudolphi, 1808 (Baer and Joyeux, 1961). The classification of Trematoda given in these volumes is that of the class Trematoda from which Monogenea is dropped and recognized as independent class.

The division of Digenea now held as subclass of Trematoda, into Prosostomata Odhner, 1905 and Gasterostomata Odhner, 1905, which has been in vogue till now and adopted by several recent authors, Manter (1940), Faust (1940, 1949), Dawes (1946, 1956) and Yamaguti (1958) has been discarded. A new classification, the foundation of which was laid by La Rue (1926) by the creation of his order Strigeatoidea is adopted. Szidat (1936) added the order Fasciolatoidea to this classification. This classification mainly based on the criteria of larval characters and life cycles and developed by La Rue in 1957 has been modified and enlarged by including morphological characters of the adult. The subclass Digenea is divided into five orders : I. Strigeatoidea La Rue, 1926, II. Fasciolatoidea Szidat, 1936 syn. Echinostomida La Rue 1957; III. Azygatoidea Mehra, 1957; IV Hemiuratoidea; Mehra, 1957 and Gorgoderida Mehra, 1958.

Stunkard (1962, 1963) proposed in his scheme of classification of Trematoda the restoration of the old discarded subclasses Pectobothridia and Malacobothridia and inclusion in the latter of the orders Aspidobothrea Burmeister, 1856 and Digenea Van Beneden, 1858.

As the order Chimaericoloidea Brinkmann, 1957 of the class Monogenea shows unmistakable affinity with the order Gyrocotyloidea Poche, 1925 of subclass Cestodaria (class Cestoidea), on account of which Monogenea has been given the status of a separate and independent class by Baer and Euzet, Stunkard's classification has not been accepted.

The work on Indian Trematodes started as early as 1860 when the material from Indian vertebrates was sent to Cobbold and others in European countries. In 1869 Cobbold recorded the occurrence of *Fasciola jacksoni* from an Indian elephant. In 1875 *Pseudodiscus collinsi* collected from the intestine of Indian horses was sent to him, which he designated as *Amphistoma collinsi* Cobbold. He received a few weeks later a few specimens collected by Stanely which he named *Amphistoma stanleyi*. He remarked that these specimens were the larger variety of *Amphistoma collinsi*. Stiles and Goldberger (1910) in their memoir of nineteen species of Paramphistomoidea maintained these two species. In 1876 Cobbold recorded the occurrence of *Cyclorchis campula* (Cobbold, 1876) in bile ducts of *Platinista gangetica*. In 1876 *Gastrodiscoides hominis* was recorded by Lewis and McConnel as *Amphistoma hominis* from a human patient in Assam where this parasite commonly infests man and pig. Southwell in 1913 created the genus *Isoparorchis* for large distomes from the air bladder of fishes in the notes from Bengal Fisheries Laboratory. Luhe (1901) described two new distomes from Indian Anura. In 1906 he described trematode parasites from marine fishes of Ceylon in Pearl Oyster Fisheries Report. The material was sent to him from India and Ceylon. Klein (1905) published the account of new distomes from South India from *Rana hexadactyla*. The blood flukes from Indian cattle, *Schistosoma indicum*, *Schistosoma spindalis* and *Schistosoma bomfordi* were described by Montgomery in 1906. The last species was included in genus *Ornithobilharzia* by Price (1929). The publication of the well known memoir on Indian cercariae "*Cercariae Indicae*" by Sewell in 1922 stands as a landmark in the knowledge of carcariae in general after the publication of Luhe's Trematoda in "*Dia Susswasserfauna Deutschlands*" series.

In 1918 Linton and Soparkar gave an account of the life cycle of *Schistosoma spindalis*. Since 1926 many trematodes belonging to different families have been described from various parts of India, Burma and Ceylon.

The trematode fauna of India is quite rich, and does not differ materially from that of Egypt, southern and central Europe, Japan, Phillipines and Australia. But the group

has been much less explored in India than in these parts of the globe, which are not far from India. Though most genera met with in India are common to almost all parts of the world, some are endemic. The following genera occur in India : *Yamagutia* and *Pseudodiscogasteroides* (Fellodistomidae), *Mehratrema* and *Buckleytrema* (Monodhelminthidae), *Brahamputrotrema* (Monorchiidae), *Artyfechinostomum*, *Singhia*, *Singhiatrema* and *Psilorchis* (Echinostomatidae), *Psilocollaris* (Psilostomidae), *Mehrastomum* (Echinostomatidae), *Mehraorchis*, *Exotidendrium*, *Caprimolgorchis*, *Basantisia* and *Vesperugidendrium* (Lecithodendriidae), *Tremiorchis*, *Spinometra*, *Glossimetra*, *Bilorchis* and *Microderma* (Plagiorchiidae), *Mehraformis* (Microphallidae), *Paramphistomoides* and *Olveria* (Paramphistomidae), *Neopronocephalus* and *Renigonius* (Pronocephalidae), *Plasmiorchis*, *Hemiorchis*, *Coeuritrema* and *Enterohaematotrema* (Spirorchiidae), *Mehrailla* and *Polyorchitrema* (Cryptogonimidae), *Thapariella* (Brachylaemidae), *Mesostephanoides* and *Muehlingina* (Cyathocotylidae), *Glossodiplostomoides* and *Subuvilifer* (Diplostomidae), *Neelydiplostomum* (Proterodiplostomidae) and *Neoprosorhynchus* (Bucephalidae).

In this volume are given the genera of the families of the suborders Echinostomata, Paramphistomata, Fellodistomata, Cyclocoelata and Opisthorchiata of order Fasciolatoidea; but the genera of the families of suborder Plagiorchiata of Fasciolatoidea and those of orders Azygatoidea, Hemiuratoidea, Gorgoderia and Strigeatoidea and of the subclass Aspidobothrea will be dealt with later in second Trematoda fauna volume. Of the three Indian genera of Aspidobothrea, *Lissemysia* occurs in India only.

Morphology

External characters.—The body is usually elongated and narrow, sometimes oval, spherical or leaf-like with two suckers, oral sucker surrounding the mouth at or near anterior end, except in gasterostomes (Bucephalidae) in which the mouth lies far behind anterior end on the ventral surface, usually near middle of body. The ventral sucker or acetabulum lies on ventral surface usually at about one third body from anterior end in distomes. In amphistomes (Paramphistomidae) the acetabulum is large, terminal or subterminal (Fig. 1D, E). In Bucephalidae there is present at anterior end adhesive organ of diverse forms, a sucker-like rhynchus with retractile tentacles in *Bucephalus* Baer (Fig. 1A), sucker-like rhynchus without tentacles in *Bucephalopsis* (Dies.)

(Fig. 1B), rhynchus with fan-shaped hood or disc and ventroposterior sucker in *Rhipidocotyle* Diesing or inverted cone-shaped rhynchus in *Prosorhynchus* Odhner. The acetabulum is absent in many digenetic trematodes and all these forms known as monostomes were included previously in suborder Monostomata. The Distomata included species with two suckers and Amphistomata included forms with terminal or subterminal acetabulum. These suborders have now been dropped. The families Notocotylidae and Cyclocoelidae constituted the heterogenous group Monostomata. A few species of genus *Cyclocoelum* Brandes possess acetabulum. Monostomes occur in several groups; these are also forms in which both suckers are absent. Some blood flukes lack acetabulum (Spirorchiidae). *Transversotrema* Witenberg and its cercaria which have a transversely elongated body, lack the oral sucker, but they possess the acetabulum. Bivesiculidae and the blood flukes, *Gigantobilharzia* Odhner and *Dendritobilharzia* Skrjabin and Zakharow lack both the suckers. The groups based on the presence, absence or position of suckers are not considered tenable. The adhesive organs are adaptive, coenogenetic and, therefore, as such are not of taxonomic importance for higher taxonomic units.

The bodywall is cuticular and usually covered with backwardly pointed spines or scales which are often present only in the anterior region. The spines are absent in Paramphistomidae, Hemiuridae and Philophthalmidae. In Paramphistomidae the body is thick and covered with strongly developed cuticle, which may be papillated, but it is never spined. In Philophthalmidae the body wall is muscular and smooth. In Hemiuridae the cuticle is smooth, finely annulated or serrated. In this family the posterior part of body may form a tail, abdomen or ecosoma, capable of being retracted into anterior region or soma in a telescoped manner, and when fully extended may be as long as or even longer than the soma. Isoparorchiidae closely related to Hemiuridae are large foliate distomes with smooth cuticle. Fasciolidae are large flat distomes with spined or unspined cuticle. Stomylotrematidae have thick stout spined body wall with large suckers. Heterophyidae contains small or very small distomes covered with scale-like spines. Opisthorchiidae comprises small to medium sized distomes, rarely very long with weakly developed suckers. In Gastrothylacinae a ventral sac formed by invagination of ventral body wall is enclosed within the body, opening to exterior by a small opening near the anterior end.

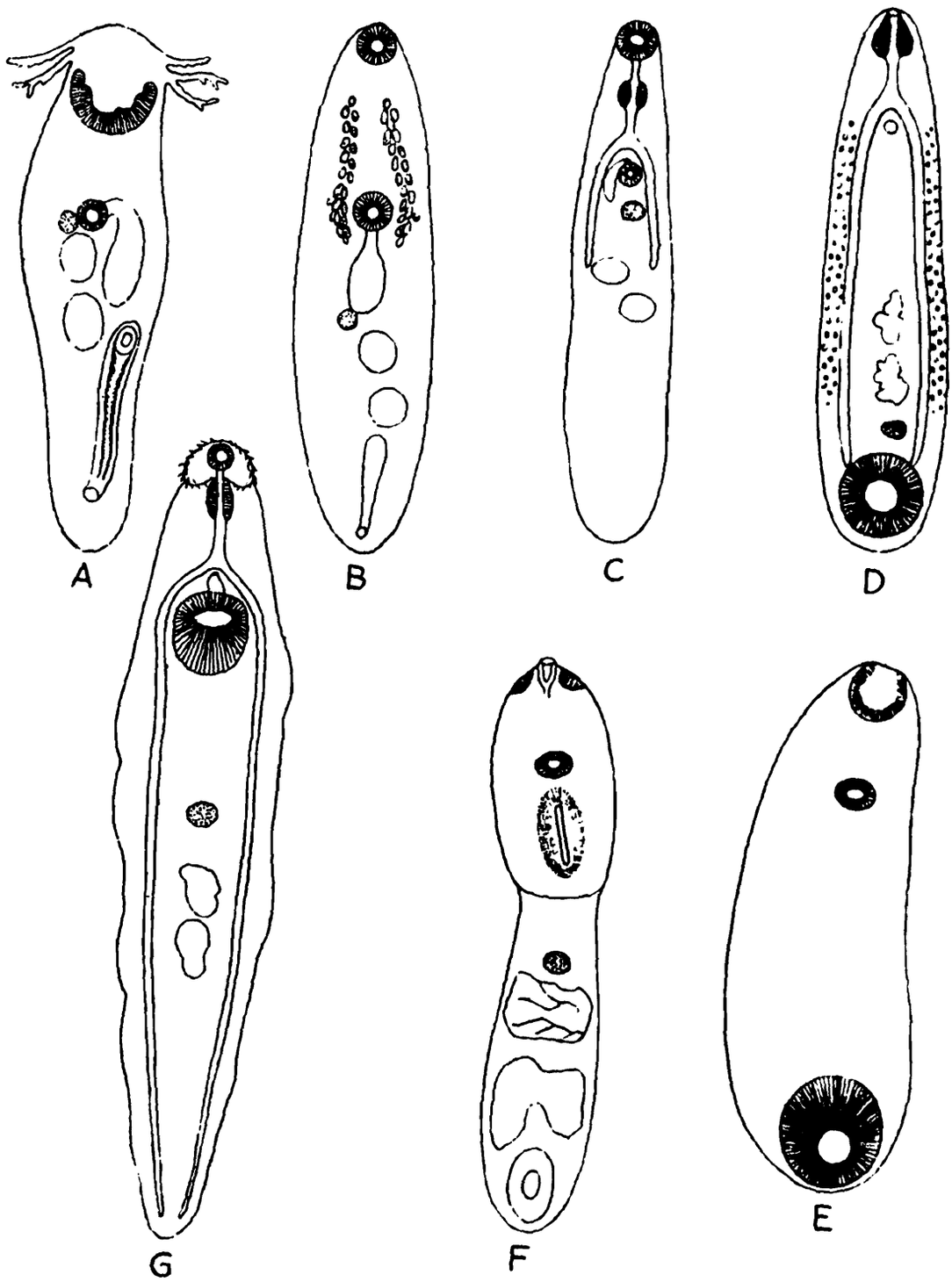


Fig. 1. A-G. Semidiagrammatic, illustrating morphological patterns of various digentic trematodes : A. *Bucephalus*; B. *Bucephalopsis*; C, *Tremiorchis ranarum*; D. *Paramphisotmum*; E. *Cotylophoron*; F. *Diplostomum* showing tribocytic organ; G. *Echinostoma* showing collar spine.

In Echinostomatidae (Fig. 1, G) the acetabulum is large usually situated close behind oral sucker. The anterior end of body is modified in this family as head collar or collar, which is marked off as a fleshy anterior region armed with a single or double crown of stout collar spines. The collar is reniform or disc-shaped, and the collar spines are marginal and ventro-lateral; sometimes the ventral corner group is separated off from the rest. In the Echinostomatinae the collar spines in single or double rows are continuous dorsally, but they are interrupted in the subfamily Echinochasminae; the collar spines are absent on the ventral bay *i.e.*, where the collar is lacking. The collar is large, bilobed, horse shoe-shaped of characteristic form with a deep dorsal incision and large ventral bay in *Patagifer* Dietz (Fig. 23); it is large disc-shaped without dorsal incision in *Nephrostomum* Dietz (Fig. 22) with single row of spines (Nephrostominae). In *Pegosomum* Ratz (Pegosominae) the collar is reduced to two dorsally uninterrupted rows of spines. A head collar is usually present in monostomes of Pronocephalidae, but it is quite different and without spines. Notocotylidae which is closely related to Pronocephalidae comprises small elongate or oval monostomes with more or less concave or flat ventral surface and provided in the genus *Notocotylus* Diesing with glands in three longitudinal rows. In *Notocotylus* (*Notocotylus*) *babai* Bhalerao the ventral glands are 15 or 16 in middle row and 17 in each lateral row. In *Gastrodiscoides* Leiper (Fig. 72) the body is divided in small anterior conical portion and large discoidal, ventrally excavated posterior portion. In *Chaunocephalus* Dietz (Fig. 2) the body is divided into a large hemispherical or pyriform bulbous region abruptly tapered into a tail-like shorter posterior region. The head collar in this genus with dorsally uninterrupted double row of spines is small, and the acetabulum is situated much behind oral sucker at about middle of cylindrical posterior region.

In Diplostomidae, Strigeidae and Proterodiplostomidae the body is distinctly or indistinctly divided into two parts, forebody and hindbody. In the former (Fig. 1F) the forebody is more or less ventrally concave with lateral margins posteriorly inrolled and sometimes united. In Strigeidae and Muehlingininae (Cyathocotylidae) the forebody is cup-shaped due to fusion of lateral extensions of body surrounding ventral concavity enlarged into a deep cavity around acetabulum and tribocytic (holdfast) organ. Cyathocotylidae have usually unsegmented or indistinctly bisegmented body.

The tribocytic organ or holdfast organ (Haft-organ) of Strigeata is characteristic of this group in the Digenea. It

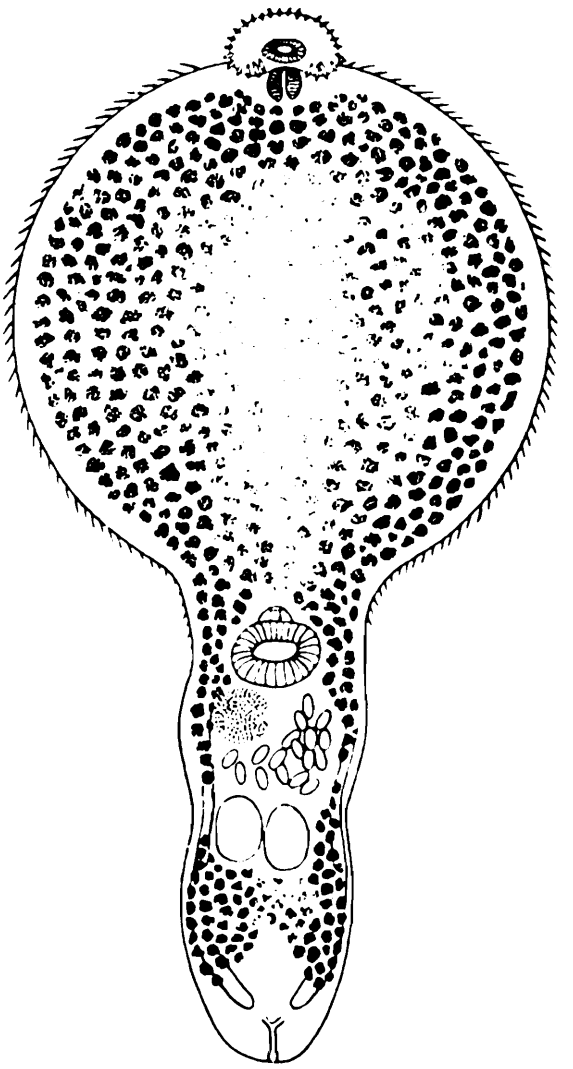


Fig. 2. *Chaunocephalus ferox* (after L, Szidat, 1935).

was previously considered as adhesive in function, but it is now known to have important role in digestion and ingestion of food. It is epithelio-glandular muscular organ formed from ventral body wall of forebody behind acetabulum. This organ is spherical or oval with or without cavity opening to exterior in Diplostomidae. In Cyathocotylidae also it is well developed, spherical or oval with a cavity and is simpler in structure. The proteolytic or adhesive gland is usually separate from tribocytic ogran in Diplostomidae, and lies close to its posterior margin as a compact mass; sometimes it lies diffuse in the wall of the tribocytic organ itself. In Strigeidae the tribocytic organ is bilobed with a base or divided into dorsal and ventral lobes, which are sometimes linguiform projecting out of the opening of forebody, rubbing

against the mucosa and entangled amongst the villi of the host's intestinal wall. The proteolytic gland or gland of holdfast organ (Druse der Haftorgan) lies quite apart from it posteriorly at junction of forebody and hindbody. The strigeids maintain a very strong attachment on the host's intestine by grasping villi between the holdfast organ and side walls of the forebody. The gland cells of the tribocytic organ and proteolytic gland pour out their secretion, which have a corroding effect on the host's tissues. *Diplostomum* V Nordmann, *Tylodelphys* Diesing, *Strigea* Abildgaard and *Cotylurus* Szidat have on either side of the oral sucker pseudosuckers, which are sucker-like depressions surrounded by gland cells.

Digestive system.—The prepharynx is usually small or absent; it is sometimes moderately long or long as in Lepocreadiidae and a few other families. The pharynx is well developed in most forms. It is absent in all families of Notocotyloidea and Schistosomatoidea, in subfamily Gorgoderinae and genus *Apharyngostrigea* Ciurea of Strigeidae. The oesophagus may be absent, short, moderately long or long. It is long, provided with large lateral lobes in Chaunocephalinae. It bifurcates in front of acetabulum into the intestinal caeca, the caeca are simple or provided with diverticula. *Euclinostomum* Travassos has caeca with long lateral branches. *Charaxicephalus* Looss has short outer and inner branches on the caeca throughout their course. In *Fasciola* Linnaeus the caeca are long and dendritic. In Cyclocoelidae and *Transversotrema* Witenberg the caeca are united posteriorly to form cycloid intestine. In Schistosomatidae the caeca are united to form long or short common caecum terminating near posterior end. In *Dendritobilharzia* the common caecum is provided with numerous dendritic branches. In *Plasmiorchis* Mehra the caeca form a short longitudinal loop at their origin on each side of oesophagus. In Opecoelinae the caeca open to the exterior by ani or open at their end into terminal part of the excretory vesicle or cloaca. In *Chaunocephalus* Dietz they also open at their ends into terminal part of the excretory vesicle near the excretory pore. In *Acanthostomum* Looss they open out through ani at their posterior end. In *Isoparorchis* Southwell the caeca have their anterior part modified as glandular stomach. The length of caeca varies in different groups or species; but they are usually long, terminating at or near posterior extremity. In Lecithodendriinae the caeca are short. In *Mesocoelium* Odhner they are half long. In Bucephalidae the mouth situated on ventral surface opens

into the pharynx, which is followed by saccular or tubular intestine terminating in front of posterior extremity.

Genital system.—The trematodes (Digenea) are hermaphroditic, except the family Schistosomatidae. There is usually a common genital pore, the opening of genital atrium in which the terminal parts of male and female ducts open: the latter open occasionally separately to the exterior near one another. The genital pore may lie median, submedian or laterally on ventral side at different levels in front of acetabulum. In Cephalogonimidae, Prosthogonimidae and Masenidae the genital pore lies at or near extreme anterior end. In Stomylotrematidae it lies to the left or right side at level of oral sucker or pharynx. In Parabascinae (Lecithodendriidae) the genital pore is submedian, lateral or submarginal at level of acetabulum. In *Vesperugidendrium* Pande (Lecithodendriidae) in which the acetabulum is modified into central circular depression bounded anteriorly and posteriorly by a muscular ridge and produced on each side into a sucker-like pouch, the genital pore lies in the middle of the acetabular depression. In *Basantisia* Pande and *Paragonimus* Braun the genital pore is postacetabular, submedian or median. In the order Strigeatoidea it is posteroterminal or dorsoterminal, near middle of body or further behind a short distance in front of hinder end. In Cyathocotylidae, Diplostomidae, Strigeidae and Proterodiplostomidae it is terminal or dorso-terminal. In Brachylaemidae it is submedian or median near posterior extremity or a little in front. In Bucephalidae it is ventro-terminal or terminal. In Harmotrematidae it is postequatorial or pre-equatorial, ventrolateral, sinistral or submarginal. In male *Bilharziella* Looss it lies to left side some distance behind acetabulum, but in the female it is immediately postacetabular. In *Schistosoma* Weinland the male is large and robust with lateral edges behind the acetabulum widened and incurved ventrally to form the gynaecophoric canal, in which the longer, narrower female lies mostly enclosed.

The testes are usually two, entire, lobed or branched, varying in shape. In *Paryphostomum* Dietz and *Artyfechinostomum* Lane the testes are deeply lobed or branched. They vary in position, oblique, tandem or symmetrically opposite according to species and genera in different families. In *Lecithodendrium* Looss, *Prosthodendrium* Dollfus, *Eumegacetes* Looss, *Exotidendrium* Mehra, *Caprimolgorchis* Jha they are symmetrically opposite at or near acetabular level. In Telorchiinae they are tandem at or near posterior extremity. In Strigeidae, Diplostomidae and most Proterodiplostomidae

they lie tandem in hindbody. The testis is single in *Haplosplanchnus* Looss (Haplosplanchnidae), *Lasiotocus* Looss syn. *Proctotrema* Odhner, *Hurleytrema* Srivastava, *Brahamputrotrema* Gupta (Monorchiidae), *Asymphylodora* Looss (Asymphylodoridae), *Haplorchis* Looss, *Haplorchoides* Chen (Heterophyidae) and *Diplodiscus* Diesing (Paramphistomidae). In a number of genera belonging to remotely related families the two testes have been split up into a number of follicles or numerous testes. The follicular testes occur in *Polyorchitrema* Srivastava (Cryptogonimidae), *Staphylorchis* Travassos, *Nagmia* Nagaty and *Gorgotrema* Dayal (Gorgoderidae), *Plasmiorchis* Mehra, *Learedius* Price and *Monticellius* Mehra (Spirorchiidae), all genera of Schistosomatidae, *Decemtestis* Yamaguti and *Helicometrina* Linton (Opecoelidae), *Charaxicephalus* Looss and *Diaschistorchis* Johnston (Pronocephalidae).

The vasa efferentia unite to form usually a short, rather inconspicuous vas deferens, which soon after its entrance into cirrus sac swells up to form thin walled sac-like, straight, bipartite or coiled vesicula seminalis, followed by small oval or long tubular pars prostatica surrounded by prostate gland cells. The latter continues into narrow muscular ductus ejaculatorius with its distal part, the eversible cirrus. The entire vas efferent apparatus is usually enclosed in cirrus sac with muscular walls. The cirrus is long or small, unspined or spined. It is usually long in species with large muscular cirrus sac. The cirrus is unspined in *Plagiorchis* Luhe, *Tremiorchis* Mehra and Negi, but *Echinostoma* Rudolphi, *Artyfechinostomum* Lane and *Spinometra* Mehra have spined cirrus. The cirrus is small in species with small, thin walled cirrus sac (*Stephanoprora* Odhner), very small, almost absent in *Echinochasmus* Dietz. It is absent in Lecithodendriinae, which possess pseudocirrus sac with thin parenchymatous walls. The cirrus sac is fairly large in some genera of Plagiorchiinae, extending a little behind acetabulum (*Plagiorchis* Luhe, *Tremiorchis* Mehra and Negi) and *Styphlodora* Looss. It extends much behind acetabulum in *Spinometra*. In many genera of Echinostomatidae the cirrus sac is almost preacetabular, slightly overlapping acetabulum or anterodorsal to it. In *Mehlesia* Johnston and *Psilocllaris* Singh (Psilostomidae) it is mostly preacetabular, slightly overlapping acetabulum. In Cyclocoelidae the cirrus sac is small, extending to hinder end of pharynx or intestinal bifurcation. In *Cercorchis* Lühe (Telorchiinae) it is very long and extends much behind acetabulum. In *Holostephanus* Szidat and *Cyathocotyle* Mühling it is large extending anteriorly to testicular region or just behind it. In *Muehlingina* Mehra it is

large with its terminal part protrusible. The protrusible part of cirrus sac in this genus consists of small bulb-like proximal region which when protruded lies within genital atrium, continuous with long distal region containing long needle-like cirrus. In *Acanthocolpus* Lühe and *Stephanostomum* Looss (Acanthocolpidae) the cirrus sac is very long, extending much behind acetabulum; the cirrus is long and spined. The cirrus sac is preacetabular in Fellodistomidae. It is horizontally placed in *Yamagutia* Srivastava as a club-shaped organ between caeca and acetabulum. In *Hurleytrema* (Monorchiidae) the cirrus sac is long, extending much behind acetabulum and the cirrus is densely spined. In *Asymphylodora* Looss it is small, postero-lateral to acetabulum. The cirrus is spined and the genital pore is sinistral marginal or submarginal at the level of acetabulum. The cirrus sac is absent in Haplosplanchnidae, Gorgoderidae, Hemiuridae, Isoparorchiidae, Opisthorchiidae, Acanthostomidae, Heterophyidae, Cryptogonimidae, Paragonimidae, Strigeidae, Diplostomidae, Proterodiplostomidae, genera *Paramphistomum* Fischoeder, *Cotylophoron* Stiles and Goldberger, *Gastrothylax* Poirier, *Gastrodiscoides* Leiper of Paramphistomidae. It is absent in *Schistosoma* Weinland, *Bivitellobilharzia* Vogel and Minning and *Ornithobilharzia* Odhner of Schistosomatidae and *Ganeo* of Pleurogenetinae.

In Lepocreadiidae the vesicula seminalis externa is present in addition to vesicula seminalis interna contained within cirrus sac. In the families Notocotylidae and Pronocephalidae the vesicula seminalis externa is well developed. In Ogmocotylinae (Notocotylidae) the enormous cirrus sac is curved in the form of C, enclosing entire seminal vesicle, prostatic complex and long ductus ejaculatorius.

In almost all groups in which the cirrus sac is absent, the hermaphroditic duct formed by the union of terminal part of the male and female ducts is present. The hermaphroditic duct may open directly to the exterior (Haplosplanchnidae, Opisthorchiidae, Acanthostomidae, Hemiuridae and Isoparorchiidae). In the last two families the hermaphroditic duct is surrounded by hermaphroditic or sinus sac, which is often muscular and functions as the cirrus. In Heterophyidae and Cryptogonimidae the hermaphroditic duct, distinct or indistinct, may be associated with cutaneous copulatory structures, the gonotyl or gonotyle. In *Heterophyes* Cobbold the gonotyl is sucker-like with a crown of spines in which the male and female pores are united. The genital pore lies antero-lateral to acetabulum, which is well developed. In *Phagicola* Faust (Ascocotylinae) the seminal vesicle is bipartite,

the genital atrium contains sometimes gonotyls and opens immediately in front of acetabulum. In *Haplorchis* Looss the ventro-genital sac is present, which is median, post-bifurcal and contains acetabulum modified with cavity reduced, with groove mid-dorsally or notch on left side opposite genital pore; divisible (except in *Vanissimus*) into nucleated base, with parenchymatous medulla embedded in body, and armed with spines, usually solidly muscular apex projecting into ventrogenital sac; gonotyl is absent. In *Mehrailla* Srivastava (Cryptogonimidae) the seminal vesicle is long, constricted and twisted; the pars prostatica is ill defined and ductus ejaculatorius well developed. The genital pore lies just in front of acetabulum in genitoacetabular depression. In *Polyorchitrema* Srivastava (Cryptogonimidae) the seminal vesicle is tubular, pars prostatica and ductus ejaculatorius are well developed. The short ductus hermaphroditicus opens into genital atrium which contains acetabulum and roughly triangular chitinous gonotyl. The genital pore is postbifurcal and triangular. In *Haplorchoides* Chen (Haplorchiinae) the vesicula seminalis is bipartite and very large. Genital pore lies to one side of median line immediately behind intestinal bifurcation, at or just outside caecum. It opens into ventrogenital sinus, containing imbedded reduced acetabulum carrying a circlet of weakly chitinised fret saw-shaped rodlets in a single row, 36–40 or 40–48 in number. Gonotyl is absent as in *Haplorchis*. Pearson (1964) transferred *Haplorchoides* from Cryptogonimidae to Haplorchiinae, Heterophyidae.

In *Levinseniella* Stiles and Hassall (Microphallinae) the papilli-form cutaneous cirrus projecting into genital atrium is produced outwards to join the metraterm and opens by the side of acetabulum. In Haploporidae (Waretrematidae) the vesicula seminalis externa leads into the vesicula seminalis interna, which along with the succeeding prostatic complex, ductus ejaculatorius, metraterm and ductus hermaphroditicus lies enclosed in hermaphroditic sac. In *Paramphistomum* and *Cotylophoron* the coiled vesicula seminalis is followed by well developed pars prostatica, which opens into ductus hermaphroditicus usually passing through a genital papilla contained within genital atrium. In *Cotylophoron* the genital sucker is present. In *Nicollodiscus* Srivastava and *Helostomatis* (Fukui) both cirrus sac and genital sucker are present. In *Caprimolgorchis* Jha the cirrus sac contains vesicula seminalis and pars prostatica; the latter opens into narrow tubular genital atrium armed internally with spines. The body region containing genital atrium and terminal part of the

cirrus sac is surrounded by well developed genital sucker, which is also armed with spines. The tubular genital atrium is surrounded by the genital sucker and is eversible. It appears to be analogous to the gonotyl of Heterophyidae and Cryptogonimidae.

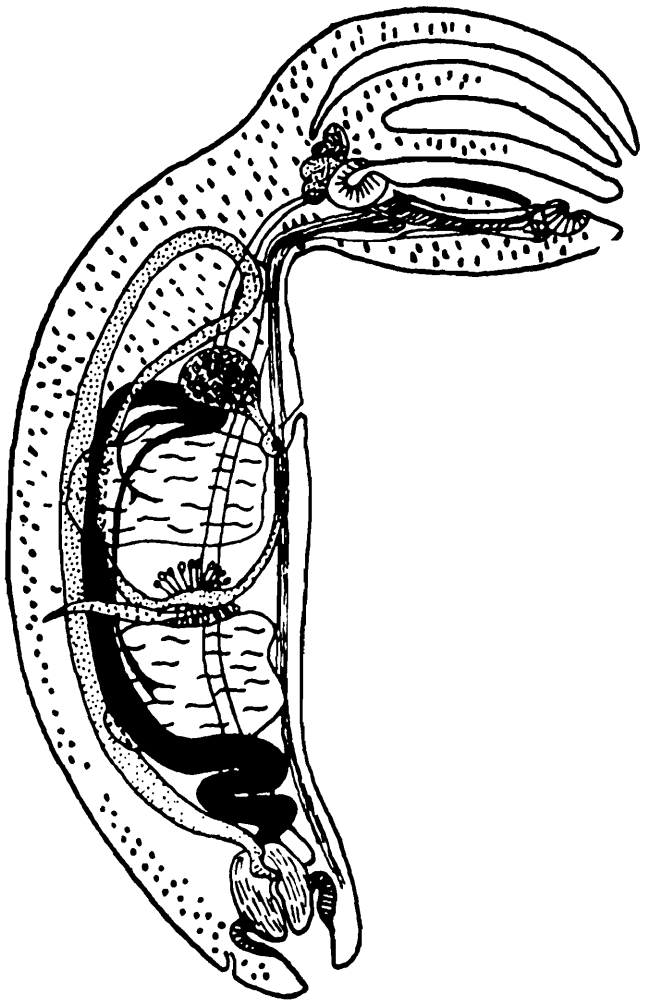


Fig. 3. Diagrammatic, schematic structures of *Strigea strigis* (after L. Szidat 1928).

In Cyathocotylidae, Diplostomidae, Proterodiplostomidae and Strigeidae the genital atrium is large with its terminal or dorsoterminal opening. In Strigeidae and Diplostomidae it is modified as copulatory bursa. In Strigeidae the hermaphroditic duct passses through a well developed muscular genital cone opening into fairly deep bursa at its base. The genital cone is sharply separated by its musculature from the body parenchyma. In *Strigea* (Fig. 3) the genital cone

is surrounded by a sucker-like sphincter, which lies between it and the basal walls of the bursa. In *Cotylurus* (Fig. 4) the bursa forms a protrusible pouch-like genital bulb, and the genital cone is absent; the terminal part of uterus and ductus ejaculatorius converge and open anteriorly on the side near the angle formed due to the formation of protrusible genital bulb at the base of the bursa. In *Schwartzitrema* Vigueras (Strigeinae, Cotylurini) the bursa is shallow with large muscular genital cone; basal part of ductus ejaculatorius is dilated to form the ejaculatory pouch; the genital cone is protrusible. In *Diplostomum* the hermaphroditic duct may open directly or through the genital cone in the bursa at its base. In *Tylodelphys* the genital cone is prominent. In *Bolbophorus* Dubois the bursa is provided with muscular bulb at its base dorsal to the genital cone. In *Posthodiplostomum* Dubois the bursa is evaginable; the genital cone enclosing hermaphroditic duct is well developed. In *Neodiplostomum* Railliet the bursa is variable in development; the genital cone may be prominent, reduced or absent. In *Subuvulifer* Dubois a prepuce-like fold inserted ventrally in the wall of bursa surrounds the genital cone, at the tip of which the hermaphroditic duct opens. In *Neelydiplostomum* Gupta (Proterodiplostomidae) the ejaculatory duct opens into bulb-like part of paraprostate, whose narrow duct-like part passes through the large genital cone opening into the bursa. An accessory genital cone with terminal swollen constricted prepuce is present. In *Proalarioides* Yamaguti the ejaculatory duct is long. Its distal part after joining the distal part of the uterus forms the hermaphroditic duct, which is enclosed in muscular bulb. The hermaphroditic duct opens at the apex of a conical protuberance projecting into the large genital atrium surrounded by musculature.

The ovary is single entire or lobed. It is multilobed or follicular in *Prosthogonimus* Luhe, four or five lobed in *Lecithaster* Lühe (Hemiuridae). It lies median, submedian to right or left side and anterior to testes in many families. The ovary is post-testicular in Dicrocoeliidae, Paramphistomidae, Hemiuridae, Isoparorchiidae, Spirorchiinae and Thapariellinae (Brachylaemidae). It is exceptionally pretesticular in Hemiuridae. In Isoparorchiidae it is a slender winding tube much behind testes. It is intertesticular in Clinostomidae, Brachylaemidae, Harmotrematidae and Coeuritrematinae (Spirorchiidae). It is usually rounded, ovoid or pear-shaped, and the oviduct originates from its inner margin near posterior end. The oviduct after running a short



Fig. 4. *Cotylurus cornuatus* Rud. Male genital apparatus reconstructed from sections (after L. Szidat, 1928).

distance is joined by the duct of receptaculum seminis and soon after by Laurer's canal and the duct of vitelline reservoir. In some species Laurer's canal arises from the duct of receptaculum seminis. The Laurer's canal is a moderately long winding tube which runs backward or forward after its origin from the oviduct or receptaculum seminis, and then upward to open on the dorsal surface near median line by a minute pore, which is lined by cuticle continuous with that of the bodywall. The receptaculum seminis is ovoid or pear-shaped and lies median or to one side closely behind the ovary. The relations of female ducts are shown in Fig. 5. The oviduct soon after joining these ducts becomes dilated to form the ootype surrounded by conical cells of Mehlis' gland which pierce through the wall of the ootype by their long, narrow ductule-like portion. The Mehlis' gland complex or shell gland complex consists of the ootype with Mehlis' gland around it, the part of the oviduct connected with it into which Laurer's canal, the duct of receptaculum seminis and vitelline reservoir and the origin of uterus from the ootype at the end

opposite to that where the oviduct enters it. Mehlis' gland complex occupies median or submedian position behind and inside the ovary. The receptaculum seminis is large and prominent in Opisthorchiidae. It is well developed in Plagiorchiidae, Brachycoeliidae, Dicrocoeliidae, Lecithodendriidae, Prosthogonimidae, Hemiuridae, Cryptogonimidae, Acanthostomidae, Heterophyidae and Telorchiidae. The receptaculum seminis is absent in Echinostomatidae, Fasciolidae, Acanthocolpidae, Cyathocotylidae, Diplostomidae, Strigeidae, Proterodiplostomidae, Notocotylidae and a few other groups. Laurer's canal is rarely absent. In Paramphistominae Laurer's canal may or may not cross the excretory vesicle; its position relatively to the excretory vesicle is of taxonomic importance in this subfamily. In *Paramphistomum* and some species of *Cotylophoron* Laurer's canal crosses the excretory vesicle, whereas in *Ceylonocotyle* Näsmark it does not cross the latter. Mehlis' gland which is usually postovarian is preovarian in Notocotylidae, intertesticular in Diplostomidae and Strigeidae. The initial coils of the uterus filled with sperms form the receptaculum seminis uterinum, which is present in forms in which the receptaculum seminis is absent. It is prominent in Cyathocotylidae and some genera of Echinostomatidae. The uterus is large, much convoluted and filled with numerous eggs in its descending and ascending coils. It first proceeds towards posterior end as a descending limb and then near posterior end turns forwards towards the genital pore as the ascending limb. Its terminal part with muscular wall called the metraterm with internal cuticular lining varies in length and serves as the vagina. The metraterm is armed with spines in Acanthocolpidae, Monorchiidae, Asymphylodoridae, Exotidendriinae. In some families, Fasciolidae, Echinostomatidae, Acanthocolpidae, Lepocreadiidae, Opecoelidae and Allocreadiidae the uterine coils are confined to preovarian or pretesticular region, the descending limb being absent. In Clinostomidae the uterus has characteristic U-shaped course, consisting of a narrow ascending limb, the uterine duct and the large wide sac-like descending limb, the uterine sac. In *Clinostomum* Leidy, *Euclinostomum* Travassos and *Clinostomoides* Dollfus the uterus arises from the ootype between the two testes and after making a few coils passes round the right side of the anterior testis as ascending limb and opens into the uterine sac at or near the anterior end, a little behind acetabulum or much behind the latter close in front of anterior testis. The uterine sac terminates into short metraterm. The genital pore lies median, immediately in front of anterior

testis in *Euclinostomum*. In *Clinostomum* it lies to left side of anterior testis at varying levels or a little behind, between the testes. The short cirrus is usually found inserted into the metraterm. In *Clinostomoides* the uterine sac is tubular, extending anteriorly to middle of body, much behind acetabulum; the distance between anterior end of uterine sac and acetabulum is much longer than between the two suckers. Posteriorly the uterine sac is continued behind anterior testis as the long metraterm opening at genital pore behind intertesticular space in level with the posterior testis.

The uterus is extremely small in Spirorchiinae and Bilharziellinae; in these blood flukes it is almost reduced to the ootype with one or a few eggs. The uterus is very short, containing 1–3 eggs in *Gogatea* Lutz and *Mesostephanoides* Dubois. In Cyathocotylidae the eggs are a few not exceeding 100. The eggs in uterus may be large, medium sized or small and usually operculated, sometimes provided with a long polar filament (Notocotylidae, Pronocephalidae).

The vitellaria are of much taxonomic importance. They are usually lateral, dendritic composed of numerous follicles in acini crowded in continuous bands or follicles may be arranged in groups or grapelike bunches more or less separate from one another. The length of vitellaria varies; but they usually extend along the length of caeca or most of body length. As they are composed of clustered follicle, small ducts from clusters join in a longitudinal duct, which at the level of ovary gives off a transverse vitelline duct towards the median line. The two transverse ducts join to form a small enlargement, the vitelline reservoir; sometimes common, rather indistinct duct or reservoir may be formed by the union of transverse ducts. The reservoir or common duct opens into the oviduct in the Mehlis' gland complex. In Echinostomatidae, Acanthocolpidae, Lepocreadiidae, Opecoelidae and Homalometridae the vitellaria extend mesially behind testes towards one another or become confluent to form a median post-testicular mass. In *Chaunocephalus* the vitellaria are extensive, uniting to form a large mass of follicles filling the large bulbous forebody, but are restricted to lateral fields in hind body. The vitellaria are postovarian, characteristically compact, lobed or branched and of restricted size in Hemiuridae. In Lecithasterinae they are composed of seven rosette-shaped or claviform lobes in *Lecithaster* Lühe, seven rosette-shaped in *Hysterolecitha* Linton, seven rounded lobes in *Aponurus* Looss. In *Apha-*

nurus Looss they form a single compact mass, in *Opisthadena* Linton two compact masses immediately behind ovary. In *Prosorchis* Yamaguti they are tubular, composed of seven very long convoluted lobes extending between ovary and posterior extremity. In *Lecithochirium* Lühe (Sterrhurinae) they are digitiform of varying length. In *Lecithocladium* Lühe (Dinurinae) they consists of seven long winding tubles, in *Stomachicola* Yamaguti and *Allostomachicola* Yamaguti (Stomachicolinae) of seven slender winding tubular lobes partly running through uterine coils or extending laterally. In *Inderogenes* Srivastava, *Genarchopsis* Ozaki and *Halipegus* Looss (Derogenetinae) the vitellaria are compact glands each divided into two lobes or composed of four to five lobes at posterior extremity. In *Isoparorchis* Southwell they form a median dendritic mass consisting of several subdivided branches immediately behind ovary. The vitellaria of Gorgoderidae are small, compact, lobed or branched post-acetabular masses, usually intercaecal, occasionally extra-ceacal. In *Gorgoderina* Looss and *Phyllodistomum* Braun they are compact or lobed, in front of or on each side of ovary. In *Staphylorchis* Travassos and *Nagmia* Nagaty they are almost median, intercaecal, small, consisting of tubular acini. In *Gorgotrema* Dayal they are median, ubranched in level with ovary. In Haplosplanchnidae they are pretesticular in hindbody. The vitellaria have systematic importance in Lecithodendriidae. In *Lecithodendrium* they form grape-like bunches behind testes. In *Prosthodendrium, Caprimolgorchis, Vesperugidendrium* and *Basantisia* they are prestesticular. In *Schistosoma, Bivitellobilharzia, Bilharziella* and *Dendritobilharzia* they extend behind ovary along common caecum to posterior extremity. In *Proalarioides* and *Neelydiplostomum* they are confined to forebody; in the former they may intrude into the hindbody. In subfamily Strigeinae they extend into both forebody and hindbody in its sub-subfamily Strigini Dubois, whereas in its sub-subfamily Cotylurini Dubois they are confined to hindbody. In the subfamily Alariinae Hall and Wigdor they are confined to forebody; in the subfamily Diplostominae they extend into both forebody and hindbody in its sub-subfamily Diplostomini Dubois, whereas in the sub-subfamily Crassiphialini Dubois they are mainly confined to hindbody.

Excretory system.—This system is known to be most conservative in the morphology of Trematoda, Digenea. The classification of the subclass into higher taxonomic units of superfamily or family rank is based on the development of excretory system in the cercariae and the cercarial characters.

The shape of the excretory vesicle and general pattern of the excretory system i.e., the distribution and arrangement of capillary groups and collecting tubes is generally constant for families. It may, however, be pointed out that it has not been studied in many cases.

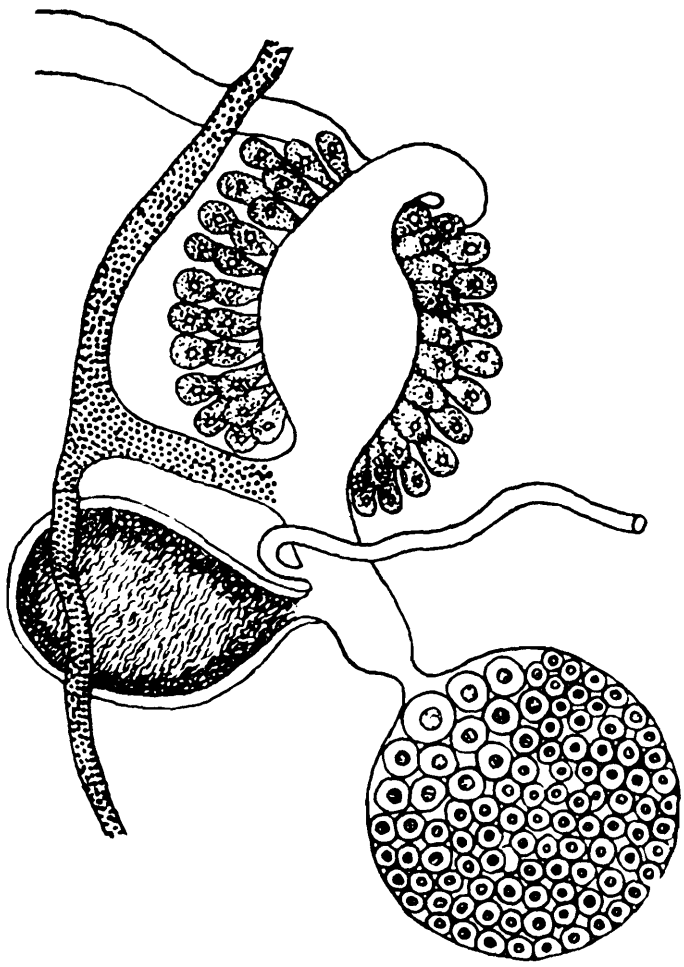


Fig. 5. Femal genital system of *Mesocoelim sociale* (after Sewell, 1920. *Rec. Ind. Mus.*).

The excretory pore is always single, terminal or subterminal near posterior end of body in the adult. The miracidia, sporocysts and rediae have a pair of excretory pores near posterior end. In miracidia of all orders except Strigeatoidea these pores lead into their respective excretory tubes each ending in a flame cell. But in Strigeatoidea the miracidia have the two excretory tubes ending in two pairs of flame cells, i.e., each tube ends in a pair of flame cells. The flame cell formula of the miracidium of Strigeatoidea is

2(1+1) = 4, whereas for the miracidium of other orders it is 2(1) = 2. In the sporocyst and redia the number is increased to four or six flame cells. In the developing cercaria the number is further increased by multiplication on each side. It is well known that the two main excretory canals in the cercarial embryo come near one another and ultimately become fused when the tail is formed near the junction of the body with the developing tail and the caudal canals thus formed resulting by this partial fusion or contact, with the original excretory pores are carried into the tail (Fig. 7 from Hussey, 1941). When the cercaria is fully developed, the original pores in the tail become the excretory pores of the cercaria and a new excretory pore is formed in the excretory vesicle at junction of body with the tail, or on the vesicle antero-drosal to acetabulum, a little in front of the posterior end of body in Paramphistomidae. The single tailed cercaria of Fasciolatoidea and fork-tailed cercariae of Strigeatoidea show the caudal excretory canal, which is characteristic of the higher taxonomic units of superfamily level. In the furcocercous cercariae the caudal canal is long and bifurcates into two branches, one running into each furca with the original excretory pores near the end of each branch, and the flame cells are present in the tail stem in Strigeatoidea. In the single tailed cercariae the length of the caudal excretory canal with the primary excretory pores on it differs in various superfamilies. In the cercariae of Paramphistomoidea the caudal canal is long with the primary excretory pores near its end, which close soon after the formation of the definitive pore on the excretory vesicle antero-drosal to acetabulum. In all other superfamilies the secondary excretory pore is formed by the contact of the fused tubes with the ventral bodywall at posterior end of body. In superfamily Echinostomatoidea the caudal canal is considerably reduced in length and the primary pores are left at the end of each short lateral branch a little behind the body-tail junction where the secondary excretory pore is formed. Exceptionally the caudal excretory canal may be longer. The formation of V-shaped or Y-shaped excretory vesicle in the adult is the result of union of the anterolateral parts of the excretory vesicle and the posterior parts of the common collecting ducts connected with it. The excretory system of *Ommatobrephus lobatum* Mehra, 1931 and of *Singhiatrema longifurca* Simha, 1958 closely resembles that of echinostome cercariae. The protonephridial system of echinostomes and amphistomes is stenostomate. The common collecting ducts of echinostome cercariae, adult *O. lobatum* Mehra and *Singhiatrema longifurca*

Simha are long, and turn back on either side of oral sucker or pharynx to proceed backwards to receive their tributaries. In cercaria of *Artyfechinostomum sufrartyfex* (*Cercaria mehrai*) and other echinostome cercariae, *C. Indicae* XII and XXIII and cercaria of *Echinoparyphium bagulai* Jain, 1961 the protonephridial system is similar. In the adult echinostomes the common collecting ducts become dilated and acquire muscular walls and become united forwards from the definitive excretory pore to give the Y-shaped excretory vesicle of the Echinostomatidae.

In the superfamily Opisthorchioidea the cercaria has the caudal excretory canal further reduced than in the echinostome cercariae, and the epithelial layer is formed around the primary excretory vesicle from mesodermal cells near the locus of the vesicle; the secondary excretory pore is formed at the junction of body and tail. The original (caudal) pores close and disappear; the secondary pore becomes the excretory pore of the adult.

In the xiphidiocercariae of Plagiorchioidea the primary excretory canals never enter the tail. The caudal excretory canal is absent in these cercariae. In Acanthocolpidae of the superfamily Allocreadioidea, however, the caudal canal is slightly longer than in the echinostome cercariae and its lateral branches are also present. Acanthocolpidae connects the suborders Echinostomata and Plagiorchiata. The V-shaped excretory vesicle of Lecithodendriidae and Y-shaped excretory vesicle of Plagiorchiidae are developed from the small excretory vesicle of the cercaria of these families. The V-shaped excretory vesicle occurs in Ommatobrephidae and Singhiatreminae amongst the Echinostomatoidea. Psilostomidae has Y-shaped vesicle like most members of Echinostomatoidea. In Cryptogonimidae, Opisthorchiidae, Acanthostomidae and Heterophyidae the vesicle is Y-shaped. In Hemiuridae and Isoparorchiidae excretory vesicle is Y-shaped with long arms united anteriorly in most genera. The Hemiurid or Cystophorous cercaria is highly modified with complicated tail consisting of the main part, the vesicle with five appendages. It has the excretory system developed in the primitive manner, the fused tubes extending to the tip of one part of the highly modified tail. An epithelial layer is formed around the excretory vesicle from a mesodermal fundament as in Pleurolophocercous (opisthorchoid) cercariae and stylet cercariae. Flame cells occur in the tail of developing cystophorous cercariae; all caudal parts of the excretory system are lost before the cercaria reaches maturity.

The protonephridial system of Trematoda is of two types,

stenostomate and mesostomate on account of the differences in the common collecting tubes and position of their main tributaries. In the stenosotmate type the main excretory canals or common collecting ducts extend forwards to the region of oral sucker or pharynx where they form a loop to continue their backward course for some distance before receiving their tributaries. In the mesostomate type the common collecting ducts are short and extend to almost the midregion of cercaria, a little behind acetabulum, where each receives its tributaries, the anterior and posterior collecting ducts. The stenostomate type occurs in all families of Echinostomatoidea, Paramphistomoidea and Notocotyloidea, Acanthocolpidae, Hemiuridae, Cryptogonimidae, Opisthorchiidae and families of Azygiatoidea, Fellodistomoidea and Brachylaemoidae. The mesostomate type occurs in Lecithodendriidae, Plagiorchiidae, Brachycoelidae, Dicrocoeliidae and families of Allocreadioidea except Acanthocolpidae, Cyathocotylidae, Diplostomidae, Strigeidae and Clinostomidae.

The excretory system of *Mesocoelium sociale* (Fig. 6) and *Tremiorchis ranarum* Mehra and Negi are known. In the former the excretory vesicle is long, tubular with two short diverticula at the dilated anterior end; in the latter also it is tubular, club-shaped and produced into two rudimentary cornua. So in both the excretory vesicle is cylindrical with two short or rudimentary cornua, each of which receives a common collecting tube, which runs diagonally to receive the anterior and posterior collecting tubes at about the level of acetabulum. The excretory system of both these species is summarized in the formula "$2\times6\times3$" = 36. Fig. 6 shows the distribution and arrangement of capillary groups and collecting tubes. Each anterior and posterior collecting tube receives three accessory collecting tubes, each of which is formed by three capillaries originating in three flame cells.

In *Plagiorchis himalayi* the excretory vesicle is Y-shaped with long stem bifurcating into short wide cornua, a little behind the ovary. The cornua pass diagonally outwards, receiving at their anterior ends short collecting tubes dividing into anterior and posterior collecting tubes. The excretory system of Plagiorchiidae and Brachycoeliidae is closely similar as shown by these forms. In Dicrocoeliidae the flame cell formula is 2 $(2+2+2)+(2+2+2) = 2\times6\times2 = 24$, and the excretory vesicle is tubular or sac-like. The families Cephalogonimidae, Prosthogonimidae and Telorchiidae which are closely related to Plagiorchiidae, and included with it in the same superfamily possess Y-shaped excretory vesicle. In *Cephalogonimus* Poirier and some genera of Styphlodorinae

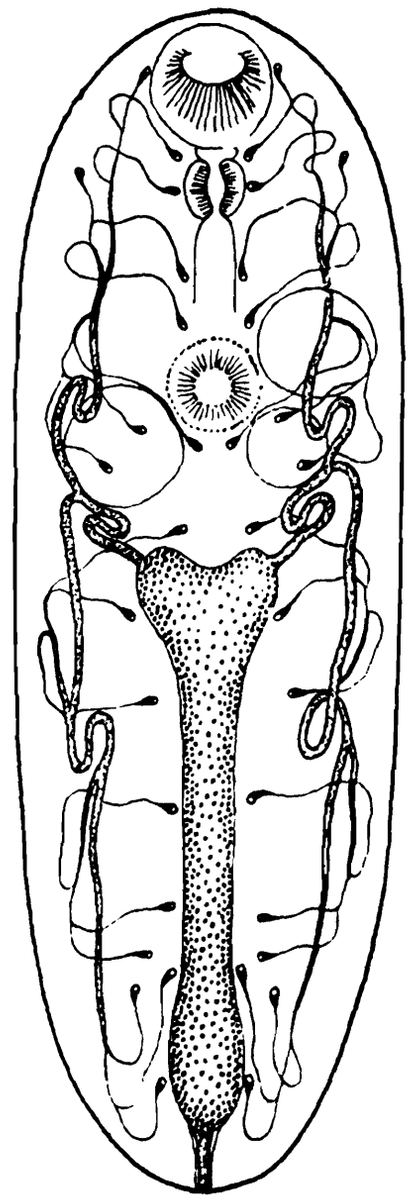


Fig. 6. Excretory system of *Mesocoelium sociale*. (after Sewell 1920. *Rec. Ind. Mus.*).

the excretory vesicle is provided with lateral branches. The tubular or sac-like excretory vesicle of Dicrocoeliidae, Lepocreadiidae and Paragonimidae is derivative of Y-shaped vesicle due to disappearance of the cornua. In the last two families the excretory vesicle is long and tubular. In Bucephalidae it is long, tubular with terminal excretory pore. In Brachylaemidae and Clinostomidae it is small, U-shaped or V-shaped with very short narrow stem and two long narrow canals. In Cyathocotylidae, Diplostomidae and Strigeidae it is small, V-shaped, rather inconspicuous in the adult and the excretory

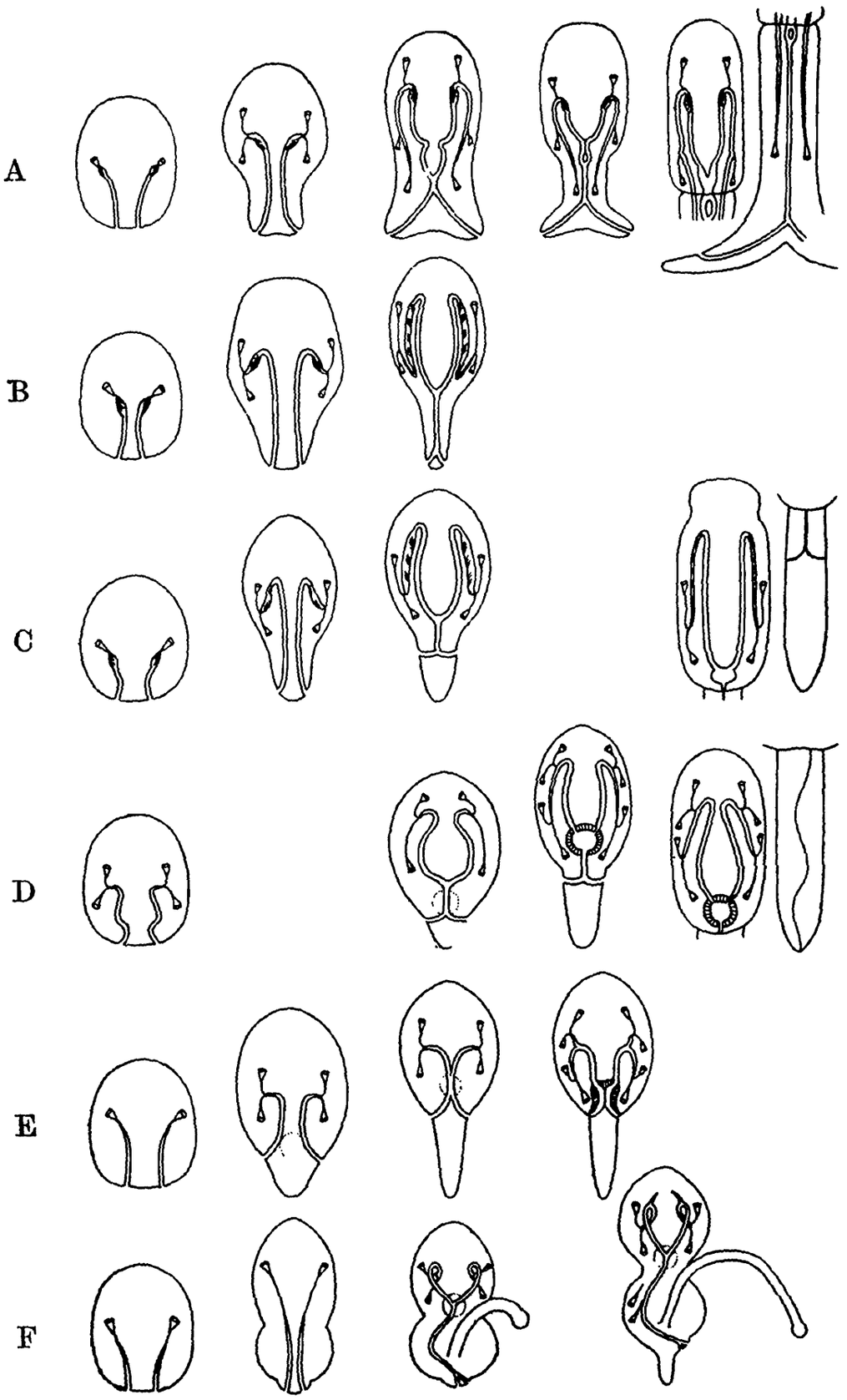


Fig. 7. (after Hussey. 1941) Excretory system : Comparison of development in six types of cercariae : A. Fork-tailed cercaria ; B. Schistosome cercaria.; C. Echinostome cercaria ; D. Pleurolophocercous cercaria ; E. Stylet cercaria ; F. Hemiurid cercaria.

system also comprises a subcutaneous network of vessels, with dorsal subterminal or almost terminal excretory pore. In Spirorchiidae and Schistosomatidae the excretory vesicle is Y-shaped with short stem and long latral canals reaching almost to anterior extremity. In Echinostomatidae the Y-shaped excretory vesicle is provided with extensively ramified lateral branches.

Lymphatic system.—In a few families, Paramphistomidae. Angiodictyidae, Apocreadiinae (Opecoelidae) there exists a system of longitudinal mesenchymatous vessels called lymph vessels, which though they are not connected with one another are associated with the excretory system and other organs of the body by their branches, forming plexuses around them, helping in the distribution of excretory and food substances. The function of these vessels is not definitely known. Hyman (1951) thinks that they possibly represent a primitive circulatory system. Tandon (1960) also mentions that the system represents a primitive circulatory system of vessels flattened with mesenchymatous cells and a fluid resembling primitive invertebrate blood. In *Paramphistomum*, *Cotylophoron* and *Ceylonocotyle*, *Gastrothylax* and *Fischoederius* the system consists of one pair of vessels. *Olveria* Thapar and Sinha (Cladorchiinæ) also possesses one pair of lymphatic vessels, but in some other genera of Cladorchiinae three pairs of vessels are present. In *Indosolenorchis* (Solenorchiinae) the system consists of two pairs of main vessels with numerous connections and branches connected with various organs of the body and lymphatic sinuses. Crusz (1951) has described it in some details. One pair runs dorsally, medial to caeca and closely adhering to the dorsal excretory canals. The members of the other pair run more ventrally, lateral to the caeca and between the vitelline follicles. Branches of these vessels are specially abundant in the region of excretory vesicles and its diverticulum with which they are inextricably bound. They are also present in the substance of the postacetabular lip and all round acetabulum. The lymph vessel is characterized by the finely granular, deeply staining nature of the coagulum contained in it. The coagulum represents the cytoplasm of lymph cells, the lymphocytes. The wall of the vessel is non-cellular and the vessel is obviously parenchymatous in origin. Willey (1930) described the system in *Cotylophoron cotylophorum* in which two vessels, one on each side of median line medial to caeca are present; each gives off ramified branches to caeca, reproductive organs and suckers. In *Olveria indica* and *Olveria bosi* two vessels give out branches in all directions. Anteriorly they give off four or five branches

forming plexuses near the oral sucker. Posteriorly they cross the caeca and give off a large number of branches ramifying all over the acetabulum. The main vessels during their course give branches to the oesophagus, caeca, reproductive organs and the excretory vesicle forming plexuses around them. In *Stunkardia* Bhalerao (Zygocotylinae) the system consists of two pairs of vessels. In the genera *Protocladorchis* Willey syn. *Maccullumia* Chatterji two pairs and *Nicollodiscus* Srivastava three pairs of vessels occur. The lymph vessels of *Megasolenia* Linton and *Haplodena* Linton resemble closely those of *Stunkardia*. Tandon (1960) described the lymphatic system of *Carmerius spatiosus*, *Gastrothylax* and *Fischoederius*. In these genera the lymphatic system has the same fundamental plan of structure (Fig. 8). The two longitudinal vessels running internally to caeca divide into two branches

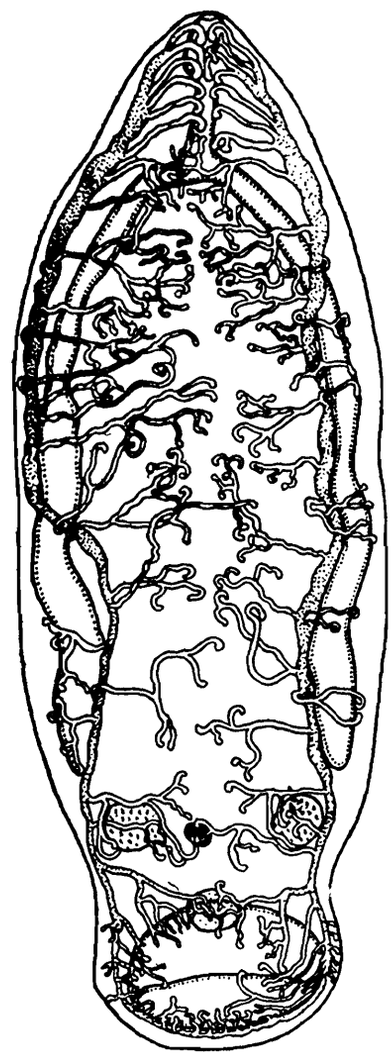


Fig. 8. Lymphatic system of *Gastrothylax crumenifer* (Crep. 1847) after Tandon 1960.

near the middle of acetabulum, one supplying the dorsal side, the other running postero-laterally gives many lateral branches to postero ventral part of acetabulum forming a network around it. At anterior end the longitudinal vessel divides into two branches at level of oral sucker; one branch runs in zigzag course to level of intestinal bifurcation, whilst the other divides into two supplying the oral sucker and oesophagus. Near the intestinal bifurcation the vessel gives three or four branches, each of which divides into two, and all these supply the oesophagus, caeca and reproductive ducts in the region. The caeca are surrounded by many branches from the vessels of the respective sides. The lymphatic plexuses around the testes are formed by transverse branches of the vessels of the respective sides, while the ovary gets its supply from both the sides, and branches come to it from those supplying the testes. The excretory vesicle is profusely surrounded by branches from both sides. Besides these the vessels give off a large number of slender wavy branches transversely in the general body, laterodorsally and lateroventrally as well as towards median line. These divide many times, giving secondary, tertiary and quarternary branches, which extend transversely in great length, resulting in the union of the branches of two sides in the median line. These branches finally terminate in knobbed ends. Lymphatic system of *Fischoederius elongatus* is essentially similar to that of *Gastrothylax crumenifer*.

Methods of examination and technique

Host animals should be freshly killed under chloroform and their gut removed from the end of buccal cavity to the anus or cloaca and divided into fairly large pieces in normal saline solution; pieces should be kept in saline solution in a glass dish preferably with low walls for 1–2 hours, during which time the fluid and walls of the gut should be examined. The strigeids do not detach themselves easily, therefore, the intestine should be thoroughly examined and fluid be carefully decanted off and changed several times for observing the parasites. The buccal cavity of birds (Ciconiformes), which contains distomes of Clinostomidae should be separately examined in normal saline solution. All other organs such as the heart with aortic arches, liver, gall bladder, bile duct, lungs, urinary bladder, kidneys, hepatic and mesenteric veins and other blood vessels should be examined. The body cavity and air sacs as well as lungs and trachaea of aquatic birds be examined for species of Cyclocoelidae.

The specimens should be fixed for entire mounts and sections in Bouin's fluid. For entire mounts specimens have to be flattened slightly under pressure of a coverglass, slide or glass plate depending upon the size and thickness of worms. For this purpose they should be gently tied by thread or string before they are kept in Bouin's fluid overnight. If they are small, they may be kept in the fixative for 2–3 hours. The specimens for sections should be transferred to the fixative straight without flattening and left in it for a few or more hours according to their size and thickness; ordinarily overnight fixation in Bouin's fluid is safer even for section cutting purpose.

The study of living specimens is necessary in the case of small worms and in other forms such as echinostomes. The excretory system can best be studied in the living worm under microscope. The flame cells become visible just before death. In the cercariae as well as adults the excretory system is of great taxonomic importance. It is generally assumed that the forms with a similar excretory system are closely related and with unlike patterns are distantly related, though there are some exceptions. The excretory vesicle, the main ducts with their tributaries can be studied and diagram showing them, the suckers, alimentary system and gonads should be drawn. The echinostomes for the diagram of collar and collar spines must be studied in living worm as some collar spines are likely to fall off during flattening or in course of transferring the material from fixative to various grades of alcohol. The position and number of collar spines is of taxonomic importance.

Bouin's fluid is the best fixative for all general purposes. Formalin 10% may be used when Bouin's fluid is not available. The specimens after fixation should be washed in water for a few hours and then transferred to 50% alcohol. They should be kept in 50% and 70% alcohol respectively overnight. 70% alcohol should be changed once after every 24 hours to remove the yellow picric acid colour of Bouin's fluid.

The stains to be used for entire mounts are :

1. 5% Aqueous solution of Haemalum diluted to 0.5 —1% strength for 5 minutes to half an hour according to the size of specimen, with several changes from tap water for differentiation to 0.1—1% HCL and back to water till the requisite stain is taken by the specimen and proper differentiation of ograns achieved. For this purpose watch glasses are used for keeping specimens in

water, the stain and acid water, and constant watching under the binocular is exercised to remove excess of stain. This stain gives the best results if it is properly used. It takes much less time than other stains.

2. Acidified carmine as recommended by W. Carl Gower in *Stain Technology* (1939) Vol. 14 :—"100 cc. of glacial acetic acid and 10 gms. of carmine are dissolved by heating and allowed to come to a boil. Cool and filter. Carefully remove the filter paper from the funnel and spread it out flat to dry. The filterate is Schneider's aceto-carmine and may be used for the uses indicated. When the residue left on the filter paper is quite dry, remove it as carefully as possible. It may be used at once or placed in tightly closed container for future use. The standing solution is made up as Mayer's carmalum, substituting acidified carmine described above for carminic acid. Acetic alum carmine diluted by distilled water by the addition of just sufficient stain to produce a port wine colour. The specimens may be left in this solution for 24 to 36 hours. The differentiation should be done in acid water, 0.5% HCL."
3. Delafield haematoxylin or Heidenhain haematoxylin differentiated with 3% iron alum, acidified water (0.5% HCL) or acid alcohol in the usual way. Delafield haematoxylin should be very dilute with a few drops of stain to a tube of distilled water to attain violet colour. The specimens may be left in this stain for 12–24 hours.

The best results were obtained by the first two methods, *viz.*, by Haemalum and Mayer's acidified carmine :

1. For staining sections Delafield haematoxylin diluted by one third stain to two-third of water is recommended. The stain should be differentiated by 0.5% acid water (dilute hydrochloric acid) or 3% iron alum. The slide with sections should be kept in the stain for 1–2 minutes according to discretion and experience. They should be washed in water or taken through grades of alcohol and differentiated in acid alcohol. If iron alum is used, the sections should be kept in it after washing in tap water. The sections should be counter-stained in 1% alcoholic eosine or orange G in 90% alcohol.
2. Heidenhain haematoxylin 1% solution and 3% iron alum method (overnight) followed by counter-stain of 1% alcoholic eosine or orange G in 90% alcohol gives good results.

Examination methods and technique for cercariae

The cercariae can best be examined in the living condition. Freshwater snails brought from ponds or swampy places should be kept in separate aquaria according to locality. For study they should be separated in tap water in a small glass vessel, the cercariae passed out be examined. The infected snails should be isolated and kept in glass tubes; the development and ripening of cercariae in germinal sacs (sporocyst or rediae) can take place for months after the samples have been taken. The collection of fresh snails from their natural environment should be kept under observation for a week. When infection has been determined and the cercariae identified; and if the number of infected snails is large, a snail may be dissected and the cercariae and germinal sacs taken out, studied and some fixed in hot 10% formalin. But for detailed study and diagram the cercariae as passed out of the snail must be relied upon; they should be studied alive in 0.35% solution of NaCl. During the slow evaporation of fluid cercaria passes in a state of asphyxia in which it keeps quiet for 10–30 minutes. In this interval it is studied and drawn. There should be enough number of specimens on separate slides to replace the dying ones. Just before death they are most suitable for study specially of the excretory system. This has been pointed out by Looss, 1894, Cort, 1918 and Wesenberg Lund, 1934. Simultaneously some specimens should be preserved in hot 5% or 10% formalin. It is necessary to use several specimens to obtain a drawing. The dimensions should be taken before their description. Wesenberg Lund has rightly pointed out that "the old manner of giving the cercaria a name was much better than that of calling them by numbers as done by Sewell, *Cercariae Indicae* I–LX. Dubois adopted the mode of nomenclature of Sewell and gave a list of cercariae I–XXXII. Szidat gave his species Letters, *Cercariae* A–C Szidat, "When the adult of the cercaria is known, the cercaria with its name should be placed under the name of the adult trematoda."

Intra-vitam staining with neutral red is recommended for study. Miller (1926) reported "Intra-vitam staining with neutral red proved very useful in the definition of certain glands and organs, and inhibiting the activity of the larva" Stunkard (1930) uniformly got good results by the use of neutral red. He used a small drop of a one thousand aqueous solution of the stain added to a drop of water containing the larvae. The stain almost immediately penetrated into the

specimens, differnetiating the glands and other structures. It is particularly favourable for the differentiation of gland cells.

For the fixed and preserved specimens Haemalum, Schneider's acetocarmine as recommended by Gower, Delafield or Ehrlich's haematoxylin followed by counterstain with alcoholic eosin or orange G as mentioned for adults gives good results. The fixatives to be used are hot 10% formalin or Fleming's solution. For making stained toto mounts it is necessary to flatten cercariae under slight pressure of coverslip before fixation.

For the study of the excretory system from fixed specimens of amphistome cercariae Peter (1960) recommends a technique for permanent toto preparations : "A few cercariae are mounted on a slide under coverslip. By slowly drawing out water with a piece of blotting paper a certain amount of pressure is exercised so as to flatten them. Bouin's fluid then is introduced in between the coverslip and slide and the original amount of pressure is maintained by drawing out again the excess of fluid. As the fluid penetrates, the cercariae take the colour of fixative, leaving the excretory vesicle and main trunks practically unstained. The preparation is left undisturbed till the cercariae are fixed in the flattened position after which the coverslip is gently removed. Previous flooding of the slide with the fixative fluid facilitates easy removal of the coverslip without damaging the cercariae that may be sticking to the slide. The preparation is then washed twice or thrice in 70% alcohol to remove the excess of fixative and after passing through ascending series of alcohol and then xylol is mounted in balsam."

History of classification of Trematoda Rudolphi, 1808

Zeder (1800) was the first to classify the parasitic worms into five groups : (1) Round worms; (2) Hooked worms; (3) Sucking worms; (4) Tape worms; (5) Bladder worms. These groups were raised to the rank of orders and given the scientific names by Rudolphi (1808–1810) who designated them : (1) Nematoidea; (2) Acanthocephala; (3) Trematoda; (4) Cestoidea; and (5) Cystica. Prof. G. H. F Nuttal (1921) rightly observed "Rudolphi's chief publication entitled *Entozoarum historia naturalis* (1808–1810) in 3 vol. has served for helminthology in a manner that may be compared to that of Linnaeus's *Systema Naturae* in its bearing on systematic Zoology" The larva "*Cercaria*" owes its origin

to O. F Muller who created it for supposedly adult worm in 1773. Bojanus (1818) who described cercariae and observed their emergence from "radiae" mentioned that they arose within snails in certain sacs called by him as "Royal yellow worms" The generic name "*Redia*" was given by De Phillippi in 1837, who later in 1854 accepted the view that the redia was a larval stage and recommended that the name be no longer used to designate a genus. La Rue (1957) has mentioned "the relation of cercariae to adult distomes was suggested by Oken, editor of the Journal *Isis* in which the papers on cercariae by Nitch (1817) and Bojanus (1818) were published. Oken appended a footnote to Bojanus's paper in which he speculated" according to Bojanus one could now wager that these cercariae are embryos of distomes"

Steenstrup (1842) in his book dealt with the principle of alternation of generations applied to various organisms including the trematodes as many observations and some speculation accumulated concerning the life history of digenetic trematodes.

Diesing (1850) still considered cercariae to be adult trematodes. In 1855 he recognized nine genera and twenty species of cercariae and erected a suborder for them. In 1858 he accepted them as flukes and their larval nature.

In 1856 two schemes of classification of Trematoda were proposed independently by Leuckart and Burmeister. Leuckart (1856) divided Trematoda into two families (1) Distomea for endoparasitic worms with metamorphosis and (2) Polystomea for ectoparasitic worms without metamorphosis. Burmeister (1856) divided Trematoda into three groups on the basis of adhesive organs : (1) Pectobothrii or Pectobothridia for trematodes with hard suckers; (2) Malacobothrii or Malacobothridia for trematodes with soft suckers; (3) Aspidobothrii or Aspidobothrea for forms with multiloculate organ.

Van Beneden (1858) divided Trematoda into two main groups "Monogenesis" for forms with direct development and "Digenesis" for forms with indirect development or those in which sexual generation alternates with asexual generations. Carus (1863) latinized the names of these groups as Monogenea and Digenea. Van Beneden did not attempt to allocate the Aspidobothrii. After Steenstrup and the discovery of the life cycle of *Fasciola hepatica* by Leuckart (1882) and Thomas (1883) alternation of generations in Digenea was firmly established.

Grobben (1879 and 1882), after demonstration of parthenogenesis in certain invertebrates thought that the life cycle of

digenetic trematodes does not involve sexual generation alternating with asexual generation with parthenogenetic ones. This view was accepted by Sinitsin (1922) who designated the redial and sporocyst generations "Parthenita" and the sexual generation "Marita".

Stunkard (1940) doubted much the existence of parthenogenesis in Digenea, saying "So far as I am aware, parthenogenesis has never been established by original and competent methods in either sporocysts or rediae, and the best recent work has shown that in several species it does not occur. Accordingly the terminology of Sinitsin, with its implied connotation is not only unjustified, but may prove very misleading. Szidat recently (1962) reported that in gyamnophalline metacercaria in Argentina after disappearance of the testes and vitellaria the ovary persists and continues producing oocytes that develop into cercariae without fertilization. James (1964) reported that the ovary was not present in his species of *Parvatrema* in two successive generations of germinal sacs which had otherwise the structure of gymnophalline metacercaria, but according to Cable (1965) his figure shows in young germinal sacs "germinal masses" near the site of the ovary in the adult. Cable (1965) cites these cases and mentions "Brooks regarded the germinal cells oogonia which cleave precociously to form germinal masses *i.e.*, potential embryos whose dissociation with subsequent development of the ex-components he interpreted as polyembryony." Cable further says "Reproduction in these gymnophalline species certainly approaches diploid parthenogenesis as reported in some rotifers and cladocera" Agreeing with James he thinks that "reproduction in the germinal sacs of trematodes probably is a type of parthenogenesis in which meiosis is not involved. Secondly, however, polyembryony could be operative if the embryo resulting from parthenogenesis dissociated to produce more than one individual of the next generation of the cycle"

Although alternation of generations was widely accepted in the life history of Digenea, there were certain anomalies. The life history of strigeids seemed to be an exception, since rediae and sporocyst stages had not been observed and the encysted tetracotyle larvae developed sexual maturity in final vertebrate hosts. In 1863 Leuckart expressed the opinion that the embryo of strigeids may develop directly into the tetracotyle. The ciliated embryo which emerges from the egg of distomes was named miracidium by Braun (1892). Linstow (1877) created the group Metastatica for the holostomes. The family Holostomidae now known as Strigeidae

was thought to have different life history from that of monogenetic and digenetic trematodes. He thought that it appears to be intermediate between them. Leuckart (1879) accepted this idea of Linstow and termed the development of the holostomes "Metastatic" This idea was accepted by Brandes (1890) and other authors who believed that the larva known as tetracotyle and *Diplostomum* (*Diplostomulum*) developed by metamorphosis of the miracidium without sporocyst or redial generation. This idea persisted till Lutz (1920), Mathias (1922) and Ruszkowski (1921) independently showed that the Strigeidae are true digenetic trematodes and that the tetracotyle larvae develop from furcocercous cercariae. Szidat (1924) reported infection experiments with forktailed cercariae possessing pharynx produced in sporocysts in various snails. He described the entry of the cercariae into the intermediate host and treated the development of the penetrated and now tailess carcariae into tetracotyle larvae and thus confirmed the findings of the above mentioned authors that the Strigeidae are true digenetic trematodes. There is no intermediate condition between monogenetic and digenetic, and the concept "Metastatica" based on wrong presumption was discarded.

Monticelli (1888) arranged the digenetic trematodes into four families and included *Aspidogaster* in the family Amphistomea. Brandes (1890) divided the Diplostomeae of Monticelli into three families : Diplostomidae, Holostomidae and Hemistomidae. The anomalous position of aspidogastrids and the acceptance of the metastatic development of tetracotyle larvae made the division of Trematoda into Monogenea and Digenea incongruous. Accordingly, Monticelli (1892) rejected the classification of Trematoda into Monogenea and Metastatic, and reverted to the scheme of Burmeister, and divided Trematoda into three suborders on the basis of adhesive organs : (1) Heterocotylea; (2) Aspidocotylea; and (3) Malacocotylea. Stunkard thinks "Actually the result was to divide the Digenea into the Aspidocotylea and Malocotylea, since the Heterocotylea was equivalent to Pectobothrea." Discussing the situation Braun (1893) noted that the aspidogasterids are monogenetic but morphologically like the distomes, whereas *Gyrocotylus* is not monogenetic, although it is morphologically like the polystomes. Braun, therefore, considered it questionable to base the system of classification of Trematoda essentially on their development, and accepted the classification of Monticelli.

Leuckart (1879) compared Archigetes, a progenetic cestode which becomes sexually mature in tubificid oligochaetes with

Aspidogaster and suggested that the aspidogastrids are essentially sexually mature rediae.

Poche (1925) divided the suborder Prosostomata Odhner, 1905 of Digenea into two tribes, Fascioloidae and Aspidogastroidae; in the latter he placed the family Aspidogasteridae Poche, 1907

Faust and Tang (1936) excluded the latter family from Digenea and erected for it a separate and independent subclass Aspidogastrea equal in rank to the subclasses Monogenea and Digenea. They reverted in a way to Burmeister's system, laying emphasis on the life history as the fundamental principle of classification. They proposed the subclass name Aspidogastrea, deriving it from the type genus *Aspidogaster*.

Baer and Euzet (1961) gave Monogenea (class Monogenoidea Bychowsky, 1957) the status of class, since the discovery of *Chimaericola* Brinkmann, 1957 and *Callorhynchicola* Brinkmann, 1957 of the order Chimaericoloidea Brinkmann, 1957 belonging to Monogenea shows that they have unmistakable affinity with Gyrocotyloidea Poche, 1925. The latter has lost all trace of digestive system except the muscular wall at the anterior extremity which represents the buccal cavity of *Chimaericola*. The lycophore of Gyrocotyloidea is ciliated bearing 5 pairs of crotchets at posterior extremity. It resembles much more the larva of Monogenea than the oncosphere of a Cestode, and notably in the form of crotchets themselves. The ciliated larva of *Chimaericola* possesses 8 pairs of crotchets on the haptor. The larva of Gyrocotyloidea develops as in Monogenea without metamorphosis and the larval crotchets persist at the posterior extremity. The posterior part of the body of adult *Chimaericola* is prolonged in the form of narrow stalk bearing the haptor of four pairs of organs of fixation in the form of pincers. The testes are numerous and the vagina are two. In these features it resembles Monogenea. *Chimaericola* has been previously met in ancient prejurassic *Chimaera*. Chimaericoloidea and Gyrocotyloidea are both parasites of Holocephali, Chimaeriin the former on the gills and the latter in the intestine. Chimaericoloidea has obviously given rise to Gyrocotyloidea.

Stunkard (1962, 1963) has reverted to the theme of the phylogeny of Trematoda. He has divided Trematoda into two subclasses : Pectobothridia Burmeister, 1856 and Malacobothridia Burmeister, 1856. He divides the latter into two orders : Aspidobothrea Burmeister, 1856 and Digenea Van Beneden, 1858. It may be recalled that Burmeister had but Aspidobothrea on equal footing with Pectobothridia

and Malacobothridia, and the division of Trematoda was into three groups.

Stunkard (1959) said "The Digenea are distinct in morphology, bionomics and life history from the Monogenea and the origin of double hosts with alternation is still an unsolved problem" In 1962 he made a statement "Members of the Malacobothridia, like those of the Cestoda, begin their life cycles as parasites of invertebrates, the former principally in molluscs, the latter in Arthropods. Both groups are undoubtedly of great geologic age and there is evidence that present families have evolved together with their hosts, (Stunkard, 1957). The cestodes are more degenerate or more highly specialized and more host specific than the trematodes. Both groups are quite distinct from the Pectobothridia which have a distinctly different structure, and presumably a different phylogenetic history" This shows that Malacobothridia and Cestoda evolved from the same line of ancestory and Pectobothridia along the other line may be included in two different classes. Baer and Euzet (1961) have shown, following Bychowsky (1957), that Monogenea and Cestoda have been evolved from the same ancestory, the latter through *Chimaericola* and other Monogenea, which means that Monogenea are more closely related to Cestoda than Digenea. In 1963 Stunkard says, "The proposal of Baer and Euzet to remove the Monogenea from the Trematoda and recognize the group as a separate and independent class disregards the historical and morphological similarity. It is true and widely accepted that the polystomes and distomes are only distantly related, but both have been accepted as trematodes by zoologists for more than 150 years" According to this he justifies the allocation of Monogenea and Digenea to the same class. Thus his views about the origin and phylogeny of Pectobothridia and Malacobothridia are hardly reconcilable. Stankard further says, "although the amphibians arose in the Cretaceous, the families Ranidae, Hylidae and Pelobatidae according to Brattastrom (1957) date from the Miocene. The polystomes of these amphibians are digenetic with an ectoparasitic generation on the gills of the aquatic stage and endoparasitic generation in the urinary bladder of the amphibian themselves" He further on says "The gyrodactyles are viviparous with successive generations and the polystomes of Amphibia are digenetic. Consequently, for these groups the designation Monogenea is inappropriate" Gyrodactyles and polystomes of Amphibia are the specialized or degenerate branches of the phylogenetic tree of Monogenea, which have diverged from their ancestor and the typical

Monogenea, and reproduced differently from them. As the gyrodactyles and polystomes of Amphibia are the few exceptions among Monogenea, the vast majority of the group being monogenetic, the nomenclature of the class Monogenea should not be changed. The emphasis on the life history as the basis of classification should be maintained, as it gives an indication of the evolutionary history of the classes Monogenea and Trematoda.

We accept the status of Monogenea as an independent class under the phylum Platyhelminthes equivalent to the class Trematoda (Rudolphi, 1808). In the Trematoda are included the two subclasses, Aspidobothrea Burmeister, 1856 and the Digenea Beneden, 1858.

Class Monogenea Beneden, 1858
Syn. Pectobothridia Burmeister, 1856
Heterocotylea Monticelli, 1892.
Monogenoidea Bychowsky, 1957

Platyhelminthes : Parasitic worms with hard suckers, the posterior sucker, opisthaptor, generally provided with hooks and hooklets and sometimes suckers or pincer-like clasps. Generally ectoparasitic on aquatic vertebrates, and monogenetic. One host life cycle.

Class Trematoda (Rudolphi, 1808) Baer et Joyeux, 1961
Platyhelminthes : Parasitic worms. Endoparasitic. Adhesive organs flexible suckers without hooks or hooklets or clamps. Ventral adhesive organ sometimes ventral adhesive disc covering ventral surface of body with alveoli (Aspidobothrea). Mouth usually surrounded by oral sucker. Suckers sometimes absent. Pharynx present, rarely absent. Intestine usually triclad type, sometimes rhabdocoele type, tubular or sac-shaped gut. Mostly hermaphroditic, sometimes unisexual. Digenetic with alternation of sexual generation in final vertebrate host with larval generations in intermediate molluscan host (subclass Digenea) or monogenetic with direct development and one host life cycle (subclass Aspidobothrea). Excretory vesicle with two principal branches : excretory opening usually single, posteroterminal or posterosubterminal.

1. Subclass Aspidobothrea Burmeister, 1856
Syn. Aspidocotylea Monticelli, 1892
Aspidogastrea Faust and Tang, 1936.

Trematoda : Endoparasitic. Monogenetic. Oral sucker absent or poorly developed. Ventral multiloculate adhesive disc present or without disc but with a single row of suckers on ventral surface; without hooks. Excretory pore single

or double, posteroterminal. Life cycle simple with direct development, without asexual or parthenogenetic reproduction. One host life cycle. Endoparasitic in molluscs or cold blooded vertebrates, fishes and turtles.

2. Subclass Digenea Beneden, 1858
Syn. Malacobothridia Burmeister, 1856
Malacocotylea Monticelli, 1892.

Trematoda : Endoparasitic. Adhesive organs flexible suckers, without hooks. Oral sucker usually present, absent in Bucephalidae; exceptionally both suckers absent. Pharynx present, rarely absent. Intestine forked gut, sometimes sca-like or tubular intestine (Bucephalidae). Digenetic with alternation of sexual generation in final vertebrate host with successive larval generations resulting by polyembryony in intermediate molluscan host. Development always heterogenetic (Indirect), Adult parasitic in natural cavities in vertebrates.

Trematoda : Digenea

Since the publication of memorable works by Looss in 1899 and 1902 on the morphology of adult digenetic forms as the result of which he split up the old genus *Distomum* Retzius, 1776 into a large number of newly created genera, subfamilies and families, the taxonomy of Digenea has assumed great and valuable proportions to which many subsequent workers have contributed. Odhner in 1906 divided Digenea into two suborders, Gasterostomata and Prosostomata on the ventral position of the mouth and the position of the adhesive organ much in front of it at the anterior end in Gasterostomata, and the terminal anterior position of the mouth surrounded by oral sucker in Prosostomata. Lühe (1909), Poche (1925), Fuhrmann (1928) Dawes (1946, 1956) and most subsequent authors up to Yamaguti (1958) accepted this classification.

Lühe (1909) classified the cercariae under five major groups, Lophocercariae, Gasterosome, Monostome, Amphistome and Distome cercariae. He subdivided the Distome cercariae into : (A) Leptocercous cercariae; (B) Rhopalocercous cercariae; (C) Cystocercous cercariae; (D) Furcocercous cercariae; and (E) Cercariaeae. He further subdivided Leptocercous cercariae into Gymnocephalous cercariae, Echinostome cercariae and Xiphidiocercariae.

Poche (1925) accepted Gasterostomata Odhner and Prosostomata Odhner. The former containing only the family

Buchephalidae Poche, 1907. He subdivided Prosostomata into two tribes, Fascioloidae and Aspidogasteroidae, the latter including only the single family Aspidogasteridae Poche, 1907.

La Rue (1926) was the first to show that Odhner's division of Digenea into Gasterostomata and Prosostomata was not based on affinities and therefore is unnatural and misleading. He drew the conclusion from Cort's work (1917) on the excretory system of five fork-tailed cercariae, the excretory system of miracidia and the morphology of adults of Strigeidae and Bucephalidae. He stressed the close affinities of Strigeidae, gasterostomes and schistosomes, quoting the life history investigations of Lutz (1920) Ruszkowski (1921) and Szidat (1924), which established that Strigeidae are true digenetic trematodes. He created the order Strigeatoidea with its suborders Strigeata, Scistosomata and Bucephalata on the basis of their affinities.

Faust (1929) divided the class Trematoda into two subclasses Monogenea and Digenea. He divided the latter into orders Gasterostomata and Prosostomata. Faust and Tang (1936) proposed that Aspidogastried trematodes should be separated from Prosostomata and be constituted into a separate subclass Aspidogastrea equal in rank to Monogenea and Digenea and forming the intermediate group between them. Faust (1940) in third revised edition of his text book *Human Helminthology* accordingly, divided Trematoda into three subclasses, Monogenea Carus, 1863, Aspidogastrea Faust and Tang, 1936 and Digenea Carus, 1863.

Dubois (1936) enunciated new principles of classification for the group Strigeida Poche, 1925. Accepting the classification by Poche he adopted Strigeida Poche, 1925 constituting a supersuperfamily corresponding to Metastatica Braun, 1893 or Holostatica Lühe, 1909 or Strigeoidea Railliet, 1919 or suborder Strigeata La Rue, 1926. He subdivided Strigeida into two superfamilies : I. Strigeides (syn Strigeoidea Railliet, partim) and II. Cyathocotylides. He subdivided the Strigeides into subsuperfamilies, families, subfamilies and subsubfamilies. Dubois (1938, 1953) incorporated this classification in his monograph of the Strigeida, in which he also divided family Cyathocotylidae into two supersubfamilies.

La Rue (1938) stressed again the importance of excretory system in the larval stages and the life history studies in relation to the problem of the taxonomy of the Digenea saying, "the development of a natural taxonomic system for the Digenea must be based upon comparative anatomy of all stages of the life history"

Szidat (1936) created the order Fasciolatoidea and the suborder Paramphistomstomata under it to include the families Paramphistomidae Fischoeder, 1901, Angiodictyidae Looss, 1902 (syn. Microscaphidiidae Travassos, 1922), Mesometridae Poche, 1925 and Notocotylidae Lühe, 1909. Later (1937) while describing the developmental history of *Sphaeridiotrema globulus* Rud., 1814 and determining the systematic position of this species in Psilostomidae, Szidat pointed out the fundamental similarity in the life cycles of the latter family and Echinostomatidae. In 1939 he set up the suborder Echinostomata under Fasciolatoidea based on similarities in the pattern of the life cycle and structure of the larval stages to include the families Echinostomatidae, Psilostomidae and Fasciolidae, and agreed with La Rue in recognizing the great importance of life history studies in determining the taxonomic system of the Digenea. He also stressed the value of host specificity as a criterion of taxonomic determination, and pointed out the remarkable degree of host specificity shown by some Digenea. To support this idea he took the example of three families the Paramphistomidae, Notocotylidae and Schistosomatidae. According to him the Paramphistomidae which has its representatives in all classes of vertebrates is of great antiquity. He suggested that the Notocotylidae was derived from it, while it itself was evolved from the Angiodictyidae. He stated that Echinostomatidae represents the central stem from which were derived the families Chathaemasiidae, Rhopaliasidae, Psilostomatidae, Philophthalmidae and Fasciolidae. In his opinion in each family such as Paramphistomidae, Notocotylidae and Schistosomatidae there are subfamilies or genera which have followed the evolution of their hosts. In the three families taken as illustration by him he tried to correlate the phylogenetic histories of the subfamilies and palaeontological record of their hosts, and came to the conclusion that the Digenea is a very old group and these parasites and their definitive hosts have had parallel evolutionary histories.

Allison (1943) on the basis of his investigations on the life cycle of *Leucochloridiomorpha constantiae* established resemblance of this life cycle with that of Strigeatoidea on account of its furcocercous cercariae with the tail stem shorter than the furca developing in branching sporocysts in an aquatic snail, whereas the other cercariae of the family Brachylaemidae which occur in land snails and without exception have very short vestigial tails or nearly tailless condition, show an adaptation of life in the terrestrial snail host. In the metacercaria of *L. constantiae* a vestigial reserve excretory

system is present showing that the species and hence, the family is closely related to the strigeids. He further showed that *L. constantiae* resembles Bucephalidae in having small eggs, in the miracidia the cillia being borne on bars and in the sporocysts being branched. Therefore, Bucephalidae and Brachylaemidae form one group and Spirorchiidae (Schistosomata), Clinostomata and Cyathocotylidae (Strigeata) form another. He created the superfamily Brachylaemoidea with Brachylaemidae Joyeux and Foley, 1930 as the type family.

Dubois (1944) elevated Brachylaemidae to the rank of supersuperfamily Brachylaemida and united it with the supersuperfamily Strigeida Poche under the subtribe Strigeoinae Dubois characterized by the furcocercous cercariae with long furca or their tailless derivatives issuing from sporocysts. He created the subtribe Clinostomoinae for the family Clinostomidae, the larvae of which have short furca and are produced in rediae in contrast to the subtribe Strigeoinae Dubois. He united the subtribes Strigeoinae and clinostomoinae to form the tribe Strigeoidea. He created for the blood fluke families Spirorchiidae and Aporocotylidae the supersuperfamily Spirorchida and united it with the supersuperfamily Schistosomatida Poche, 1925 to form the tribe Schistosomatoidea Dubois, 1944. Finally he combined his two tribes Strigoidea and Schistosomatoidea under the suborder Strigeata La Rue, 1926, which he united with the suborder Bucephalata La Rue, 1926 to constitute the order Strigeatoidea La Rue, 1926. The closer affinity of Brachylaemida to Strigeida, on account of which Dubois combined in the same subtribe Strigeoinae is reverse to Allison's view (1943) who says "in respect to the miracidial sporocyst generations just compared, it is apparent that the Bucephalata and Brachylaemidae form one group and the Spirorchidae (Schistosomata), Clinostomata and Cyathocotylidae (Strigeata) another" Cort, Ameel and Van der Woude (1951) mention that Allison included Brachylaemidae under the suborder Buchephalata, but he did not say so in these words though he probably implied it. He removed Brachylaemidae from the Prososomata and included it in the order Strigeatoidea under the new superfamily Brachylaemoidea.

Mehra (1950) remarked on the basis of Allison's findings in the life cycle of *L. constantiae* "Odhner's view that the blood flukes are closely related to the Brachylaemidae is upheld. The superfamily Brachylaemoidea is no doubt closely related to the Strigeata, Clinostomata and Bucephalata so as to be included under the order Strigeatoidea as a suborder Brachylaemata."

Stunkard (1946) after giving a brief historical review of the systematic position of Aspidogasteridae Poche, 1907 considered the creation of a distinct subclass Aspidogastrea by Faust and Tang (1936) as "a backward step in the formulation of the natural system". He thought that "their affinities are clearly with the Digenea, although present information is insufficient to determine whether their life cycle is primitive or secondarily simplified" He also mentioned "The division of the Digenea into Gasterostomata and Prosostomata has outlived its usefulness and should be discarded.' He rightly criticised the validity of the Monostomata. In reviewing the work on monostome families Cyclocoelidae and Eucotylidae and the distomes of Opisthorchioidea (Faust, 1929) Vogel, 1934 and Renicolidae Dollfus, 1939 he is rightly led to the conclusion that no significance can be attached to the presence, location and absence of acetabulum and the arrangement of these worms into suborders Amphistomata, Distomata and Monostomata has little phylogenetic or taxonomic support. He criticised the system of classification of larval stages of digenetic trematodes as that of Lühe, which he considers to be one of the most useful in which cercariae were classified chiefly on the form of the tail and on the presence and absence of the stylet, and those of Lebour (1912) separating the cercariae which develop in sporocysts from those which develop in rediae and Sewell (1922) who based his classification on the presence or absence of acetabulum and the excretory system and refers to Allison (1943) and others that cercarial tail "is not reliable index of genetic relationship" mentioning the larval group *Cercariaeum* Diesing comprises diverse forms of tailless cercariae belonging to Cyclocoelidae, Zoogonidae, Brachylaemidae and Eucotylidae. Though the difficulties in formulating the natural system of classification have been recognized Lühe's and Sewell's systems of classification have served a useful purpose. Lühe's system is helpful even now in the laying out of a natural classification. His group of cystocercous cercariae based on the cyst forming character of the tail is of great significance in this connection. We do not agree with Stunkard that as the cercariae are merely developmental stages in the life history of species belonging to diverse families, attempts at their classification have little fundamental value. In our opinion it is the judgement and discretion of the systematist to properly evaluate the larval characters in consonance with the morphological and biological characters of the adult as well as other important data provided by the life history in expressing genetic relationship, which help

to chalk out a natural system of classification. It may be mentioned that free living larvae are equally subject to natural selection and evolution as the adults, and modern knowledge has enabled us to realize how the course of evolutionary history of several large groups has been considerably changed by the course of events in modifications of the larval forms. Stunkard admits at the end of his review "the study of both adults and larval stages must be evaluated with the greatest care."

Cort, Ameel and Van der Woude (1954) in review of their investigations on germinal development in the germ sacs of digenetic trematodes enunciate the "germinal lineage hypothesis" proposed by Leuckart in 1879 and reviewed by Dollfus in 1919. The hypothesis has been supported by study of the germ cell cycle (Cable 1934, Chen 1937, Rees 1939 and Pieper, 1953). The mechanism or method of multiplication of germinal cells varies in different groups. These mechanisms according to these authors have been evolved in different groups to increase the number of embryos produced in germinal sacs, and as they give some indication about the relationships of these groups, they may be utilized as a criterion of taxonomic value. In the order Fasciolatoidea Szidat, 1936 the mechanism is regarded to be of the most primitive type. This order has been considered as the most primitive on account of the simple sac-like mother sporocyst and the secondary germinal sacs being rediae with well developed digestive system and locomotor appendages and the cercariae being large with well developed adult characters such as those of amphistomes and notocotylids having eye spots and extensive pigmentation. Their life cycle is simple having no second intermediate host. In Psilostomes and Echinostomes the second intermediate host relations were present are of primitive kind as the cercariae have no specialized structures for penetration and the metacercariae do not feed or grow. The multiplication of germ cells in the germinal sacs of the suborder Paramphistomata Szidat, 1936 is simple and very limited and the number of individuals produced is very small compared with other digenetic trematodes. In the suborder Echinostomata Szidat, 1939 there occur in both first and second generation rediae permanent" germinal masses as centres of multiplication of germinal cells" which in the first generation rediae provide for a sufficient number of second generation rediae to fill the digestive gland of the intermediate host. The largest embryos are similar to the smallest ones, which are produced by the breaking of the largest embryos from the germinal

sacs. In the daughter rediae the mechanism provides for the production of a large number of cercariae. In Heterophyidae (*Cryptocotyle lingua* and *Euryhelmis monorchis*) according to them the mechanisms of multiplication is similar to that of amphistomes in which there are no germinal masses. The Heterophyidae also resemble Paramphistomata in having cercariae of very large size, which complete their development in tissues of the snail host. The cercariae in most species also resemble in having eye spots. It is suggested by these authors that "the Heterophyidae are also primitive and have arisen as offshoot from the Paramphistomata. But they are much more specialized than the latter as they have evolved a second host relationship, in which the cercariae are modified for penetration into fish and amphibians and the metacercariae undergo considerable development" La Rue (1957), however, on the basis of development of the excretory bladder, as shown by Hussey (1941), Lundahl (1941) and Kuntz (1952) denies the close relationship of the heterophyids with amphistomes and does not accept the mechanism of multiplication of germinal cells in the germ sacs as a criterion of relationship. It is quite likely that the superfamily Ophisthorchioidea has been evolved from Paramphistomata Szidat or its immediate ancestor as a branch of more highly evolved distomes. We do not agree with La Rue that similarity in development of the epithelial excretory bladder is a criterion of relationship. Cable (1954) admits this "In the Strigeatoidea the excretory vesicle of the cercaria is always thin walled, whereas in other Digenea (Prosostomata) it may be thick or thick walled, the latter condition being evidently a secondary one."

"The mechanism of germinal development in superfamily Plagiorchioidea Dollfus 1930 is one of the most effective that has been evolved in any one of the trematode groups. The large size and complexity of the mother sporocyst make possible the production of large number of daughters by direct division of the germinal cells. Also, the development of a single persistent centre of multiplication of each daughter in the form of a floating germinal mass, which in some case may be quite large and complicated, provides for the production of very large numbers of cercariae which escape every day during mature life of the infection. It can be suggested that this type of germinal development has been evolved from that of the Echinostomata by the increase in the number of germinal cells of the mother sporocyst, made possible by the increased size and complexity, and by the change from the rather simple germinal mass found in each redia to the

complicated floating germinal mass of the plagiorchioid daughter sporocyst". It may be pointed out that this fits in well with our view about the evolution of the suborder Plagiorchiata La Rue, 1957 from the suborder Echinostomata of the order Fasciolatoidea.

The order Strigeatoidea according to these authors contains the subòrders Strigeata La Rue, 1926, Clinostomata Allison, 1943 and Bucephalata La Rue, 1926. They follow Faust in placing the superfamilies Strigeoidea Raillict, 1919, Clinostomoidea Dollfus, 1931 and Schistosomatoidea Stiles and Hassall, 1926 in the suborder Strigeata on the basis of life history studies of *Clinostomum marginatum* by Krull (1934) and Hunter and Hunter (1934 and 1935). They apparently drop the suborder Schistosomata La Rue, 1926. The germinal development of Clinostomata resembles that of Strigeata in producing large numbers of embryos. The group of germinal cells of 2–5 cells in young mother sporocysts and daughter sporocysts of Strigeata resembles the germinal cell groups in the rediae (mother rediae and two generations of daughter rediae) of clinostomes. The sporocyst of *C. marginatum* produces only one redia, which is followed by at least two generations of daughter rediae, and the same type of germinal development takes place in all these three generations. It appears that the cells of germinal groups are continuously dividing and breaking up into new groups, and some germinal cells in them are constantly developing into embryos. As groups of germinal cells are present in mature rediae containing larger numbers of well developed rediae or cercariae, some germinal cells retain the power to continue dividing almost throughout the life of rediae. This mechanism is considered to produce very large numbers of cercariae. In the Strigeata the largest embryos attached to the germinal mass contains 6–8 germinal cells, which continue to divide after the separation of embryos. In daughter sporosyst ready to escape from the mother sporocyst only germinal masses are developed, which vary in size and the number of their cell components. The mechanism provides for the production of large numbers of cercariae over a long period and is a higher step than in the germinal development of the Clinostomata. In Strigeata the cercariae are coming out in numbers from the oldest daughter sporocyst before the germinal masses of the mother sporocyst have finished to produce new daughter sporocyst embryos. The two suborders Clinostomata and Strigeata though they resemble in the mechanism, are sharply differentiated in the

character of germinal sacs and of their furcocercous cercariae and in the morphology of the adult.

The mechanism of germinal development in Spirorchidae and Schistosomatidae is essentially similar in both the mother and daughter sporocysts. Division of germinal cells goes on through the life of germinal sacs. No germinal masses are present, but the germinal cells are scattered along inside the wall of the body cavity; this attachment of germinal cells to the wall persists and embryos are produced for a long time. These authors clearly mention that the germinal development of the mother and daughter sporocysts of blood flukes is quite different from that of the strigeids. The difference in the pattern of germinal development of the Spirorchidae and Schistosomatidae from that of the Strigeata in our opinion justifies the inclusion of both these families in a separate suborder Schistosomata. This should be considered as one of the criteria for the retention of the latter suborder. La Rue (1957) has dropped the suborders Clinostomata and Schistosomata, but has retained their superfamilies Clinostomatoidea Dollfus, 1931 and Schistosomatoidea Stiles and Hassall, 1926 in the suborder Strigeata. In this he obviously accepted the guggestion of Stunkard (1946) to suppress the suborders Strigeata, Bucephalata, Schistosomata and Clinostomata. He, however, retains only the Strigeata saying that it "still has value" We, on the other hand, maintain that they are all well differentiated and have a value in natural classification. La Rue (1957) created the suborder Brachylaimata for the superfamily Brachylaemoidea Allison, 1943 and the superfamily Fellodistomatoidea La Rue, 1957 though the suborder name Brachylaemata Mehra, 1950 was previously occupied, Fellodistomata was created by Singh (1960). Revision of Fellodistomoidea Mehra, 1963 syn. Fellodistomatoidea La Rue, 1957 has been given by Mehra (1963).

Cort and his co-workers have presented conclusive evidence that reproduction in the germinal sacs (sporocyst and rediae) in digenetic trematodes is a germinal lineage in the intermediate molluscan host in which multiplication of germ cells signifying "polyembryony of the fertilized ovum" take place, but it is by parthenogenesis and not asexual reproduction that it take place as shown recently by Szidat (1962), James (1964) and Cable (1965). Further, Cort and his coauthors have shown that the different mechanisms involved in different groups for the multiplication of germinal cells throw light on the relationships of these groups and help in the building up of natural system of classification.

La Rue (1957) gave a new system of classification of Digenea based on similarities in the life cycles and developmental stages and processes in the formation of the execretory system chiefly the excretory bladder whether nonepithelial or epithelial. He created two superorders, Anepithellocystidia for forms with non-epithelial exretory bladder in cercarial and metacercarial stages, and Epitheliocystidia for forms with epithelial excretory bladder in carcarial and metacercarial stages having epithelial wall derived from a mesodermal cell mass. The superorder Anepitheliocystidia consists of three orders : Strigeatoidea La Rue, 1926, Echinostomida La Rue, 1957 and Renicolida La Rue, 1957 Order Strigeatoidea includes the suborders : 1. Strigeata La Rue, 1926 with superfamilies Strigeoidea Railliet, 1919, Clinostomatoidea Dollfus, 1931 and Schistosomatoidea Stiles and Hassall, 1926; 2. Azydiata La Rue, 1957 with superfamilies Azygioidea Skrj. and Guschanskajam 1956 and Transversotrematoidea La Rue, 1957; 3. Cyclocoelata La Rue, 1957 with superfamily Cyclocoeloidea Nicoll, 1934; 4. Brachylaimata La Rue, 1957 for superfamilies Brachylaimoidea Allison, 1943, Fellodistomatoidea La Rue, 1957 and Buchephaloidea La Rue, 1926. The order Echinostomida contains suborders : 1. Echinostomata Szidat, 1939 with superfamily Echinostomatoidea Faust, 1929 and 2. Paramphistomata Szidat, 1936 containing superfamilies Paramphistomoidea Stiles and Goldberger, 1910 and Notocotyloidea La Rue, 1957. The order Renicolida stands for suborder Renicolata La Rue, 1957 with superfamily Renicoloidea La Rue, 1957.

The superorder Epitheliocystidia contains the orders : 1. Plagiorchiida La Rue, 1957 and 2. Opisthorchiida La Rue, 1957. Plagiorchiida includes the suborder Plagiorchiata La Rue, 1957 comprising the superfamilies Plagiorchioidea Dollfus, 1930 and Allocreadioidea Nicoll, 1934. The order Opisthorchiida includes suborders : 1. Opisthorchiata La Rue, 1957 for superfamily Opisthorchioidea Faust 1929 and 2. Hemiurata Skrjabin and Guschanskaja, 1954 for superfamily Hemiuriodea Faust, 1929.

Fuhrmann (1928) and Dawes (1946) did not give in their works higher taxonomic divisions than families under suborders Gasterostomata and Prosostomata of the order Digenea. Yamaguti (1958) dealt with all families of suborders Gasterostomata and Prosostomata of Digenea and arranged them host-wise under different classes of vertebrates.

Mehra (1957) suggested the suppression of superorders created by La Rue as the development of the epithelial excretory bladder in the cercariae is a secondary character

having no phylogenetic significance and not showing closer relationship of the groups in Epitheliocystidia to one another than to some groups of Anepitheliocystidia. As for instance the suborders Echinostomata and Paramphistomata are closely related to Opisthorchiata and Plagiorchiata than to the suborders Strigeata and Brachylaemata. The suborder Cyclocoelata is more closely related to Paramphistomata of the order Fasciolatoidea than to the order Strigeatoidea. The loss or great reduction in length of the tail in certain cercariae has taken place by convergence as adaptation in the life cycle in which the free swimming stage is omitted as pointed out by Cort (1918), Wallace (1941) and Allison (1943), and this has taken place independently in Cyclocoelata, Brachylaemata and families Zoogonimidae and Asymphylodoridae of Allocreadioidea. Cyclocoelata is not closely related to Brachylaemata and hence the Strigeatoidea. The order Echinostomida La Rue must be dropped and replaced by the order Fasciolatoidea Szidat, 1936 on the basis of priority. A new order Azygiatoidea was created to accommodate the suborder Azygiata on account of the ginantic furcocystocercous cercariae with flame cell groups in the tail, which develop in sausage-shaped rediae having terminal pharynx but without intestine and locomotor appendages. The genital pore lies anterior to acetabulum. Another new order Hemiuratoidea was created to accomodate the suborder Hemiurata as the latter is definitely distinctive from the suborder Ophisthorchiata so as to be separated from it on account of its cystophorous or Hemiurid cercariae and the development of the excretory system. Mehra (1958) created new superfamily Gorgoderoidea and a new order Gorgoderida for the family Gorgoderidae Looss, 1901 on account of its possessing macrocercous and rhopalocercous cercariae. Mehra (1960) pointed out that the cystocercous character of the cercariae is monophyletic and the furcocercous polyphyletic. The evolution of Digenea was discussed on this basis. It was shown that it has taken place along three divergent lines, one giving the order Fasciolatoidea, the other giving the orders Azygiatoidea, Hemiuratoidea and Gorgoderida, and the third giving the order Strigeatoidea. A new suborder Transversotremata was created under the order Azygiatoidea Mehra for the superfamily Transversotrematoidea La Rue, 1957

Dawes (1959) in review of *Systema Helminthum* by Yamaguti Vol. 1. The digenetic trematodes of vertebrates comments on La Rue's classification of Digenea thus "La Rue has revived the method of utilizing developmental data".

He thinks that many helminthologists are not likely to accept it as "it is based on the development of the excretory vesicle and associated parts, both larval and adult characters are necessary for delineation of genetic relationships" He obviously agrees with us that the superorders created by La Rue are untenable.

Mehra (1961) created a new superfamily Haploporoidea under suborder Echinostomata Szidat, 1939 to include families Haploporidae Nicoll, 1914, Waretrematidae Srivastava, 1939, Haplosplanchnidae Poche, 1925 and Megaperidae Manter, 1934. But the superfamily of this name had been created by Nicoll in 1934 *Zool. Rec.* Vol. 71 to include the families Haploporidae, Fellodistomidae, Monorchiidae and Zoogonidae. The superfamily was emended by Dollfus (1952) to include the families Haploporidae, Zoogonidae, Stegodermatidae and Proctotrematidae. This superfamily as created by Mehra is in accordance with the recent researches on the life cycle of Haplosplanchnidae and Megaperidae by Cable (1954) and on the basis of adult morphology of these worms. The families Monorchiidae Odhner, 1911 Zoogonidae Odhner, 1911, Asymphylodoridae Mehra, 1962, Aconthocolpidae, Lühe, 1909, Lepocreadiidae Nicoll, 1934 have been included with Deropristidae Skrjabin, 1938, Masenidae Yamaguti, 1954, Allocreadiidae Stossich, 1903, Opecoelidae Ozaki, 1925 and Homalometridae Mehra, 1962 in the superfamily Allocreadioidea by Mehra (1962) in Revision of Allocreadioidea Nicoll, 1934, Part I.

Mehra (1963) included Fellodistomidae Woodcock, 1912 Gymnophallidae Dollfus, 1939 and Monodhelminthidae Dollfus, 1937 in the superfamily Fellodistomoidea Mehra 1963 syn. Fellodistomatoidea La Rue, 1957 under the suborder Fellodistomata Singh, 1960 (under order Fasciolatoidea Szidat). Mehra (1961) created superfamily Orchipedioidea under the suborder Echinostomata to include Orchipedidae Skrjabin, 1924 syn. Achillurbainiidae Dollfus, 1939. Mehra (1962) published Revision of Brachylaemidae Joyeux et Foley, 1930 with new subfamilies Thapariellinae and Urotrematinae and new family Harmotrematidae with the subfamilies Harmotrematinae Yamaguti, 1933 and Helicotrematinae n. subf. The families Thapariellidae Srivastava, 1955 and Uritrematidae Poche, 1926 are reduced to the rank of subfamilies Thapariellinae n. subf. and Urotrematinae n. subf. respectively and included in the family Brachylaemidae. The family Leucochloridiidae Dollfus, 1934 is recognized as subfamily Leucochloridiinae Poche, 1907 as done by us (1936).

Mehra (1963) erected a new family Liliatrematidae for the subfamily Liliatrematinae Gubanov, 1954, excluding the latter from the family Cathaemasiidae Fuhrmann, 1928, in which Yamaguti (1958) placed it. He discussed the taxonomic position of this family and placed it under superfamily Echinostomatoidea Faust, 1929. A key to the families of the latter superfamily is given.

Mehra (1962) erected two new families of superfamily Hemiuroidea Faust, 1929 : Oesophagicolidae n. fam. from marine snakes and Arnolidae n. fam. from marine fishes. The subfamily Oesophagicolinae Yamaguti, 1933 assigned to the family Opisthorchiidae Braun, 1901 by him was elevated to the rank of a family which stands somewhat intermediate between Hemiuridae Lühe, 1901 and Opisthorchiidae Braun, 1901. But the totality of organization particularly the excretory system and vitellaria composed of branched tubular acini and the habitat of the trematodes with correspondingly modified bodywall decide its position in the superfamily Hemiuroidea Faust, 1929.

The subfamily Arnolinae Yamaguti, 1958 is elevated to the rank of the family Arnolidae as it differs much from Hemiuridae on account of the presence of well developed pyriform cirrus sac, the oblique position of testes separated from one another by uterine coils. In the presence of cirrus sac it resembles the family Azygiidae Odhner, 1911, but in its vitellaria it is typically a Hemiurid. We restrict the family Hemiuridae to distomes which lack a cirrus sac and possess the vesicula seminalis and prostatic complex free in parenchyma. Ductus hermaphroditicus or hermaphroditic pouch is present in Hemiuridae or pars prostatica opens into genital sinus. So Arnolidae Mehra, 1962 which possesses a cirrus sac enclosing convoluted vesicula seminails and well developed prostatic complex should be recognized as a valid family. It, however, resembles Hemiuridae in the character of its compact, somewhat lobed postovarian vitellaria. Its excretory vesicle with a long S-shaped median sten and long cornua extending to oral sucker and united anteriorly is characteristic of this family. The family stands intermediate between Hemiuridae and Azygiidae. The acetabulum lies much behind anterior extremity quite apart from oral sucker as in the Azygiidae, reverse to the usual condition in the Hemiuridae.

Mehra (1966) published *Revision of Allocreadioidea Nicoll, 1934*, Part II. Families : Opecoelidae Ozaki, 1925, Opistholebetidae Fukui, 1929, Allocreadiidae Stossich 1903, Bunodcridae Nicoll, 1914, Acanthocolpidae Lühe, 1909, and Pleor-

chiidae Poche, 1925; and *Allocreadioidea, Nicoll, 1934* Part III. Families Monorchiidae Odhner, 1911, Asymphylodoridae Mehra, 1962 and Zoogonidae Odhner, 1911. The suborder Allocreadiata Skrjabin, Petrow and Koval, 1958 and superfamilies Lepocreadioidea Cable, 1956 and Opecoelioidea Cable, 1956 are untenable. They are held to be identical with the superfamily Allocreadioidea Nicoll, 1934 of the suborder Plagiorchiata La Rue, 1957. The family Opistholebetidae Fukui, 1929, which is closely related to Opecoelidae belongs to Allocreadioidea. It is a specialized aberrant group evolved from a primitive Opecoelid.

The new genus *Staffordiella* is created for *Psilostomum chilkai* Chatterji, 1956 within subfamily Plagioporinae, family Opecoelidae.

The points of view of Stunkard about the relationship and systematic position of Acanthocolpidae are discussed. It is maintained that Acanthocolpidae is the primitive family of Allocreadioidea as shown by the location of the primary excretory pores and caudal canals in the cercariae of the genus *Stephanostomum* Looss, 1899.

The family Pleorchiidae Poche, which is closely related to Acanthocolpidae and presents resemblances to Campulidae Odhner is maintained for the genus *Pleorchis* Railliet, 1896.

The keys to subfamilies of Opecoelidae, Allocreadiidae and Acanthocolpidae, and to the genera of Opecoelinae, Plagioporinae and Horatrematinae and of the family Opistholebetidae are given.

Classification of Subclass **DIGENEA**

Digenea is divided into the following orders :

I. Order FASCIOLATOIDEA Szidat, 1936 syn. ECHINOSTOMIDA La Rue, 1957 Digenea : Genital pore near anterior end, preacetabular, generally not behind middle of body (postequatorial and preacetabular in Renicoloidea La Rue, 1957). Cirrus sac typically present, absent in some groups. Cercariae single tailed, sometimes fork-tailed, but without flame cells in tail (Fellodistomata), sometimes tail very short or absent (Cyclocoelata), developing in rediae or sporocysts. Protonephridia stenostomate or mesostomate. Miracidium with one pair of flame cells.

II. Order STRIGEATOIDEA La Rue, 1926. Digenea : Distomate or monostomate. Genital pore near posterior end, near or behind middle of body, postacetabular. Cercariae furcocercous, small, with flame cells in tail, developing in sporocysts or rediae. Protonephridia mesostomate. Active penetration into next host. Miracidium with two pairs of flame cells.

III. Order AZYGIATOIDEA Mehra, 1957 Digenea : Distomate or monostomate with acetabulum or without sucker. Genital pore near anterior end, preacetabular (Azygiata) or in middle of anterior margin of transversally elongated body (Transversotremata). Cirrus sac present or absent. Cercariae furcocystocercous and of gigantic size (Azygiata), monostomate without oral sucker, brevifurcate with tail stem bearing a pair of forwardly directed arm-like appendages (Transversotremata), developing in rediae. Miracidium with one pair of flame cells. Parasitic in fishes.

IV Order HEMIURATOIDEA Mehra, 1957 Digenea : Distomes typically. Genital pore near anterior end. Cirrus sac absent. Cercariae highly specialized, cystophorous, developing in rediae. Caudal canal present in development, fused tubes extending to the tip of one part of highly modified tail. Protonephridia stenostomate. Miracidia nonciliate with spinose anterior tip and one pair of flame cells. Second intermediate host a Copepod.

V Order GORGODERIDA Mehra, 1958. Digenea : Distomate. Genital pore near anterior end, preacetabular. Cercariae Macrocercous or Rhopalocercous, rarely microcercous. Protenephridia mesostomate. Miracidia with one pair of flame cells.

Key to orders of Subclass **DIGENEA**

1.	Cercariae cystocercous.	2
	Cercariae non-cystocercous.	3
2.	Cercariae furcocystocercous; usually gigantic; adults parasitic in fishes.	AZYGIATOIDEA Mehra, 1957
	Cercariae cystophorous (Hemiurid); second intermediate host a Copepod; adults parasitic in fishes and amphibians	HEMIURATOIDEA Mehra, 1957
	Cercariae Macrocercous or Rhopalocercous, developing in Lamellibranchs; adults parasitic in fishes, amphibians and turtles.	GORGODERIDA Mehra, 1958
3.	Cercariae furcocercous, small, with flame cells in tail; miracidia with two pairs of flame cells; adults parasitic in all classes of vertebrates	STRIGEATOIDEA La Rue, 1926
	Cercariae single tailed, sometimes fork-tailed but without flame cells in tail; miracidia with one pair of flame cells; adults parasitic in all classes of vertebrates..	FASCIOLATOIDEA Szidat, 1936

SYSTEMATIC ACCOUNT

Order **FASCIOLATOIDEA** Szidat, 1936

Syn. Echinostomida La Rue, 1957

Opisthorchiida La Rue, 1957

Plagiorchiida La Rue, 1957

Key characters of the suborders of FASCIOLATOIDEA

1. Usually monostomate; cercariae tailless or with very reduced tail, developing in rediae or daughter sporocysts; encysting in snail host near rediae or in daughter sporocysts; caeca united posteriorly or sometimes terminate blindly (Eucotyloidea n.supf.); parasitic in birds.	CYCLOCOELATA La Rue, 1957
2. Distomate; cercariae frocoeurcous with short tail stem and longer furca without flame cells in tail, developing in sporocysts in marine Lamellibranchs, rarely gastropods; parasitic in fishes.	FELLODISTOMATA Singh, 1960
3. Distomate. Cercariae pleurolophocercous or opisthorchoid, with eye spots and two or three rows of oral spines, developing in simple rediae; metacercariae encysted in lower vertebrates, usually fishes, sometimes amphibians.	OPHISTHORCHIATA La Rue, 1957
4. Amphistomate or monostomate, acetabulum near posterior extremity when present; cercariae amphistomate or monostomate, with long caudal excretory canal, without penetration glands, with heavily pigmented body and two or three black eye spots, developing in rediae emerging in snail host before completing development and encyst in the open.	PARAMPHISTOMATA Szidat, 1936
5. Distomate with acetabulum much in front of hinder end; cercariae single tailed with reduced caudal excretory canal; developing in rediae, encysting in the open or usually in snail, sometimes fish or amphibian host.	ECHINOSTOMATA Szidat, 1939

6. Distomate typically: cercariae xiphidiocercariae, usually with stylet; caudal canal absent in developing cercariae except in Acanthocolpidae; encystment in invertebrates usually arthropods, rarely in vertebrates.	PLAGIORCHIATA La Rue, 1957

1. Suborder ECHINOSTOMATA Szidat, 1939

Distomate.—Acetabulum ventral, much in front of hinder end. Pharynx present. Genital pore preacetabular. Cirrus sac present or absent. Cercariae with strong single tail. Excretory caudal canal reduced in length in cercaria. Cystogenous cells numerous. Protonephridia stenostomate. Cercariae develop in rediae with collar and stumpy legs. Life cycle usually involving two hosts, sometimes three hosts. Encystment in the open or usually within snail host, sometimes in second snail host or fish or amphibian host.

A. Superfamily *ECHINOSTOMATOIDEA* Faust, 1929.

Echinostomata: Cercariae echinostomate or modified in respect of collar and collar spines or non-echinostomate without caudal lobes or lateral caudal fins, developing in rediae with collar and stumpy appendages. Life cycle usually involving two hosts sometimes three hosts. Intestinal caeca double. Testes two. Cirrus sac present. Excretory vesicle Y-shaped, V-shaped or tubular, sometimes with two or four anterior branches. Eggs large, sometimes containing miracidia.

Key to Indian families of ECHINOSTOMATA :

Superfamilies ECHINOSTOMATOIDEA and HAPLOPOROIDEA

1. Cirrus sac absent; hermaphroditic sac or hermaphroditic duct present parasitic in marine fishes.	Superfamily HAPLOPOROIDEA Nicoll, 1934. 2
Cirrus sac present; parasitic in aquatic or terrestrial vertebrates	Superfamily ECHINOSTOMATOIDEA Faust, 1929. 3
2. Acetabulum relatively small; hermaphroditic sac present	HAPLOPORIDAE Nicoll, 1914
Acetabulum large; hermaphroditic sac absent.	HAPLOSPLANCHNIDAE Poche, 1925

3. Testes and ovary branched; parasitic in mammals	FASCIOLIDAE Railliet, 1895
Ovary entire; testes usually entire, sometimes branched; parasitic in vertebrates from fish to mammals	4
4. Head collar and collar spines present.	ECHINOSTOMATIDAE Poche, 1925
Head collar and collar spines absent.	5
5. Testes lobed or branched, occasionally entire; parasitic in Ciconiformis birds	CATHAEMASIIDAE Fuhrmann, 1928
Testes entire or slightly lobed; parasitic in reptiles, birds and mammals.	6
6. Bodywall smooth, unspined; parasitic in conjuctival sac or orbit or cloaca, exceptionally intestine of birds.	PHILOPHTHALMIDAE Travassos, 1918
Bodywall unspined; excretory vesicle V-shaped; parasitic in rectum or intestine of reptiles.	OMMATOBREPHIDAE Poche, 1925
Bodywall spined or unspined; excretory vesicle Y-shaped usually forming cutaneous network	PSILOSTOMIDAE Odhner, 1913

I. Family ECHINOSTOMATIDAE Poche, 1925

Echinostomata, Echinostomatoidea : Head collar surrounding oral sucker dorsally and laertally present. Collar spines in single or double dorsally continuous or interrupted row with or without corner groups. Head collar without spines in *Pseudechinostomum* Odhner. Acetabulum large, usually preequatorial, sometimes equatorial or postequatorial. Oral sucker small, occasionally rudimentary or absent (*Pegosomum* Ratz). Oesophagus with cells *i.e.*, pseudoesophagus; caeca reaching near posterior extremity, sometimes opening into excretory vesicle (*Chaunocephalus* Dietz). Genital pore preacetabular. Testes usually tandem, sometimes diagonal or juxatposed. Cirrus sac preacetabular anterodorsal to acetabulum or extending behind the latter, exceptionally absent (*Pelmatostomum* Dietz). Ovary pretesticular. Receptaculum seminis usually absent. Vitellaria usually lateral, postacetabular, sometimes extending in front of acetabulum. Uterus short or long, intercaecal, preovarian. Eggs large, 0.065–0.12 long. Excretory vesicle Y-shaped with simple or chambered stem, bifurcating behind posterior testis into long cornua

reaching anterior end with or without ramified branches. Parasitic in gut of fishes, reptiles, birds and mammals, in bile ducts, ureter and urinary tubules of birds.

Type genus : *Echinostoma* Rudolphi, 1809

Key to subfamilies of ECHINOSTOMATIDAE

1. Body divided into two regions, anterior region broad, semi-circular or club-shaped, hinder region cylindrical, shorter; vitellaria filling forebody, lateral in hindbody.	*CHAUNOCEPHALINAE* Travassos, 1922
Body undivided	2
2. Vesicula seminalis externa present.	*PARORCHIINAE* Lal, 1936 nom. emend. Yamaguti, 1958
Vesicula seminalis externa absent.	3
3. Head collar feebly developed as two lateral ridges or bulges, one on each side of oral sucker, collar spines discontinuous dorsally.	*MICROPARYPHINAE* Mondheim, 1943
Head collar feebly developed with double or single dorsally uninterrupted row of spines; acetabulum strikingly near anterior end	*HYPODERAEINAE* Skrjabin et Baschkirova, 1956
Head collar small, rudimentary armed with minute spines smaller than cutaneous spines.	*PSILORCHIINAE* n. subf.
Head collar feebly developed, devoid of spines.	*PSEUDECHINOSTOMINAE** n. subf.
Head collar rudimentary with spines in dorsally continuous double row; oral sucker absent; parasitic in bile ducts of birds.	*PEGOSOMINAE* Mondheim, 1943.
Head collar well developed with single or double dorsally continuous or interrupted row.	4
4. Head collar with dorsally uninterrupted single or double row of spines.	5
Head collar with dorsally interrupted single or double row of spines.	7

* Subfamily Pseudoechinostominae has already been proposed by Gupta (1957)—*Ed.*

Head collar large disc-shaped or bilobed horse shoe-shaped.	*NEPHROSTOMINAE* Mendheim, 1943
5. Acetabulum very small, preequatorial; parasitic in fishes.	*SINGHIINAE* Yamaguti, 1958
Acetabulum large, subequatorial or postequatorial; parasitic in birds.	*PETASIGERINAE* Mendheim, 1943
Acetabulum moderate sized; parasitic in birds and mammals	6
6. Testes oblique; parasitic in birds.	*MEHRASTOMINAE* Saksena, 1959
Testes parallel ; head collar small: parasitic in birds.	*PARALLELOTESTISII-NAE* n. subf.
Testes tandem; head collar well developed; parasitic in birds and mammals	*ECHINOSTOMATINAE* Faust, 1929
7. Excretory vesicle V-shaped with small transverse terminal part and long spacious cornua, without diverticula or branches; parasitic in reptiles.	*SINGHIATREMATINAE* n. subf.*
Excretory vesicle Y-shaped with stem and cornua branched; parasitic in reptiles, birds and mammals.	*ECHINOCHASMINAE* Odhner, 1911

1. Subfamily *ECHINOSTOMATINAE* Faust, 1929

Syn. *Echinostominae* Looss, 1899
Paryphostominae Mendheim, 1943

Echinostomatidae : Body elongated, spinulate. Head collar well developed. Collar spines in single or double dorsally uninterrupted row; end group of corner spines present. Pseudoesophagus moderately long or short; caeca long, not undulating. Testes tandem, postequatorial, entire, with irregular or indented margin, strongly lobed or branched. Cirrus sac preacetabular, overlapping acetabulum or extending behind it. Vesicula seminalis coiled, sometimes elongated or bipartite. Cirrus long, usually unspined, coiled when not protruded. Uterus long or short. Vitellaria postacetabular, rarely extending to acetabulum. Eggs numerous, moderate in number or a few. Parasitic in intestine of birds, mammals and reptiles.

Type genus : *Echinostoma* Rud., 1809

* Subfamily Singhiatrematinae has already been proposed by Simha (1958)—*Ed.*

Key to Indian genera of ECHINOSTOMATINAE

1. Cirrus sac extending behind acetabulum	*Artyfechinostomum*	Lane, 1915
Cirrus sac not extending behind middle of acetabulum..	2	
2. Testes deeply lobed or branched.	3	
Testes not deeply loebd.	4	
3. Body narrow posteriorly.	*Paryphostomum* Dietz, 1909	
Body broad posteriorly as in *Echinochasmus*	*Pseudoechinochasmus*	Verma, 1936
4. Testes strikingly sinuous or more or less spirally twisted	*Euparyphium* Dietz, 1909	
Testes not sinuous but elongated oval to elliptical, entire or indented	5	
5. Uterus short with a few eggs.	*Echinoparyphium*	Dietz, 1909
Uterus long, much coiled with numerous eggs	*Echinostoma* Rudolphi, 1809	

Genus 1. **Echinostoma** Rudolphi, 1809

Echinostomatinae : Body elongate. Head collar well developed with single or double dorsally uninterrupted row of spines. Acetabulum near anterior extremity. Testes post-equatorial, tandem. Cirrus sac anterior to acetabulum or somewhat overlapping it. Genital pore postbifurcal. Ovary median or slightly submedian, pretesticular, usually equatorial or preequatorial. Vitellaria surrounding caeca in hindbody reaching almost posterior margin of acetabulum, confluent or not in post-testicular region. Uterus long, coiled, intercaecal between ovary and acetabulum. Excretory vesicle Y-shaped, arms and side branches often distended with concretions; collecting duct turning on itself at anterior end of body, with ciliary flames on inner face of its wall. Parasitic in reptiles, birds and mammals.

Type-species : *E. revolutum* (Froelich, 1802) Looss, 1899

Key to Indian species of **Echinostoma**

1. Body spinulate.	2
Body without spines	3

2. Collar spines exceptionally 35 or 34 in rows, two 5 in each ventral corner group; parasitic in ducks, geese, sometimes muskrat, crows and man.	*E. revolutum* (Froel., 1802)
Collar spines 32 in single row, 4 in each corner group.	*E. govindum* (Moghe, 1932)
Collar spines 34 in single row (immature form)..	*E. chasma* Lal, 1939
Collar spines 35, 5 in each ventral end group; end spines and dorsal spines of nearly equal size.	*E. bhattacharyai* Verma, 1936
3. Body rather small, without spines; collar with spines on dorsal surface in two rows, number uncertain owing to some having dropped.	*E. minimus* Verma* 1936

1. **Echinostoma revolutum** (Froelich, 1802) Looss, 1899

(Fig. 9)

Syn. *Fasciola revolutum* Froelich, 1802
Distoma echinatum Zeder, 1803
Distoma echinatum Bremser, 1824
Echinostoma revolutum Dietz, 1909
Echinostoma coalitum Barker and Beaver, 1915
Echinostoma armigerum Barker and Irvine, 1915
Paryphostomum novum Verma, 1936
Echinostoma novum (Verma, 1936) Baugh, 1950
Echinoparyphium splendens Verma, 1936.

Specific diagnosis.—Body elongated, spined, 9.4–22.8 long, 1.5–2.5 broad. Collar spines 37 or sometimes 34–35 in double or partly double row; 5 spines in each corner group. Oral sucker rounded or oval, 0.17–0.5 in diameter. Acetabulum 0.7–1.7 in diameter. Prepharynx distinct; pharynx 0.21–0.35 in long diameter, oval. Oesophagus 1.3–2.1 long. Genital pore preacetabular, slightly to left of median line. Testes tandem, postequatorial, varying in shape, entire, oval or lobed. Cirrus sac relatively small, encroaching on anterior face of acetabulum. Ovary almost equatorial, rounded or transversely oval, median, Mehlis' gland a little behind ovary. Vitellaria of small follicles from a little behind acetabulum or about its middle to posterior extremity, intruding in middle line or not in posttesticular region. Uterus intercaecal, transversely coiled between anterior testis and acetabulum.

* Full discription of *Echinostoma minimus* Verma, 1936 was not available to Prof. Mehra. It has been rediscribed by Srivastava (1974).—*Ed.*

Eggs 0.097–0.126×0.059–0.071. Life cycle involves two molluscan hosts, the first for the development of two generations of rediae, the second for encystment of metacercariae.

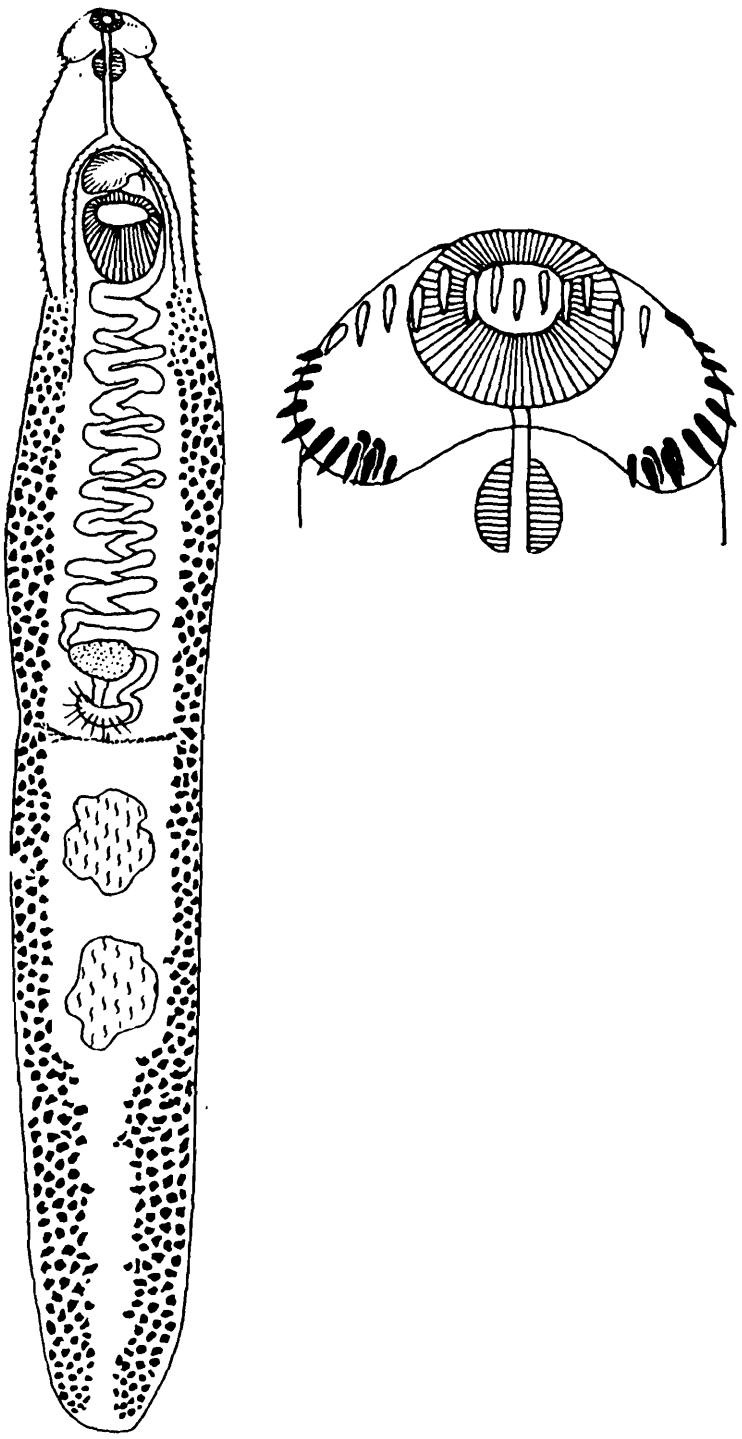


FIG. 9. *Echinostoma revolutum* (Froelich) and its Head Collar.

Hosts.—Ducks, geese, fowl, crow, muskrat (*Ondatra zibathica*). Collected from Indian domestic duck, *Anas*

platyrhynchos platyrhynchos domestica in Mathura, U.P. by J.P. Dube (1964).

Location.—Intestine.

Locality.—Allahabad, Mathura, U.P., Calcutta; Burma; Phillipines; Formosa; Australia; Europe; Canada; U.S.A.; Gogate (1932) found this species in Burma, but gave no description, nor a diagram. It is a cosmopolitan species.

2. **Echinostoma govindum** Moghe, 1932

(Fig. 10)

Syn. *Echinostomum govindum* Moghe, 1932
Echinostoma crecci Verma, 1936

Specific diagnosis.—Body elongated, spined, 4.6–8 long, 0.92–1.4 broad. Collar spines 32 in single row, 4 in each corner group. Oral sucker 0.144–0.133 in diameter. Acetabulum 0.6 in diameter or $0.638 \times 0.638 - 0.705$, in anterior fifth of body Prepharynx short. Testes tandem, ovoid or rounded with irregular margin, 1.4×0.24 or anterior 0.6×0.44, posterior 0.55×0.42. Cirrus sac ovoid between intestinal bifurcation and anterior margin of acetabulum or along anterior border of acetabulum. Genital pore median behind intestinal bifurcation. Ovary rounded or transversely ovoid, equatorial or slightly postequatorial, 0.12 in diameter or 0.27×0.336. Uterus long, sinuous or coiled, preovarain. Vitellaria of large rounded follicles from anterior level of acetabulum or slightly behind the latter. Eggs $0.047 \times 0.023 - 0.067$

Host.—*Philomachus pugnax,* common teal.

Location.—Rectal caeca, small intestine.

Locality.—Nagpur (Maharashtra); Allahabad, U.P.

3. **Echinostoma bhattacharyai** Verma, 1936

Specific diagnosis.—Body 5.7×1.05, spined. Collar spines 35; end spines in each corner group 4 or 5 and dorsals of nearly equal size. Oral sucker 0.185×0.235. Acetabulum 0.713–0.798, in anterior fifth of body. Prepharynx short; pharynx round, 0.194 in diameter; oesophagus 0.336 long. Anterior testis ovoid with irregular margin, 0.462×0.303; posterior testis elongated oval with feebly rugose margin, separated from anterior testis by 0.5, size 0.5×0.28; post-

testicular space 1.6. Cirrus sac short, anterodorsal to acetabulum. Cirrus curved. Ovary transversely oval, median, nearly equatorial. Shell gland mass larger than ovary. Vitellaria from behind acetablum to almost posterior end. Eggs about 25, large, operculated, 0.091—0.109×0.067—0.072.

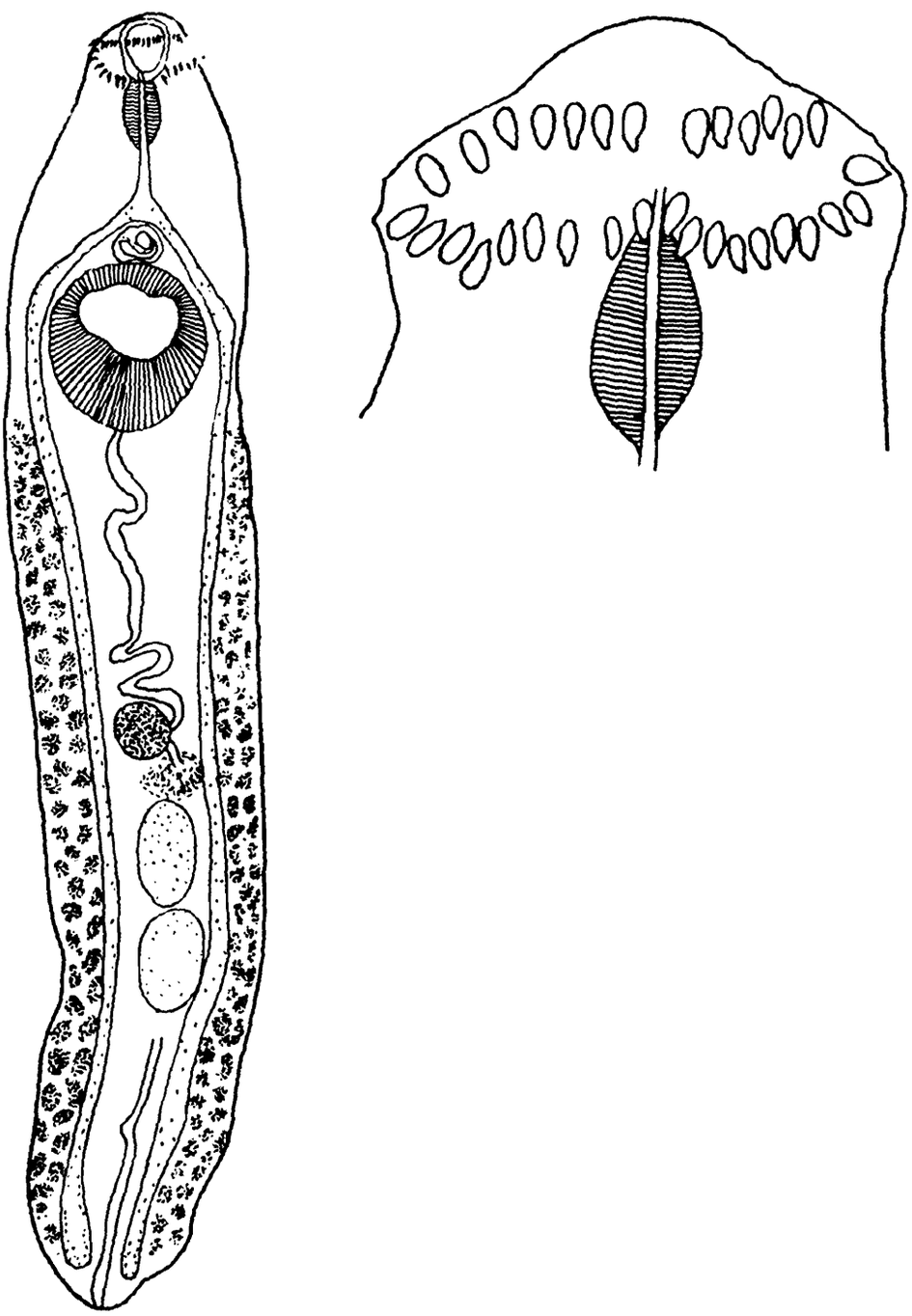


FIG. 10. *Echinostoma govindum* Moghe, 1932 and its Head Collar.

Host.—Black-winged stilt.

Location.—Small intestine.

Locality.—Mainpuri, U.P.

4. **Echinostoma chasma** Lal, 1939
(Fig. 11)

Specific diagnosis.—Body spined, 2.58×0.64. Collar spines 34 in single row; dorsal spines 0.075 long, lateral marginals 0.05 long. Oral sucker 0.15 in diameter. Acetabulum 0.45×0.41 at 0.65 from anterior end. Prepharynx small; pharynx 0.175×0.125; oesephagus 0.25 long; cacca with much crenated margins to posterior end. Testes ovoid; anterior 0.13×0.15; posterior 0.11×0.15. Cirrus sac overlapping acetabulum; vesicula seminalis incompletely bilobed. Cirrus fairly long, unspined. Genital pore median behind intestinal bifurcation. Ovary oval, 0.85×0.55. Uterus more or less sinuous, straight course to acetabulum in median line. Eggs not present. As specimens are immature, its validity is doubtful.

Host.—Querquedula circia.

Location.—Intestine.

Locality.—Amusi, near Lucknow, U.P.

Genus 2. **Echinoparyphium** Dietz, 1909

Echinostomatinae : Body elongated, slender, usually small, attenuated posteriorly, usually spinulate anteriorly. Head collar reniform with double row of dorsally uninterrupted spines; oral marginal spines smaller than aboral spines; end group of spines present. Acetabulum large near anterior end at about junction of first and second fourth of body. Testes tandem, elongated oval to elliptical with smooth or irregular margin, postequatorial. Cirrus sac preacetabular, anterodorsal to acetabulum or partly overlapping the latter. Uterus short with a few eggs. Vitellaria of moderate sized follicles, quite separate posteriorly, extending anteriorly to acetabulum or anterior end of anterior testis. Parasitic in intestine of birds, sometimes mammals.

Type-species : *E. elegans* (Looss, 1899) Dietz, 1909

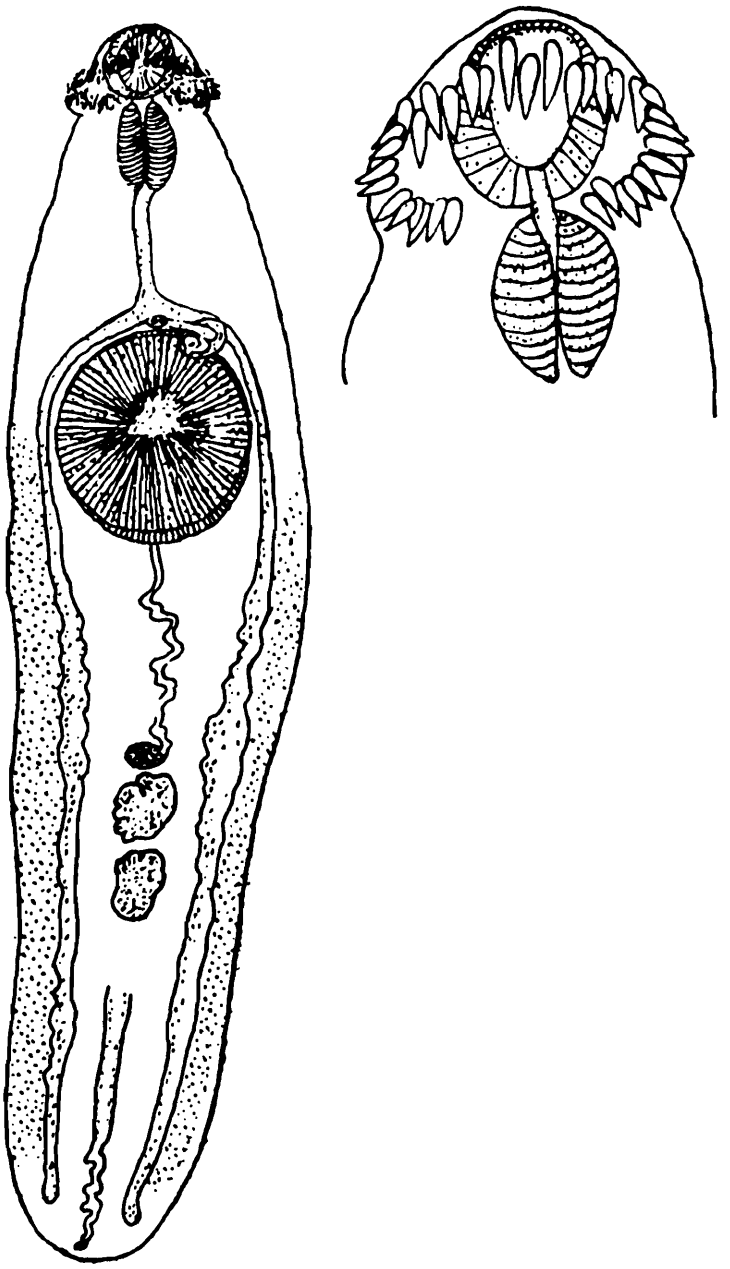


FIG. 11. *Echinostoma chasma* Lal, Ventral view and its Head Collar.

Key to Indian species of **Echinoparyphium**

1. Vitellaria reaching acetabulum . .	2
Vitellaria reaching anterior end of anterior testis.	4
2. Body characteristically bent on itself behind acetabulum.	*E. recurvatum* (V. Linst, 1873) Dietz, 1908.
Body not bent on itself.	3

3. Collar spines 34	*E. longicirrus* (Verma, 1936)
Collar spines 22	*E. gizzardai* Verma, 1936
Collar spines 41 or 42; corner spines 4 on each side.	*E. clerci* Skrjabin, 1915
4. Cuticle smooth; collar spines 34; receptaculum seminis absent.	*E. dollfusi* Agarwal, 1959
Cuticle spined; collar spines 38; receptaculum seminis present	*E. indicum* Rai, 1962

5. **Echinoparyphium recurvatum**
(V Linst. 1873) Dietz, 1909

Specific diagnosis.—Body characteristically bent over itself from behind acetabulum, with lateral margins of neck curled ventrally, 2.8–4.7 long. Collar spines 45 larger than in the previous description of the species, 0.126×0.08 instead of 0.068. Testes of varying size and shape as noted by Dietz (1909), Skrjabin (1915) and Yamaguti (1933). Verma has not described it nor given any figure.*

Host.—Common snipe and brahmany duck.

Locality.—Not mentioned probably Allahabad.

6. **Echinoparyphium longicirrus** (Verma, 1936)
Syn. *Echinostoma longicirrus* Verma, 1936

Specific diagnosis.—Body thin, elongated, spined neck region with margins ventrally curled and neck often bent at an angle to posterior body, 5–7 long, 0.9–1.2 broad, broadest in region of acetabulum. Collar spines 34 in two alternating rows; larger spines 0.057×0.0165 smaller about two third as long; 3 spines in each end group. Oral sucker 0.18×0.21. Acetabulum 0.45–0.56 in diameter, at anterior one third body length. Prepharynx a little longer than oral sucker; pharynx smaller than oral sucker; oesophagus 0.5 long. Testes large; anterior subquadrate, posterior elongate conical; each testis twice as long and broad as ovary. Cirrus sac small, conical, partly overlapped by acetabulum. Cirrus everted very long 0.34×0.025. Ovary small, rounded nearly equatorial or just postequatorial, 0.15 in diameter, midway between acetabulum and anterior testis. Vitellaria from hinder margin of acetabulum to posterior end, lateral up to hind testis, but approach one another behind; follicles large, dense. Uterus short with a few eggs, only 4 in one specimen, none

* Verma's specimen has been redescribed by Srivastava (1974)—*Ed.*

in the other larger specimen. Excretory pore ventroterminal; excretory vesicle two chambered.

Host.—Mute Swan.

Location.—Intestine.

Locality.—Patna, Bihar.

7 **Echinoparyphium gizzardai** Verma, 1936

Specific diagnosis.—Body elongated, slender, neck concave with ledges ventrally curved, 2.855–3.0 × 0.46–0.55 in testicular region, spined. Collar spines 22; angular 0.05 × 0.015; of border ones, larger 0.042 × 0.01, smaller 0.0252 × 0.09. Oral sucker almost spherical 0.084 × 0.1008. Acetabulum 0.336 × 0.293, in anterior fourth of body. Pharynx 0.08 in diameter; oesophagus as long as acetabulum. Testes ovoid or oval, smooth margined; anterior 0.2352 × 0.21; posterior 0.336 × 0.21; post-testicular space 0.62. Cirrus sac 0.252 × 0.168, reaching to middle of acetabulum. Genital pore median on intestinal fork. Ovary subspherical, 0.143 in diameter, equatorial. Vitellaria of large follicles from posterior border of acetabulum to near posterior extremity. Uterus short, between ovary and acetabulum, intervitellarial, with a few eggs, 13–20, ovoid or nearly rounded, 0.0756 × 0.067 or 0.1008 × 0.071.

Host.—Black Swan.

Location.—Gizzard.

Locality.—Not mentioned (No. 19 of Calcutta School of Tropical Medicine).

8. **Echinoparyphium dollfusi** Agarwal, 1959

(Fig. 12)

Specific diagnosis.—Body small, unspinulate, 2.09–3.115 × 0.36–0.53 in acetabular region. Collar spines 34 in two rows; oral spines smaller than aboral ones and arranged alternately with them; end spines 4 in each group, largest 0.043–0.05 × 0.014–0.019 (in one specimen odd spine of one group 0.028 × 0.009). Oral spines 0.014–0.025 × 0.005–0.009; aboral spines 0.021–0.032 × 0.007–0.01. Oral sucker 0.054–0.057 × 0.054–0.086. Acetabulum 0.0299–0.377 × 0.26–0.36, about five times the size of oral sucker. Prepharynx long; pharynx 0.054–0.09 × 0.039–0.057; oesophagus long, slender. Testes tandem; anterior 0.23–0.34 × 0.22–0.3. mostly ovoid,

sometimes slightly lobed; posterior 0.28–0.33 × 0.22–0.3, ovoid to distinctly four lobed with intermediate condition. Cirrus sac small, preacetabular, 0.068–0.18 × 0.043–0.126. Pars prostatica absent; cirrus without spines. Genital pore submedian, a little behind intetsinal bifurcation. Ovary rounded, 0.078–0.104 × 0.065–0.13. Receptaculum seminis absent. Vitelline follicles from anterior margin of anterior testis, passing mesially behind testes but remain separate. Eggs a few, 10–14, elliptical, large, 0.078–0.091 × 0.052–0.065.

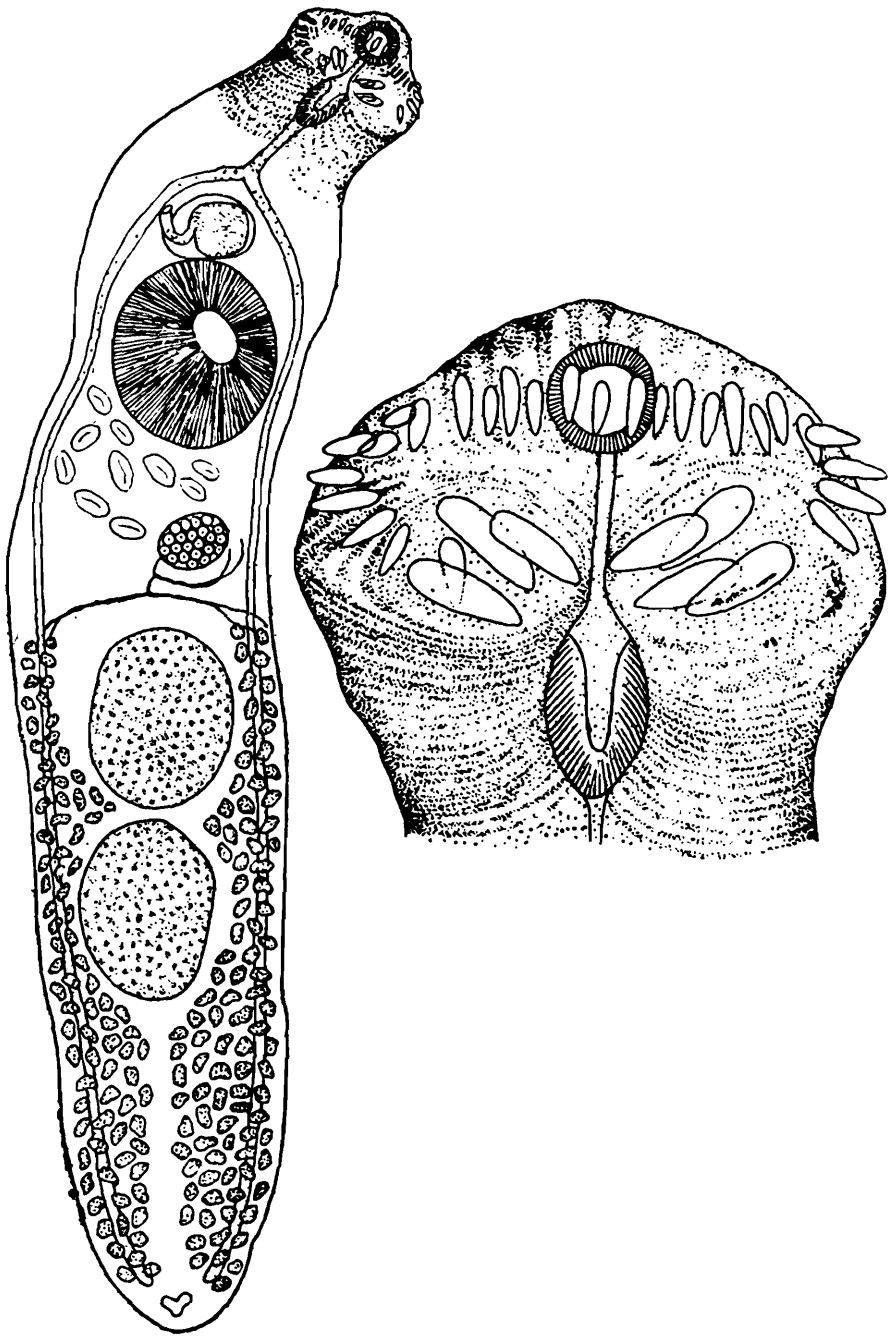


FIG. 12. *Echinoparyphium dollfusi* Agarwal, 1959 and its collar,

Host.—Anhinga melanogaster, (darter).

Location.—Intestine.

Locality.—Panagar, near Jabalpur, M.P.

9. **Echinoparyphium indicum** Rai, 1962
(Fig. 13)

Specific diagnosis.—Body slender, spined, 5.388–6.2 × 1.31–1.37 in acetabular region. Collar spines 38 in two rows; spines of oral row slightly larger than those of aboral row; oral row spines 0.036–0.042 × 0.006–0.008; aboral row spines 0.026–0.033 × 0.006–0.008; 4 spines in each end group, 0.039–0.062 × 0.013–0.019, much larger than spines of both rows. Oral sucker 0.049–0.099 × 0.066–0.099. Acetabulum pre-equatorial, 0.32–0.39 × 0.27–0.39. Prepharynx present; pharynx 0.072–0.082 × 0.049–0.069; oesophagus 0.072–0.082 long; caeca reaching a little short of posterior end. Testes tandem, ovoid; anterior 0.26–0.34 × 0.23–0.29; posterior near or touching anterior testis, 0.28–0.37 × 0.23–0.31. Cirrus sac oval, preacetabular or partly overlapping acetabulum to middle, 0.148–0.33 × 0.082–0.138. Cirrus long, unspined. Ovary submedian or median, 0.62–0.28 behind acetabulum, 0.094–0.133 × 0.109–0.14. Receptaculum seminis 0.033–0.042

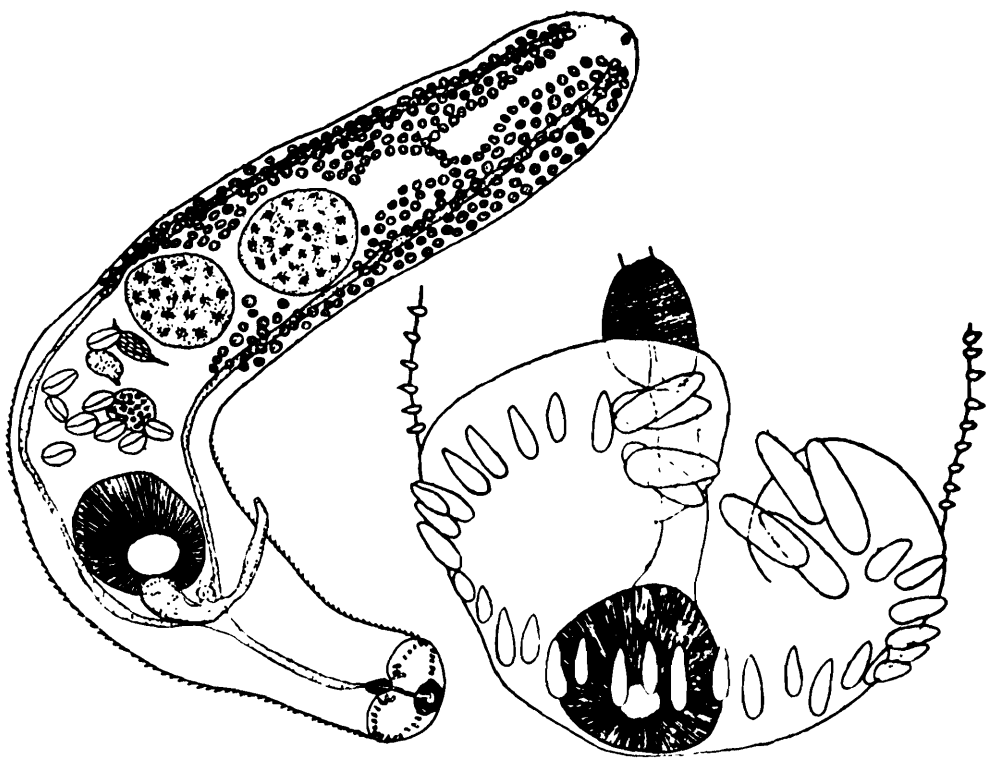


FIG. 13. *Echinoparyphium indicum* Rai, 1962 and its collar,

×0.019–0.029. Eggs a few, 7–10, 0.082–0.095×0.042–0.049. Vitellaria reaching anterior level of anterior testis from a little in front of posterior end, follicles sometimes confluent at a few places in posttesticular region; vitelline reservoir prominent in front of anterior testis.

Host.—*Nephron perconopterus* (Linnaeus)

Location.—Intestine.

Locality.—Bal Sagar, near Jabalpur, M.P.

10. **Echinoparyphium clerci** Skrjabin, 1915

Syn. *Echinoparyphium bagulai* Jain, 1961

Specific diagnosis.—Body spined, 1.57–3.9 long, 0.38–0.56 broad, widest at acetabular level. Head collar 0.30 in width according to Dube (1964); collar spines 41 (Dube) or 42 (Jain); corner spines 4 on each side (Dube); the largest spine 0.06 long and smallest 0.04 long (Dube). Corner spines larger than marginal spines, aboral spines larger than oral spines (Jain). Oral sucker terminal 0.10×0.09–0.12 (Dube). Acetabulum 0.365×0.321 (Jain), 0.41–0.44×0.31–0.35 (Dube); sucker ratio 3 : 4. Prepharynx short, 0.12–0.15; pharynx 0.065 ×0.0528; oesophagus relatively long 0.61–0.70 long; caeca reaching almost to posterior end. Testes tandem elongate, entire or slightly indented, postequatorial; anterior 0.15–0.52 ×0.12–0.17; posterior 0.19–0.56×0.12–0.19 (Dube). Cirrus sac extending to middle of acetabulum or anterodorsal to acetabulum, 0.12–0.17×0.08–0.10 (Dube) or 0.288 in diameter (Jain). Vesicula seminalis large, filling up cirrus sac; cirrus long, aspinous. Genital pore between acetabulum and intestinal bifurcation. Ovary median, transversely oval, 0.127–0.154 in diameter (Jain) or 0.08–0.15×0.08–0.12 (Dube). Mehlis' gland immediately postovarian. Uterine coils a few; eggs a few up to 20 (Dube), 66–73×33–37μ, (Dube) or 0.0528–0.0792×0.044–0.0484 (Jain). Vitelline follicles lateral, dorsal and ventral to caeca in a continuous series from immediately behind acetabulum to posterior extremity, confluent in posttesticular region.

Host.—Indian domestic duck (*Anas platyrhynchos platyrhynchos domesticus* according to Dube, 1964 obtained from Mathura; from the same host obtained by Jain experimentally in 1961 at Allahabad.

Location.—Intestine.

Locality.—Allahabad, Mathura, U.P.

Mature worms were obtained from the intestine of domestic duck, *Anas poecilorhyncha* when it was fed with the cysts of the echinostome obtained from *Lymnea luteola*. These cysts were experimentally obtained by Jain after exposure of young snails to actively moving echinostome cercariae of the "Echinata" group of Sewell, in which is included *Cercariae Indicae* XXIII, which belongs to a species of *Echinoparyphium*. It does not belong to the "Coronata" group as Jain (1960) thought. It has two rows of collar spines of different sizes and has developed into *E. clerci* Skrajbin, 1915.

Genus 3. **Euparyphium** Dietz, 1909

Echinostomatinae : Body slender, subcylindrical or filiform under middle sized to middle-sized, spinulate. Head collar reniform with double row of dorsally uninterrupted spines. Acetabulum near anterior end. Testes tandem, strikingly elongated and sinuous or spirally twisted, entire. Cirrus sac oval, anterodorsal to acetabulum, reaching to its middle. Ovary submedian, near first third of body length nearer anterior testis than acetabulum. Uterus short, slightly coiled with a few large eggs. Vitellaria lateral, mostly extending from behind acetabulum to near posterior end, approaching mesially behind posterior testis. Parasitic in intestine of birds and mammals.

Type-species : *Euparyphium capitaneum* Dietz, 1909

11. **Euparyphium longitestis** Verma, 1936*

Specific diagnosis.—Body very long, 10.5–11.7 long, 1.5–1.7 in maximum breadth in testicular region, spined. Collar rather feebly developed, 0.547 in breadth; collar spines not known. Oral sucker 0.227 × 0.27 Acetabulum 1.007 × 0.925, very close to anterior end, 0.956–1.1 from it. Prepharynx absent; pharynx 0.227 × 0.21; oesophagus short, nearly as long as pharynx. Testes very long, sinuous with smooth margins, in middle third of body; anterior 1.96 × 0.4; posterior 1.05–1.07 × 0.46; posttesticular space 4.2. Cirrus sac elongate, oval, 0.882 × 0.42, reaching to near hind margin of acetabulum. Ovary near first third of body length, oblique, 0.336 × 0.252. Receptaculum seminis present, dorsal to shell gland, which lies between ovary and anterior testis. Intestinal caeca

* Srivastava (1974) has proposed genus *Vermatrema* for this species—*Ed.*

terminate at 0.336 from hind end. Vitellaria lateral, mostly extracaecal from behind acetabulum to near hind end of body. Eggs oval, 0.1008–0.1092×0.067–0.0756.

Host.—Black Swan.

Location.—Intestine.

Locality.—Not known; Tube 19. School of Tropical Medicine, Calcutta.

Verma says about the collar spines "spines owing to specimens being rather thick, could not be counted. In the single straightened specimen examined in creosote they appeared to have been dropped."

Genus 4. **Paryphostomum** Dietz, 1909

Echinostomatinae : Body elongated, spinulate or unspinulate, small, undermiddle sized to middle sized. Head collar reniform with 27–47 spines in single or double dorsally uninterrupted rows; 2–5 spines in each end group. Acetabulum large near anterior extremity. Testes tendem, strongly lobed or branched, rosette-shaped, clover leaf-shaped, antler-shaped or of other typical shape. Cirrus sac small, preacetabular or anterodorsal to acetabulum. Vesicula seminalis saccular, bipartite. Cirrus coiled when not protruded. Ovary about midway between acetabulum and anterior testis or posterior testis. Uterus with a few or many coils. Vitellaria, lateral, from acetabulum to posterior extremity, approaching mesially or becoming confluent in posttesticular region. Eggs a few or numerous. Excretory vesicle Y-shaped with long median stem bifurcating behind posterior testis. Parasitic in intestine of birds.

Type-species : *P radiatum* (Dujardin, 1845) Dietz, 1909

Key to Indian species of **Paryphostomum**

1. Collar spines 27 in one or two rows .	2	
Collar spines more than 27 in one or two rows.	3	
2. Collar spines 27 in two rows; corner spines two pairs in each end group	*P. radiatum* (Duj., 1845)	
Collar spines in one row; testes 3-lobed, Y-shaped	*P. testitrifolium*	Gogate, 1935

3. Collar spines in one row	4	
Collar spines in two rows	5	
4. Collar spines 39; corner spines 5 or 6 in each end group; cuticle spinulate; testes 3-lobed.	*P. horai*	Baugh, 1950
Collar spines 46 or 47, corner spines 3 in each end group; cuticle unspinulate; testes deeply lobed	*P. dollfusi*	Agarwal, 1958
5. Collar spines 47 with end group of 5 spines, of which one is large.	*P. giganticum*	Rai and Agarwal, 1961
Collar spines 35 with end group of 6 spines in 3 pairs.	*P. pentalobum*	Verma, 1936

12. **Paryphostomum radiatum** (Duj., 1845) Dietz, 1909

Specific diagnosis.—Prudhoe (1944) says "Terminal spines of head crown measure 0.15–0.2 in length and 0.037–0.045 in width and marginal spines 0.112–0.162 in length and 0.03–0.032 in basal width. The length of spines is slightly greater than that recorded for this species given by Yamaguti, 1939 who gives 0.18 for the terminal spines and 0.14 for the marginal spines. In other respects the specimen agrees with previous description. "Yamaguti's observations: body 5.0–5.5 long, 1.1 broad or 3.7–7.8 × 0.7–1.3 with parallel sides of hindbody which is rounded behind, tapering anteriorly in forebody, Head collar 0.42–0.7 broad with 27 spines. End group spines in two pairs, 93–180 × 24–51μ the outer aboral one being the largest; marginal spines arranged in a single row laterally but in two alternate rows dorsally, 81–114 × 18–33μ. Oral sucker 0.13–0.22 × 0.15–0.2. Pharynx 0.2 × 0.18–0.2. Oesophagus 0.15–0.3 long. Acetabulum slightly drawn posteriorly 0.5–0.88 × 0.46–0.85, at second sixth of body. Testes 3–6 lobed. tandem; anterior at middle of body. Cirrus sac oval or elliptical, 0.45–0 65 × 0.25–0.4 obliquely overlapping acetabulum at its posterior half. Ductus ejaculatorius muscular, eversible; vesicula seminalis bipartite. Genital pore just behind intestinal bifurcation. Ovary globular, slightly dextral, 0.13–0,24 in diameter, separated from anterior testis by compact shell gland. Metraterm sigmoid. Eggs 78–90 × 54–63μ. Vitelliaria from immediately behind acetabulum to posterior extremity, reaching to near median line behind posterior testis.

Host.—Cormorant, *Phalacrocorax carbo sinensis* or the Indian shag, *Phalacrocorax fusicollis.*

Locality.—Sri Lanka.

13. **Paryphostomum testitrifolium** Gogate, 1934
(Fig. 14)

Specific diagnosis.—Body 3.5–5, spined, maximum breadth 0.555–0.952 in testicular region. Collar spines 27 in single row; each end corner group of 4 spines. Oral sucker 0.115 ×0.128. Prepharynx small; pharynx 0.135×0.093; oesophagus 0.464 long. Acetabulum 0.647×0.539. Testes trifoliate, two antero-lateral and one posteromedian branches;

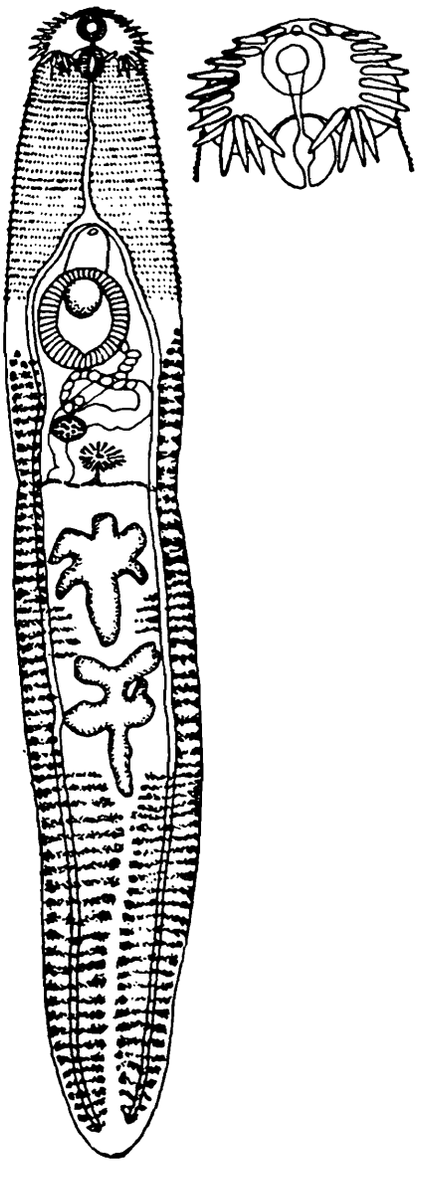


FIG. 14. *Paryphostomum testitrifolium* Gogate, 1934 and its collar.

posterior testis larger. Cirrus sac 0.197×0.0945, dorsal and oblique to acetabulum. Ovary globular, 0.17×0.165. Shell gland mass between ovary and anterior testis. Receptaculum seminis posterior to ovary. Vitellaria between acetabulum and posterior extremity, filling posttesticular region with loosely packed follicles. Uterus short, not much coiled, pretesticular, intercaecal. Metraterm dorsal to acetabulum. Eggs numerous, small, 0.0771×0.0409.

Host.—*Dendrocygna javanica* and *Phalacrocorax pygmaeus*.

Location.—Intestine.

Locality.—Rangoon, Burma; Russia

14. **Paryphostomum pentalobum** Verma, 1936

Specific diagnosis.—Body long, stout, 19.5×2.28 in uterine zone, spinulate. Head collar 0.713×0.966. Collar spines 35; dorsal spines in two rows; ventral end group of 6 spines in three couples of two each; end spines 0.1092×0.0336; dorsal spines 0.084–0.091×0.0252. Oral sucker 0.24×0.5 Acetabulum 1.007×1.175, within anterior one-fifth of body. Prepharynx short; oesophagus less than 2.0 long. Cirrus sac transverse between intestinal fork and acetabulum, partly overlapped by the latter. Vesicula seminalis bent over itself. Cirrus well developed. Ovary transverse, oval, 0.286×0.67, almost equatorial. Testes 5-lobed, each lobe with smooth rounded outline; anterior testis 0.84×0.67; posterior testis 0.924×0.67 Vitellaria lateral from behind acetabulum, confluent behind testes. Eggs numerous, large, 0.1008–0.1092×0.0588–0.071.

Host.—Snipe.

Location.—Intestine.

Locality.—Allahabad, U.P.

15. **Paryphostomum horai** Baugh, 1950

(Fig. 15)

Specific diagnosis:—Body elongate, tapering at ends, 3.05–6.97 long, 0.61–1.76 in maximum breadth in region of ovary; scale-like spines on ventral surface upto anterior testis. Collar 0.19×0.35. Collar spines 39; ventro-lateral spines in single row, dorsals shorter showing tendency towards double arrangement, 0.03–0.05×0.009–0.014. End group collar spines 5 on right side 6 on the left, not arranged in pairs, and in each group slightly stouter and broader, 0.044–0.049

$\times$0.019. Besides there is additional very long spine on each side near the end group, the right one being of the same length but much broader and almost cylindrical, and lies so close to the end group that it is included among them, while the left one is quite apart. This spine measures 0.058 $\times$ 0.014–0.019. The smallest end group spine of both sides 0.039 $\times$ 0.014. The left end group has an extra very small spine, 0.029 $\times$ 0.009. Oral sucker 0.098 $\times$ 0.137 Acetabulum 0.37

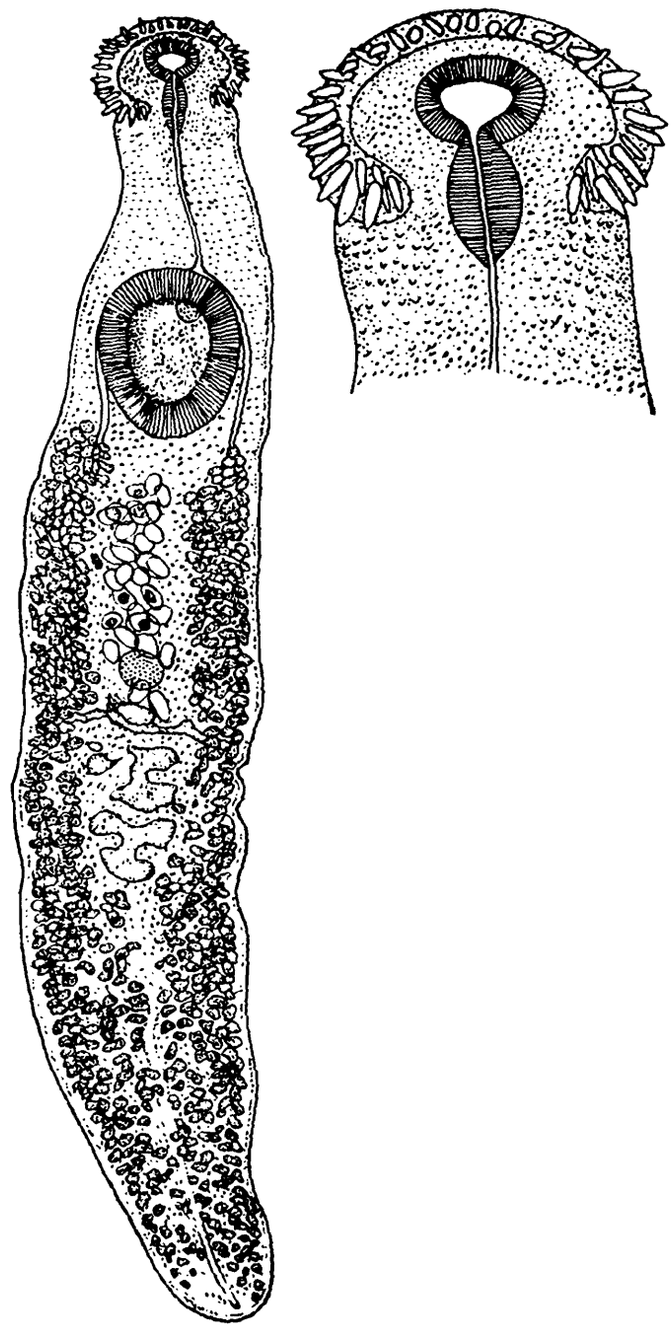


FIG. 15. *Paryphostomum horai* Baugh, 1950. Ventral view and its collar region.

×0.33, at anterior body third. Ratio of suckers 1 : 3.8. Prepharynx absent; pharynx oval, 0.117×0.058; oesophagus 0.27 long. Testes postequatorial, tandem, trilobate with simple broad lobes; anterior testis 0.15×0.19; posteriortestis slightly longer 0.19×0.21. Cirrus sac pear-shaped, dorsal to acetabulum, parallel to longitudinal axis of body, its anterior end abutting against oesophageal arch and posterior end extending over anterior third of acetabulum. Vesicula seminalis bent on itself, bipartite with much longer proximal part; pars prostatica short; cirrus present. Ovary spherical, median, equatorial, 0.098×0.137 Vitellaria extracaecal, partly intercaecal, from posterior border of acetabulum to posterior extremity, confluent behind testes. Vitelline reservoir prominent, 0.117×0.058; shell gland median just posterior to ovary. Laurer's canal present. Receptaculum seminis absent. Uterus short with a few coils, intercaecal, pretesticular. Metraterm dorsal to acetabulum. Eggs only 30, oval, nonoperculate, 0.058–0.098×0.039–0.058. Genital pore median, preacetabular.

Host.—Domestic duck, *Anas poecilorhyncha* Forster.
Location.—Intestine.
Locality.—Allahabad, U.P.

16. **Paryphostomum dollfusi** Agarwal, 1958

Syn. *Paryphostomum bubulcusi* Agarwal, 1958

Specific diagnosis.—Body stout, unspined, 8.44–13.36×1.96–2.56. Collar 1.07–1.3 broad. Collar spines 46 or 47 in a single row; end spines 3 in each group, not larger than marginals. Oral sucker 0.19-0.28×0.2–0.23. Acetabulum 1.2–1.35. Ratio of suckers 1 : 4.5–5. Prepharynx small; pharynx 0.2–0.27×0.22–0.26; oesophagus 0.39–0.57 long. Testes deeply lobed, rosette-shaped; anterior 0.69–1.15×0.49–0.68, 5–7 lobed; posterior 0.76–1.0×0.49–0.68. 6–7 lobed; posttesticular region 2.47 long. Cirrus sac oblique, dorsal to acetabulum, 0.52–0.96×0.26–0.4 or 0.32–0.41×0.31–0.32. Vesicula seminalis bipartite. Male and female pores separate. Ovary entire or feebly lobed, median, equatorial, 0.44×0.68 or 0.24–0.32×0.44–0.48. Eggs numerous, 0.091–0.1×0.032–0.052. Vitellaria from a little behind acetabulum, not confluent in posttesticular region.

Host.—Bubulcus ibis.
Location.—Intestine.
Locality.—Jabalpur, M.P.

17 **Paryphostomum giganticum** Rai and Agarwal, 1961

(Fig. 16)

Specific diagnosis.—Body stout, reddish brown, 16.15–18.6 × 1.94 at posterior level of acetabulum; cuticle spined. Collar 0.93–0.96 broad. Collar spines 47 in two rows; spines of

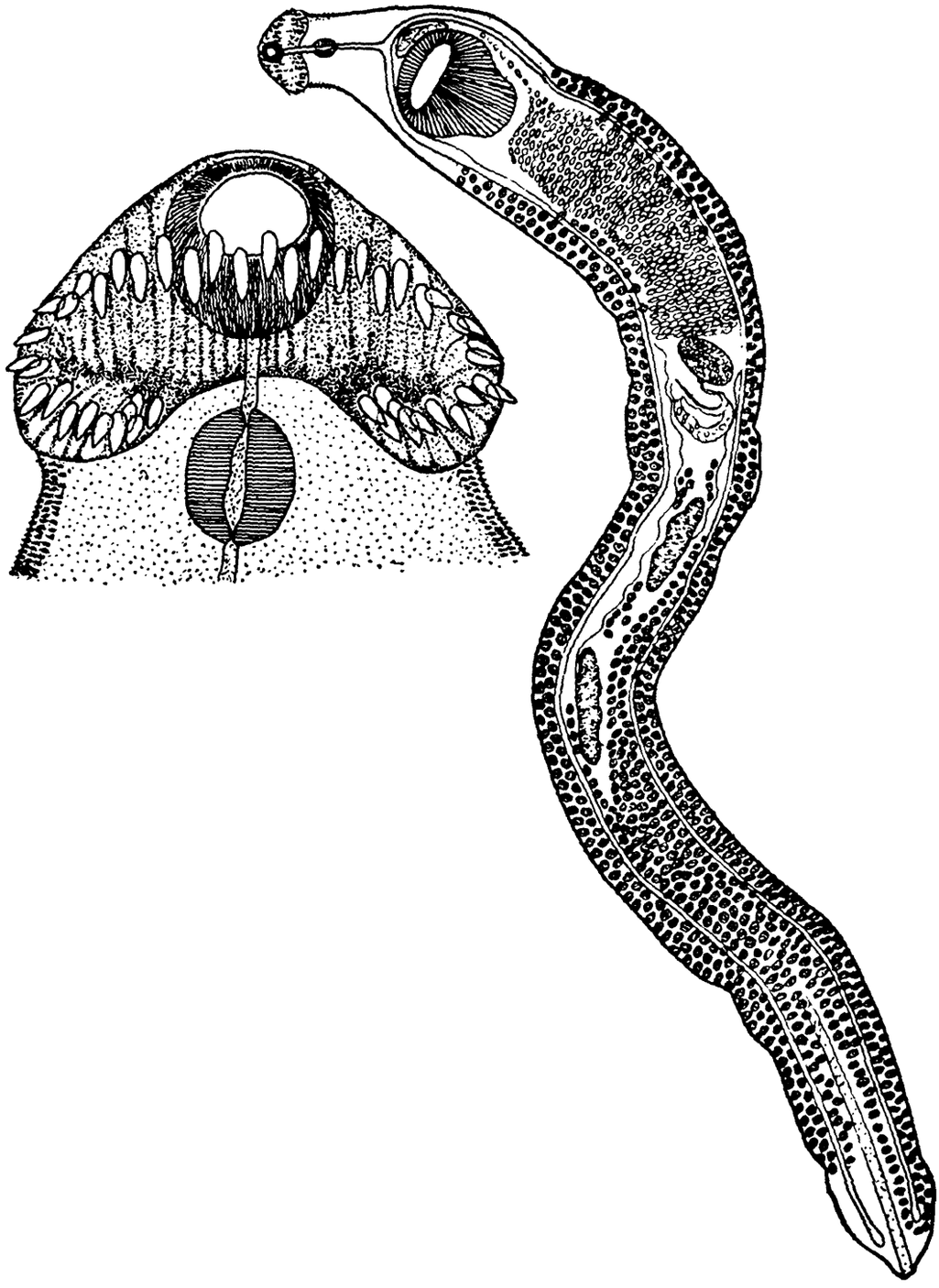


FIG. 16. *Paryphostomum giganticum* Rai and Agarwal 1961 and its collar.

both rows equally long; end group of 5 spines of which one is larger. Dorsal spines of upper row 0.0945–0.112×0.0315–0.0385, of lower row 0.105–0.119×0.035. Smaller end spines 0.0595–0.1015×0.0315–0.0385, larger end spines 0.1015–0.1085×0.0385–0.0455. Oral sucker 0.36–0.39×0.35–0.36. Acetabulum 1.42–1.59×1.4–1.43, in anterior sixth of body. Ratio of suckers 1 : 4. Prepharynx 0.189 long; pharynx 0.27–0.28×0.25–0.26; oesophagus 0.5–0.6 long; caeca sinuous, terminating a little anterior to posterior extremity. Testes 4–6 lobed; anterior testis 1.21–1.23×0.35; posterior testis 1.28–1.31×0.34–0.42. Cirrus sac small, ovoid, preacetabular, 0.28–0.347×0.867–0.88. Vesicula seminalis bipartite. Cirrus present. Male and female pores median. Ovary ovoid, entire, 0.457–0.5×0.57–0.68. Receptaculum seminis and Laurer's canal present. Vitellaria from posterior level of acetabulum to caecal ends, approaching mesially, sometimes confluent behind testes. Uterus much coiled, preovarian, intercaecal. Eggs numerous, 0.105–0.1155×0.059–0.0735.

Host.—Purple moorhen, *Porphyrio poliocephalus* (Latham).

Location.—Intestine.

Locality.—Balsagar tank, near Jabalpur, M.P.

Genus 5. **Artyfechinostomum** Lane, 1915

Syn. *Testisacculus* (Bhalerao, 1927) Yamaguti, 1958
Testisacculus Bhalerao, 1927
Testifrondosa Bhalerao, 1924
Paryphostomum Bhalerao, 1931
Reptiliotrema Baschkirova, 1941
Pseudoartyfechinostomum Bhardwaj, 1963
Neoartyfechinostomum Agarwal, 1963

Echinostomatinae : Body elongated, spinulate, submedium to medium sized. Collar reniform, small. Collar spines 42 or 43, sometimes 39 or 40 in single or double dorsally uninterrupted row, each end group with 5 or 6 spines, of which one may be stout. Acetabulum large, pear-shaped or posteriorly prolonged, near anterior extremity. Oral sucker small. Prepharynx small or indistinct. Pharynx almost equal to oral sucker; oesophagus short or very short: caeca terminating near posterior extremity. Genital pore submedian or median, immediately behind intestinal bifurcation. Testes deeply lobed or branched, usually postequatorial, anterior testis sometimes equatorial, Cirrus sac long, extending a little behind acetabulum. Vesicula seminalis large, elongate, saccular with narrow distal part slightiy coiled.

Cirrus long, coiled when not protruded. Ovary pretesticular, submedian, subequatorial or preequatorial. Receptaculum seminis absent, rarely present. Uterus coiled, pretesticular, anterior coils usually forming receptagulum seminis uterinum when receptaculum seminis absent. Metraterm usually present. Vitellaria from level of middle or posterior border of acetabulum to posterior extremity, confluent behind testes. Eggs large, usually numerous. Parastic in intestine of mammals and reptiles.

Type-species: *A. sufrartyfex* Lane, 1915

Key to Indian species of **Artyfechinostomum**

1. Collar spines 39 or 42; 5 in each end group; ovary oval, irregular or lobed; parasitic in lizards. *A. indicum* (Bhalerao, 1927)

2. Collar spines 41–43; 5 or 6 in each end group, of which usually one is strikingly large; ovary oval, spherical or pear-shaped; parasitic in mammals. *A. sufrartyfex*, Lane 1915

18. **Artyfechinostomum sufrartyfex** Lane, 1915

Syn. *A. malayanum* (Leiper, 1911)*
Euparyphium malayanum Leiper, 1911
Artyfechinostomum paradoxyuri Baugh, 1962
Neoartyfechinostomum shubhrai Agarwal, 1963
Artyfechinostomum mehrai (Faruqui, 1930) Jain, 1957
Testifrondosa cristata Bhalerao, 1924.

Specific diagnosis.—Body elongated, usually indented at posterior end in middle; almost whole ventral surface and anterior region of dorsal side spined; bodywall strongly muscular, cuticle thick, spined. Length 8–19, breadth 2.19–6.0. Collar small with 41, 42 or 43 spines, marginals in a single row laterally and in two alternating uninterrupted rows dorsally; end spines in each group 5 or 6, of which one is usually strikingly large and stout, 0.08×0.024; marginals 0.07–0.079×0.02. Acetabulum prominent, characteristically drawn out posteriorly, 0.95–1.8 in diameter. Oral sucker and pharynx almost equal. Oesophagus short, 0.22–0.6 long. Genital pore median or submedian preacetabular, immediately behind intestinal bifurcation. Testes postequatorial, tandem, deeply lobed, rather branched; anterior testis sometimes equatorial, 1.07–2.4×1.07–2.49; posterior 1.32–2.5×1.9–2.32.

* The name *E. malaynuns* should get priority over *E. sufrartyfex* but the position is still controversial (yamaguti, 1971), as such synonymy as given by Mehra is retained.—*Ed.*

Cirrus sac elongated, claviform, extending a little distance behind acetabulum, 1.7–4.0 long. Vesicula seminalis large, with saccular basal and narrow distal coiled parts; ducts ejaculatorius long; pars prostatica apparently absent; prostate cells absent; protrusible cirrus very long, closely coiled when not protruded, with small spines in its outer cuticular surface (surface serrated). Ovary submedian, subequatorial, oval, spherical or pear-shaped, 0.5–0.8 in diameter. Mehlis' gland prominent, almost double the size of ovary, median, postovarian. Receptaculum seminis absent but reported to be present by a few; when absent receptaculum seminis uterinum present. Vitellaria mostly extracaecal, extending from level of middle of acetabulum or its hinder margin to posterior end of body, meeting or confluent behind testes. Uterine coils pretesticular, intercaecal. Eggs numerous, 0.09–0.135×0.07 –0.0756.

Host.—Domestic pig, *Sus scrofa domestica*, *Sus cristata;* man; Palm Civet, *Paradoxurus hermaphroditus* Schreber; white rat (Experimental).

Location.—Intestine.

Locality.—Throughout India, Assam; Calcutta; Banaras; Aligarh, Lucknow, U.P.; Jabalpur, M.P.; Madras; Rangoon, Burma; Malaya States.

19. **Artyfechinostomum indicum** (Bhalerao, 1927)

(Fig. 17)

Syn. *Testisacculus indicum* Bhalerao, 1927
Paryphostomum indicum Bhalerao, 1931
Reptiliotrema indicum (Bhalerao, 1931) Baschkirova, 1941
Pseudoartyfechinostomum larueiformis Bhardwaj, 1963
Reptiliotrema tandani Agarwal, 1963

Specific diagnosis.—Body elliptical, spined, narrow at both ends, 5.079–8.1×0.18–1.11 maximum breadth in testicular region. Collar spines 42 or 39, marginals in a single row laterally and double uninterrupted row dorsally; end spines 5 in each corner group; smallest spine 0.043×0.015 and the largest 0.08×0.02. Acetabulum having posterior prolongation, 0.62–0.65 in diameter or 0.64×0.65, at one fifth to one seventh body length. Oral sucker 0.15–0.18 in diameter. Prepharynx distinct; pharynx 0.19×0.17; oesophagus short, 0.16 long. Testes intercaecal, deeply lobed or branched with 3–7 branches; anterior almost equatorial, 0.84–1.17×0.82–0.92; posterior testis close behind, just postequatorial, 0.84–1.43 ×0.62–0.88. Cirrus sac extending a little behind acetabulum,

1.38×0.32. Vesicula seminalis large in broad basal part of cirrus sac, its distal part slightly coiled; pars prostatica short; ductus ejaculatorius coiled; cirrus well developed, muscular, unspined. Ovary precquatorial, oval or somewhat lobed, 0.216–0.66×0.24–0.36. Receptaculum seminis present according to Bhalerao and Agrawal. Receptaculum seminis uterinum present according to Bhardwaj. Shell gland mass in front of anterior testis, larger than ovary. Uterus with a few coils. Metraterm present. Vitellaria of small follicles extending from middle or posterior margin of acetabulum to

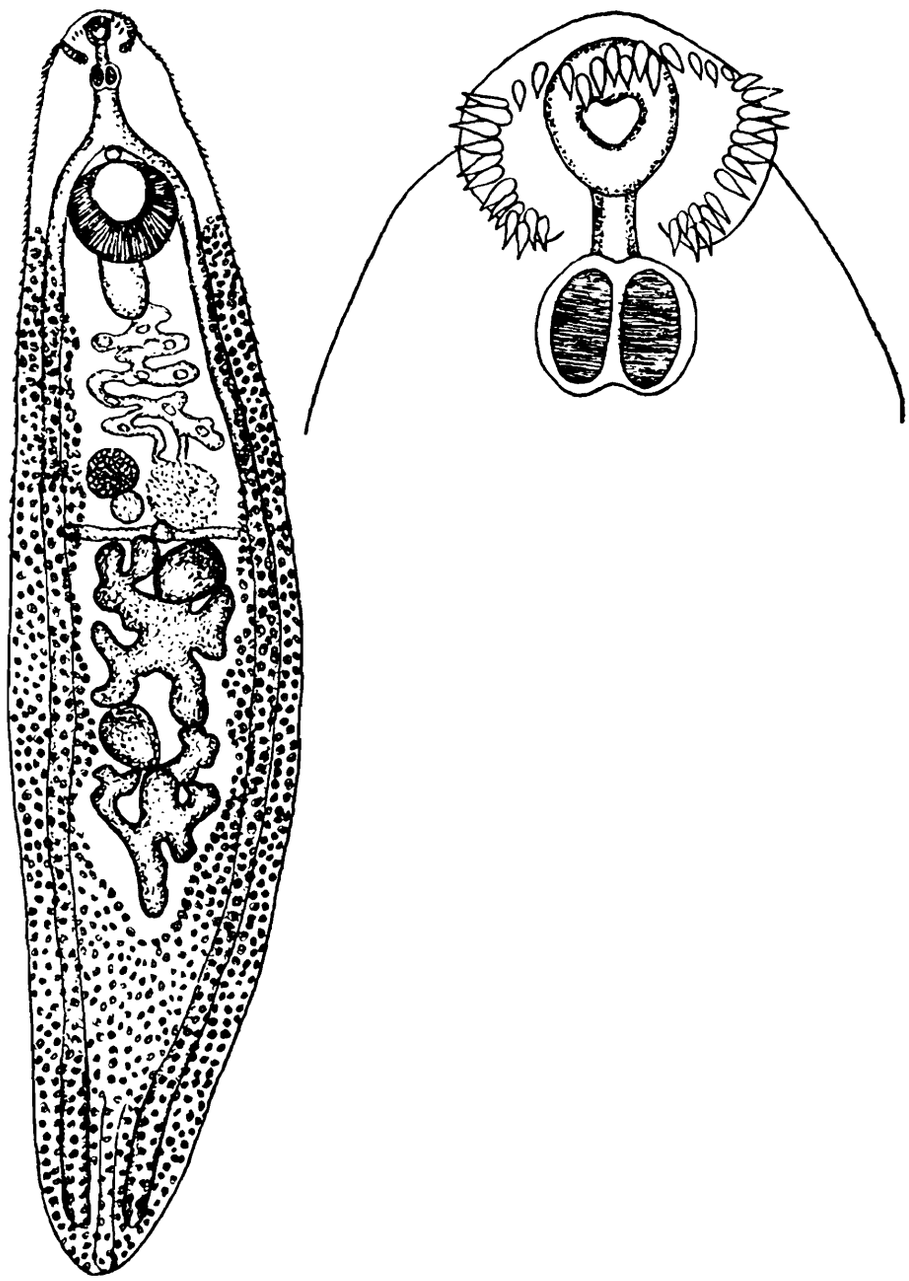


FIG. 17. *Artyfechinostomum indicum* (Bhalerao, 1927) and its collar.

posterior extremity, confluent behind testes. Eggs a few, 0.0747–0.15×0.06–0.09.

Host.—*Uromastix hardwickii, Varnaus monitor.*

Location.—Duodenum, intestine.

Locality.—Nagpur; Jabalpur, M.P.; Lucknow, Allahabad, U.P.

Genus 6. **Pseudoechinochasmus** Verma, 1936

Echinostomatinae : Body elongated, broadly rounded posteriorly like *Echinoschasmus*, short 1.8–2.2×0.4–0.6, of almost uniform breadth from behind acetabulum, spinulate. Collar broader than long with double dorsally uninterrupted rows of spines. Acetabulum large in anterior one-fourth to one-fifth body. Testes tandem, lobed, anterior equatorial, separated from posterior testis by equal distance to that from ovary. Cirrus sac anterodorsal to acetabulum, not extending behind its middle. Cirrus often everted, long. Ovary submedian, rounded, entire or feebly lobed. Vitellaria lateral, from anterior level of anterior testis to near posterior extremity, approaching mesially in posttesticular region. Uterus short, transversely coiled, pretesticular. Excretory vesicle Y-shaped, stem bifurcating behind testes. Parasitic in intestine of birds.

Type-species : *P. satjivani* Verma, 1936

20. **Pseudoechinochasmus satjivani** Verma, 1936

Specific diagnosis.—Body spined, 1.8–2.2×0.4–0.6 breadth, which is almost the same behind acetabulum. Collar broader than long, 0.15–0.3, united across venter. Collar spines 37; 19 alternating dorsal spines of same length, 0.0336; laterals 4 on each side, of two sizes *0.033×0.008 or 0.399×0.01006*; end groups of 5 spines each, four large 0.0596×0.01596, one small 0.0339 long. Oral sucker 0.067 Prepharynx 0.0252 long; pharynx 0.067×0.05; oesophagus 0.14–0.143 long. Acetabulum 0.32–0.36 in diameter. Testes close behind shell gland mass, separated from one another by same distance as that between ovary and anterior testis; anterior testis transversely elongated, 0.181–0.192×0.248–0.225, lobes 5–7, subdivided in some specimens; posterior often subtriangular with rounded hinder margin, lobes 3–5, subdivided or not. Ovary 0.13–0.14 in diameter. Eggs 30–40, 0.084–0.0924 ×0,050–0.0588.

Host.—Sooty Gull.

Location.—Intestine.

Locality.—Mainpuri.

II. Subfamily *HYPODERAENAE* Skrjabin et Baschkirova, 1956

Echinostomatidae : Anteior part of body short, widened. Head collar feebly develop d with double dorsally uninterrupted row of large number of small spines; collar spines larger than cutaneous spines. Acetabulum large, strongly muscular, very near anterior end. Oesophagus short or very short. Genital pore immediately postbifurcal, median or sub-median. Testes elongate with smooth or indented margins in midregion of body. Cirrus sac elongate, may reach to posterior end of acetabulum. Ovary median pretesticular. Vitellaria lateral from behind acetabulum to near posterior extremity. Uterus long, coiled, containing numerous eggs, pretesticular. Excretory vesicle Y-shaped, with numerous lateral branches. Parasitic in birds.

Type genus : *Hypoderaeum* Dietz, 1909

Genera *Multispinotrema* Skrj. et Baschkirova, 1956 and *Skrjabinophora* Baschkirova, 1941 are dropped.

Genus 7 **Hypoderaeum** Dietz, 1909

Hypoderaeinae : Body elongate, spinulate. Head collar very feebly developed. Collar spines in double dorsally uninterrupted row, very small, 43 or more up to 72 in number. Acetabulum large, strongly muscular, strikingly near anterior end. Oral sucker small. Prepharynx present or absent; pharynx muscular, sometimes as large or slightly larger than oral sucker; oesophagus very short or short; caeca simple, reaching near posterior end. Testes elongated, with smooth or indented margins in midregion of body. Cirrus sac elongate, partly overlapping acetabulum or reaching its posterior end; vesicula seminalis large; cirrus well developed, unspined. Ovary median, usually preequatorial. Vitellaria separate, lateral, from posterior end of acetabulum or a little behind to posterior extremity. Uterus long; eggs numerous.

Type-species : *H. conoideum* (Bloch, 1782) Dietz, 1909

Key to Indian species of **Hypoderaeum**

1. Collar spines 47; cirrus sac partly covering acetabulum not extending behind its middle.	*H. microspina* (Singh, 1954) Skrjabin et Boschkirova, 1956.
Collar spines 47–53 (average 49); cirrus sac extending to posterior end of acetabulum.	2
2. Oesophagus shorter than pharynx; cirrus very long.	*H. magnocirrusa* Verma, 1936
Oesophagus twice the length of pharynx; cirrus not very long.	*H. conoideum* (Bloch, 1782) Dietz, 1909.

21. **Hypoderaeum conoideum** (Bloch, 1782) Diezt, 1909

Syn. *Hypoderaeum mainpuria* Verma, 1936

Specific diagnosis.—Body 7.7–12 long, 1.3–2.0 broad in front of acetabulum. Cuticular spines broad, scale-like arranged in rings around collar, diminishing rapidly behind acetabulum, visible up to level of ovary. Collar very short, feebly developed. Collar spines very minute, number not ascertained by Verma but 49 (47–53) in European form. Acetabulum 0.7–0.88 in diameter, 0.67–0.75 behind anterior extremity. Oral sucker 0.156×0.21. Pharynx 0.1–0.118×0.84×0.109 Oesophagus twice as long as pharynx. In European form pharynx rounded, 0.14–0.18 in diameter or elongated oval, 0.16–0.2×0.13–0.16. Oesophagus 0.2–3.0 long. Genital pore median, immediately behind intestinal bifurcation. Testes elongated with faintly depressed margins at 2–3 places, some specimens elongated sausage-shaped with more or less deeply indented margins, almost equally large, 0.88–1.24 ×0.46–0.62. According to Verma anterior testis 0.65–0.67 ×0.34–0.42, almost equatorial, one third in anterior half, two third behind equatorial line; posterior testis 0.6–0.756 ×0.35–0.365; posttesticular distance 0.57–0.60. Cirrus sac about as long as acetabulum; in pressed specimens it shifts from its dorsal position over acetabulum to one side or anteriorly. Vesicula seminalis long, winding. Cirrus strongly developed. Ovary rounded or transversely oval, 0.31–0.44 in diameter or 0.35–0.37×0.29–0.3; according to Verma transversely oval 0.21×0.3–0.42 in front of second third of body. Vitellaria from behind acetabulum to near end of caeca, extracaecal at first, then partly overlap caeca, running in

median line behind testes, even feebly meeting here and there, follicles large thick. Uterus between ovary and acetabulum, transversely coiled with thin walls. Eggs oval, 30 in one specimen, about 125 in the other (uterus long with numerous eggs according to Dietz), 0.051–0.068.

Host.—Shoveller duck.

Location.—Intestine.

Locality.—Mainpuri, U.P.

22. **Hypoderaeum magnocirrusa** Verma, 1936

Specific diagnosis.—Body 9.3–10.1 long, 1.75 in greatest breadth at acetabulum. Cuticle spined to near ovary. Collar very feebly developed. Collar spines not distinct. Oral sucker 0.218×0.269. Acetabulum very large, 1.05×1.18, 0.7–0.9 behind anterior end. Prepharynx short, pharynx 0.168×0.185; oesophagus reduced, shorter than pharynx. Testes and ovary separated from one another by nearly same distance, all situated in middle third of body. Testes elongate oval; anterior more elongated, 0.672×0.336, margin slightly notched at 2 or 3 places; posterior 0.605×0.336. Cirrus sac extending to a little behind acetabulum. Vesicula seminalis wavy. Cirrus very long, 0.6×0.17 everted in one specimen. Ovary 0.319×0.302, just behind equator. Mehlis' gland large, compact. Vitellaria lateral, from behind acetabulum, internal to caeca only behind posterior testis but never meet. Uterus intercaecal, widely convoluted between Mehlis' gland and acetabulum. Eggs many, operculated, 0.091–0.11×0.058 –0.067 Excretory pore terminal.

Host.—Pin Tail.

Location.—Intestine.

Locality.—Allahabad, U.P.

23. **Hypoderaeum microspina** (Singh, 1954) Skrjabin et Baschkirova, 1956

(Fig. 18)

Syn. *Echinostoma microspina* Singh, 1954

Specific diagnosis.—Body 7.34×0.87, spined ventrally with rose thorn-shaped spines up to middle of acetabulum. Head collar very small well marked from body. Collar spines 47 arranged partly in single row, those at end slightly larger

than others which are equal in size. Acetabulum very muscular, 0.703×0.7, just posterior to oral sucker at about one ninth anterior body length. Oral sucker rounded, 0.185

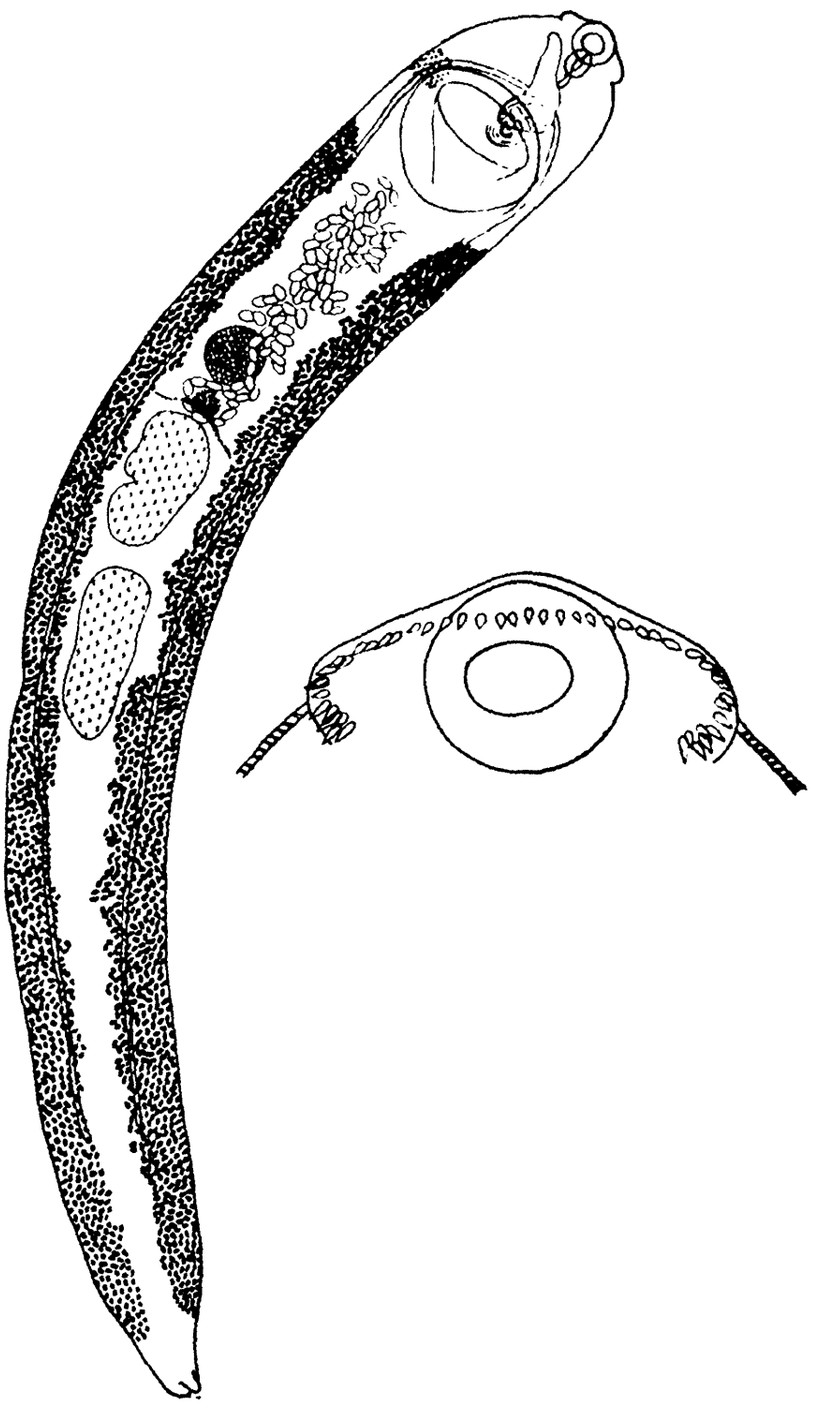


FIG. 18. *Hypoderaeum microspina* (Singh, 1954) Skrjabin et Baschirova, 1956 and its collar.

in diameter. Prepharynx absent; pharynx fairly muscular, 0.15×0.105. Oesophagus short; caeca reach almost posterior end. Testes elongated, bean-shaped close behind one another in posterior half of body; anterior slightly preequatorial, 0.722×0.332; posterior separated from anterior testis by 0.1 distance, 0.795×0.32. Cirrus sac partly covered by acetabulum, 0.3×0.2. Seminal vesicle large, slightly colied. Cirrus well developed, muscular, unarmed, 0.31 long, 0.175 in diameter at base. Ovary rounded, 0.26 in diameter. Mehlis' gland diffused between ovary and anterior testis, 0.15 in diameter. Vitellaria lateral along and overlapping caeca, from base of acetabulum to 0.34 from posterior end of body. Uterus forms a loop posterior to ovary and then runs coiled to open beside male genital pore. Eggs many between ovary and acetabulum, 0.085–0.092×0.046–0.058.

Host.—*Anas acuta*, pin-tail duck.

Location.—Intestine.

Locality.—Lucknow, U.P.

III. Subfamily *PSILORCHIINAE* n. subf.

Echinostomatidae : Body elongated. Head collar small, rudimentary, reniform, armed haphazardly with minute scattered, spines, smaller than the cutaneous spines. Acetabulum large near anterior end with characteristic anteriorly directed opening, sphincter around its anterior part and fairly deep cavity armed with small spines similar to cutaneous spines. Oral sucker small. Prepharynx present; pharynx well developed; oesophagus short or very short; caeca terminating a little in front of posterior extremity. Genital pore submedian, preacetabular between intestinal bifurcation and acetabulum. Testes tandem, postequatorial, elongate oval or sausage-shaped with smooth or irregular margin. Cirrus sac preacetabular, overlapping anterior margin of acetabulum. Ovary pretesticular, preequatorial or subequatorial, almost spherical. Receptaculum seminis absent Uterus intercaecal, pretesticular, winding. Vitellaria lateral mostly extracaecal, somewhat approaching mesially behind posterior testis but not meeting each other, extending from a little behind acetabulum to caecal ends. Extretory vesicle Y-shaped, stem bifurcating behind posterior testis and longer cornua extending towards pharynx. Parasitic in intestine of birds.

Type genus : *Psilorchis* Thapar and Lal, 1935

Another genus probably *Psilocollaris* Singh, 1954

Psilocollaris is at present retained in the family Psilostomidae Odhner as it lacks cutaneous spines as well as collar spines. It also differs in the character of the acetabulum.

Genus 8. **Psilorchis** Thapar and Lal, 1935

Syn. *Neoechinostoma* Agrawal 1963

Echinostomatidae, Psilorchinae : Body elongated, middle sized; cutaneous spines scale-like. Head collar small, rudimentary, reniform with scattered minute spines smaller than cutaneous spines. Acetabulum large, near anterior end with characteristic anteriorly directed opening, sphincter around its anterior part and fairly deep cavity armed with small spines similar to cutaneous spines. Oral sucker small, Prepharnyx present; pharynx well developed; oesophagus short or very short. Genital pore submedian, slightly dextral, preacetabular. Testes tandem postequatorial, elongate oval or sausage-shaped with smooth or irregular margins. Cirrus sac preacetabular overlapping anterior margin of acetabulum. Vesicula seminalis retort-shaped or pyriform. Ductus ejaculatorius short. Ovary preequatorial or sub-equatorial, almost spherical. Receptaculum seminis absent. Uterus inter caecal, pretesticular, winding; receptaculum seminis uterinum sometimes present. Vitellria lateral, mostly extracaecal, somewhat approaching meisally behind posterior testis, but not meeting each other, extending from a little behind acetabulum to caecal ends. Excretory vesicle Y-shaped stem bifurcating behind posterior testis and cornua longer extending to pharynx. Parasitic in intestine of birds.

Type-species : *P. indicus* Thapar and Lal 1935

24. **Psilorchis indicus** Thapar and Lal, 1935

(Fig. 19)

Syn. *P. ajgainis* Lal, 1938
P. thapari Baugh, 1949
P. mehrai Gupta, 1956
P. halcyoni Chatterji, 1948
P. ketupi Chatterji, 1956
Neoechinostoma spinosa Agrawal, 1963

Specific diagnosis.—Body elongated, spined, 5.76–8.57 long, 0.075–1.26 in maximum breadth in acetabular region. Collar small, 0.27–0.32×0.39–0.43, rudimentary with minute hap-

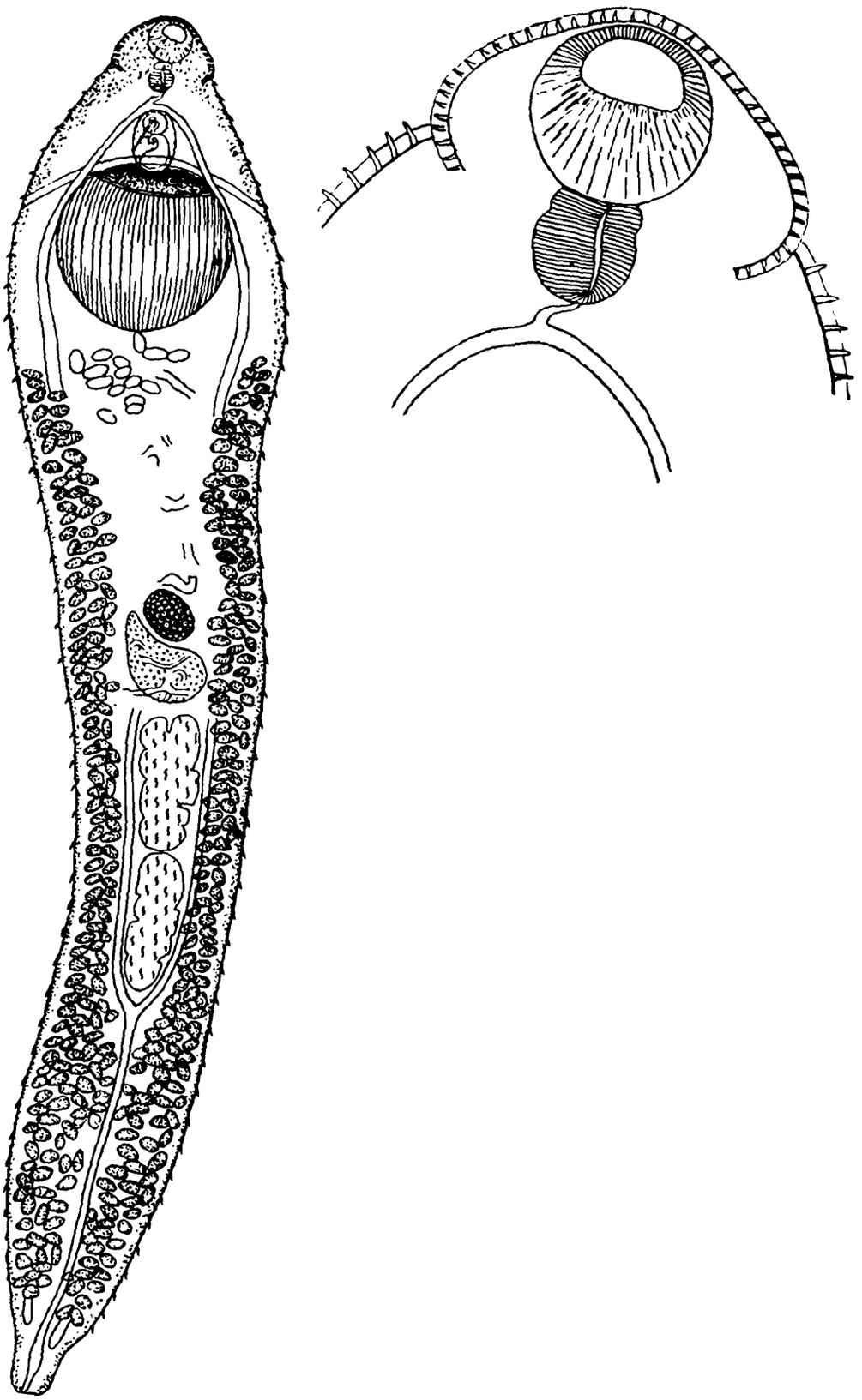


FIG. 19. *Psilorchis indicus* Thapar and Lal, 1935 and its collar region.

hazardly scattered spines all over it; collar spines smaller than cutaneous spines. Acetabulum large near anterior end with anteriorly directed opening, sphincter around its anterior part and deep cavity armed with minute spines, 0.62–0.87. Oral sucker small, 0.02–0.21 in diameter. Prepharynx distinct; pharynx 0.096–0.18 in diameter; oesophagus short. 0.05–0.14 long; Baugh mentions very short, 0.03 long. Genital pore slightly dextral or median, a little in front of acetabulum between it and intestinal bifurcation. Testes variable in form and size, elongate oval or with irregular margins or slightly lobed; anterior 0.57–0.84 × 0.25–0.68; posterior 0.5–0.84 × 0.26 –0.57. Cirrus sac 0.27–0.35 × 0.16–0.31. Cirrus protrusible, short massive. Ovary subspherical, spherical or oval, 0.2–0.41 × 0.21–0.32. Eggs large, oval, 0.08–0.14 × 0.03–0.08.

Host.—Kingfisher, *Halcyon smyrensis fusca, Alcedo inspida;* common teal, *Nettion crecca;* owl, *Athena brama indica, Ketupa zeylonensis leschenaulti, Tyto alba.*

Location.—Small intestine.

Locality.—Lucknow, Banaras, Allahabad, Gorakhpur, U.P.; Cuttack, Orissa.

IV. Subfamily *PSEUDECHINOSTOMINAE* n. subf.*

Syn. *Pseudechinostomatinae* Skrjavin et Baschkirova, 1956

Echinostomatidae : Body elongated, narrow, almost uniform in breadth, spinulate, medium sized. Head collar very feebly developed consisting of lateral lapperts with or without dorsal connection. Collar spines entirely absent. Acetabulum large bowl-shaped, near anterior end. Genital pore immediately behind intestinal bifurcation. Oral sucker small. Pharynx small; oesophagus very small or moderately long; caeca terminating near posterior extremity. Testes tandem, elongate oval, entire or slightly lobed, postequatorial or anterior testis equatorial. Cirrus sac extending to posterior margin of acetabulum or a little behind. Vesicula seminalis, pars prostatica and cirrus enclosed within cirrus sac. Cirrus long, unspined. Ovary submedian, pretesticular. Uterus coiled, pretesticular; first one or two coils forming receptaculum seminis uterinum behind ovary. Metraterm well developed

* Gupta (1957) has also erected the subfamily Pseudoechinostominae. According to rules the authorship of the subfamily should be Pseudechinostominae Skrjabin et Baschkirova, 1956 emend. Gupta, 1957—*Ed.*

along acetabulum. Vitellaria restricted to lateral fields from behind acetabulum to posterior extremity, tending to extend mesially behind posterior testis. Eggs large, numerous. Excretory vesicle Y-shaped with long stem bifurcating behind posterior tetis; subcutaneous excretory plexus absent. Parasitic in intestine of birds.

Type genus : *Pseudechinostomum* Odhner, 1911

Genus 9. **Pseudechinostomum** Odhner, 1911

Pseudechinostominae : Body long, slender, cylindrcal, spinulate. Head collar very feebly developed. Collarcal, spines absent. Acetabulum large, bowl-shaped near anterior extremity. Genital pore immediately behind intestinal bifurcation. Oral sucker small. Pharynx small; oesophagus very small or moderately long. Testes tandem, elongated oval, entire or slightly lobed, postequatorial or tanerior testis equatorial. Cirrus sac extends to posterior margin of acetabulum or a little behind it. Cirrus long, unspined. Ovary submedian, rounded or transversely oval. Uterus coiledr pretesticular; receptaculum seminis uterinum present behind ovary. Metraterm well developed. Vitellaria lateral, from behind acetabulum to posterior extremity, tending to extend mesially behind posterior testis. Eggs large, numerous. Excretory vesicle Y-shaped with long stem bifurcating behind posterior testis. Parasitic in intestine of birds.

Type-species : *P. incoronatum* Odhner, 1911

Key to species of **Pseudechinostomum**

Oesophagus moderately long; cirrus-sac broader at base, narrow terminally extending behind acetabulum; ovary rounded.	*P. incoronatum* Odhner,* 1911
Oesophagus very short; cirrus sac with three or four constrictions, broader transversely, reaching almost posterior border of acetabulum; ovary transversely oval... ..	*P. indicus* Mehra, 1944.

25. **Pseudechinostomum indicus** Mehra, 1944

(Fig. 20)

Specific diagnosis.—Body 7.5–9.5 long, 1.68–1.75 in maximum breadth in region of ovary; bodywall thick muscular,

*This species has not been recorded from India so far—*Ed.*

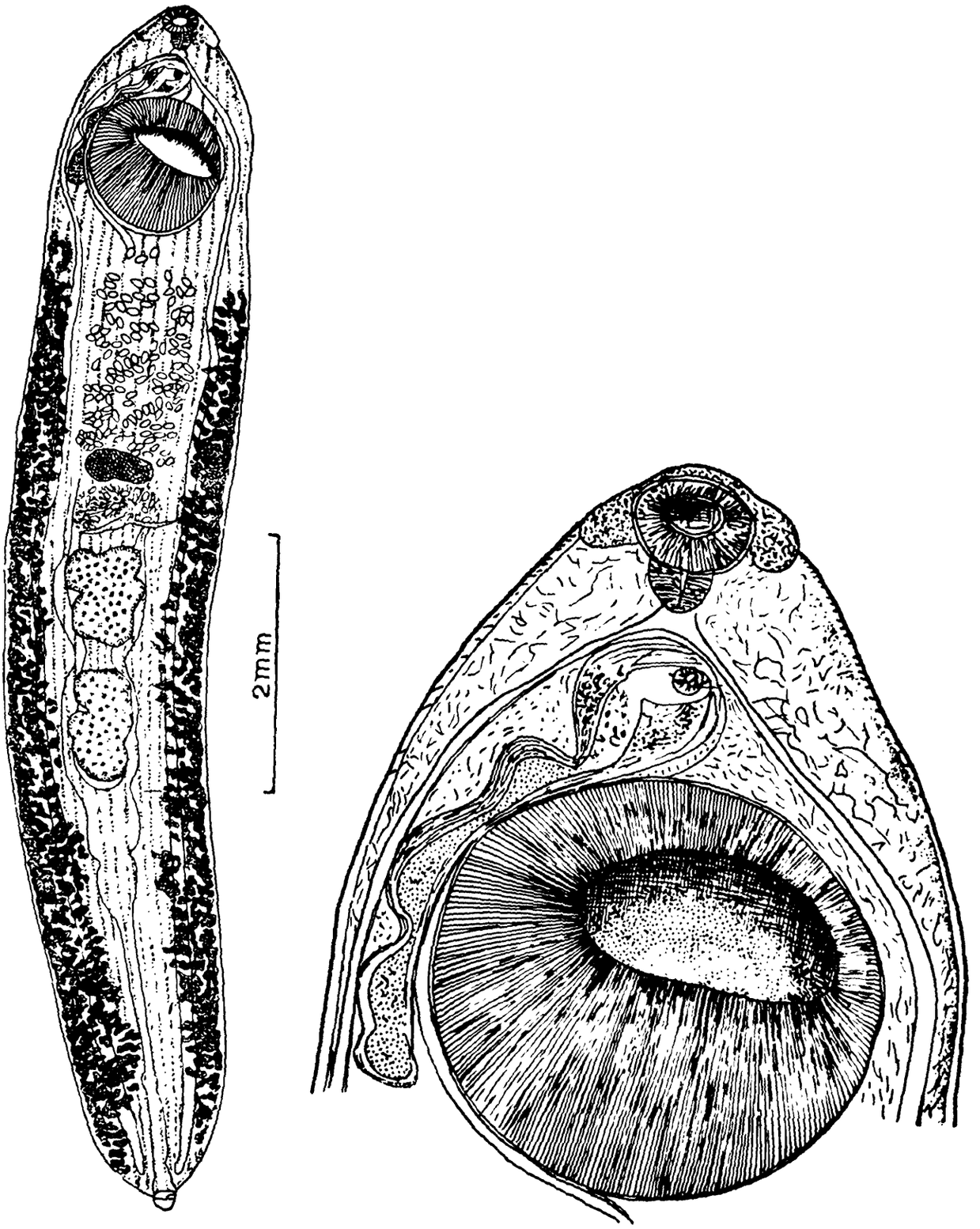


FIG. 20. *Pseudechinostomum indicus* Mehra, 1944 and its anterior region.

spined. Collar 0.527×0.221 in maximum breadth, not properly seen in living specimens but visible in entire mounts; collar lappets not united ventrally. Oral sucker 0.19–0.22 ×0.225. Acetabulum rounded, 0.99–1.035×1.05–1.11. Prepharynx absent; pharynx 0.118×0.15; oesophagus extremely small, 0.16×0.1; caeca terminating 0.15–0.25 in front of hinder end. Genital pore suckerlike to left side behind intestinal bifurcation close inside left caecum. Testes elongated, slightly lobed, median ; anterior 0.63×0.8–0.72, equatorial; posterior 0.84–0.87×0.5–0.7, at 0.15–0.165 behind anterior end 3–3.2 in front of hinder end. Cirrus sac 1.35×0.32 maximum breadth near its anterior end, to right side of acetabulum, extending to near its posterior margin, showing three or four constrictions. Vesicula seminalis long. Ovary oval, transversely elongated, 0.48–0.54×0.27–0.315, median or to right. Shell gland mass just behind ovary. Receptaculum seminis absent; receptaculum seminis uterinum present. Metraterm alongside acetabulum between it and cirrus sac. Eggs nemerous, 0.0957–0.1×0.0561–0.0627 Vitelline follicles moderate sized of irregular shape. Excretory pore terminal.

Host.—Indian teal, *Nettion crecca crecca.*

Location.—Intestine.

Locality.—Allahabad, U.P.

V Subfamily *PARALLELOTESTISIINAE* n. subf.

Echinostomatidae ; Body fusiform or lancet-shaped with somewhat pointed ends, spinulate all over. Head collar very small with double row of dorsally uninterrupted spines. Acetabulum large, preequatorial at about anterior one third or nearer middle of body. Oral sucker small. Pharynx prominent; oesophagus moderately long, bifuracting in front of acetabulum. Genital pore submedian behind intestinal bifurcation. Testes symmetrical, parallel, immediately postequatorial or equatorial at level of or just behind broadest part of body. Cirrus sac preacetabular. Cirrus stout, spined. Ovary pretesticular in front of right testis. Vitellaria from acetabular zone or just behind intestinal bifurcation to posterior extremity, approaching mesially in region of gonads, confluent behind testes. Uterus coiled, preovarian. Eggs large, numerous. Parasitic in intestine of birds.

Type genus : *Parallelotestis* Belopolskaia, 1954

Genus 10. **Parallelotestis** Belopolskaia, 1954

Syn. *Proechinocephalus* Srivastava, 1958

Parallelotestisiinae n. subf. : Body medium sized, spined all over, broadest at level of testes or in front near acetabulum. Head collar very small with double row of dorsally uninterrupted spines, 23–27 in number; ventral spines not in angular groups. Testes symmetrically parallel, immediately postequatorial or equatorial, at level of or just behind broadest part of body. Cirrus sac preacetabular, diagonal between acetabulum and intestinal bifurcation. Cirrus stout, spined. Ovary in front of right testis, rounded. Vitellaria of large or small follicles extending from just behind intestinal bifurcation or acetabular zone to posterior extremity, approaching mesially in region of gonads, confluent behind testis, surrounding gonads in a semicircle behind acetabulum. Uterus coiled, preovarian. Eggs large, numerous. Parasitic in intestine of birds.

Type-species: *P. horridus* Belopolskaia, 1954

26. **Parallelotestis tarai** (O. N. Srivastava, 1958)

(Fig. 21)

Syn. *Proechinocephalus tarai* O. N. Srivastava, 1958

Proechinocephalus egreti P. S. Srivastava, 1960

Specific diagnosis.—Body 7.42–9.88× 3.09–3.72 maximum breadth; breadth almost uniform in middle third of body. Collar small, terminal, 0.37×0.6. Collar spines 23–25, alternately in double rows; 4 ventral spines on each side the largest; largest ventral spines 0.095×0.027; spines bluntly pointed, lack straight margins. Cutaneous spines present all over body, smaller than collar spines. Oral sucker 0.27 in diameter or 0.135×0.17. Acetabulum preequatorial, 0.96 in diameter or 1.088×1.224. Prepharynx funnel-like, 0.05 ×0.13 or 0.068 long; pharynx longer than broad, 0.255–0.306 ×0.204; oesophagus 1.53–1.96 long, its anterior part broad flask-like, posteriorly slightly curved; caeca slightly sinuous, extending to posterior end with their breadth gradually increasing posteriorly, wide apart in pretesticular region, closer in posttesticular region. Genital pore slightly dextral, half-way between intestinal bifurcation and acetabulum. Testes intercaecal, symmetrical, globular or broader than long, equal 0.487 in front of hinder end, at posterior limit of middle third of body, 0.45 in diameter or anterior left testis 0.476×0.748; right or slightly posterior testis 0.51×0.6.

Testes separated by 0.15 distance transversely by a few oblique muscle fibres. Cirrus sac small, 0.375–0.612×0.225–0.78, obliquely preacetabular or extending diagonally from anterolateral margin of acetabulum. Cirrus spined in posterior part, spines 0.018–0.025 long. Ovary spherical, dextral close to right caecum, 0.6 behind acetabulum, 0.25–0.498 ×0.3–0.357. Laurer's canal present. Vitelline follicles small, extending laterally in pretesticular region to level of genital pore, filling entire posttesticular region; vitelline reservoir prominent, median in front of testes. Uterus coiled, between genital field and acetabulum. Metraterm short, slender. Eggs 0.05–0.09×0.051–0.06 or 0.1.

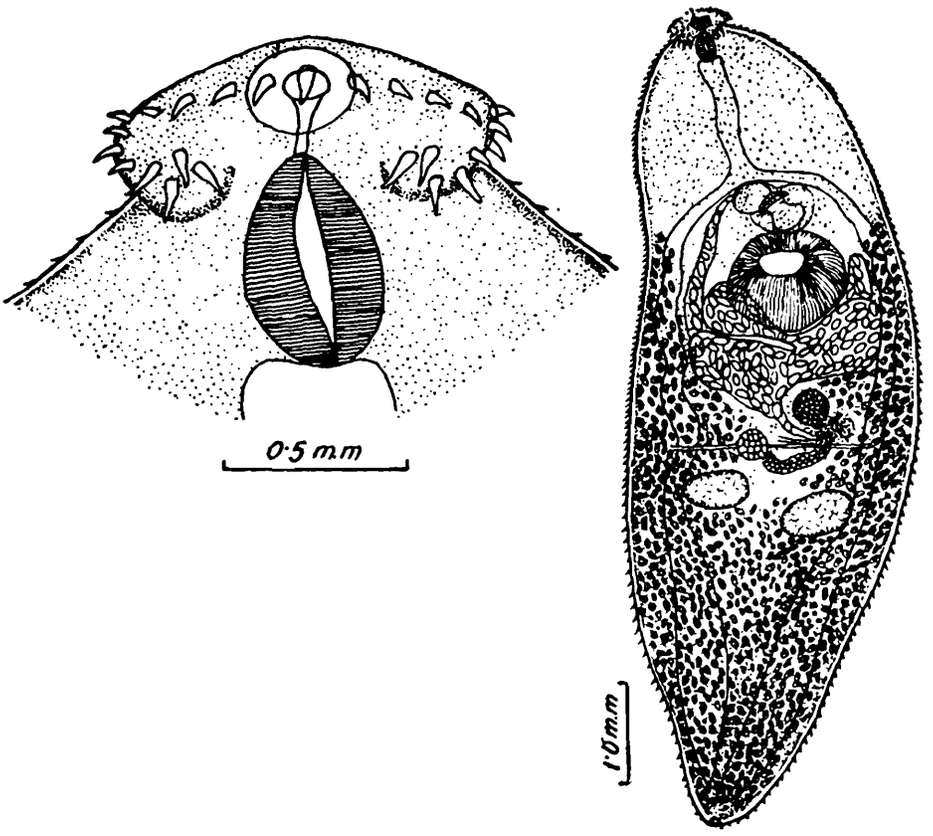


FIG. 21. *Parallelotestis tarai* (O. N. Srivastava, 1958) and its anterior region.

Host.—Indian cattle egret, *Bubulcus ibis coromandus.*
Location.—Small intestine.
Locality.—Tarwa, Allahabad, U.P.; Raipur, M.P.

VI. Subfamily *NEPHROSTOMINAE* Mendheim, 1943

Echinostomatidae : Body elongated, unspined. Head collar large, disc-shaped (*Nephrostomum*) or horse shoe-shaped of typical bilobed form with dorsal incision (*Patagifer*). Collar

spines in single dorsally uninterrupted or interrupted row. End group of collar spines present. Acetabulum large, cup-shaped or funnel-shaped near anterior end. Testes small, tandem in midbody or hinder half. Cirrus sac small, pre-acetabular, reaching anterior margin of acetabulum or overlapping it. Vesicula seminalis coiled; pars prostatica and cirrus present. Ovary pretesticular, smaller than testes. Vitellaria restricted to lateral fields from posterior margin of acetabulum to posterior extremity, separate throughout their length. Uterus large, intercaecal, median, coils never filling entire breadth between vitellaria. Eggs numerous. Parasitic in intestine of birds.

Type genus: *Nephrostomum* Dietz, 1909. Other genus: *Patagifer* Dietz, 1909

Key to genera of *NEPHROSTOMINAE*

Collar disc-shaped .	*Nephrostomum* Dietz, 1909
Collar horse shoe-shaped.	*Patagifer* Dietz, 1909

Genus 11. **Nephrostomum** Dietz, 1909

Nephrostominae: Medium sized to large. Cuticle smooth. Head collar broad, reniform, disc-shaped with or without shallow depression on anterior border. Collar spines in single uninterrupted row, innermost spines on each side near median line very small, increasing in size laterally towards lappets. 4 or 5 corner spines in each end group. Acetabulum large, prolonged backwards or funnel-shaped, near anterior extremity. Testes median, tandem, in hinder half of body, small, hardly larger than ovary, rounded with irregular margin or often strikingly lobed. Cirrus sac small, almost entirely preacetabular or dorsally overlapping anterior margin of acetabulum. Ovary median, sometimes indented, equatorial. Uterus large, in closely packed coils between ovary and acetabulum. Eggs large, very numerous. Parasitic in intestine of birds.

Type-species: *N. ramosum* (Sonsino, 1895) Dietz, 1909

27. **Nephrostomum ramosum** (Sonsino, 1895) Dietz, 1909

(Fig. 22)

Syn. *Nephrostomum bicolanum* Tubangui, 1933

Specific diagnosis.—Body elongated, light brown in live specimens, somewhat constricted in acetabular region, narrow

anteriorly, tapering towards posterior end, 10–14 long, 2.5–3.24 in maximum breadth just in front of ovary. Reniform disc-shaped collar with 47 or 48 spines in dorsally uninterrupted single row 1–2.7 across body. Oral sucker ventroterminal rounded or transversely oval, 0.11–0.36×0.12–0.45. Acetabulum bowl-shaped, situated near oral sucker, 0.9–1.48 ×1.0–1.4. Prepharynx small. Pharynx smaller than oral sucker; oesophagus very small, 0.169–0.185 long; caeca terminate near hinder end. Testes median, tandem with margin notched or slightly lobed, postequatorial, 0.33–1.25×0.4–0.72; anterior testis smaller than posterior. Cirrus sac transversely oval, 0.48–0.58×0.3–0.36, enclosing coiled vesicula seminalis, pars prostatica and ductus ejaculatorius, partly overlaps acetabulum obliquely. Genital pore median, immediately postbifurcal. Ovary equatorial, pretesticular, transversely elongated, 0.18–0.63×0.34–0.56. Shell gland complex larger than overy, immediately postovarian. Laurer's canal present. Receptaculum seminis absent. Vitellaria mostly extracaecal from a little in front of acetabulum to hinder end of body. Uterus intercaecal between ovary and acetabulum. Eggs numerous, 0.09–0.1×0.04–0.05. Excretory vesicle Y-shaped with long stem dividing into cornua behind posterior testis with paired lateral branches.

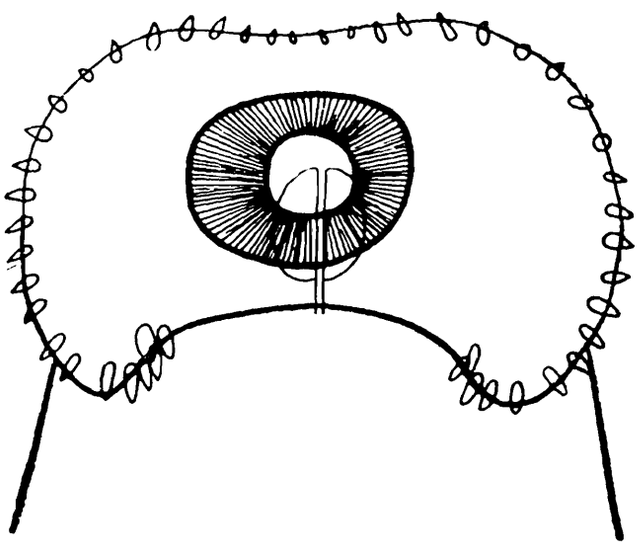


FIG. 22. Head collar of *Nephrostomum ramosum* (Sonsino, 1895) Dietz, 1909.

Host.—White necked stork, *Disurus episcopa episcopa.*

Location.—Intestine.

Locality.—Allahabad U.P.

Genus 12. **Patagifer** Dietz, 1909

Nephrostominae : Body submedian sized to large. Cuticle smooth. Head collar strongly developed deeply bilobed due to dorsal incision reaching oral sucker and much broader ventral bay; collar broader or narrower than body. Collar spines around margin in singie dorsally interrupted row, dorsal spines smallest; 4 spines in each end group in couples of 2 large and 2 small. Acetabulum large funnel-shaped or cup-shaped near anterior end. Testes median, tandem, in hinder half of body, small elongated oval or irregularly ovoid. Cirrus sac small, preaceatbular, slightly or partly overlapped by acetabulum. Vesicula seminalis coiled; pars prostatica present. Cirrus long, coiled when not protruded. Ovary median equatorial or preequatorial. Receptaculum seminis uterinum present. Uterus long, transversely coiled. Vitellaria restricted to lateral margins, overlapping and outside caeca. Eggs large, numerous.

Type-species : *P. bilobus* (Rud., 1819) Dietz, 1909

Key to Indian species of **Patagifer**

Acetabulum without a notch at its posterior margin	*P. wesleyi* Verma, 1936
Acetabulum with a notch at its posterior margin; collar spines 30 or 31 on each side of collar ..	*P. simarai* Nigam, 1944

28. **Patagifer wesleyi** Verma, 1936

(Fig. 23)

Syn. *Patagifer chandrapuri* Srivastava, 1952
Patagifer srivastavai Peter, 1954

Specific diagnosis.—Body 12.1–24.3×1.8–2.4, broadest in acetabular region. Collar 2.3×1.7 or 0.9×1.19; collar spines 31 on each side of margin of collar; 2 small angular spines of each group 0.09–0.1×0.037, 2 large spines 0.16–0.185 ×0.08–0.09. Ventral groups 0.93 apart. Neck region marked off by a constriction between collar and acetabulum; a less deep constriction present behind acetabulum. Oral sucker 0.17-0.41×0.2–0.45. Acetabulum 1.17–1.98×1.26–1.98. Testes longitudinally elongated, apart by same distance as that between ovary and anterior testis, equal in size, 1.95×0.49 with irregular margin; posttesticular space about one third of body length. Cirrus sac 0.78×0.41. Ovary 0.25×0.17 or 0.57×0.48. Eggs 0.074-1.03×0.059.

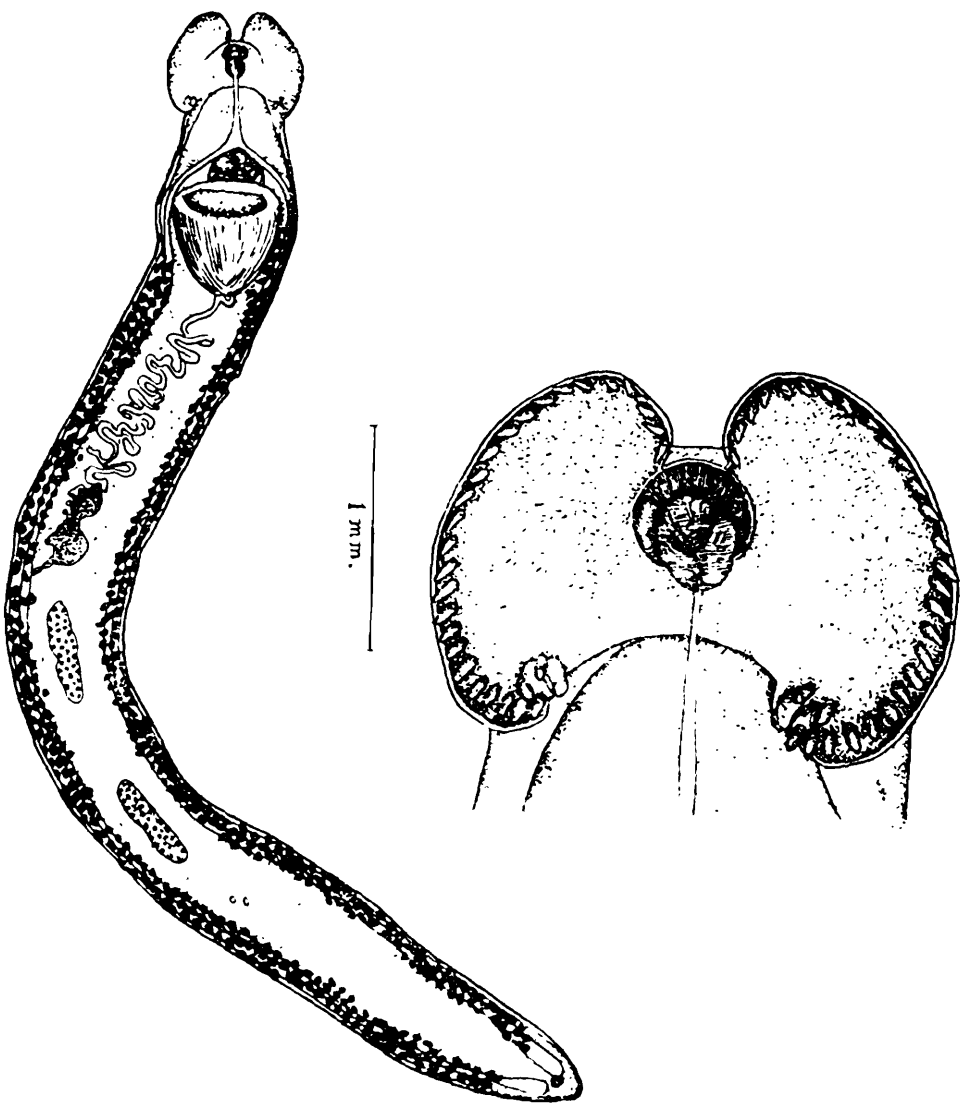


FIG. 23. *Patagifer wesleyi* Verma, 1936 and its collar.

Host.—Curlew and white ibis., *Numinius arquate, Threskiornis melanocephalus.*

Location.—Intestine.

Locality.—Fatehpur and Allahabad., U.P.

29. **Patagifer simerai** Nigam, 1944

Syn. *Patagifer sarai* Saksena, 1957

Specific diagnosis.—Body 20.0–23.2×2.1–3.06. Collar spines 30 or 31 on each side. Smallest dorsal spines 0.056–0.119 ×0.027–0.028; largest spines 0.135–0.14×0.0325–0.048. Two large and two small spines in each angular group. Oral sucker 0.49–0.81×0.43–0.51. Acetabulum with a notch at

posterior end or margin, 1.98–2.6×1.72–1.9. Pharynx 0.2 in diameter; oesophagus 0.68–1.16 long. Testes irregularly ovoid, almost equal 1.61–1.93×0.6–0.77. Cirrus sac 0.71–0.77 ×0.53–0.64. Cirrus long armed with small spines. Ovary oval or rounded, preequatorial. Eggs 0.081×0.054.

Host.—*Platalea leucordia*, *Threskiornis melanocephalus* (white ibis).

Location.—Intestine.

Locality.—Shahjahanpur (U.P.) and Raipur (M.P.).

VII. Subfamily *PEOGOSOMINAE* Mendheim, 1940*

Syn. *Pegosomatinae* Skrjabin et Schultz, 1937

Echinostomatidae : Body spindle-shaped narrow towards both ends, spinulate in entire length. Head collar poorly developed almost rudimentary. Collar spines in alternate double rows uninterrupted dorsally; corner end groups of spines present. Oral sucker absent or much reduced. Pharynx prominent. Oesophagus long; caeca undulating. Acetabulum relatively small, immediately preequatorial. Genital pore or separate male and female pores median between acetabulum and intestinal bifurcation. Testes tandem postequatorial, transversely elongated. Cirrus sac large, preacetabular extending slightly in acetabular zone, curving round left side; vesicula seminalis in basal part of cirrus sac; cirrus unarmed, often protruded. Ovary dextral, pretesticular. Receptaculum seminis absent. Laurer's canal present. Uterus short, coiled, between acetabulum and anterior testis, mostly preovarian. Vitellaria extensive, extending from pharynx or middle of oesophagus to posterior extremity, united mesially up to cirrus sac, separated behind level of intestinal bifurcation. Parasitic in bile duct or bile passages of birds.

Type genus : *Pegosomum* Ratz, 1903

Genus 13. **Pegosomum** Ratz, 1903

Pegosominae : Head collar poorly developed, collar spines in two dorsally uninterrupted rows; end group of spines present. Oral sucker absent or much reduced; pharynx

* The authorhip of the subfamily should go to Odhner, 1911 according to rules.—*Ed.*

prominent; oesophagus long; caeca undulating. Acetabulum relatively small, nearer middle of body. Testes transversely elongated, near posterior end. Cirrus sac preacetabular and extending to acetabular zone. Ductus ejaculatorius with locking apparatus ("Verschluss appart"). Cirrus often found protruded. Vitellaria extending from pharynx or middle of oesophagus, united anteriorly upto cirrus sac. Ovary small, dextral, between acetabulum and anterior testis. Parasitic in bile duct and bile passages of birds.

Type-species : *P. saginatum* (Ratz, 1898) Ratz, 1903

30. **Pegosomum egretti** Srivastava, 1957

(Fig. 24)

Specific diagnosis.—Size 6.67–8.7 × 2.6–3.25 maximum breadth just anterior to acetabulum. Collar 0.336 across, with 25 spines; ventral corner group consisting of 4 larger bluntly pointed spines, 0.05–0.06 × 0.012–0.024; dorsal spines 0.021–0.036 × 0.012–0.015. Cutaneous spines smaller and sore closely set in preacetabular region than in postacetabular region. Oral sucker terminal, very weak, 0.15 in diameter; in most specimens pharynx projected outside through inconspicuous oral sucker. Acetabulum 0.78.0.93 across. Pharynx 0.21 × 0.13, when fully protruded 0.3 × 0.18. Oesophagus long; caeca somewhat sinuous, come close towards one another in post-testicular region. Testes tandem; anterior boat-shaped, 0.91–1.43 × 1.56–2.34; posterior wedge-shaped, with irregular anterior margin, sometimes rounded to oval, 1.1–1.56 × 1.49–1.88. Cirrus sac 0.61 × 0.18 mostly preacetabular, slightly curves round on left side, extending to one fourth of acetabulum. Vesicula seminalis constricted. Cirrus thick, narrower than pars prostatica, curved when protruded, prominent. Ovary slightly lobed, somewhat pear-shaped, 0.45 × 0.27–0.36 with long axis transverse. Laurer's canal well developed. Vitellaria of small follicles in bunches; extending from middle of oesophagus to anterior margin of posterior testis. Eggs 0.09–0.126 × 0.03–0.09.

Host.—Cattle egret, *Bubulcus ibis coromandus.*
Location.—Liver.
Locality.—Allahabad, U.P.

VIII. Subfamily *PETASIGERINAE* Mendheim, 1943

Echinostomatidae ; Body elongated with or without distinct neck region, spinulate anteriorly. Head collar with usually

two dorsally uninterrupted rows of spines; 4 corner spines in each end group. Acetabulum equatorial, immedlately pre-equatorial, near middle of body. Oral sucker small, feebly muscular. Testes median, tendem, transversely elongated, contiguous or oblique near one another, postequatorial or near posterior extremity. Cirrus sac small, preacetabular or with posterior end extending a little or more behind anterior margin of acetabulum but never reaching to its middle. Vesicula seminalis large, saccular, not bilobed. Cirrus long, slender, unspined. Ovary pretesticular to right side, sometimes larger than testes. Vitellaria lateral from level of

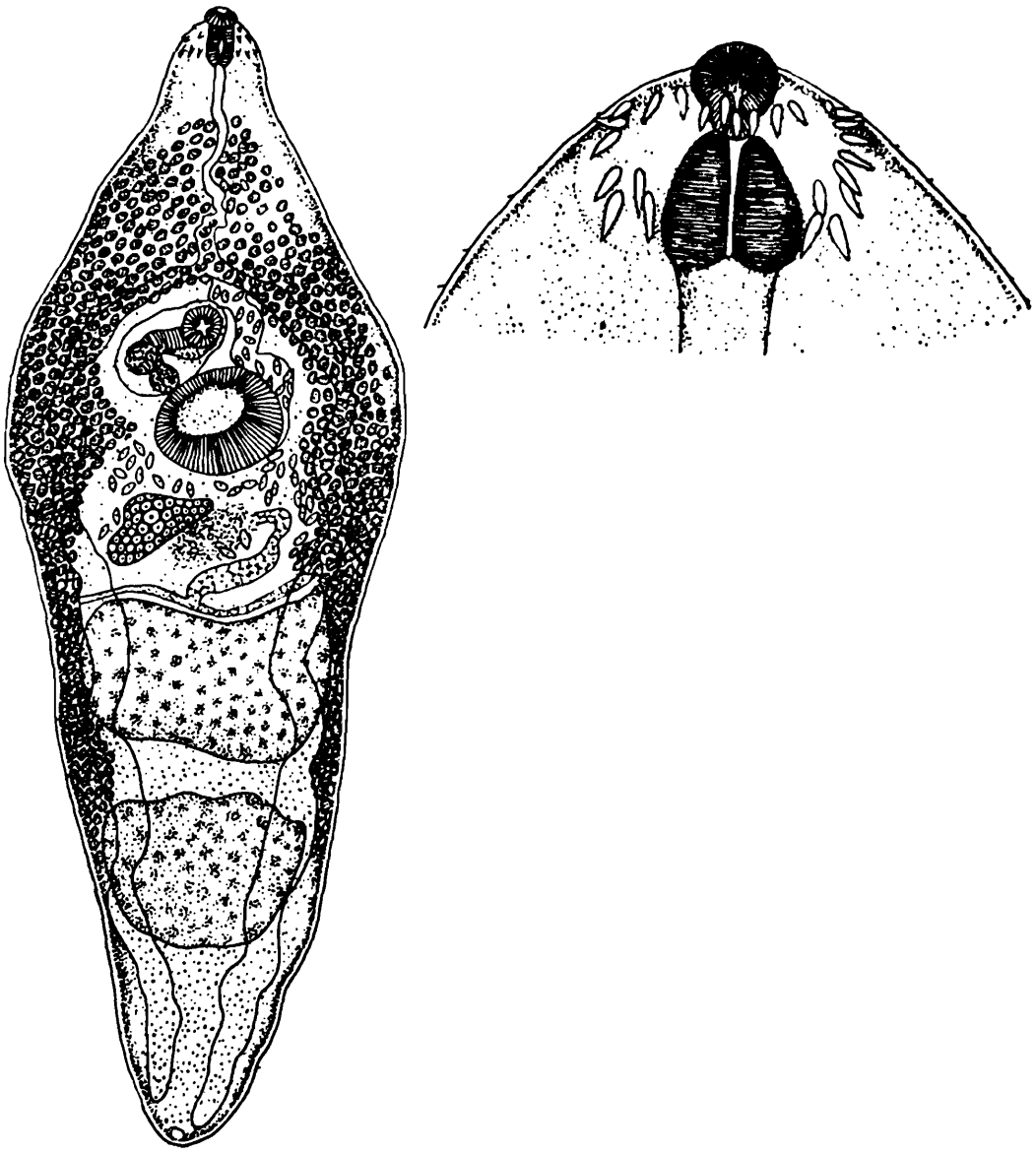


Fig. 24. *Pegosomum egretti* Srivastava, 1957 and its anterior region.

intestinal bifurcation or anterior border of acetabulum, approaching mesially or confluent behind testes. Uterus short or long. Eggs large, a few or numerous. Parasitic in intestine of birds.

Type genus : *Petasiger* Dietz, 1909

Genus 14. **Petasiger** Dietz, 10909

Syn. *Navicularia* Mendheim, 1943

Generic diagnosis the same as for the subfamily.

Type-species : *P. exaeretus* Dietz, 1909

Mendheim (1943) created the genus *Navicularia* for the species of *Petasiger* with spindle-shaped body, oblique testes, anterior testis sinistral, posterior testis median. There is no clear demarcation between the two genera *Petasiger* and *Navicularia*. Anterior testis in some species of the former has become shifted forward to the left side. *P. nicolli* Pande, 1939 with its oblique testes comes near *P variospinosum* Odhner, 1911, the genotype of *Navicularia*. The testes in *P. nicolli* are larger than the ovary, reverse to that in *P. variospinosum*. The greatest breadth of body in several species of *Petasiger* lies in acetabular region as for instance in *P. nicolli* Pande, 1939 and *P. antigonus* Nigam, 1944. The eggs are numerous in the former and a few, only 5 in the latter and this is a specific character. We, therefore, drop the genus *Navicularia* Mendheim.

Key to Indian species of **Petasiger**

Testes oblique, anterior sinistral, posterior median; eggs numerous. ..	*P. nicolli* Pande, 1939
Testes tandem; eggs a few, only 5.	*P. antigonus* Nigam, 1944

31. **Petasiger nicolli** Pande, 1939

(Fig. 25)

Syn. *Petasiger yamagutii* Nigam, 1944

Specific diagnosis.—Body elongated, somewhat spindle-shaped with broad anterior and pointed posterior ends, 2.51–2.93×0.73–0.85, broadest in acetabular region. Collar 0.17×0.5 broad. Collar spines 27; marginals 19 in two

alternating rows, 0.07–0.08×0.02; each end group with 4 larger spines, 0.1×0.04. Oral sucker 0.14–0.15 in diameter. Pharynx slightly smaller or almost equal to oral sucker,

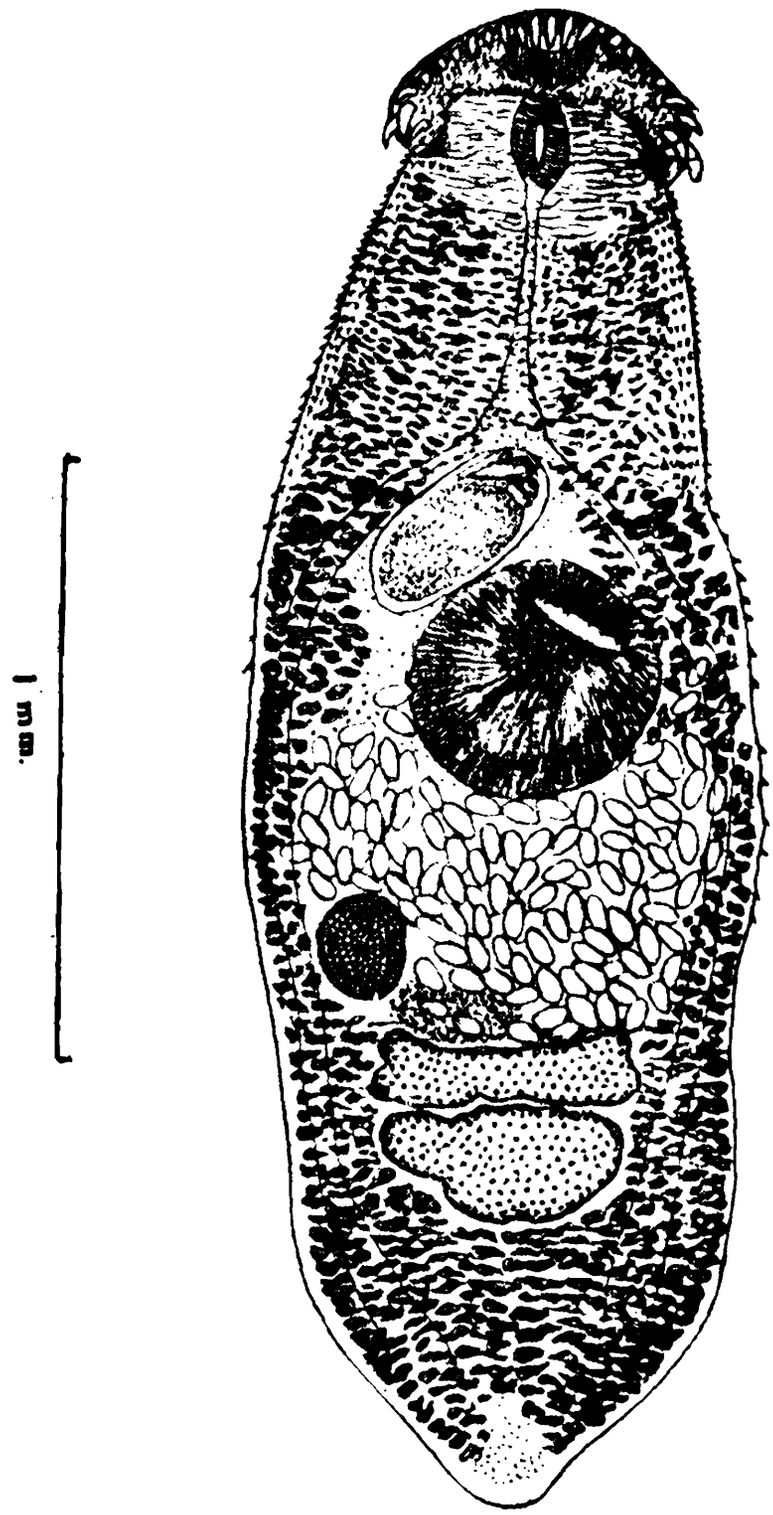


Fig. 25. *Petasiger nicolli* Pande, 1939.

0.13 in diameter or 0.187×0.112. Oesophagus 0.34–0.476 long, surrounded by a dense mass of gland cells. Acetabulum 0.44×0.37 or 0.408 in diameter, just in front of equator or immediately behind one third body length. Genital pores separate. Testes oblique, oval in third quarter of body; anterior sinistral, 0.22×0.27; posterior median, 0.27×0.3. Cirrus sac median, oblique or with posterior end a little behind anterior border of acetabulum and anterior end slightly inclined ventrally. Vesicula seminalis voluminous or plump oval. Ovary almost rounded or oval, close behind middle of body, 0.16×0.17 or 0.15×0.17, to right side. Metraterm as long as cirrus sac. Vitellaria from level of genital pores. Eggs numerous, 0.08–0.085×0.047–0.052.

Host.—*Anhinga melanogaster*

Location.—Small intestine.

Locality.—Allahabad, U.P.

32. **Petasiger antigonus** Nigam, 1944

(Fig. 26)

Specific diagnosis.—Body without a neck region, 2.55×0.8, broadest in acetabular region. Collar 0.46 broad, 0.22 long. Collar spines 27; marginals 19 in single row, 0.07×0.02, central spines larger 0.1×0.025; each end group of 4 spines. Oral sucker 0.117 in diameter. Prepharynx 0.119 long; pharynx 0.14×0.13. Oesophagus 0.2 long. Acetabulum pre-equatorial, 0.39×0.34. Testes tandem, contiguous at almost half distance between acetabulum and posterior end; anterior 0.425×0.187 broad; posterior longer, equally broad. Cirrus sac preacetabular. Ovary rounded, 0.17 in diameter, to right side nearer testes than acetabulum. Eggs only 5, 0.085–0.09×0.05–0.075. Vitellaria from just in front of intestinal bifurcation, extending mesially here; dense mass of oesophageal gland cells present just in front of vitelline follicles.

Host.—Crane, *Antigone antigone.*

Location.—Small intestine.

Locality.—Shahjahanpur, U.P.

IX. Subfamily *CHAUNOCEPHALINAE* Travassos, 1922

Echinostomatidae: Body divided into two regions, anterior bulbous, semispherical not protruded anteriorly (*Chauno-*

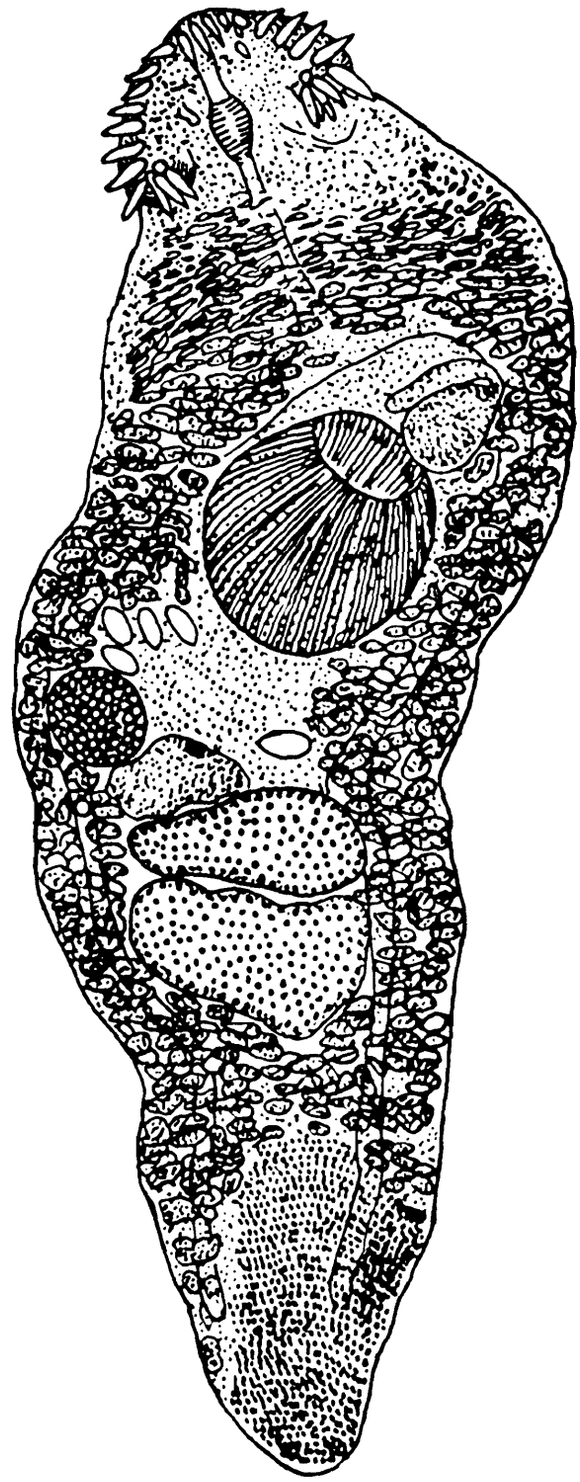


Fig. 26. *Petasiger antigonus* Nigam, 1944.

cephalus), or produced anteriorly into small conical part (*Balfouria*), and tail-like cylindrical short hindbody. Head collar small, reniform with double row of dorsally uninterrupted spines. Oral sucker small. Acetabulum not strongly

muscular, postequatorial or almost equatorial, exceptionally preequatorial. Pharynx present; oesophagus (pseudooesophagus) very long; intestinal bifurcation a little or much in front of acetabulum; caeca opening into excretory vesicle or ending blindly near posterior extremity. Genital pore immediately preacetabular. Testes small, almost parallel, diagonal or juxtaposed near middle of hindbody or further forward in forebody near its junction with hindbody (*Balfouria*). Cirrus sac small immediately preacetabular. Ovary postacetabular, pretesticular. Vitellaria extensive filling forebody and confined to lateral fields in greater part of hindbody (*Chaunocephalus*) or fan-shaped in lateral parts of forebody separated by large median uterus (*Balfouria*). Uterus coiled usually in hindbody not extending in front of genital pore (*Chaunocephalus*) or very large filling median broad region of forebody in front of genital pore (*Balfouria*). Eggs large, numerous, exceptionally a few. Excretory vesicle Y-shaped with two or three chambered stem bifurcating behind posterior testis in *Chaunocephalus*. Parasitic in intenstine usually in cysts or crypts of its wall in birds.

Type genus: *Chaunocephalus* (Rud., 1802) Dietz, 1909

Other genus: *Balfouria* Leiper, 1908

Genus 15. **Chaunocephalus** (Rud., 1802) Dietz, 1909

Chaunocephalinae: Under middle sized to middle sized. Forebody spinulate, subspherical, club-shaped or elongate broad, flat ventrally, convex dorsally; hindbody narrower, cylindrical, usually shorter than forebody. Collar small, reniform with double rarely single row of dorsally uninterrupted row of spines. Corner spines in each end group 4, always longer than marginal spines. Acetabulum large, postequatorial, equatorial or rarely preequatorial. Genital pore preacetabular, median or submedian behind intestinal bifurcation, usually sucker-like. Oral sucker small. Prepharynx usually present; oesophagus long, glandular, provided with sac-like diverticula, bifurcating just in front of acetabulum; caeca opening into excretory vesicle near posterior extremity or ending blindly. Testes diagonal, parallel near one another or juxtaposed in hindbody behind ovary. Cirrus sac almost oval, preacetabular. Ovary submedian, usually dextral, spherical or oval, usually larger than testes. Vitellaria occupying entire forebody and laterally great part of hindbody. Uterus much coiled in anterior part of hindbody,

usually first few coils forming receptaculum seminis uterinum. usually in crypts or cysts of its wall opening by a small pore into the lumen.

Type-species : *C. ferox* (Rud., 1795) Dietz, 1909.

Key to Indian species of **Chaunocephalus**

1.	Hindbody very long, much longer than forebody; latter narrower than in other species; acetabulum pre-equatorial; collar spines 25	*C. elongatum* Vedvrat, 1947
	Hindbody not longer than forebody; forebody bulbous; acetabulum post-equatorial or equatorial; collar spines 26–29.	2
2.	Collar spines 26 in single row; forebody elongated	*C. kirati* Vedvrat, 1947
	Collar spines in double row; forebody bulb-like.	3
3.	Caeca opening into excretory vesicle.	4
	Caeca ending blindly	5
4.	Collar spines 28	*C. travassosi* Vedvrat, 1947
	Collar spines 27 or rarely 26.	*C. ferox* (Red., 1795) Dietz, 1909
5.	Collar spines 29; vitellaria reaching posterior end	*C. leucocephalus* Vedvrat, 1947
	Collar spine 26, vitellaria not reaching posterior end	*C. olhneri* Vedvrat, 1947

33. **Chaunocephalus ferox** (Rud., 1795) Dietz, 1909

Syn. *Chaunocephalus simili ferox* Verma, 1935*

Specific diagnosis.—Length 4.4–8.8. Breadth of forebody 3.0–4.0; breadth of hindbody 0.7–1.0. Collar spines 27, rarely 26 in double dorsally uninterrupted row; ventral spines 0.126–0.168 × 0.036–0.038; larger dorsals 0.109–0.134 × 0.017–0.045. Oral sucker 0.115–0.23 × 0.115–0.33. Prepharynx short; pharnyx 0.14–0.3 × 0.116–0.36. Oesophagus 1.65–3.77 long with saccular diverticula; caeca sinuous opening into excretory vesicle in front of posterior extremity. Genital pore sucker-like, median or submedian. Testes spherical or oval, oblique or almost parallel or side by side; anterior right testis 0.141–0.46 × 0.167–0.417; posterior or

* This species has been redescribed and considered valid by Srivastava (1974).—*Ed.*

left 0.167–0.334×0.2–0.334. Cirrus sac small, 0.118–0.2 ×0.052–0.105. Ovary little behind acetabulum, dextral, spherical or oval, 0.183–0.45×0.2–0.5. Mehlis's gland median to left side of ovary. Eggs 0.084–0.1×0.039–0.058.

Host.—Black necked stork, Indian Gull (according to Verma), *Anastomus oscitans* (Bodd.), *Nephros perconopterus* (L.) according to Rai (1963).

Location.—Intestine.

Locality.—Not recorded by Verma; Jabalpur, M.P. recorded by Rai (1963).

34. **Chaunocephalus leucocephalus** Vedvrat, 1947

(Fig. 27)

Specific diagnosis.—Body length 8.04; maximum breadth in middle of forebody 4.16. Forebody 5.1 long; length of hindbody 1.24×1.36 maximum breadth. Collar 0.75×0.15. Collar spines 29, unequal; angular spines large, pointed 0.325×0.0375. Oral sucker 0.29. Prepharynx 0.117 long; pharynx 0.25×0.17; oesophagus 4.5 long; caeca ending blindly 0.25 from posterior end. Acetabulum 0.8×0.6. Ratio between suckers 1 : 3. Testes median, side by side partly overlapping each other, transversely elongated, entire; right 0.22×0.5; left 0.2×0.12. Cirrus sac more or less oval, thin walled, 0.204×0.119. Genital pore surrounded by sucker, slightly dextral behind intestinal bifurcation. Ovary dextral near right body margin, 0.42 behind acetabulum and 0.366 in front of testes, four times larger than testes, nearly equal to acetabulum, globular, 0.6 in diameter, Receptaculum seminis uterinum long, coiled. Mehlis' gland mostly to left side of ovary, behind its posterior margin immediately in front of testes, 0.935×0.395. Vitellaria typical of the genus, in hindbody lateral, extending up to 0.34 distance in front of hinder end, not meeting mesially. Stem of excretory vesicle 3 chambered.

Host.—Ibis leucocephalus.

Location.—In crypts of intestinal wall in pairs.

Locality.—Simerai, Shahjahanpur, U.P.

35. **Chaunocephalus travassosi** Vedvrat, 1947

(Fig. 28)

Specific diagnosis.—Size 6.76×3.48. Forebody 4.67×3.48, spined. Collar 0.66×0.17 Collar spines 28; and group of

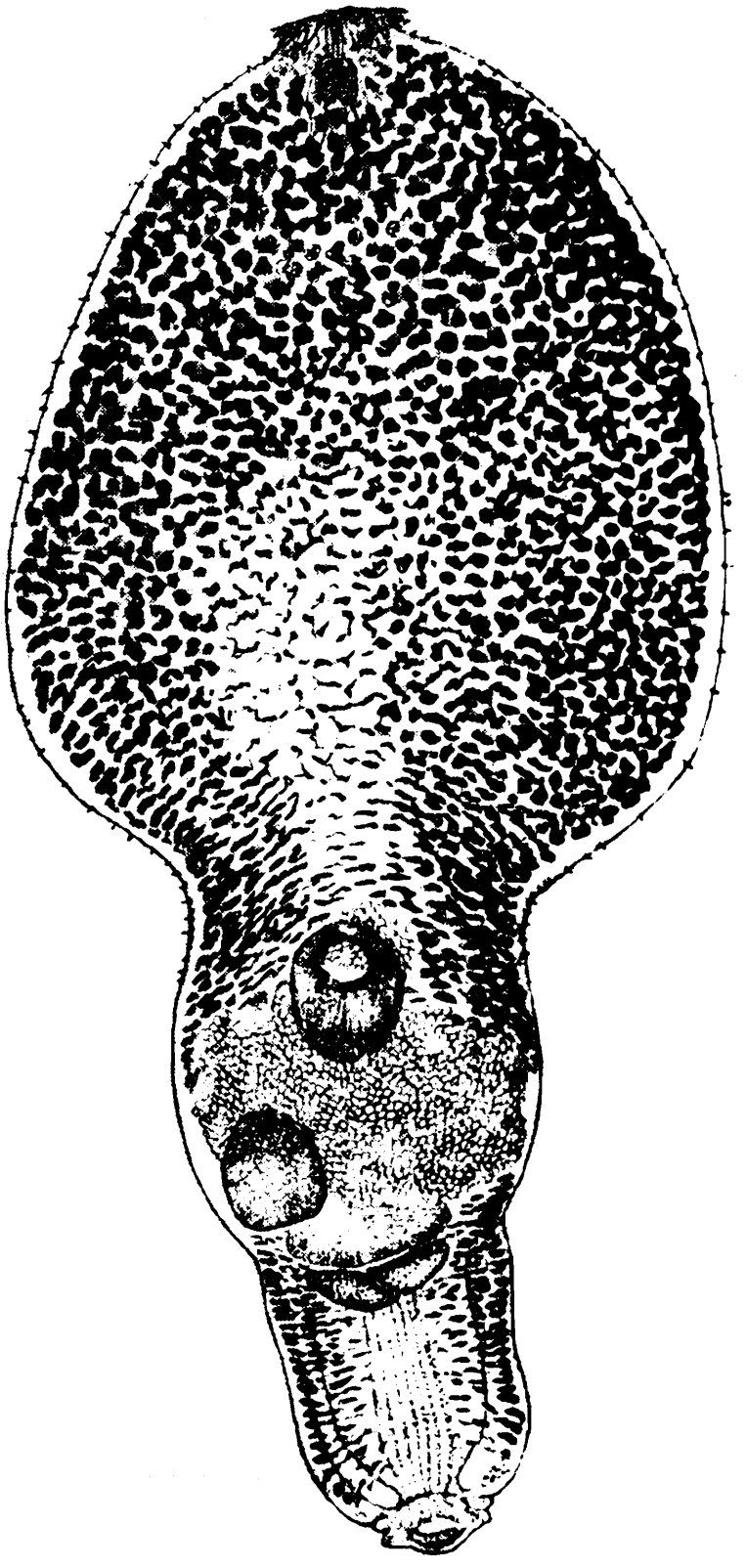


Fig. 27. *Chaunocephalus leucocephalus* Vedvrat, 1947 Ventral view.

4 spines largest, 0.1525×0.025; marginal spines 0.1×0.0175. Oral sucker 0.25×0.17 Prepharynx 0.085 long; pharynx 0.374×0.34; oesophagus 3.65 long, with glandular walls and

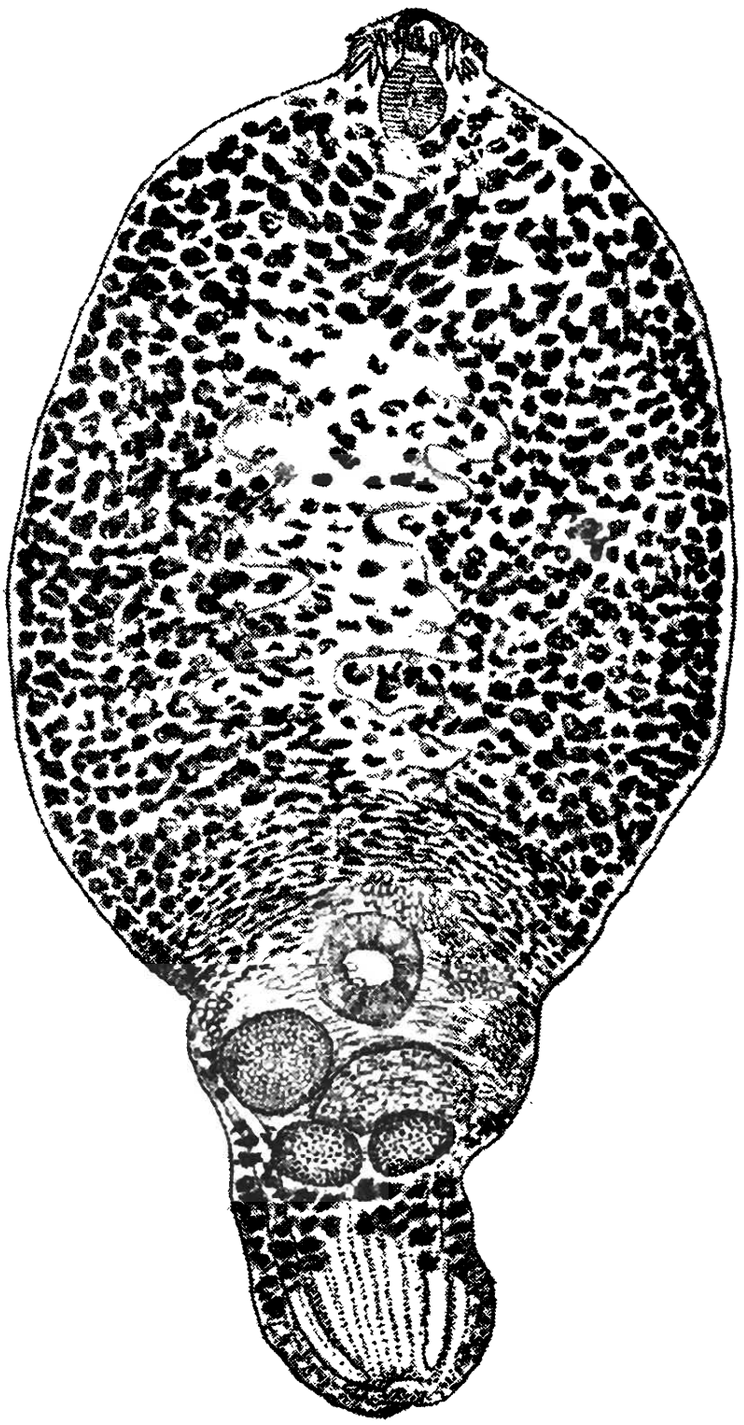


Fig. 28. *Chaunocephalus travassosi* Vedvrat, 1947 Ventral view.

lateral pouches; caeca open into excretory vesicle. Acetabulum 0.54×0.49. at junction of anterior and middle parts of body, 4.33 behind anterior end. Testes ovoid, entire, transversely elongated, opposite and close to one another; right testis 0.42×0.29; left 0.34×0.25. Cirrus sac almost oval, thin walled, 0.51×0.187 Genital pore sucker-like, slightly dextral, immediately behind intestinal bifurcation. Ovary larger than testes, equal to acetabulum, oval to globular, 0.578×0.47, dextral. Mehlis' gland 0.85×0.32, to left of ovary, between it and acetabulum. Vitellaria much reduced in the intermediate part, lateral in hindbody to 0.68 behind testes, extending mesially towards one another, but never unite. Stem of excretory vesicle 3 chambared. Eggs numerous, 0.08×0.05.

Host.—Sarus crane, *Antigone antigone.*

Location.—Small intestine.

Locality.—Simarai, District Shahjahanpur, U.P.

36. **Chaunocephalus odhneri** Vedvrat, 1947

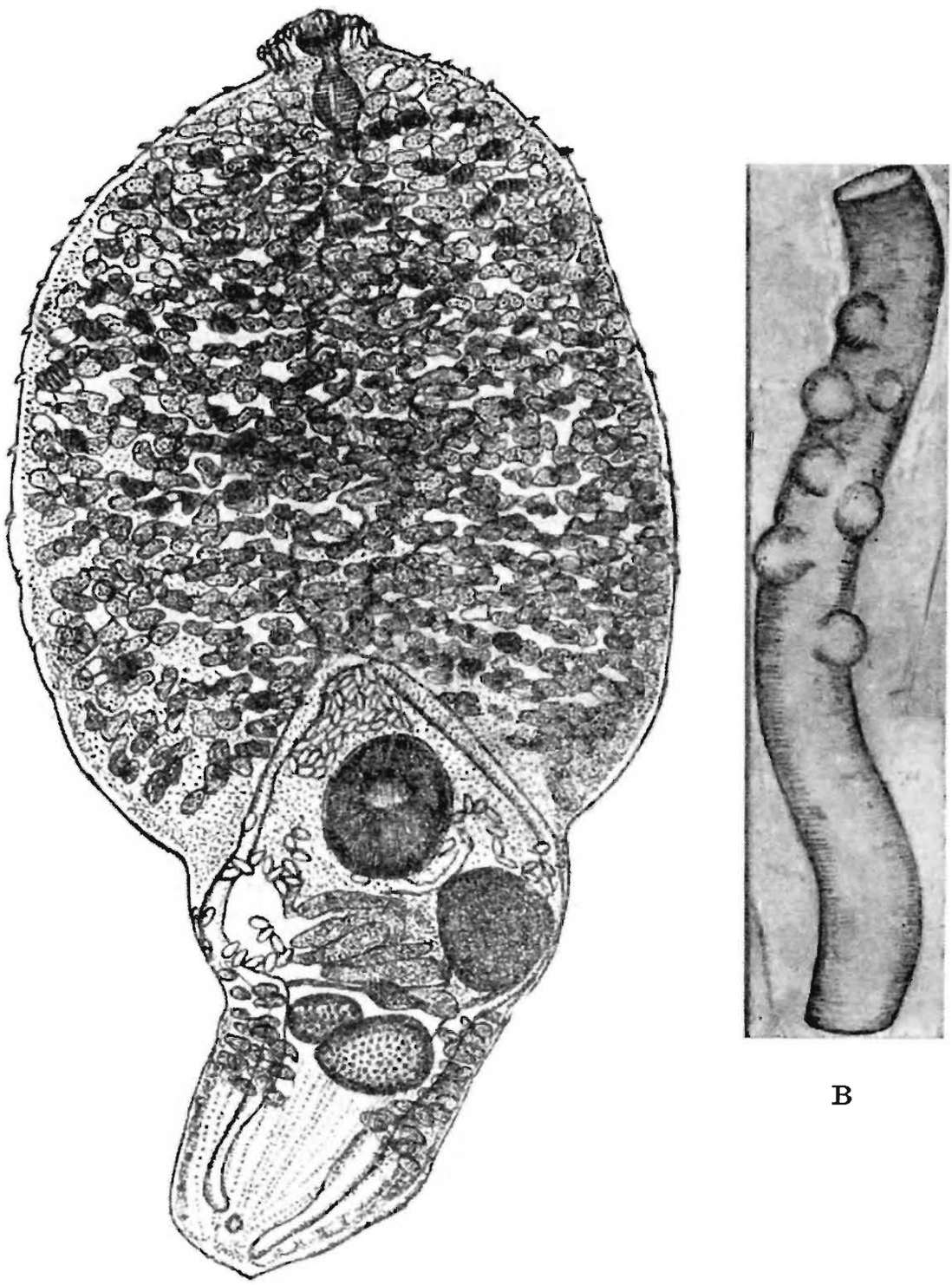
(Fig. 29)

Specific diagnosis.—Body brick red, globular with short narrow conical hindbody, 5.491 long. Forebody dilated bulb-like, spined, 3.077 long; hindbody narrow, non-spined, 1.564 long joined together by intermediate part of 0.85 length; breadth of three respective parts 2.92, 1.02 and 1.598. Collar 0.56×0.187 Collar spines 26 bluntly pointed, arranged in two rows dorsally continuous, 0.075×0.015. End spines 4 in each group, 0.1×0.025 are larger othan other spines. Oral sucker 0.102 in diameter. Prepharynx short, 0.204 long; pharnyx 0.255×0.221; oesophagus 0.38 long with characteristic lateral diverticula along its length; caeca do not open into excretory vesicle. Acetabulum 0.595×0.544, in anterior region of intermediate part, 3.91 behind anterior end. Ratio between suckers 1 : 6. Testes oval, transversely elongated, overlapping each other in median line; left testis much smaller, 0.34×0.222; right testis 0.51×0.34. Ovary rounded to ovoid, 0.51 in diameter, touching right caecum close to right body margin, 0.238 in front of testes, 0.153 behind acetabulum. Mehlis' gland close to inner margin of ovary a little in front of testes, 0.83×0.44. First four convolutions of uterus forming receptaculum seminis uterinum. Eggs numerous, 0.11×0.055.

Host.—*Anastomus oscitans.*

Location.—Intestine, 2–3 in one crypt.

Locality.—Not mentioned, probably Shahjahanpur, U.P.



B

Fig. 29. *Chaunocephalus odhneri* Vedvarat, 1947. A–Dorsal view; B–Crypts of *C. odhneri.*

37. **Chaunocephalus kirati** Vedvrat, 1947

(Fig. 30)

Specific diagnosis.—Body 4.76 long, divided into two parts. Forebody club-shaped, heavily spined, 2.63×1.19 maximum breadth; hindbody 2.12×1.02. Collar 0.42×0.2; collar spines 26 in a single row, 0.065×0.015; corner spines 4 in each end group, larger and bluntly pointed, 0.085×0.02. Oral sucker 0.136 in diameter. Prepharynx 0.085 long; pharynx 0.17×0.136; oesophagus 1.73 long; caeca open into posterior part of excretory vesicle. Acetabulum 0.425 in diameter, 2.32 behind anterior end. Testes unequal, oblique, separated from each other by 0.015 distance; right testis double of the left in size, 0.37×0.22; left testis 0.22×0.15. Cirrus sac oval, thin walled, 0.221×0.135. Ovary globular, 0.22×0.2, close to right caecum at about halfway between acetabulum and right testis. Receptaculum seminis uterinum in first three or four coils of uterus. Vitellaria terminate 0.85 in front of hinder end, to lateral sides in hindbody, never uniting mesially. Stem of excretory vesicle 2-chambered, caeca opening into the last chamber.

Host.—Anastomus oscitans.

Location.—Small intestine, mostly in pairs in small crypts.

Locality.—Probably Shahjahanpur, U.P.

38. **Chaunocephalus elongatus** Vedvrat, 1947

(Fig. 31)

Specific diagnosis.—Body dirty white, much elongated, 6.8 long, much narrower than that of other species of the genus. Forebody club-shaped, narrower than in other species, tapers gradually up to ovary and then passes into cylindrical part. Cutaneous spines up to ovarian region. Collar 0.187×0.255. Collar spines 25 in two dorsally uninterrupted rows. End group spines larger than others as usual, 0.175–0.18×0.0375; other spines 0.0875–0.0925×0.0225. Oral sucker 0.136 in diameter. Prepharynx absent; pharynx 0.204×0.136; oesophagus 1.7 long; caeca do not open into excretory vesicle. Testes entire, elongated, lie side by side closely touching one another in median line; right testis 0.2×0.136; left 0.17×0.136; post-testicular space exceptionally long and narrow, 3.43 long. Cirrus sac small, oval to rounded, 0.12×0.1075. Genital pore median immediately behind intestinal bufurcation. Ovary rounded or transversely elongated, 0.17×0.204, dextral, 0.153 behind acetabulum and 0.136 in front of testes. Uterus in a few coils

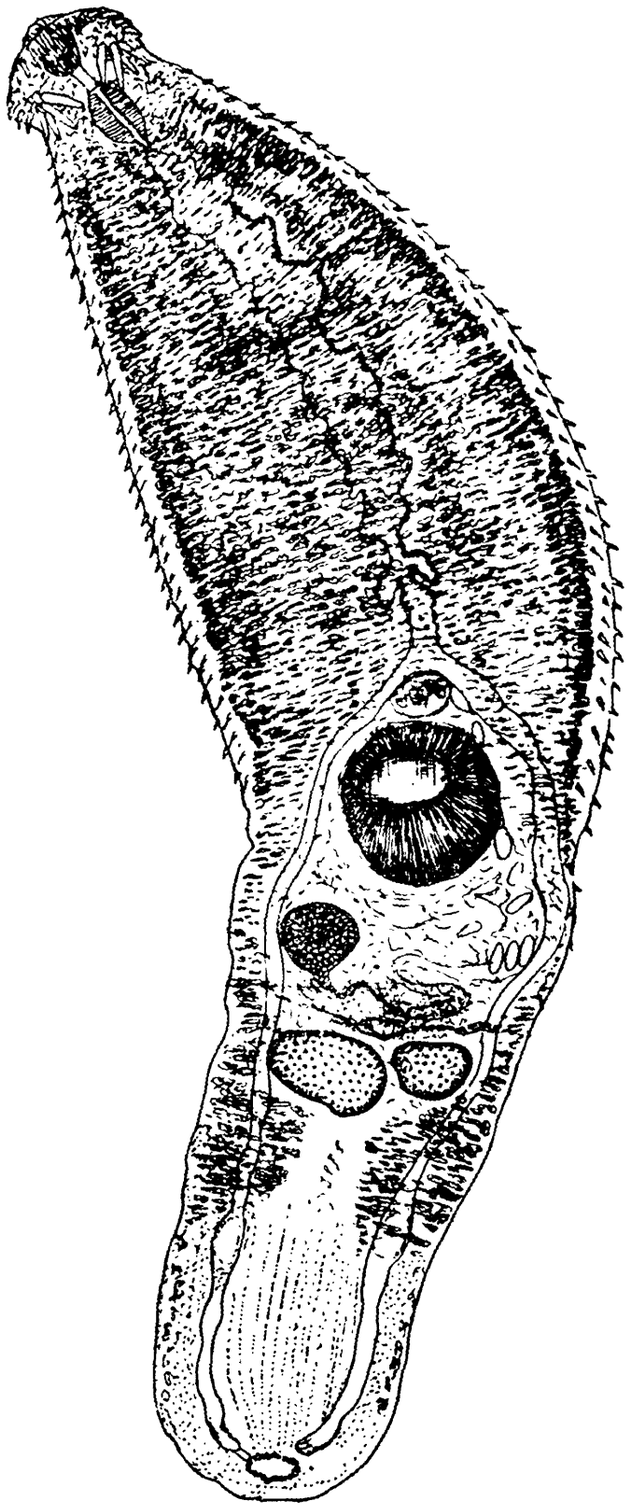


Fig. 30. *Chaunocephalus kirati* Vedvrat, 1947 Ventral view.

mainly behind acetabulum, first two coils receptaculum seminis uterinum. Eggs operculated, 15–24, 0.0925×0.0475. Excretory vesicle stem 3-chambered.

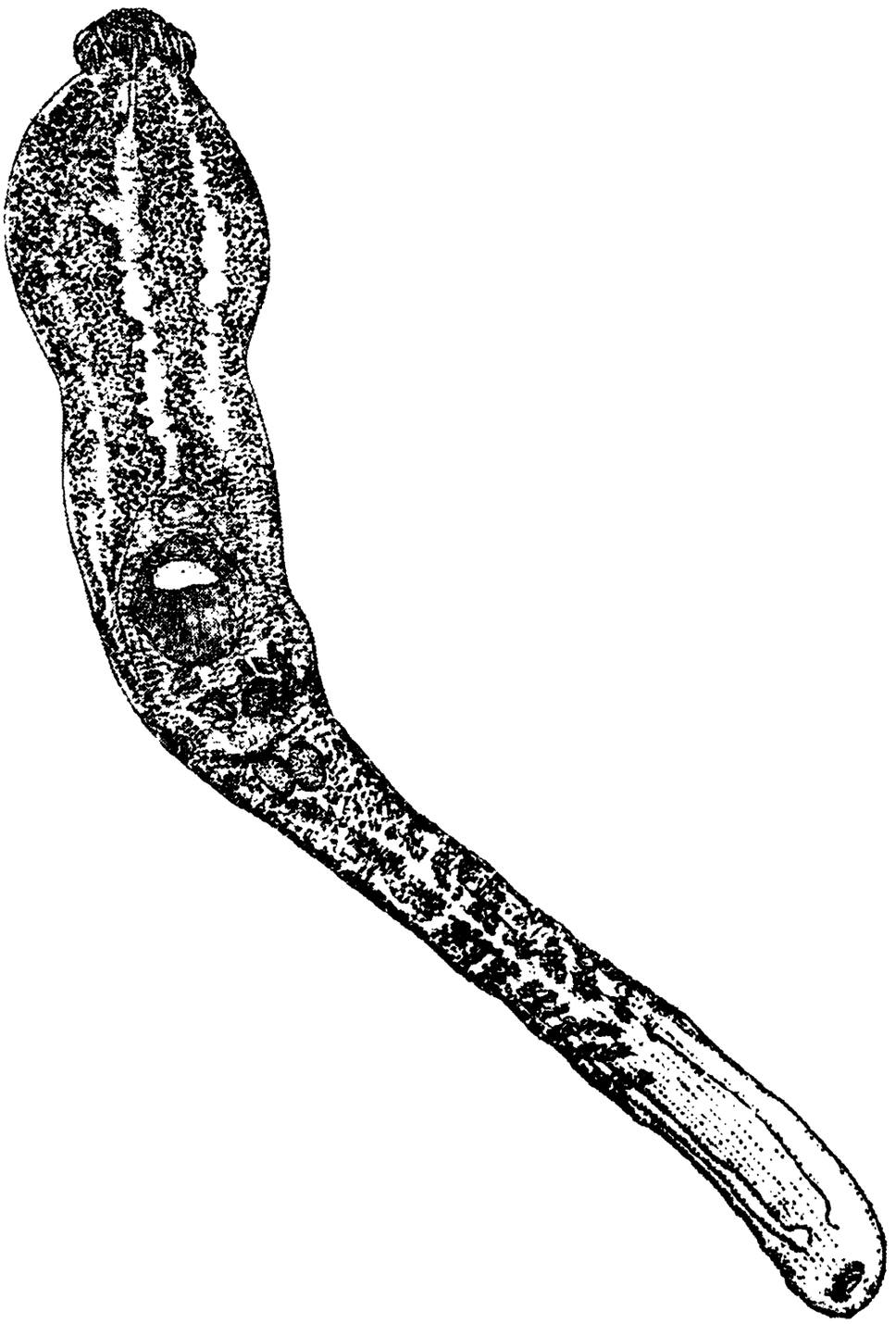


Fig. 31. *Chaunoceohalns elongatus* Vcdvrat, 1947; Ventral view.

Host.—Anhinga melanogaster.

Location.—In long narrow cavities in intestinal wall, opening into lumen by narrow openings.

Locality.—Near Shahjahanpur, U.P.

X. Subfamily *SINGHIINAE* Yamaguti, 1958

Echinostomatidae: Body medium sized, elongate, spined ventrally. Head collar fairly large constricted off from body by neck. Collar spines in a single dorsally uninterrupted row; end spines 2 in each corner group. Acetabulum very small near anterior end just behind intestinal bifurcation. Oral sucker smaller than acetabulum. Prepharynx moderately long; pharynx present; oesophagus moderately long; caeca narrow, reaching posterior end. Genital pore just behind intestinal bifurcation. Gonads near one another. Testes near posterior end, diagonal. Cirrus sac small, partly or wholly overlapping acetabulum. Vesicula seminalis large within cirrus sac; cirrus unspined. Ovary pretesticular, partly in level with anterior testis, submedian. Uterus very large in closely packed transverse coils filling entire intercaecal space between ovary and acetabulum. Vitellaria extracaecal between intestinal bifurcation or acetabulum and posterior end, follicles fairly large. Excretory vesicle Y-shaped, stem bifurcating behind posterior testis into two wide cornua. Eggs large, numerous. Parasitic in intestine of fishes.

Type genus : *Singhia* Yamaguri, 1958

Genus 16. **Singhia** Yamaguti, 1958

Singhiinae : Diagnosis the same as for the subfamily.

Type-species : *S. thapari* (Singh, 1953) Yamaguti, 1958

39. **Singhia thapari** (Singh, 1953) Yamaguti, 1958

(Fig. 32)

Syn. *Echinostoma thapari* Singh, 1953

Specific diagnosis.—Size 7.69–11.5 (9.85 average)×2.62, maximum breadth in posterior half of body; cuticle spined ventrally. Collar 2.03–2.61 (2.29) across with 25 spines; end spines 2, large, 0.084–0.102 long; last marginal i.e. 3rd 0.09, fourth 0.098, fifth 0.087, sixth, seventh and eighth 0.071,

ninth, tenth and eleventh 0.073, twelfth 0.053 and thirteenth, the mid dorsal 0.092 long. Oral sucker 0.37–0.46×0.24–0.3. Acetabulum 0.37–0.46×0.34–0.4. Prepharynx 0.225–0.37 long; pharynx 0.27–0.31×0.19–0.25; oesophagus 1.05–1.2 long, slightly dilated anteriorly. Testes diagonal near one another, oval; anterior 0.42–0.72×0.27–0.45; posterior 0.51–0.83 ×0.3–0.53. Cirrus sac 0.255–0.31×0.17–0.225. Cirrus 0.39 ×0.15. Male genital pore surrounded by slightly developed genital papilla just posterior to intestinal bifurcation. Ovary varies in position relatively to testes and Mehlis' gland, elongated oval, 0.36–0.63×0.15–0.225. Mehlis' gland just posterior to ovary, 0.3 across. Uterine coils approximately thirty. Eggs 0.1–0.125×0.05–0.07 Vitelline follicles from level of acetabulum to posterior extremity; follicles large in two lateral rows.

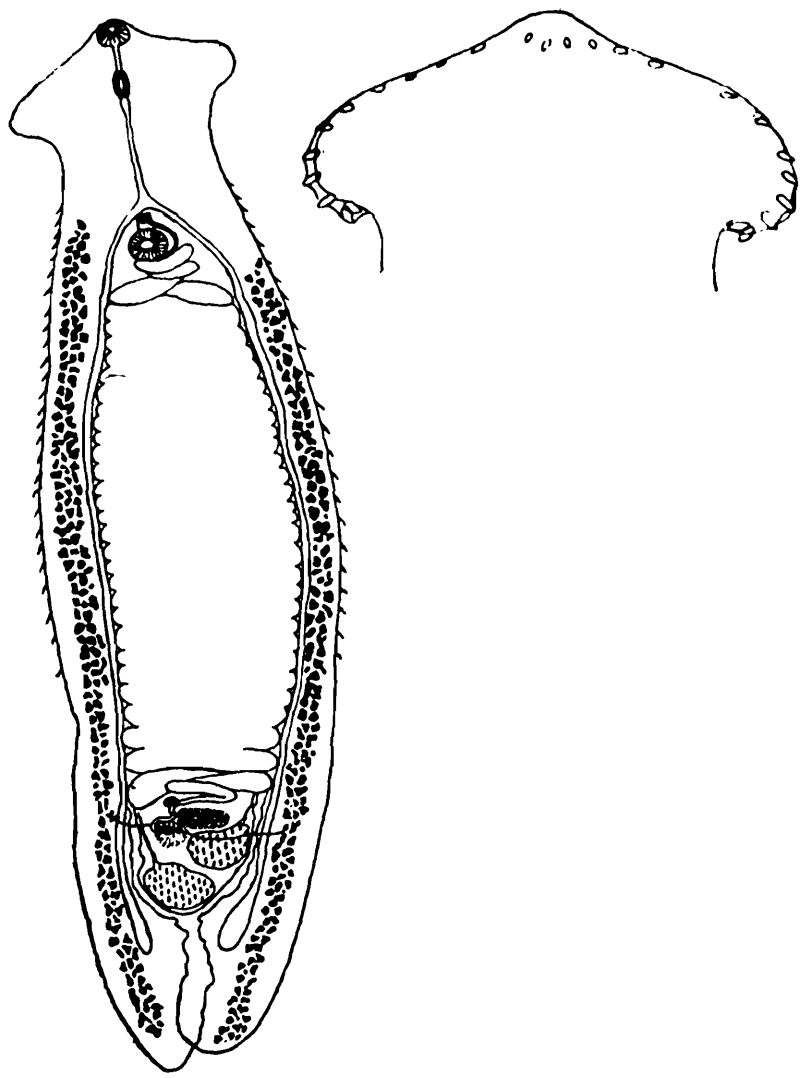


Fig. 32. *Singia thapari* (Singh, 1953) Yamaguti, 1958 and its collar.

Host.—*Notopterus chitala* (Hamilton).

Location.—Intestine.

Locality.—Lucknow, U.P.

XI. Subfamily *MICROPARYPHIINAE* Mendheim, 1943

Echinostomatidae : Body elongate, small to undermiddle sized, broadest at acetabular level, spinulate anteriorly. Head collar reduced to a ridge or bulge on eahch side of oral sucker. Collar spines confined to ridges and 4–5 spines a little in front with a dorsal gap. Oral sucker very large, strongly muscular. Acetabulum large, strongly muscular, preequatorial or subequatorial. Prepharynx very small; pharynx well developed; oesophagus small. Testes median, tandem, midway between acetabulum and posterior extremity, small, lobed or indented. Cirrus sac small, preacetabular or anterodorsal to acetabulum. Vesicula seminalis bipartite. Vitellaria lateral in hindbody extending mesially behind testes, but not confluent. Uterus in closely packed coils between shell gland complex and acetabulum. Eggs numerous. Parasitic in intestine of birds.

Type genus : *Microparyphium* Dietz, 1909

Genus 17 **Microparyphium** Dietz, 1909

Microparyphinae : With characters of the subfamily.

Type-species : *M facetum* Dietz, 1909

40. **Microparyphium montei** Verma, 1936

Specific diagnosis.—Body elongated, stout, broadly tapering towards ends, posterior end with a caudal process, 7.1–7.6 $\times$0.67–0.72; minute cuticular spines in neck region. Collar feebly developed as two bulges along sides of oral sucker; collar spines not seen. Oral sucker 0.205 in diameter. Prepharynx absent; pharynx 0.134$\times$0.117; oesophagus very small, 0.05 long. Acetabulum 0.64 in diameter, close to oral sucker, 0.67–0.7 behind anterior end. Testes lobed; anterior 5 or 6-lobed, 0.67$\times$0.46; posterior more elongated, margin indented at two or three places laterally, 0.806$\times$0.403; interesticular gap 0.1. Cirrus sac small, pear-shaped, overlapped sometimes posteriorly by acetabulum, but usually between intestinal fork and acetabulum. Ovary ovoid, oblique, 0.302$\times$0.258, at about middle of body length.

Mehlis' gland massive posterior to ovary. Uterus long, broadly coiled with many large eggs, 100 or more, 0.109×0.0758. Vitellaria lateral, hardly reaching a little internal to caeca here and there.

Host.—Kingfisher.

Location.—Intestine.

Locally.—Bengal.

M. montei Verma, 1936 resembles *M. capallae* Yamaguti, 1935 in the lobed condition of the testes, but it differes in being the largest known species according to Verma. In *M. capallae* the body is 2.13–2.5 long. The description by Verma is incomplete. He did not see the collar spines, therefore, validity of the species is doubtful.†

XII. Subfamily *SINGHIATREMATINAE* n.subf.*

Echinostomatidae : Body small, smooth unspined, elongate with narrow preacetabular and broad postacetabular parts. Head collar with 22 spines in a single dorsally interrupted rwo with a wide gap. Acetabulum large, equatorial or immediately preequatorial. Oral sucker large. Pharynx well developed; oesophagus moderately long; caeca short, terminating in front of gonads. Genital pore usually sucker-like between intestinal bifuraction and acetabulum. Gonads at posterior end of body. Testes side by side obliquely parallel near one another a little in front of posterior extremity. Cirrus sac thin walled, preacetabular. Vesicula seminalis bilobed. Cirrus absent. Ovary dextral in front of for between diverging anterior ends of testes. Receptaculum seminis elongated, sac-like. Uterus coiled extending posteriorly between testes. Vitellaria lateral, short, restricted to pretesticular region behind acetabulum. Eggs small or moderately large with oculate miracidia. Excretory vesicle closely resembling that of Ommatobrephidae, characteristically V-shaped with small contractile bladder like stem bifuracting behind testes into two long cornua extending to behind oral sucker and there passing backwards as common collecting ducts. Parasitic in rectum and intestine of snakes.

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* Subfamily *SINGHIATREMATINAE* has already been erected by Simha (1962).—*Ed.*

† *M. montei* Verma, 1936 has been redescribed by Srivastava (1974. *J. zool. Soc. India,* **24**(2) : 169-191).—*Ed.*

Type genus : *Singhiatrema* Simha, 1954

Genus 18. **Singhiatrema** Simha, 1954

Singhiatrematinae n.subf. : With characters of the sub-family.

Type-species : *S. singhia* Simha, 1954

Key to species of **Singhiatrema**

1. Caeca long extending far behind acetabulum to a little in front of ovary...	*S. longifurca*, Simha, 1958
Caeca shorter ending at level of hinder border of acetabulum or just behind.	2
2. Body pear-shaped; testes lobed, separate and diverging anteriorly; genital pore sucker-like. .	*S. singhia* Simha, 1954
Body narrow, slightly bulging in acetabular region; testes oval, entire, closely approximated together; genital pore not sucker-like ..	*S. hyderabadensis* Simha, 1958

41. **Singhiatrema singhia** Simha, 1954

(Fig. 33)

Specific diagnosis.—Body pear-shaped, unspined, 1.6–2.4 × 1.18–1.4 maximum breadth. Oral sucker 0.17 in diameter. Acetabulum almost equatorial, 2½ times larger than oral sucker, 0.3–0.38 × 0.5–0.55. Genital pore sucker-like. Pharynx 0.1 in diameter. Oesophagus 0.34 long; caeca not extending beyond acetabulum. Testes elongated, lobed, side by side, apart and anteriorly diverging; right testis 0.28–0.3 × 0.14–0.15; left testis 0.29–0.34 × 0.14. Ovary immediately anterior to testes, oval, 0.06–0.07 × 0.11–0.14. Eggs 0.04–0.05 × 0.02–0.03.

Host.—*Ptyas* (*Zamenis*) *mucosus.*

Location.—Rectum.

Locality.—Hyderabad (Deccan).

42. **Singhiatrema longifurca** Simha, 1958

Specific diagnosis.—Body elliptical with bluntly pointed anterior end and rounded posterior end, unspined, 1.7–3.5 × 0.61–1.34 maximum breadth from middle of body to a little in front of gonads. Oral sucker 0.12–0.34 in diameter. Acetabulum at about one third of body, twice as large as

oral sucker, 0.32–0.6×0.3–0.34. Pharynx 0.09–0.1 in diameter. Oesophagus 0.29–0.45 long; caeca terminating much behind acetabulum, some distance anterior to gonads. Testes side by side, lobed on outer border; right testis 0.19–0.6 ×0.09–0.27; left testis 0.19–0.46×0.09–0.21. Vesicula seminalis retort-shaped. Ovary between anterior diverging ends of testes close to right one, 0.53–0.129×0.07–0.16. Eggs 0.064–0.07×0.03.

Host.—*Tropidonotus piscator.*
Location.—Rectum.
Locality.—Hyderabad (Deccan).

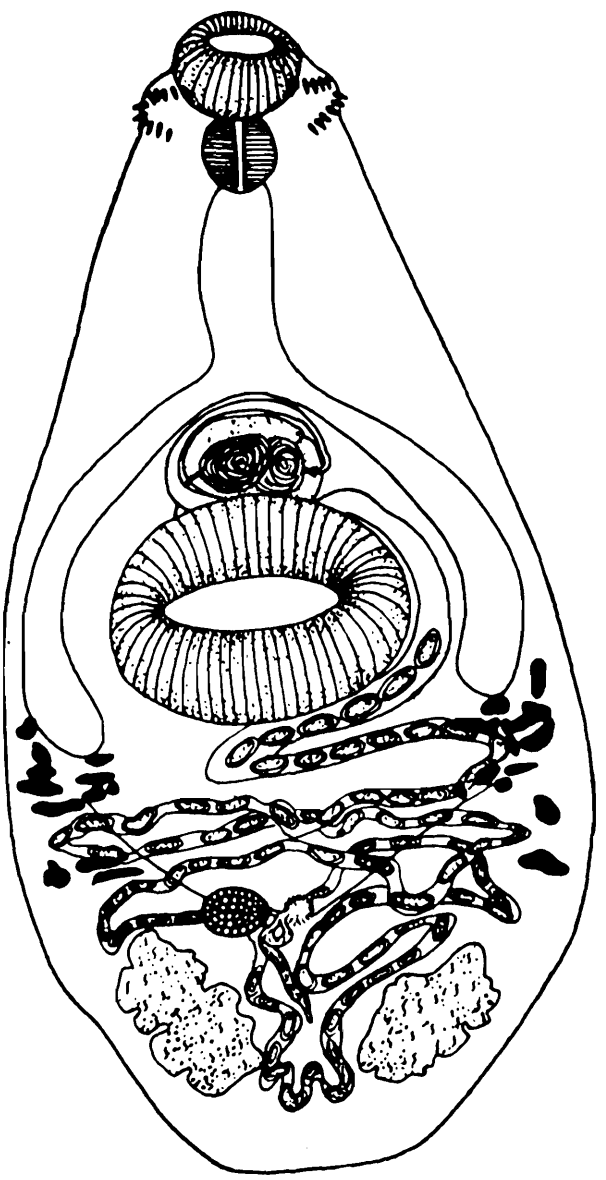


Fig. 33. *Singhiatrema singhia* Simha, 1954. Ventral view.

43. **Singhiatrema hyderabadensis** Simha, 1958

Specific diagnosis.—Body narrow slightly bulging in acetabular region, unspined, 1.5–2.2 × 0.46–0.58. Oral sucker 0.14–0,17 in diameter. Acetabulum equatorial, 0.32–0.42 in diameter, three times size of oral sucker. Pharynx 0.08–0.12 in diameter. Oesophagus 0.33–0.42 long; caeca extend slightly beyond acetabulum. Testes smooth, oval, approximated together; right 0.17–0.2 × 0.09; left 0.18–0.24 × 0.11–0.17 Seminal vesicle bilobed. Ovary some distance in front of testes, 0.05–0.09 in diameter. Genital pore not sucker-like. Eggs 0.04–0.05 × 0.01–0.012.

Host.—Tropidonotus piscator.

Location.—Intestine.

Locality.—Hyderabad (Deccan).

XIII. Subfamily *ECHINOCHASMINAE* Odhner, 1911

Syn. Ignaviinae Yamaguti, 1958

Echinostomatidae : Body spinulate, elongated, small to medium sized, narrow anteriorly and broad posteriorly or sometimes long, much elongated (*Stephanoprora*), long slender flattened cylindrical (*Ignavia*), long very slender, delicate (*Dissurus*). Head collar well developed, reniform or reduced to two lateral lobes (*Ignavia*). Collar spines 20–26 in single, occasionally double dorsally interrupted rows; angular group of spines absent, corner spines being in the same row as others; "Ventral Verbindungskante" absent. Acetabulum preequatorial or equatorial. Oral sucker small or moderately large (*Ignavia*). Pharynx well developed, small in *Ignavia*. Oesophagus short or moderately long. Testes tandem, in middle third or posterior half of body. Cirrus sac usually small, pear-shaped, almost entirely preacetabular or anterodorsal to acetabulum. Vesicula seminalis bipartite; pars prostatica present; ductus ejaculatorius small. Cirrus usually strikingly small almost absent, sometimes strongly developed though small (*Stephanoprora*). Ovary submedian or median, pretesticular. Uterus short with a few coils or long with many coils, pretesticular, exceptionally extending behind testes (*Saakotrema*). Vitellaria lateral, of varying length, usually confined to hindbody, commencing from acetabulum or behind it from testes or ovary, sometimes extending to pharynx and confluent in preacetabular region

(*Episthmium*). Eggs a few or numerous. Parasitic in intestine of reptiles, birds and mammals or in ureters and urinary tubules of birds (*Ignavia*).

Type genus : *Echinochasmus* Dietz, 1909

Key to Indian genera of ECHINOCHASMINAE

1. Parasitic in kidneys and ureters of birds	*Ignavia* Freitas, 1948
Parasitic in intestine of reptiles, birds and mammals	2
2. Uterus extending behind testes.	*Saakotrema* Skrjabin and Baschkirova, 1956
Uterus not extending behind testes	3
3. Protrusible cirrus present; collar spines 22 or 26.	*Stephanoprora* Odhner, 1902
Cirrus rudimentary or absent; collar spines usually 24, sometimes 22.	4
4. Vitellaria extending in front of acetabulum as far as pharynx and confluent in preacetabular region	*Episthmium* Luhe, 1909
Vitellaria extending anteriorly to acetabulum or behind	5
5. Cutaneous spines ordinary; body short, broad rounded posteriorly.	*Echinochasmus* Dietz, 1909
Cutaneous spines characteristic with cleft base in anterior half; body long, very slender with cylindrical neck region resembling *Himasthla* Dietz in body form.	*Dissurus* Verma, 1936

Genus 19. **Echinochasmus** Dietz, 1909

Syn. *Heteroechinostomum* Odhner, 1911
Allechinostomum Odhner, 1911
Velamenophorus Mendheim, 1940

Echinochasminae : Small to medium sized. Body spined, plump, narrow anteriorly and broad rounded posteriorly. Collar spines 24 or 22. Acetabulum well apart from oral sucker. Testes usually large, median, tandem, rounded or somewhat indented, at about middle of body or near posterior end. Cirrus sac small, preacetabular or slightly overlapping acetabulum. Cirrus absent or poorly developed. Ovary

rounded or transversely oval, to right side or almost median. Uterus short with a few eggs exceptionally long with numerous eggs. Parasitic in intestine of birds and mammals.

Type-species : *E. coaxatus* Dietz, 1909

Key to Indian species of **Echinochasmus**

1.	Coilar with 24 spines; parasitic in mammals	*E. perfoliatus* Ratz, 1908
	Collar with 24 spines; parasitic in birds	2
2.	Genital atrium with large papilla.	*E. famelicus* (Odhner) 1911, Prudhoe, 1944
	Gential atrium without papila	3
3.	Coilar spines in two rows.	*E. bagulai* Verma, 1935
	Coilar spines in a single row.	4
4.	Body tapering posteriorly; eggs numerous; vitellaria commence short distance behind acetabulum.	*E. antigonus* Gupta, 1953
	Body broad rounded posteriorly; eggs not many; vitelloria commence from level of acetabulum, from its hinder margin or just behind.	5
5.	Oesophagus short; vitellaria of large follicles from just behind acetabulum.	*E. megavitellus* Lal, 1939
	Oesophagus moderately long	6
6.	Vitellaria commence from level of hinder margin of acetabulum; ratio of suckers 1 : 2.	*E. ruficapensis* Verma, 1935
	Vitellaria commence from level of acetabulum; ratio of suckers 1 : 3	*E. naravani* Mudaliar, 1938

44. **Echinochasmus antigonus** Gupta, 1953

Specific diagnosis.—Body narrow, elongated, posterior end slightly tapering, 11.75–12.92 × 1.2–1.43. Collar 1.425–1.55 broad with large ventral gap. Collar spines 24 in single dorsally interrupted row, 0.065–0.08 × 0.03–0.041. Acetabulum at middle or anterior third, 0.89–0.984 in diameter. Prepharynx 0.15–0.168; pharynx 0.26–0.302 × 0.225–0.24; oesophagus 0.854–0.875 long. Genital pore almost median between acetabulum and intestinal bifurcation. Testes longitudinally elongated, 0.46–0.76 apart from each other; anterior testis 0.987–1.1 × 0.486–0.542; posterior 0.928–1.1

×0.486. Cirrus sac preacetabular and partly overlapping anterior border of acetabulum. Ovary subglobular or globular, 0.263–0.284 in diameter, slightly dextral. Receptaculum seminis uterinum large; uterus densely coiled. Eggs numerous, 0.104–0.126×0.057–0.068. Vitellaria commence from short distance behind acetabulum, tend to come closer in post-testicular region, but are not confluent.

Host.—Saurus crane, *Antigone antigone* (Linnaeus).

Location.—Small intestine.

Locality.—Hardoi, U.P.

45. **Echinochasmus bagulai** Verma, 1935

(Fig. 34)

Specific diagnosis.—Body broadly rounded posteriorly, tapering gradually towards anterior end, 1.0–1.75×0.25–0.5 greatest breadth about middle of body. Head collar with 24 spines in two dorsally interrupted alternate rows; dorsal innermost spine of each side overlapping oral suckers; spines of outer row longer than those of inner row. Oral sucker 0.05–0.07 in diameter. Acetabulum 0.15–0.25 in diameter, at commencement of middle third of body. Ratio of suckers 1 : 3. Prepharynx 0.05 long; pharynx usually larger than oral sucker; oesophagus 2½ times as long as pharynx, 0.05 long. Testes tandem, midway between acetabulum and posterior end, mostly contiguous, transversely elongated; anterior quadrangular, 0.067–0.151×0.076–0.193; posterior subtriangular with rounded hinder margin, 0.084–0.168 ×0.084–0.173. Cirrus sac thin walled, pear-shaped with narrow end posterior, preacetabular, partly overlapping acetabulum. Genital pore midventral between intestinal bifurcation and acetabulum. Ovary rounded, slightly dextral, postequatorial, 0.042–0.06 in diameter. Uterus pretesticular. Eggs a few, 7–15 or more. Metraterm present. Eggs 0.067–0.0756×0.05–0.0588. Vitellaria commence from about posterior border of acetabulum, confluent behind posterior testis. Exceretory vesiculae Y-shaped with short stem of 5 chambers narrow at ends, bifurcating behind posterior testis into long cornua with ramified lateral branches.

Host.—*Ardeola grayi* (Sykes) and *Nycticorax nycticorax* (Linnaeus).

Location.—Small intestine.

Locality.—Allahabad, U.P. and Nagpur.

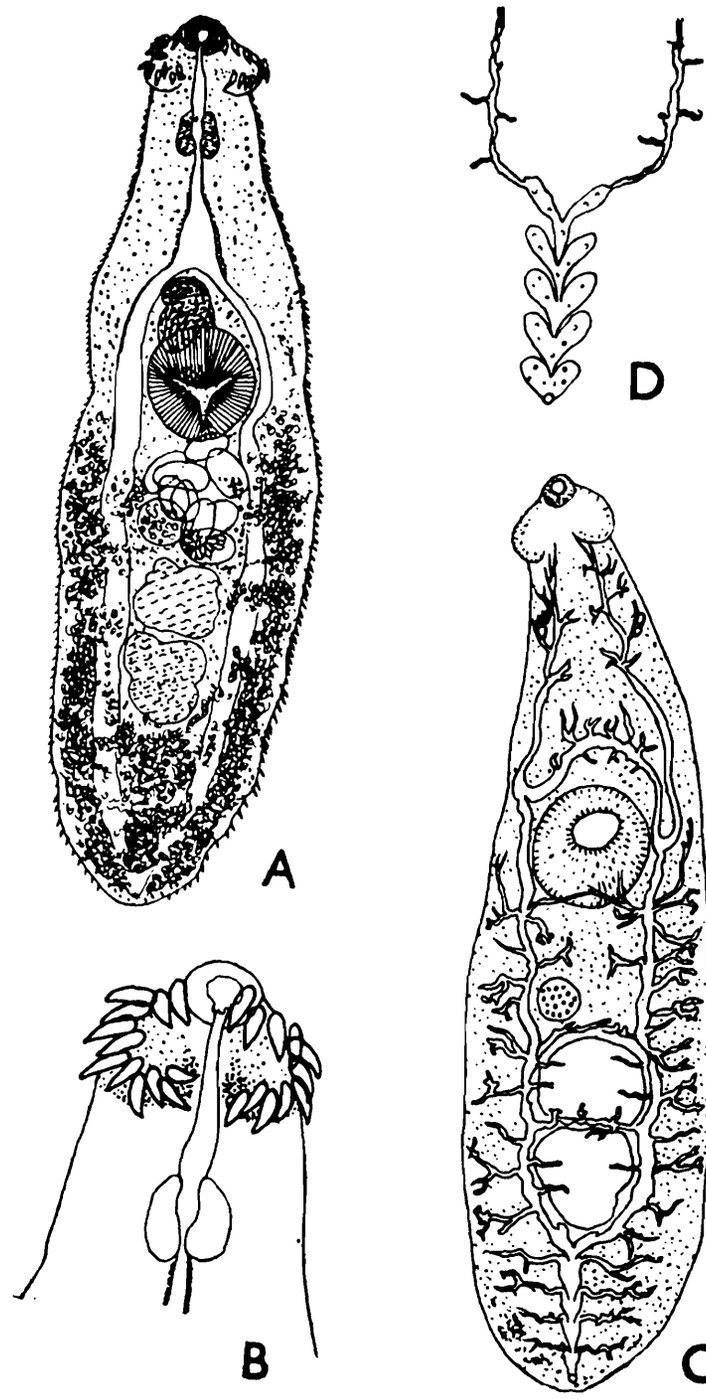


Fig. 34. A—*Echinochasmus bagulai* Verma, 1935.
B—Its collar ; C—and D—Excretory system.

46. **Echinochasmus ruficapensis** Verma, 1935

(Fig. 35)

Specific diagnosis.—Body elongated, rounded posteriorly, 2.5–3.5 long, 0.4–0.6 in maximum breadth in front of acetabulum. Collar 0.3–0.45 × 0.5–0.65, with 24 spines in single dorsally interrupted row; ventral most spine of each side

smaller, 0.047 long, others nearly equal, 0.052 long. Oral sucker 0.16 or 0.15×0.1. Acetabulum 0.35 in diameter, at one third anterior body length. Ratio of suckers 1 : 2. Prepharynx 0.1–0.2; pharynx 0.15×0.17; oesophagus 0.25–0.5 long. Testes median close behind one another, entire; anterior subquadrate or ovospherical, broader than long, 0.18–0.25×0.19–0.35; posterior ovospherical or subtriangular, 0.18–0.25×0.18–0.2. Cirrus sac twice as long as broad, partly overlapping acetabulum. Ovary small, oval, equatorial or just ahead, separated from anterior testis by half to two third distance between it and acetabulum. Eggs 8 or 20–21 in number, 0.07–0.08×0.039–0.052. Vitellaria commence from level of hinder margin of acetabulum.

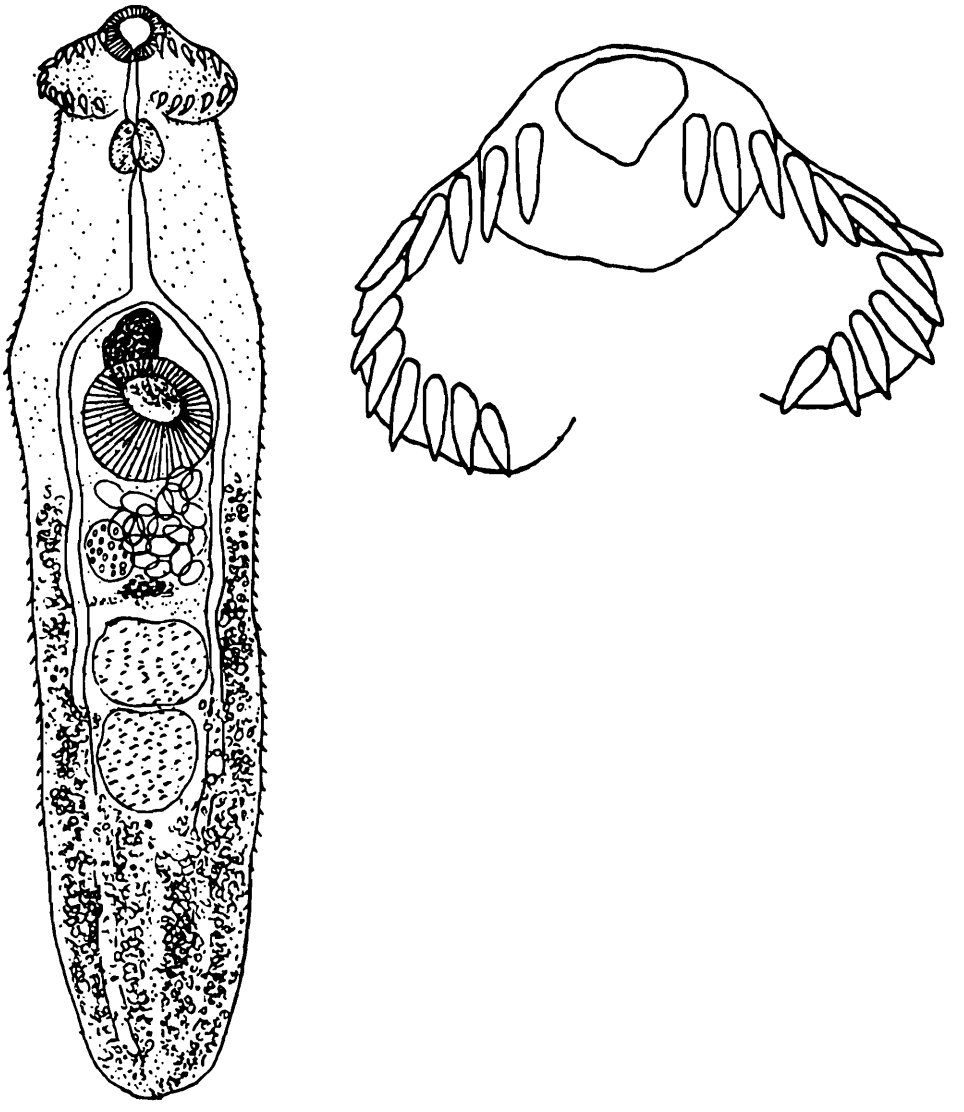


Fig. 35. *Echinochasmus ruficapensis* Verma, 1935 and its collar.

Host.—Podiceps ruficollis (Pallas) var. *capensis*, the Indian Little Grebe or Diver.

Location.—Intestine.

Locality.—Allahabad, U.P.

47. **Echinochasmus megavitellus** Lal, 1939

Specific diagnosis.—Body elongated oval with broad posterior end, 1.05×1.45. Collar with 24 spines in a single row in two groups of 12 each, uniform in size, 0.025 long. Oral sucker 0.06×0.05. Acetabulum 0.18×0.17, at 0.09 behind intestinal bifurcation. Ratio of suckers; 1 : 3. Prepharynx 0.075 long; pharynx 0.09×0.1; oesophagus short; caeca narrow with ends curved inwards, terminating a little in front of hinder end. Testes very close almost contiguous in posterior third of body; anterior 0.2×0.11; posterior 0.17×0.112. Cirrus sac very thin walled, transversely pre-acetabular; vesicula seminalis bipartite, 0.1 long. Ovary slightly dextral, ovoid, 0.08×0.07 Uterus short with very few eggs between ootype and acetabulum. Genital pore submedian, 0.02 in front of acetabulum. Vitellaria of large compact follicles from behind acetabulum, confluent behind posterior testis. Eggs fairly large, thick shelled, 0.07×0.05.

Host.—Ardeola gravi.

Location.—Intestine.

Locality.—Lucknow, U.P.

48. **Echinochasmus narayani** Mudaliar, 1938

(Fig. 36)

Specific diagnosis.—Body lanceolate, broad posteriorly, tapering anteriorly, spined, 1.5–1.8×0.6–0.62. Oral sucker 0.05–0.06 in diameter. Acetabulum 0.14×0.18. Collar with 24 spines in single dorsally interrupted row; spines larger towards dorsal side except the last three at either end which are the smallest, "0.03–0.06×0.05–0.02" Pharynx 0.08–0.12; oesophagus 0.18 long; intestinal bifurcation immediately in front of acetabulum; caeca terminating near posterior extremity. Testes postequatorial, tandem, contiguous; anterior rectangular with slightly indented margin, 0.35–0.4×0.16–0.2; posterior more or less traingular with very few notches at its margin, 0.3–0.35×0.21–0.25. Cirrus sac partly overlapping acetabulum. Genital pore median, preacetabular. Ovary round, dextral, 0.1–0.12 in diameter, a little in front

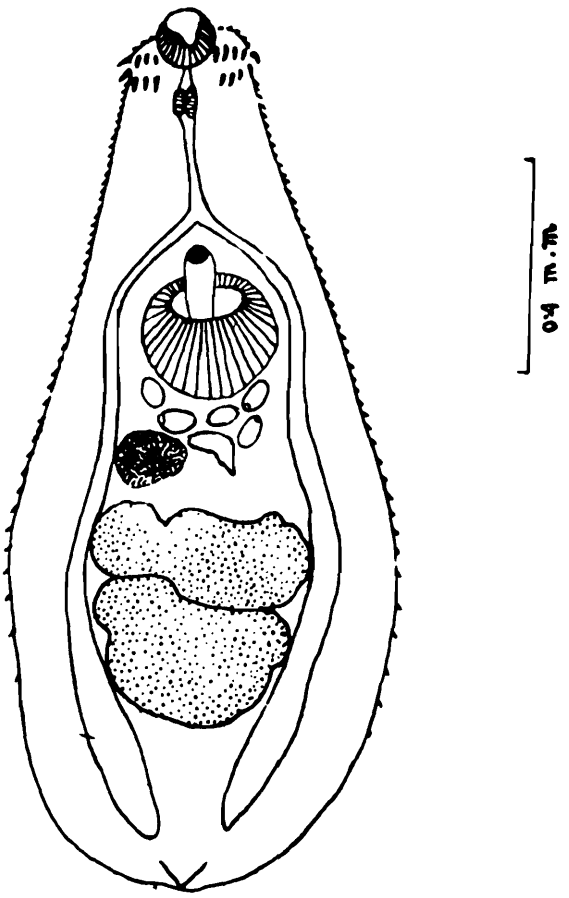


Fig. 36. *Echinochasmus narayani* Mudaliar, 1938—its anterior part.

of anterior testis. Eggs a few, operculated, oval, 0.06×0.048. Vitellaria lateral, commencing from level of acetabulum to posterior extremity, confluent behind posterior testis.

Host.—Kite, *Milvus migrans govinda.*

Location.—Intestine.

Locality.—Madras, South India.

49. **Echinochasmus perfoliatus** (V Ratz, 1908) Dietz, 1909

Syn. *Echinochasmus perfoliatus* var. *shielda* Tubangui, 1922
Echinochasmus perfoliatus var. *japonicus* Tanabe, 1922

Specific diagnosis.—Body elongate usually oval, 0.5–3.0 long, 0.1–4.0 in breadth, creamy coloured when fresh suffused with pinkish tinge; entire body spinulate. Acetabulum at one third body length. Collar spines 24 of approximately equal size. Prepharynx narrow; pharynx globular; oesophagus long : caeca extending to subcaudal region. Genital pore submedian immediately behind intestinal bifurcation.

Testes large, almost spherical, slightly compressed, just behind middle of body. Cirrus sac preacetabular, overlapping anterior margin of acetabulum. Ovary globular or oval, to right side a little in front of anterior testis. Receptaculum seminis present. Vitellaria extend from anterior margin of acetabulum to posterior end, lateral, more or less encroaching on caeca throughout their length, extending mesially behind testes but not confluent. Uterus short, slightly coiled, preovarian. Eggs a few, 2–25, ellipsoidal, 90–130 ×55–95

Host.—Man, dog, cat, pig and fox.

Location.—Intestine.

Various species of fishes are the second intermediate hosts in Japan. Mammals incur the infection through consumption of raw or insufficiently cooked fish. According to Kobayashi (1934) only the gills of these fishes harbour the encysted metacercariae. On account of its occurrence in cats and dogs in Japan it appears as a possible parasite of man in India as mentioned by Bhalerao (1947).

50. **Echinochasmus famelicus** (Odhner, 1911) Prudhoe, 1944

Syn. *Echinostomum famelicum* Odhner, 1911
Echinostoma famelicum Dollfus, 1932

(Fig. 37)

Specific diagnosis.—Body 5.3–6.7 long, 8.65 long according to Odhner, maximum breadth in midregion 1.2–1.4 (1.55 according to Odhner). Cuticle on ventral surface armed with transverse rows of scale-like spines up to a short distance behind acetabulum. Head collar 0.54–0.66 in diameter. Collar spines 24; innermost collar spines on each ventral lobe 0.077–0.08×0.027–0.035; other collar spines 0.082–0.097 ×0.028–0.037 Acetabulum 0.64–0.69 in diameter (0.95 according to Odhner), situated at 1.0 from anterior end. Oral sucker 0.27–0.31 (0.35 according to Odhner). Pharynx elongate, 0.27×0.22 or 0.3×0.27 (0.34×0.24 according to Odhner). Cirrus sac poorly developed, overlapping anterior margin of acetabulum, pear-shaped. Ejaculatory duct partly differentiated as pars prostatica. Vesicula seminalis large, deeply constricted into two equal parts. Ejaculatory duct appears to enter the shallow genital atrium through a large cone-shaped projection or papilla. Testes elongate, somewhat rectangular, 0.75–1.0×0.5–0.75. Ovary transversely elongate, 0.16–0.21×0.25–0.31. Vitellaria as figured by

Odhner, extending from a little behind acetabulum to posterior extremity, almost meeting mesially behind posterior testis. Eggs thin shelled, 0.112–0.125×0.062–0.07 (0.11–0.12×0.06–90.7 according to Odhner). The principal characters used by Odhner for separating *Allechinostomum* from *Echinochasmus* was the presence in the former, of a papilla through which male genital entered into genital sinus. Prudhoe says that he observed a similar projection in the genital atrium of *Echinoschasmus coaxatus*, the type species. Consequently

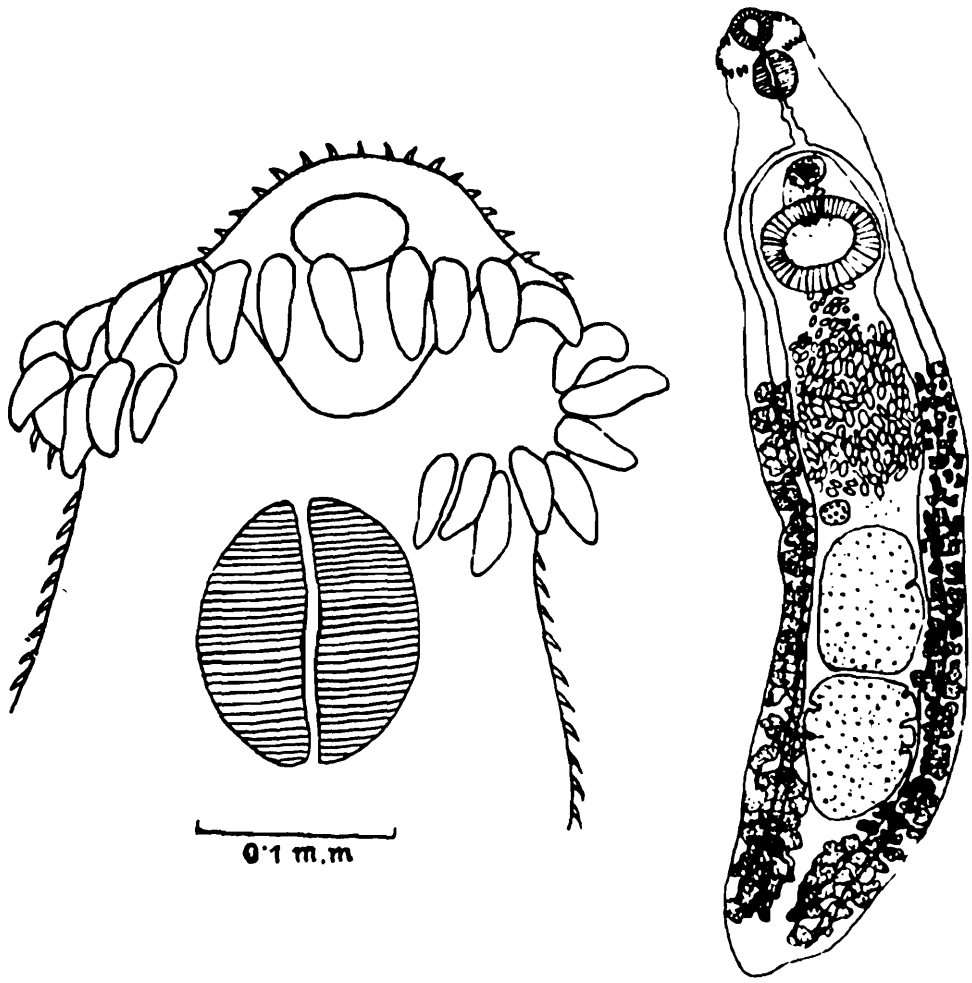


Fig. 37. *Echinochasmus familicus* (Odhner, 1910) Prudhoe, 1944.

Allechinostomum is considered a synonym of *Echinochasmus*, and its other species, *A. crocodili* becomes *Echinochasmus crocodili* (Poirier, 1886).

Host.—Smaller adjutant stork, *Leptoptilos javanicus*.

Locality.—Colombo, Sri Lanka.

Genus 20. **Episthmium** Lühe, 1909

Syn. *Episthochasmus* Verma, 1936

Echinochasminae : Body small to submedium-sized, elongate or plump, broadest in testicular or acetabular region, spinulate. Collar spines 24 in single dorsally interrupted row. Acetabulum preequatorial or almost equatorial. Testes large, spherical, ovoid or transversely elongated, postequatorial or only posterior testis postequatorial. Cirrus sac small, anterodorsal to acetabulum or preacetabular. Vesicula seminalis bipartite. Cirrus nonprotrusible slightly developed or absent. Ovary spherical or ovoid, submedian or median. Receptaculum seminis absent. Vitellaria extensive, extending in front of acetabulum to pharynx, confluent in front of genital pore or acetabulum and behind testes, sometimes extending mesially in ovarian region. Uterus pretesticular, with a few or numerous eggs. Parasitic in bursa Fabricii or intestine of birds, sometimes in intestine of mammals.

Type-species : *E. africanum* (Stiles, 1901) Lühe, 1909

Key to Indian species of **Episthmium**

1. Uterus with a few eggs; parasitic in the intestine of common crow, *Corvus splendens* and carnivores mostly dogs, sometimes cats and jackals — *E. corvus* (Bhalerao, 1926)
2. Uterus with a few to numerous eggs; parasitic in the bursa Fabricii of birds ... — *Episthmium bursicola* (Crepl., 1837)

51. **Episthmium bursicola** (Creplin, 1837)

Syn. *Echinostomum bursicola* (Crepl, 1837)
Echinochasmus bursicola Odhner, 1911
Episthmium chauhani Rai, 1963

(Fig. 38)

Specific diagnosis.—Body elongate, plump, small to medium-sized, spines dorsally as well as ventrally, 2.68–4.12 × 0.92–1.56 (1.5–2.1 × 0.6–0.65 according to Odhner); hinder end sometimes more pointed, sometimes more rounded. Head collar with 24 spines in single dorsally interrupted row; innermost ventral spine often the smallest, the next four form two pairs on each side in which the inner is usually ahead of the outer. Collar spines according to Rai 0.117–0.264 × 0.264–0.411 (according to Odhner the smallest spine 0.035 long, others

0.043–0.054×0.014 at base). Acetabulum 0.367–0.529×0.411–0.485 (riynded, 0.3–0.37 in diameter according to Odhner). Oral sucker 0.113–0.153×0.097–0.161 (riunded, 0.1–0.12 in diameter according to Odhner). Ratio of suckers 1 : 3. Prepharynx small; pharynx 0.137–0.189×0.121–1.189 (according to Odhner 0.13–0.14×0.09) a little larger than oral sucker. Oesophagus 0.147–0.367 long. Testes large; anterior testis rounded or quadrangular, 0.396–0.749×0.573–0.882; posterior testis longitudinally elongated, 0.536–0.799×0.426–0.764. Rai mentioned degenerating condition of testes in a few specimens. Cirrus sac varies in extension from preacetabular condition to middle of acetabulum. Vesicula seminalis

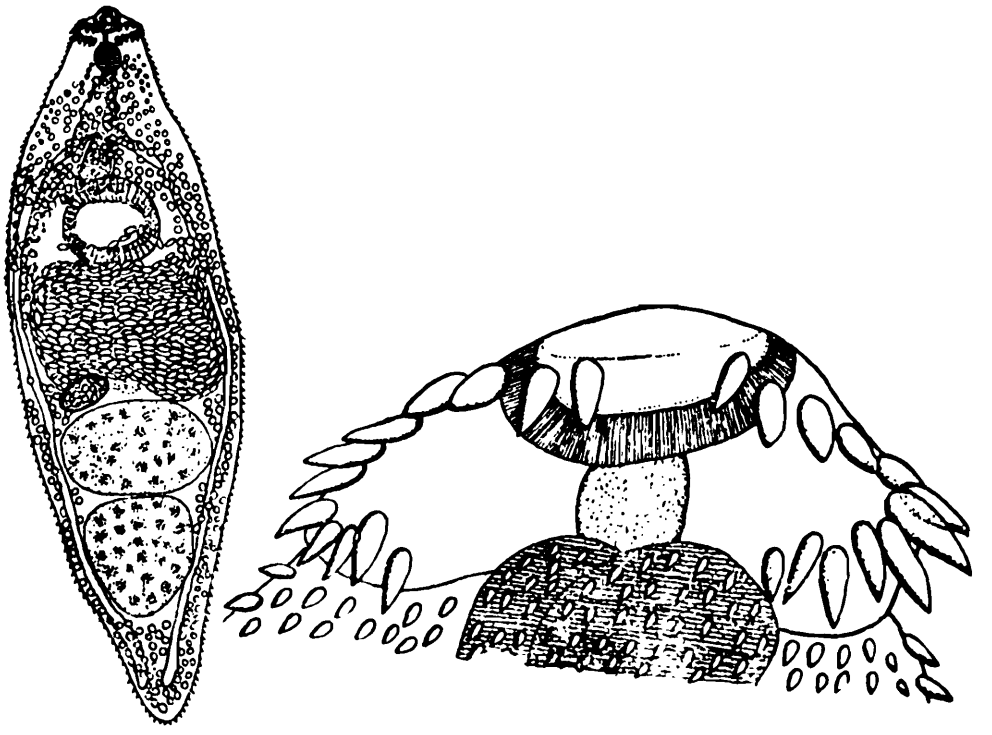


Fig. 38. *Episthmium bursicola* (Creplin, 1837) Lühe, 1909 and its collar.

bipartite, posterior chamber much larger. Pars prostatica small. Genital pore submedian a little behind intestinal bifurcation. Ovary oval to spherical, median to submedian, 0.147–0.22×0.147–0.41. Uterus small or large containing a few or numerous eggs. Eggs 0.056–0.085×0.032–0.056 (according to Odhner 0.075–0.085×0.046–0.048). Vitellaria extending from anterior end of pharynx to posterior extremity, confluent in preacetabular and posttesticular regions. Some variations in extension of vitelline follicles were recorded by Rai.

Host.—*Bulbulcus ibis* (Linnaeus).

Location.—Bursa Fabricii.

Locality.—Near Jabalpur, M.P.

Odhner collected in Egypt (West Nile) from the bursa Fabricii of *Circaetus gallicus*, *Ardea comata*, *Ardea purpurea*, *Circus cyaneus*. Two specimens were also collected near Cairo from *Botaurus stellaris* and dozen specimens from *Bulbulcus ibis* were collected by Looss near Cairo. This species has a wide geographical range from Europe, Egypt to India.

There is great discrepancy in the measurements of collar spines of the Indian and Egyptian specimens, which in all other features agree. The measurements of collar spines by Rai are high and need confirmation.

52. **Episthmium corvus** (Bhalerao, 1926)

Syn. *Echinochasmus corvus* Bhalerao, 1926
Episthochasmus caninum Verma, 1935
Echinochasmus reniovarus Lal, 1939
Echinochasmus canai Chatterji, 1954
Echinochasmus corvus Gupta and Pande, 1963

(Fig. 39)

Specific diagnosis.—Body small, elongated, 0.74–2.09 × 0.38–0.59, spines. Collar spines 24 in two groups of 12 each, four being dorsal, four lateral and four constituting the ventral corner group, one innermost dorsal spines on each side overlapping the oral sucker; ventral corner spines arranged in two rows, the third being the largest and of nearly the same size as the dorsals, which like the laterals measure 0.036–0.048 × 0.009–0.011; first and fourth ventral corner spines, the smallest of the entire group of twelve, measure 0.025–0.033 × 0.007–0.009. Oral sucker terminal, 0.06–0.11 in diameter. Acetabulum 0.12–0.27 × 0.14–0.28. Prepharynx short, 0.1–0.24 long. Pharynx 0.058–0.12 × 0.05–0.12. Oesophagus short or moderately long, 0.1–0.24 long; caeca extending to posterior extremity. Genital more median between intestinal bifurcation and acetabulum. Testes tandem, contiguous, postequatorial; anterior oval or rectangular, entire, 0.08–0.24 × 0.14–0.31; posterior usually entire, oval or subspherical, 0.13–0.26 × 0.15–0.28. Cirrus sac anterodorsal to acetabulum or dorsal to acetabulum almost to its hinder end. Ovary immediately anterior to testes, dextral, oval or

reniform, 0.06–0.14×0.08–0.13. Receptaculum seminis absent. Uterus short, containing a few eggs. Eggs 0.07–0.085 ×0.045–0.066. Vitellaria extending to posterior end of acetabulum or beyond up to pharynx with intergradations between two extremes almost uniting mesially in front of acetabulum and in posttesticular region. Gupta and Pande suggest that genus *Episthmium* should be suppressed and held synonymous to *Echinochasmus* on account of the variability in the extent of vitellaria. This variability is exceptional only in this species of *Episthmium*.

Host.—Common crow, *Corvus insolens*, dog and other canines (cats and jackals).

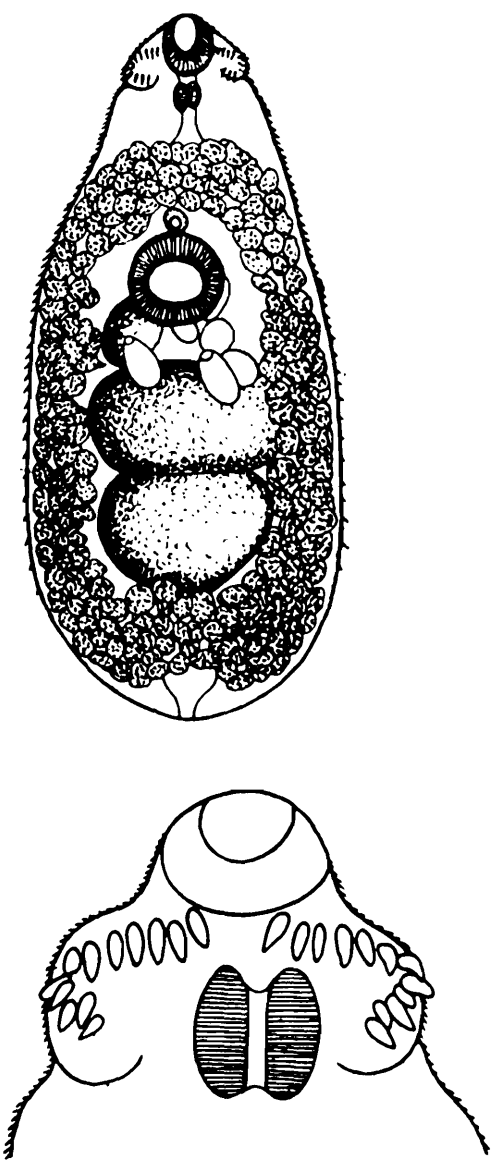


Fig. 39. *Episthmium corvus* (Bhalerao, 1926) and its collar.

Location.—Intestine.

Locality.—Rangoon (Burma), Lucknow, U.P.; Calcutta, Bengal.

Gupta and Pande recently (1963) have advocated the suppression of genera or subgenera *Episthmium* Luhe, 1909, *Episthochasmus* Verma, 1935 and *Stephanoprora* Odhner, 1902 and maintained them as synonyms of *Echinochasmus* Dietz. *Stephanoprora* is a valid genus not only on account of the anterior limit of its vitellaria but also of the presence of protrusible cirrus and 22 or 26 collar spines. Vitellaria in this genus extend to testicular or ovarian zone. The genus *Episthochasmus* Verma is no doubt synonymous to *Episthmium*. There is a difference of opinion about the validity of the latter genus, but it appears necessary to maintain it as the vitellaria extend anteriorly in front of acetabulum up to pharynx and confluent in front of genital pore and behind testes. There are some exceptional or abnormal cases in which the vitellaria do not extend beyond posterior end of acetabulum in *Episthmium corvus* as noticed by Gupta and Pande. In one of such cases only one testis is present. These abnormalities cannot justify the suppression of *Episthmium*.

Genus 21. **Saakotrema** (Saskova, 1952) Skrjabin and Baschkirova, 1956

Syn. *Brijicola* Pande, 1960

Echinochasminae : Closely related to *Episthmium*. Body small, elongate, broadest in acetabular region, spinulate. Collar spines 24 in single dorsally interrupted row. Acetabulum preequatorial. Testes large, postequatorial, spherical or ovoid, tandem. Cirrus sac mostly preacetabular, partly overlapping acetabulum, never extending behind its middle. Vesicula seminalis bipartite; cirrus short. Genital pore submedian, preacetabular. Ovary pretesticular, small, oval or subglobular. Vitellaria extending from pharyngeal region to hind end of body, confluent anteriorly in front of genital pore and behind testes, tending to merge in the ovarianr egion. Uterus long with many eggs, extending behind testes to near hind end of body. Receptaculum seminis absent; receptaculum seminis uterinum present. Excretory vesicle Y-shaped with 6-chambered stem and long cornua. Parasitic in bursa Fabricii of birds.

Type-species : *S. metatestis* (Saakova, 1952) Skrjabin and Bachkirova, 1956

53. **Saakotrema metatestis** (Saakova, 1952) Skrjabin and Baschkirova, 1956

(Fig. 40)

Syn. *Brijicola caballeroi* Pando, 1960
Opisthometra metatestis Saakova, 1952

Specific diagnosis.—Body small, spinose, 1.5–2.47×0.046–0.58. Collar spines 0.026–0.042×0.007–0.012. Oral sucker 0.06 in diameter. Acetabulum 0.27–0.285 in diameter, at one third body length from anterior end. Prepharynx short; pharynx 0.08×0.12, larger than oral sucker; oesophagus well developed; caeca narrow, extending almost to posterior end of body. Testes large, tandem; anterior testis 0.31–0.322×0.253–0.31; posterior testis 0.311–0.345×0.27–0.45. Cirrus sac muscular, small, preacetabular, partly overlapping acetabulum. Ovary 0.117–0.15×0.108–0.12. Eggs 0.0745–0.0843×0.0418–0.0476.

Host.—Little egret, *Egretta gazetta gazetta* (Linnaeus).

Location.—Bursa Fabricii.

Locality.—Mathura, Bulandshahar, Lucknow, U.P.

The genus *Saakotrema* was created on the posttesticular extension of uterus. In all other characters *Saakotrema metatestis* represents a species of *Episthmium*. Posttesticular extension of uterus is an unusual character for a member of Echinostomatidae, but there is no doubt that this form belongs to Echinochasminae and is closely related to the genus *Episthmium*. Gupta (1962) has correctly mentioned "Moreover, judging from the very compact body of *S. metatestis*, with no significant space left between the ventral sucker and the gonads, owing to the large size of testes it may be well presumed that the posttesticular extension of the uterus in this form is merely a secondary readjustment for accommodation of the uterus".

Genus 22. **Dissurus** Verma, 1936

Echinochasminae ; Body long, very selender, with cylindrical neck region, resembling *Himasthla* Dietz in body form; cutaneous spines characteristic with cleft base on anterior half. Collar with 24 spines in single dorsally interrupted row, without end group. Oral sucker terminal; mouth ventroterminal. Acetabulum preequatorial near anterior end,

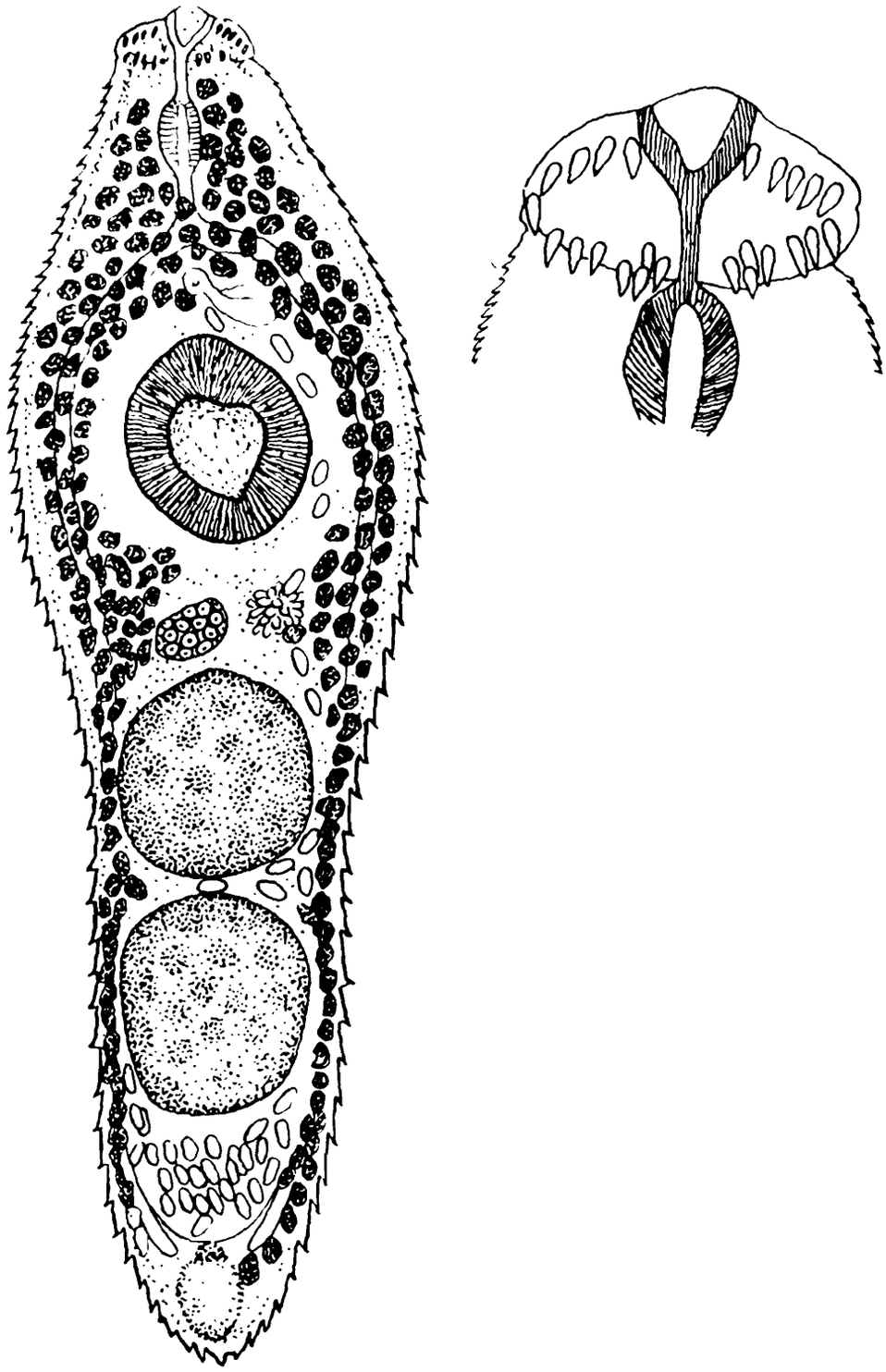


Fig. 40. *Saakotrama metatestis* (Saakova, 1952) Skrjabin et Baschkirova, 1956 and its collar.

Oesophagus long. Testes elongated oval with rugose margin in posterior third to fourth body. Cirrus sac anterodorsal to acetabulum, conical. Ovary rounded behind anterior one third body length. Vitellaria from ovary to caecal ends.

Uterus preovarian, intercaecal. Eggs less than hundred, large. Parasitic in birds.

Type-species : *D. farrukhabadi* Verma, 1936

54. **Dissurus farrukhabadi** Verma, 1936

(Figure not given by the author*)

Specific diagnosis.—Body 9.0–13.6 long, considerably attenuated between acetabulum and ovary, 0.18–0.21; neck region subcylindrical, 0.35–0.38 broad, very gradually broadening behind ovary and ending in a rounded extremity; maximum breadth 0.6–0.8 in testicular region a short distance in front of posterior extremity. Cuticular spines cleft at base on anterior half. Collar 0.25–0.336 × 0.38–0.46. Collar spine 24 in one row interrupted dorsally; no end group; innermost ventral 0.055 × 0.117; largest lateral 0.062 × 0.0199; innermost dorsal 0.046 × 0.0165. Oral sucker 0.084–0.0126. Prepharynx as long as pharynx; pharynx 0.084–0.01 × 0.067–0.07; oesophagus thin, 0.5–0.6 long; caeca straight to near hind end. Acetabulum 0.378–0.506 in diameter. Anterior testis 0.65 –0.71 × 0.32–0.4 with two notches on each side, 2.2–3.36 behind ovary; posttesticular distance 0.67–1.17 Cirrus sac 0.21–0.23 × 0.12, conical, anterodorsal to acetabulum, not reaching posterior to its middle. Seminal vesicle bipartite. Ovary rounded, 0.21–0.27 × 0.176–0.198. Mehlis' gland postero-lateral to ovary, sometimes partly overlapping it. Eggs. 0.1–0.118 × 0.05–0.07

Host.—White necked stork, *Dissura episcopa.*

Location.—Intestine.

Location.—Farrukhabad, U.P.

Genus 23. **Stephanoprora** Odhner, 1902

Syn. *Mesorchis* Dietz, 1909
Monilifer Deitz, 1909
Sobolevistoma Sundarikov, 1950

Echinochasminae : Body long, much elongated, spined anteriorly. Collar spines 22 or 26. Acetabulum in anterior third of body. Testes median, tandem, in middle third of

*This species has been redescribed and figured by Srivastava (1974). *Ed.*

body. Cirrus sac small, preacetabular or anterodorsal to acetabulum, occasionally extending to posterior end of the latter. Cirrus present. Ovary median or submedian, a little in front of anterior testis. Vitellaria occupying entire post-testicular region, extending anteriorly to testicular or ovarian zone. Uterus not long. Parasitic in intestine of reptiles and birds.

Type-species : *S. ornata* Odhner, 1902

Key to Indian species of **Stephanoprora**

1. Cirrus sac extending to posterior end of acetabulum; receptaculum seminis present	*S. reynoldi* Bhalerao, 1926
Crrus sac not extending behind middle of acetabulum; receptaculum seminis absent.	2
2. Vitellaria extending to anterior margin or posterior testis or in between two testes.	3
Vitellaria extending to anterior margin of anterior testis or ovary.	4
3. Testes unequal; eggs a few.	*S. nigerica* Gupta, 1963
Testes almost equal: eggs numerous.	*S. fusca* Lal, 1939
4. Oesophagus long, surrounded by thick coat of gland cells; ovary trilobed: body exceedingly long, 22.5–26.7 long.	*S. gigantica* Gupta, 1962
Oesophagus moderately long, not surrounded by thick coat of gland cells; ovary pear-shaped; body shorter, 7.5 long	*S. pennanti* (Verma, 1936)

55. **Stephanoprora pennanti** (Verma, 1936)

Syn. *Mesorchis pennant* Verma, 1936

Specific diagnosis.—Body slender, long, 7.5×0.925. Collar 0.252×0.336. Collar spines 11 on each side i.e., 22 in all, but the number is uncertain; spines zalong lateral margins 0.061×0.0201. Oral sucker 0.08 in diameter. Acetabulum 0.42, at anterior one third body length. Pharynx 0.1×0.08,

Oesophagus 1.6 long. Ovary and testes close together. Anterior testis 0.55×0.88, transversely elongated, quadrilateral, 0.67 behind acetabulum; posterior testis 0.86×0.71, oval or subtriangular, Cirrus sac 0.134×0.21, oval with anterior end broadly rounded, obliquely in front of acetabulum. Ovary pear-shaped, dextral. Mehlis' gland between ovary and anterior testis. Vitellaria filling posttesticular region extending laterally along testes to anterior margin of anterior testis. Uterus short between anterior testis and acetabulum. Eggs less than 100, 0.0756–0.08×0.058, broadly oval.

Host.—Indian Dater.
Location.—Intestine.
Locality.—Not mentioned.

56. **Stephanoprora reynoldi** Bhalerao, 1926

(Fig. 41)

Specific diagnosis.—Body spined, 4.2 long, maximum breadth at acetabular level. Collar followed by neck region. Collar spines 22 in one dorsally discontinuous row; 2 angular spines the smallest on each side, 0.025×0.009, the marginals on each side 9, the largest spine 0.0407×0.019. Oral sucker 0.21×0.68. Prepharynx short; oesophagus of moderate length, 0.2 long. Testes oval, entire, in the centre of body, one testis in anterior half and other in posterior half; anterior 0.38×0.33; posterior more elongated, 0.5×0.33. Cirrus sac sinistral to acetabulum, extending from intestinal fork to acetabular posterior end, pear-shaped, broad anteriorly and tapering posteriorly. Vesicula seminalis bilobed; pars prostatica and ductus ejaculatorious small; cirrus not well developed. Ovary oval, slightly dextral, 0.15×0.115. Receptaculum seminis postovarian, slightly to left, shell gland diffuse, median, Uterus with a few eggs, between anterior testis and acetabulum. Vitellaria from centre of anterior testis to posterior end along sides of body, approaching each other very closely at posterior end. Eggs 0.056–0.0895×0.031–0.049.

Host.—*Corvus insolens.*

Location.—Intestine.

Locality.—Rangoon, Burma.

57. **Stephanoprora fusca** Lal, 1939

Specific diagnosis.—Body cylindrical, 4.775×0.45 greatest breadth a little behind posterior testis. Collar spines 22 of

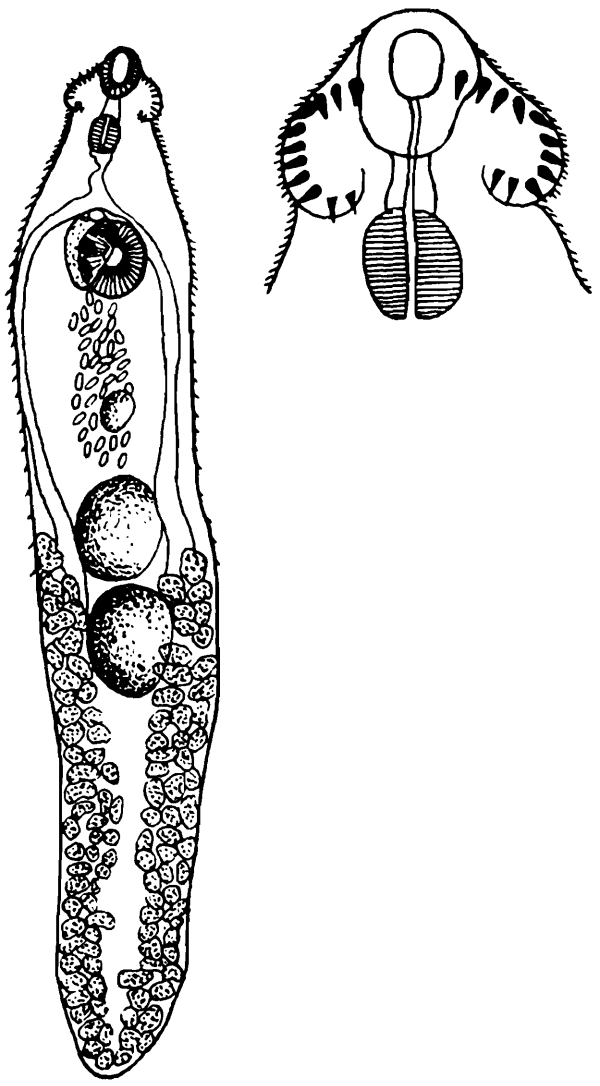


Fig. 41. *Stephanoprora reynoldi* Bhalerao, 1926 and its collar.

uniform size, 0.05×0.02 in one row except four pairs towards pharynx which show arrangement in double row. Oral sucker 0.1 in diameter. Prepharynx small, 0.15; pharynx 0.125×0.1; oesophagus 0.275 long. Acetabulum 0.25 in diameter, at 0.9 from anterior end. Testes oval, entire, equatorial; anterior 0.375×0.25; posterior 0.4×0.22. Cirrus sac thin walled, 0.3 long. Cirrus small. Ovary median, 0.75 behind acetabulum, oval, 0.15×0.11. Mehlis' gland between ovary and anterior testis. Eggs many, 0.05×0.025. Vitellaria extending from in between testes or posterior margin of anterior testis to posterior end, approaching each other but not meeting behind testes.

Host.—Spotted red shank, *Totanus fuscus.*
Location.—Intesine.
Locality.—Lucknow, U.P.

58. **Stephanoprora gigantica** Gupta, 1962
(Fig. 42)

Specific diagnosis.—Body exceedingly long and slender, 22.5–26.764, long, 1.39–1.69 in maximum breadth in acetabular region, behind which it is of uniform breadth; spinulate up to preovarian region. Collar spines 22 in single dorsally broken row, 0.064–0.091 × 0.018–0.023. Terminal oral sucker 0.154 –0.21 × 0.21–0.238. Acetabulum 0.476–0.532 at middle of anterior third of body. Prepharynx short, 0.056–0.098 long; pharynx elliptical, larger than oral sucker, 0.252–0.308 × 0.164–0.214; oesophagus long, slender, 2.437–3.001 long, surrounded by a thick coat of small, compact galnd cells : caeca extending to hind end of body. Testes tandem, closely placed in anterior region of middle third of body, quadrangular or oval; anterior 1.01–1.54 × 0.81–0.994; posterior 1.240–1.582 × 0.771–0.98. Cirrus sac pear-shaped, extending to middle of acetabulum, 0.602–0.84 × 0.258–0.406. Vesicula seminalis bipartite; cirrus spiny. Genital pore immediately behind intestinal bifurcation. Ovary median, trilobed, 0.294–0.42 × 0.532–0.616. Vitellaria of small follicles from level of ovary to posterior end. Mehlis' gland just behind ovary. Receptaculum seminis absent; proximal part of uterus forms receptaculum seminis uterinum. Uterus of several transverse coils pretesticular. Eggs 0.0945–0.1002 × 0.0535–0.0628. Excretory vesicle with 4-chambered stem; pore terminal.

Host.—Black necked stork, *Xenorhynchus asiaticus* (Letham).

Location.—Intestine.

Locality.—Hardoi and Lucknow, U.P.

59. **Stephanoprora nigerica** Gupta, 1963
(Fig. 43)

Specific diagnosis.—Body elongated, spinose in anterior half, 2.683–4.01 long, 0.450–0.551 broad at level of testes. Collar with a large ventral gap, 0.28–0.295 broad with 22 spines in single dorsally broken row, dorsal chasma slightly less than breadth of oral sucker. Collar spines 0.041–0.049 × 0.005–0.007 Suckers weakly developed. Oral sucker 0.059–0.109 × 0.056–0.102. Acetabulum 0.18–0.218 × 0.164–0.233, in posterior region of anterior body third. Prepharynx short, 0.045–0.064 long; pharynx 0.065–0.009 × 0.047–0.063; oesophagus 0.341–0.591 long; caeca reaching almost to posterior end. Testes tandem, contiguous, pear-shaped, in

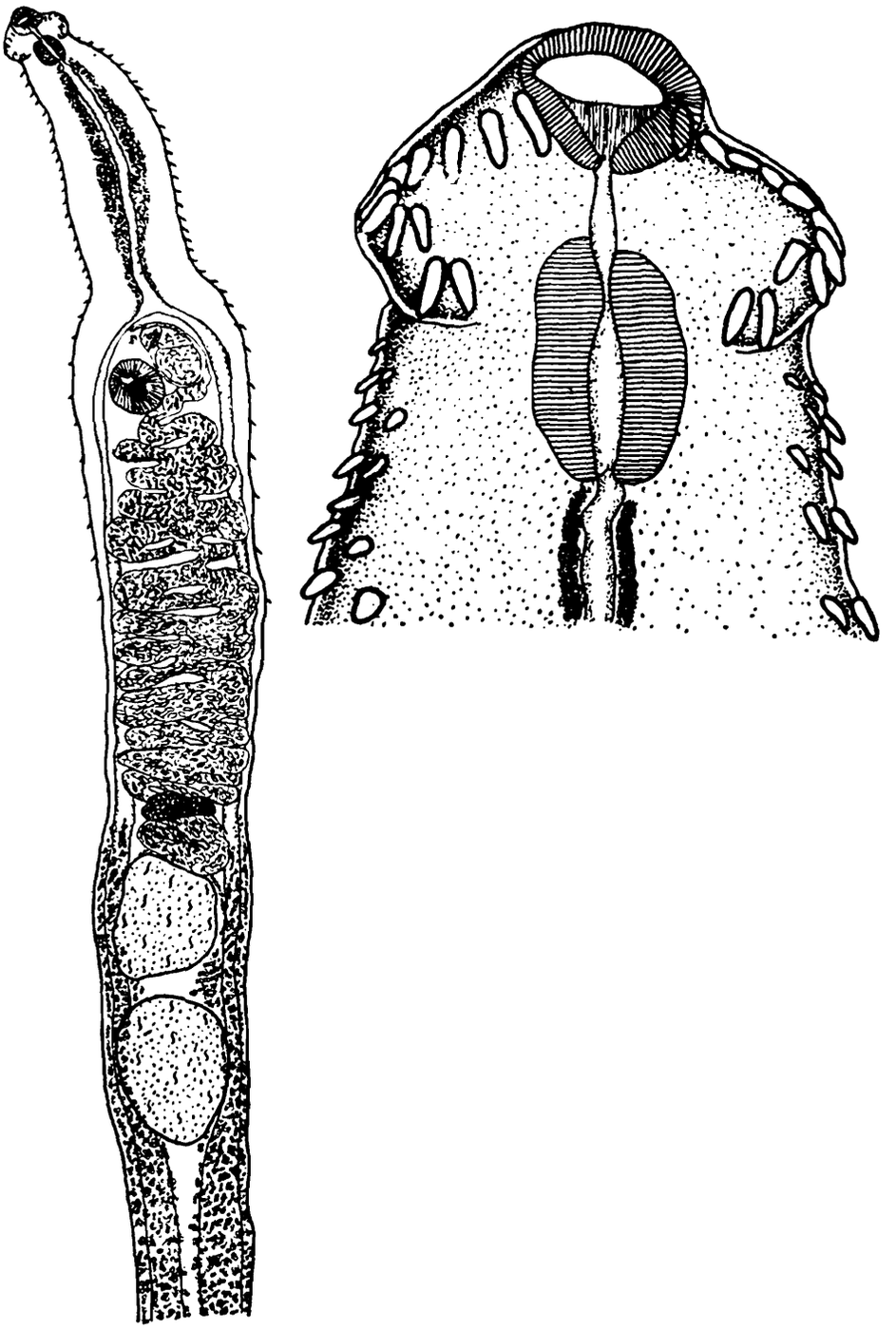


Fig. 42. *Stephanoprora gigantica* Gupta, 1962 and its collar.

middle region of body; anterior testis 0.255–0.368 × 0.306–0.454; posterior testis 0.419–0.551 × 0.282–0.436, always larger than anterior testis. Cirrus sac elongated, saceular, 0.198–0.326 × 0.108–0.135, extending to middle of acetabulum. Vesicula seminalis bipartite; pars prostatica weakly developed; ductus ejaculatorius short. Genital pore median or submedian, postbifurcal. Ovary median or slightly dextral, 0.113–0.141 in diameter. Vitellaria lateral, of medium sized

follicles from level of anterior border of posterior testis to posterior extremity; follicles tend to merge together in post-testicular region. Mehlis' gland intercalated between ovary and anterior testis. Receptaculum seminis absent. Recep-

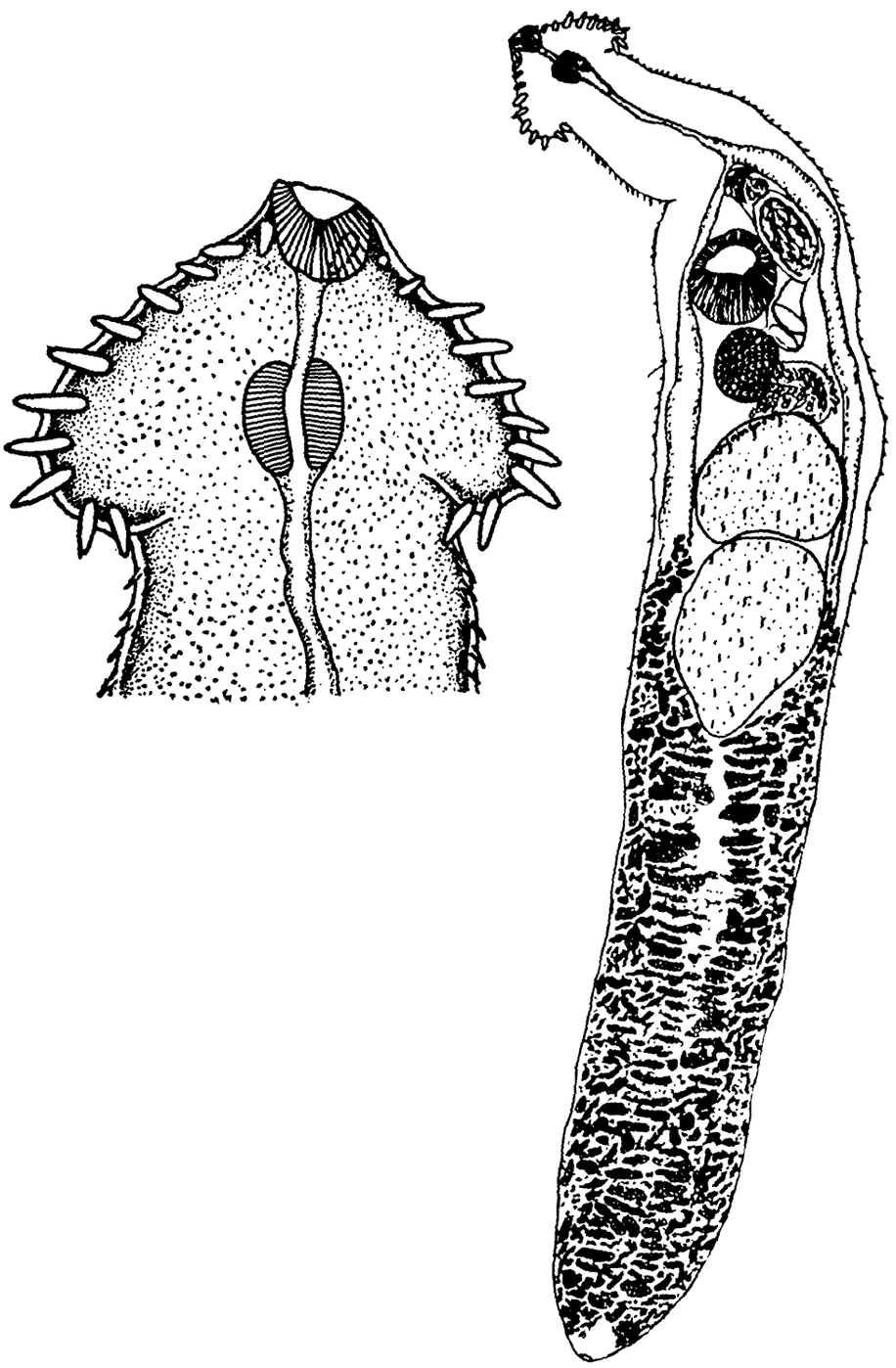


Fig. 43. *Stephanoprora nigerica* Gupta, 1963 and its collar.

taculum seminis uterinum present. Uterus short consisting of two to four transverse coils, pretesticular. Eggs a few, 2–8, 0.0679–0.0765 × 0.0501–0.0549.

Host.—Little cormorant, *Phalacrocorax niger* (Vieillot).

Location.—Small intestine.

Location.—Anupshahar, U.P.

Genus 24. **Ignavia** Freitas, 1948

Syn. *Nephroechinostoma* Oshmarin et Belous, 1951

Echinochasminae : Body long, narrow, cylindrical, spinulate. Head collar well developed laterally, reduced dorsally as a ridge with a dorsally interrupted row of 20–22 spines. Suckers well developed. Acetabulum larger than oral sucker, at the middle or anterior third of body. Prepharynx distinct; pharynx small; oesophagus long, with or without diverticula; caeca terminating at posterior extremity. Genital pore between intestinal bifurcation and acetabulum. Testes tandem, lobate or entire. Cirrus sac small, preacetabular or anterodorsal to acetabulum, enclosing bipartite vesicula seminalis, short pars prostatica and ductus ejaculatorius. Ovary pretesticular, median or submedian. Vitellaria mostly extraceaecal, extending from just behind acetabulum to posterior extremity. Laurer's canal present. Receptaculum seminis present or absent. Uterus long, intercaecal, pretesticular. Eggs a few or moderate in number. Excretory vesicle Y-shaped, stem bifurcating behind posterior testis; excretory pore terminal. Parasitic in kidneys and ureters of birds.

Type-species : *I. venusta* Freitas, 1948

60. **Ignavia breviovarica** Gupta, 1962

(Fig. 44)

Specific diagnosis.—Body long, narrow with broad anterior and pointed posterior extremity, spined in anterior half, 4.57–6.951 long, 0.462–0.751 broad in testicular region. Collar prominent at sides of oral sucker, dorsally almost flushed with body surface, ventrally discontinuous. Collar spines 21, stout, small; 3–5 spines at ventro-lateral angle on each side showing alternate arrangement, others in a single row; wide gap in the row of spines in mid-dorsal line; spines 0.021–0.029 × 0.011–0.012. Oral sucker 0.219–0.241 × 0.245–0.297 Acetabulum 0.329–0.39 × 0.36–0.495, in anterior third

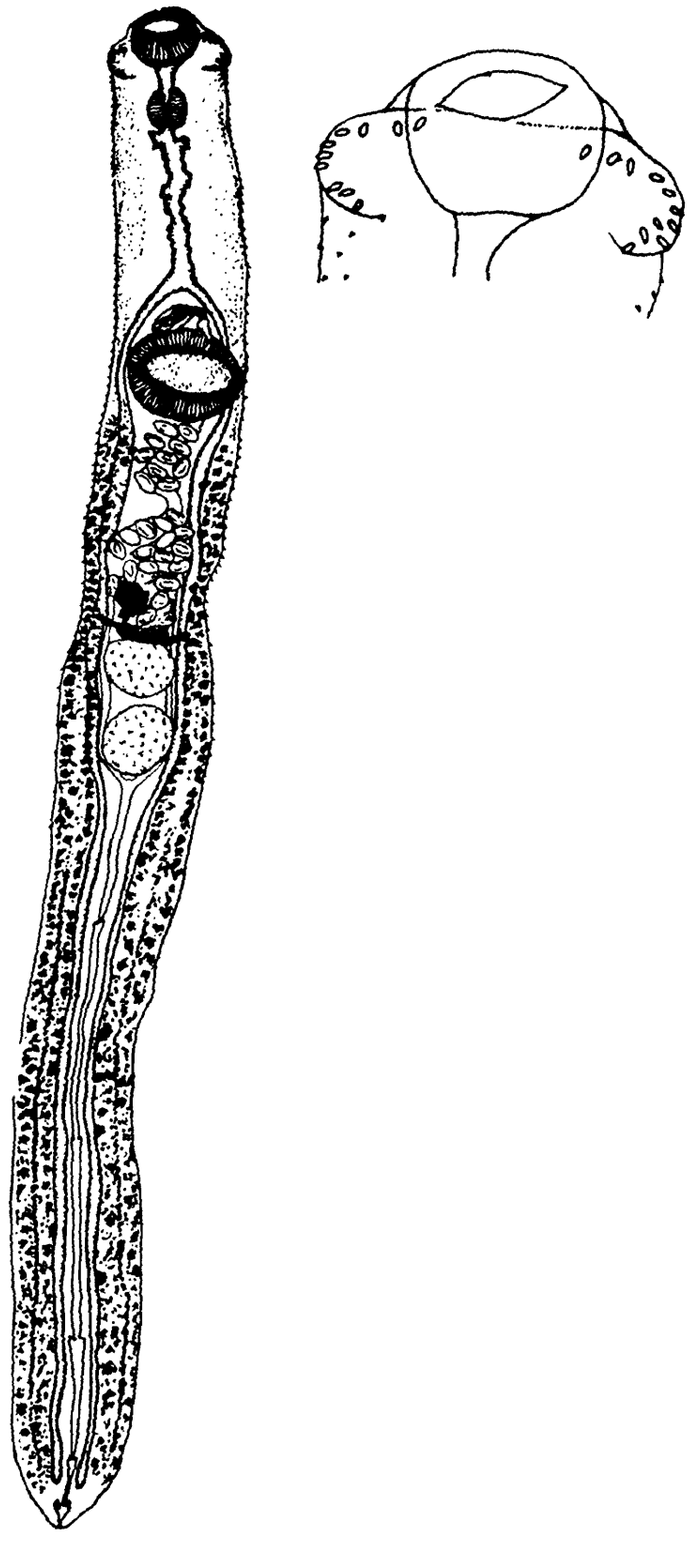


Fig. 44. *Ignavia breviovarica* Gupta, 1962 and its collar.

of body. Prepharynx short; pharynx 0.122–0.175×0.114–0.17 Oesophagus with lateral outgrowths, 0.47–0.621 long. Testes oblong to round in posterior region of anterior half; anterior 0.208–0.255×0.195–0.305; posterior 0.301–0.311× 0.279–0.286. Cirrus sac pear-shaped, 0.167–0.2×0.079–0.121. preacetabular or partly overlapping anterior margin of acetabulum. Vesicula seminalis large, bipartite; pars prostatica short; ejacularoty duct short. Genital pore median or submedian, preacetabular. Ovary dextral, ovoid to subglobular, 0.056–0.109×0.118–0.12. Vitellaria of small follicles, lateral, from posterior border of acetabulum to posterior extremity; follicles mostly extracaecal. Mehlis' gland immediately postovarian. Receptaculum seminis absent. Receptaculum seminis uterinum present. Uterus with a few transverse coils, intercaecal, preovarian. Eggs 0.1025–0.1148 ×0.0651–0.08. Excretory vesicle stem 6-chambered.

Host.—Purple Heron, *Ardea purpurea* (Linnaeus).

Location.—Ureters and kidneys.

Locality.—Lucknow, Hardoi, U.P.

XIV Subfamily *PARORCHIINAE* Lal, 1936 nom.emend. Yamaguti, 1958

Echinostomatidae : Body pyriform or elliptical, spinulate. Head collar rudimentary with or without a row of spines. Acetabulum large, just preequatorial, twice as large as oral sucker. Genital pore sometimes borne on a papilla, preacetabular. Prepharynx present; oesophagus spacious, moderately long; caeca terminating a little in front of posterior extremity, at higher level of testes. Testes juxtaposed or parallel, just medial to caeca near posterior extremity. Cirrus sac small, preacetabular. Vesicula seminalis externa oval or spindle-shaped, just behind acetabulum with long narrow part dorsal to acetabulum. Pars prostatica and ductus ejaculatorious enclosed in cirrus sac. Cirrus spined. Ovary median, pretesticular. Receptaculum seminis absent or small. Vitellaria short, extracaecal, a few posterior follicles crossing caeca towards ovary. Uterus coiled, between acetabulum and anterior testis, extending outside caeca. Excretory vesicle sac-like with short lateral outgrowths and two long duct like cornua forming anastomosing chambers probably by fusion of short branches, extending to anterior end, and posteriorly uniting to form a transverse connection.

Type genus : *Parorchis* Nicoll, 1907

Genus *Parorchis* Nicoll was included in Philophthalmidae by Nicoll (1907), Yamaguti (1958), whereas Odhner (1911), Fuhrmann (1928) and Sprehn (1932) included it in Echinostomatidae. Subfamily Parorchiinae should be included in Echinostomatidae on account of its spined cuticle and collar. It stands near Singhiatrematinae n.subf. and Ommatobrephidae Poche, 1925.

Genus 25. **Parorchis** Nicoll, 1907

Syn. *Zeugorchis* Nicoll, 1906 preoccupied, renamed.
Proctobium Skrjabin, 1924

Parorchiinae : Body small or medium sized, pyriform or elliptical, spinulate. Head collar poorly developed with or without a row of marginal spines. Collar spines continuous in *P. acanthus* Nicoll, discontinuous in *P. snipis* Lal with a large dorsal gap. Acetabulum just preequatorial. Oral sucker well developed. Prepharynx present; pharynx bulbous; oesophagus spacious, moderately long; caeca terminating at level of hinder end of testes near posterior extremity. Testes parallel or juxtaposed, more or less lobate, just medial to caeca. Cirrus sac preacetabular, thin walled, enclosing vesicula seminalis and spined cirrus. Vesicula seminalis externa posterior to acetabulum. Genital pore submedian, between intestinal bifurcation and acetabulum. Ovary median, rounded, pretesticular. Vitellaria mostly extracaecal between acetabulum and testes. Uterus coiled from side to side, pretesticular. Eggs containing oculate miracidia. Parasitic in bursa Fabricii or cloaca of birds.

Type-species : *P. acanthus* (Nicoll, 1906) Nicoll, 1907

61. **Parorchis snipis** Lal, 1936

(Fig. 45)

Specific diagnosis.—Body 2.58×1.11. Collar ridge-like with a single row of minute spines, four pairs at lateral margin of collar larger, 0.025 long. Oral sucker 0.24×0.27. Acetabulum 0.58×0.55. Prepharynx 0.07 long; pharynx 0.12×0.18. Oesophagus 0.19 long. Excretory vesicle 0.26×0.3. Right testis 0.35×0.27; left testis 0.26×0.225. Vesicula seminalis externa behind acetabulum, 0.2×0.13. Cirrus sac 0.09 long. Ovary 0.185×0.14. Receptaculum seminis behind ovary, 0.035×0.032. Eggs 0.05–0.06×0.025. Vitelline follicles about a dozen on each side partly intercaecal and partly extracaecal.

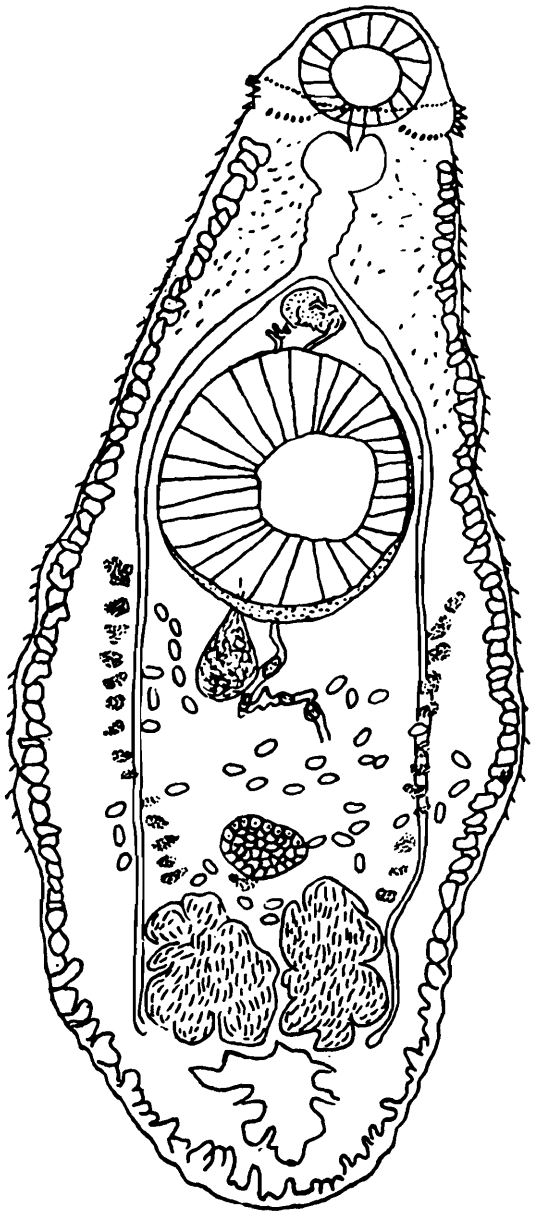


Fig. 45. *Parorchis snipis* Lal, 1936.

Host.—*Totanus hypoleucos.*
Location.—Cloaca.
Locality.—Lucknow, U.P.

XV Subfamily *MEHRASTOMINAE* Saksena, 1959

Echinostomatidae : Head collar well developed at the sides as lappets, dorsally as a low ridge, ventrally incomplete; collar spines present at the sides with middorsal chasm (interruption) between the collar spines on lappets well marked. Oral sucker large. Acetabulum larger than oral sucker, just preequatorial in fully mature specimens, equa-

torial in less mature specimens. Testes lobate, diagonal near posterior extremity. Cirrus sac small between intestinal bifurcation and acetabulum. Vesicula seminalis tubular, tortuous; prostatic complex well developed; cirrus short. Genital pore submedian or median, just postbifurcal. Ovary pretesticular, postequatorial, median or submedian. Vitellaria lateral, extensive overlapping caeca, mostly extracaecal, coming close to one another anteriorly towards median line, extending from intestinal bifurcation to posterior extremity on each side of terminal excretory pore. Uterine coils occupy entire intercaecal space between acetabulum and anterior testis. Excretory vesicle Y-shaped with short four chambered stem without branches bifurcating between testes into long narrow tubular cornua without outgrowths extending to oral sucker turning backwards to posterior extremity. Parasitic in intestine and cloaca of birds.

Type genus : *Mehrastomum* Saksena, 1959

Genus 26. **Mehratstomum** Saksena, 1959

Echinostomatidae, Mehrastominae : Body elongate, spines in preacetabular region. Head collar well developed at the sides, dorsally developed as low ridge, ventrally incomplete (without "Ventral verbindungekante"). Collar spines dorsally interrupted, present at the sides. Oral sucker large. Acetabulum larger than oral sucker, just preequatorial in sexually mature specimens, equatorial in less mature specimens. Prepharynx and pharynx well developed; oesophagus moderately long; caeca reaching near posterior extremity. Testes diagonal, lobate, near posterior extremity. Cirrus sac small, between acetabulum and intestinal bifurcation, extending to anterior border of acetabulum or slightly overlapping its anterior margin, enclosing tubular tortuous vesicula seminalis and prostatic complex; cirrus short. Genital pore median behind intestinal bifurcation. Ovary pretesticular, postequatorial, median or submedian, globular. Shell gland complex just behind ovary. Receptaculum seminis absent. Receptaculum seminis uterinum present. Uterus extensively coiled, occupying entire intercaecal space between acetabulum and anterior testis. Metraterm present. Vitellaria lateral overlapping caeca, mostly extracaecal, extending from intestinal bifurcation to posterior extremity, coming near one another anteriorly. Excretory vesicle U-shaped with short four chambered stem bifurcating between testes into long, narrow tubular cornua extending to oral sucker, without

branches, turning backwards towards posterior end. Parasitic in intestine and cloaca of birds.

Type-species : *Mehrastomum minutum* Saksena, 1959

62. **Mehrastomum minutum** Saksena, 1959

(Fig. 46)

Specific diagnosis.—Body elongated, claviform narrow anteriorly, broad posteriorly, spined with minute spines in preacetabular region, 4.615–5.114 long, 0.95–1.18 broad at level of ovary. Head collar well developed at the sides, appearing as lappets in some specimens, runs dorsally as a low ridge, ventrally incomplete. Collar spines 28 small, 14 on each side; dorsal region of collar devoid of spines, represented by a wide chasm or interruption; a few spines at ventral angle of collar show alternate arrangement while remaining spines are in a single row. Collar spines 0.0235 × 0.0102 breadth at base. Oral sucker terminal, 0.26–0.372 × 0.393–0.51. Acetabulum preequatorial, 0.612–0.71 × 0.558–0.681; equatorial position of acetabulum in specimens described by Saksena (1959) due to preequatorial region of body not being fully developed (Baugh and Gupta, 1962). Prepharynx 0.097–0.100 long. Pharynx 0.186–0.265 × 0.214. Oesophagus moderately long, 0.465–0.673 in length; caeca extend to posterior end of body. Testes lobate, oblique, near posterior end; anterior 0.379–0.610 × 0.176–0.254; posterior 0.310–0.435 × 0.175–0.254. Cirrus sac small, elongate, 0.341–0.440 × 0.110, behind intestinal bifurcation, partly overlapping anterior border of acetabulum or its posterior part lies deflected to one side of the latter in some specimens. Genital pore slightly behind intestinal bifurcation. Ovary globular, 0.179–0.210 × 0.135–0.180, pretesticular, median or slightly lateral. Vitellaria lateral, mostly extracaecal, from level of intestinal bifurcation to posterior extremity; anterior follicles of both sides come near towards median line; transverse vitelline ducts unite behind ovary to form large vitelline reservoir. Shell gland complex large behind ovary. Laurer's canal present. Receptaculum seminis uterinum present. Uterus large, coiled, full of eggs, intercaecal, occupying entire intercaecal space between anterior testis and acetabulum. Metraterm may pass over acetabulum or to one side of the latter. Mature eggs partly embryonated, operculate, pale yellow, 0.112–0.132 × 0.076–0.08. Excretory system as mentioned in generic diagnosis.

Host.—White necked stork, *Dissura episcopa*, Gape billed, stork, *Anastomus oscitans* (Boddaert).

Location.—Intestine and cloaca.
Locality.—Raipur, M.P.; and Hardoi, U.P.

The species was first described by Saksena (1959) who obtained it from the intestine of *Dissura episcopa* at Raipur,

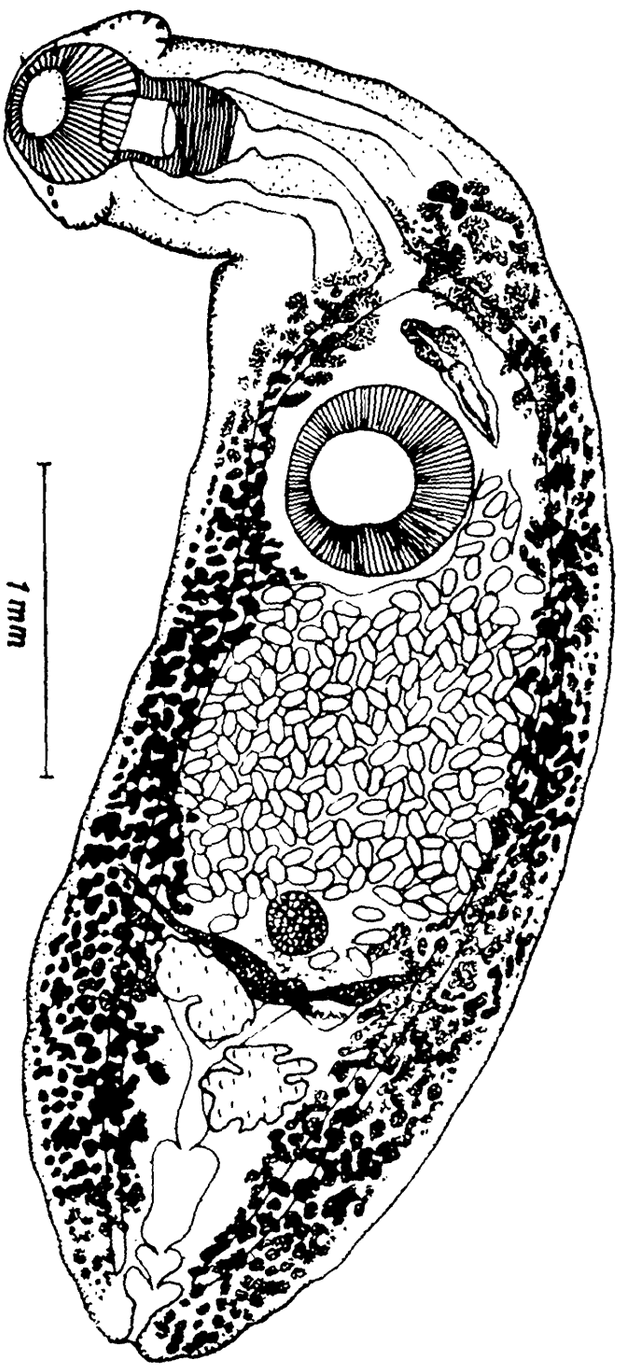


Fig. 46. *Mehrastomum minutum* Saksena, 1959 (Ventral view) (*After* Baugh and Gupta, 1961).

M.P. He created the genus and subfamily for it, and assigned it to the family Philophthalmidae. His specimens were not fully sexually mature, and he overlooked the collar spines and the minute cutaneous spines in the preacetabular region of body. Baugh and R. Gupta (1962) described it from the fully mature specimens obtained by one of them from the cloaca of two Gapebilled stork, *Anastomus oscitans* (Boddaert) shot in the environs of Hardoi, U.P. They correctly allocated *Mehrastomum minutum* and the subfamily Mehrastominae to the family Echinostomatidae.

II. Family PHILOPHTHALMIDAE Travassos, 1918

Echinostomata, Echinostomatoidae—Body small to medium sized, spinose or aspinose, muscular, elongated, oval or elliptical without head collar. Head with crown of numerous small cephalic spines present in Echinostephillinae Yamaguti, 1958. Acetabulum large, preequatorial, almost equatorial or just postequatorial. Oesophagus short or moderately long; caeca terminating near posterior extremity. Genital pore median or submedian, immediately preacetabular near intestinal bifurcation or prebifurcal. Testes tandem, diagonal or side by side, postequatorial or near posterior extremity. Cirrus sac small or elongated, entirely preacetabular, reaching posterior end of acetabulum or extending behind it. Vesicula seminal is externa present or absent. Pars prostatica present. Ductus ejaculatorius present; Cirrus spinose or aspinose. Ovary pretesticular, entire. Receptaculum seminis absent except in *Skrjabinovermis* Belopolskaja, 1954. Laurer's canal present. Uterus coiled, pretesticular; initial coils usually form receptaculum seminis uterinum. Metraterm present. Vitellaria usually slightly developed, lateral comprising longitudinal follicles in single row and so appearing tubular in *Philophthalmus* Looss between acetabulum and anterior testis, curving mesially between ovary and anterior testis, shorter, diagonal across caeca in *Pygorchis* Looss, *Cloacitrema* Yamaguti and *Ophthalmotrema* Sobolov. Mature eggs contain fully developed oculate or non-oculate miracidia. Parthenitae may be differentiated in the miracidia before oviposition of eggs. Megalurus cercariae are the characteristic cercariae. Excretory vesicle V-shaped, U-shaped or Y-shaped. Parasitic in conjunctival sac or orbit (*Philophthalmus*, *Opthalmotrema*), cloaca (*Pygorchis*, *Cloacitrema*) or intestine (*Echinostephilla*, *Skrjabinovermis*) of birds.

Type genus : *Philophthalmus* Looss, 1899

Key to subfamilies of PHILOPHTHALMIDAE

1. Head with crown of numerous small spines ..	*ECHINOSTEPHILLINAE* Yamaguti, 1958
Head with cephalic spines absent.	2
2. Body very much elongated; receptaculum seminis present.	*SKARJABINOVERMIINAE* Yamaguti, 1958
Body not much elongated; receptaculum seminis absent.	*PHILOPHTHALMINAE* Looss, 1899

Subfamily Cloacitrematinae Yamaguti, 1958 (wrongly mentioned as Cloacitreminae by Baugh, 1962) is dropped. Subfamily Parorchiinae Lal, 1936 nom. emend. Yamaguti is included in Echinostomatidae Poche, 1925.

XVI. Subfamily *PHILOPHTHALMINAE* Looss, 1899

Philophthalmidae : Body elongate, ovate, clavate or pyriform, constricted in middle in *Ophthalmotrema* Sobolev, 1943. Cuticle spined or unpsined. Acetabulum larger than oral sucker, preequatorial, almost equatorial or just postequatorial (*Cloacitrema*). Prepharynx present or absent; pharynx usually large (*Philophthalmus*); oesophagus absent, short or moderately long. Testes tandem, diagonal or side by side near posterior extremity. Cirrus sac preacetabular, extending to equator or posterior end of acetabulum or extending behind it. Vesicula seminalis externa absent, present in *Cloacitremma*. Cirrus present. Ovary pretesticular. Receptaculum seminis uterinum usually present. Uterus coiled, intercaecal or overlapping caeca and reaching laterally near bodywall between acetabulum and anterior testis. Vitellaria lateral, extracaecal of long tubular follicles, or shorter diagonally directed of small follicles. Excretory vesicle Y shaped or V-shaped. Parasitic in conjunctivel sac, nictitating membrane, orbit or cloaca of birds.

Genus 27 **Philophthalmus** Looss, 1899

Philophthalminae : Body elongated, fusiform, pyriform or club-shaped. Acetabulum larger than oral sucker, at about one third body length from anterior end. Prepharynx short; pharynx unusually large; oesophagus short or very short; caeca terminate near or at posterior end. Genital pore

median or submedian, just anterior to or behind intestinal bifurcation. Testes tandem or somewhat diagonal close in front of one another near posterior end. Cirrus sac long, lateral to acetabulum, usually extending behind it, enclosing seminal vesicle, prostatic complex, long ductus ejaculatorius; short cirrus present. Ovary closely in front of anterior testis, entire, medain in posterior quarter of body. Laurer's canal present. Receptaculum seminis uterinum usually present. Uterus coiled between testes and acetabulum, sometimes overlapping caeca laterally and extending outside near body-wall. Vitellaria outside caeca from behind acetabulum to anterior testis, curving mesially between ovary and anterior testis. Eggs moderately large, containing oculate miracidia. Excretory vesicle Y or T-shaped with short stem and long cornua. Parasitic in conjunctival sac or orbit of birds.

Type-species : *P. palpebrarum* Looss, 1899

63. **Philophthalmus gralli** Mathis et Leger, 1910

(Fig. 47)

Syn. *P. mirzai* Jaiswal and Singh, 1954
P. indicus Jaiswal and Singh, 1954
P. aequilla Jaiswal, 1955
P. lucknowensis Baugh, 1962
P. halcyonsis Baugh, 1962
P. (*Mixophthalmus*) *chrysommae* Karyakarte, 1967

Specific diagnosis.—Body aspinose, elongated 2.50–7.86 in length, 1.01–2.18 broad (maximum) in middle or slightly behind middle or aody. Oral sucker terminal, 0.22–0.657 × 0.32–0.735. Acetabulum 0.34–0.763 × 0.38–0.763. The wide range of variations in size of body and size of suckers is noteworthy. Prepharynx short. Pharynx large, globular, 0.24–0.38 × 0.26–0.41; oesophagus short or indistinct; caeca end near posterior extremity. Testes entire or slightly lobed; anterior testis 0.13–0.36 × 0.31–0.35; posterior testis 0.16–0.34 × 0.15–0.65. Vasa efferentia distinct. Cirrus sac long, tubular, thin walled, lateral to acetabulu, 0.63–2.13 × 0.13–0.18 extending to near its hinder margin or 0.29 behind it. Vesicula seminalis, long ductus ejaculatorius enlosed in cirrus sac. Cirrus short or long sometimes carrying short spines in its distal half. Genital pore to right or left side of oesophagus or in level with intestinal bifurcation or median or submedian beside caecal arch. Ovary rounded, 0.18–0.24 × 0.21–0.27, just in front of anterior testis, median or slightly lateral. Ovary may sometimes be larger than testes. Vitellaria postacetabular, extracaecal, extending from near posterior

border of cirrus sac or middle of body to level of anterior border of anterior testis or hinder border of ovary, tubular or follicular or at some places follicular or beaded in appearance. Shell gland complex slightly sinistral, close to postero-lateral border of ovary, partly covered by initial uterine coils. Receptaculum seminis uterinum present. Uterine coils arising from ootype pass between ovary and anterior testis, ascending in transverse loops, some of which overlap caeca laterally and extend outside into lateral fields. Metraterm muscular, runs along cirrus sac to genital pore. Mature eggs elongated oval, 0.07–0.073 × 0.0266–0.031 or 75–88μ long × 30–38μ broad, containing fully developed oculate miracidia. In the body size, size of organs, smooth or irregular form of testes and their position, posterior extent of cirrus sac, size-ratio of ovary and testes in different hosts there is a distinct intergradation.

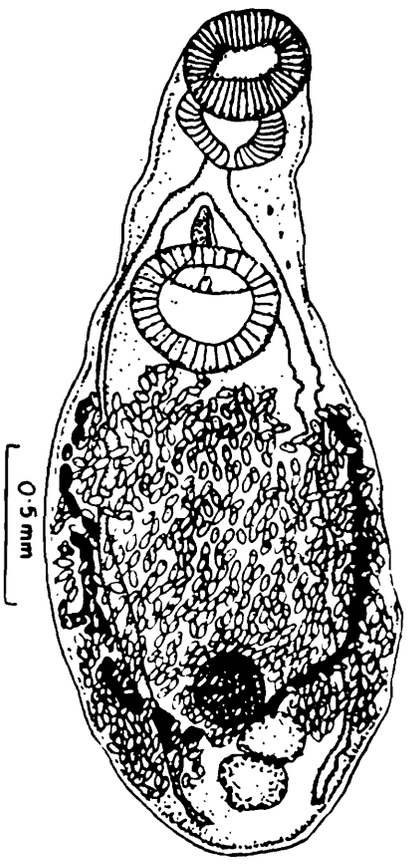


Fig. 47. *Philopthalmus gralli* Mathis et leger.

Host.—Falconiformes and Coraciformes, common kite, *Milvus govinda*, smaller white scaverger vulture, *Nephron percenopterus gingianus*; white-breasted kingfisher, *Halcoyon*

smyrensis; Steppe Eagle, *Aquilla nipalensis* Hudson; Passeriformes, yellow eyed babler; Anseriformis, Lesser Whistling teal, *Dendrocygna javanica*; pintail, *Anas acuta*.

Location.—Conjunctival sac or orbital cavity or nictitating membrane.

Locality.—Hyderabad, Deccan; Lucknow, U.P.

The development of *P gralli* in Hawaii, from metacercarial stage to the adult form in experimental chickens, ducks, rats and rabbits, was studied by Ching (1961). Variations on account of age and the type of host used in these experiments were observed in the reproductive organs of the adults experimentally recovered.

Commenting on the three Indian species, *P. aequillai*, *P. indicus* and *P mirzai* Ching stated that *P. indicus* resembled *P. occulare* Wu, 1938 in the location of the genital pore, the sucker and gonad ratios and the egg sizes but differed in being twice its size and the vitellaria and the elongated vitelline follicles extending 91% to the acetabulum, while the vitellaria, in *P. occulare* were tubular, asinous and 75% extended to the acetabulum. *P mirzai*, with the location of seminal vesicle, the suckers and the vitellaria is identical to *P nocturnus* Looss 1907 and with a similar size ratio of the gonads differed in shape of the testes which were lobed in *P. nocturnus*. The genital pore in *P. mirzai* was located anterior to intestinal bifurcation. These differences have all been observed in the specimens available in comparison for this study, such variations have also been noted in the specimens recovered during life cycle studies. The species described from the Indian region have all been assigned recently to *P mirzai* which appears to be in no way different from *P. gralli*, which was totally excluded for differentiation by earlier Indian workers. This would necessitate a modification of the earlier concept and *P. mirzai* merges into synonymy with *P gralli*, which alone occurs in the kite, white scavenger vulture, eagles, white-breasted kingfisher and yellow eyed babler. Alicata and Noda (1960) rightly opined that a good many of the species listed by them might be synonyms and that, during life history work, a large number of adult worms obtained from a variety of hosts might enable an accurate assessment of the status of most of these species.

III. Family OMMATOBREPHIDAE Poche, 1925

Echinostomata, Echinostomatoidae : Body unspined. Acetabulum strongly developed, preequatorial or almost equatorial. Pharynx prominent; oesophagus spacious, moderately long; caeca terminating a little in front of posterior extremity or at level of posterior border of acetabulum. Genital pore behind intestinal bifurcation. Testes almost symmetrical at posterior extremity. Cirrus sac thin walled, entirely preacetabular. Ovary immediately anterior to testes. Vitellaria restricted to lateral body edges, postacetabular. Uterus coiled between testes and acetabulum. Receptaculum seminis absent. Receptaculum seminis uterinum present. Eggs embryonated with oculate miracidia in ascending coils. Excretory vesicle V-shaped with short transversely elongated contractile bladder-like stem and long spacious, somewhat sinuous cornua extending to pharynx, and forming a loop there to extend backwards as common collecting ducts. Parasitic in snakes and lizards.

Type genus : *Ommatobrephus* Nicoll, 1914

Genus 28. **Ommatobrephus** Nicoll, 1914

Ommatobrephidae : Body small, fusiform, pyriform or conical with smooth unspined bodywall. Acetabulum large, subequatorial or preequatorial. Prepharynx present; pharynx globular; oesophagus spacious, moderately long; caeca half long or reaching near posterior extremity. Testes almost symmetrical, somewhat diverging, separated from each other by uterine coils at posterior extremity. Cirrus sac round, oval or pyriform, preacetabular. Vesicula seminalis saccular, bipartite. Pars prostatica short. Cirrus short. Genital pore median or submedian, preacetabular. Ovary submedian, immediately pretesticular, subspherical or pear-shaped. Receptaculum seminis uterinum present. Receptaculum seminis absent. Laurer's canal present. Vitellaria restricted to lateral fields behind acetabulum, pretesticular. Uterus coiled of descending and ascending loops, postacetabular passing between testes. Eggs contain oculate miracidia. Excretory vesicle V-shaped, stenostomate of Echinostome cercarial pattern. Parasitic in rectum and intestine of snakes and lizards.

Type species : *O. singulare* Nicoll, 1914

Key to Indian species of **Ommatobrephus**

Caeca long.	*O. lobatum* Mehra, 1928
Caeca short, half long	*O. megacetabulus* Simha, 1958

64. **Ommatobrephus lobatum** Mehra, 1928

(Fig. 48)

Syn. *O. folium* Thapar and Farzand Ali, 1929
O. nicolli N. K. Gupta, 1954

Specific diagnosis.—Body pear-shaped or conical, 1.5–4.0 × 0.52–1.3 maximum breadth in acetabular region. Oral sucker 0.25–0.3 diameter. Acetabulum stouter, 0.44–0.7 in diameter, at a little behind one third body length from anterior end. Ratio of suckers 1 : 2.3. Prepharynx present; pharynx 0.14–0.2 in diameter; oesophagus 0.27–0.49 long; caeca terminate at 0.37 from posterior end. Testes unequal, irregularly lobed, symmetrical with anterior ends diverging, 0.27–0.38 × 0.16–0.19. Cirrus sac 0.135–0.25 × 0.1–0.12. Ovary subspherical or pear-shaped, 0.065–0.16 in diameter. Metraterm present. Eggs oval thin shelled, 0.07–0.085 × 0.035–0.042.

Host.—Zamenis mucosus, Tropidonotus (*Natrix*) *piscator, Naja tripudians, Varanus bengalensis.*

Location.—Rectum and intestine.

Locality.—Allahabad, Lucknow (U.P.), Calcutta, Ludhiana (Punjab), Rangoon (Burma).

65. **Ommatobrephus megacetabulus** Simha, 1958

Specific diagnosis.—Body pear-shaped, 1.092 × 0.46–0.675 in greatest breadth slightly posterior to acetabulum. Oral sucker terminal 0.138 × 0.16–0.161. Acetabulum huge, equatorial, oval, 0.29–0.306 × 0.3312. Prepharynx short; pharynx globular, 0.093 in diameter; oesophagus 0.23 long; caeca slender, hardly reaching level of hinder border of acetabulum. Testes slightly lobed; right testis somewhat larger, 0.154–0.206 × 0.08–0.109; left testis 0.138–0.205 × 0.08–0.106. Cirrus sac immediately in front of acetabulum. Seminal vesicle distinctly bilobed. Genital pore slightly preacetabular, submedian, just lateral to cirrus sac. Ovary pear-shaped, 0.69 × 0.033. Receptaculum seminis uterinum forming a distinct loop between hinder border of testes. Vitellaria composed of very small follicles close to lateral margins of body,

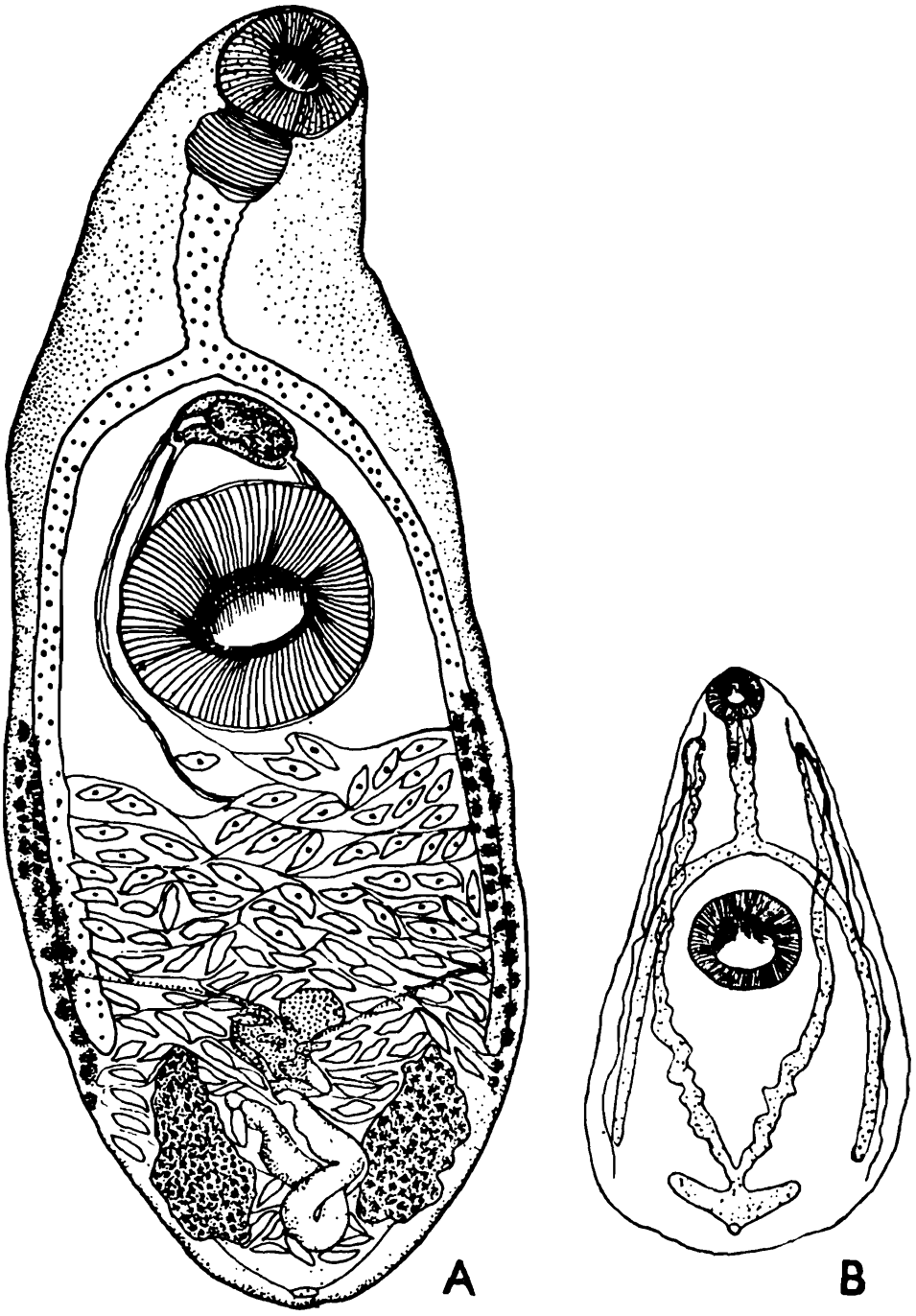


Fig. 48. A—*Ommatobrephus lobatum*, Mehra, 1928. B—Excretory system.

extending from level of posterior border of ovary to a little in front of blind ends of caeca. Uterus runs a zigzag course first towards testes and then forwards towards genital pore. Genital atrium inconspicuous. Eggs 0.056–0.076 × 0.033–0.041.

Host.—*Tropidonotus piscator.*
Location.—Intestine.
Locality.—Hyderabad, Deccan.

IV. Family PSILOSTOMIDAE Odhner, 1913

Echinostomata, Echinostomatoidea : Body elongated, fusiform, lanceolate, plump or ovoid, spined or unspined. Head collar absent except in *Psilocollaris* Singh. Acetabulum preequatorial, usually near anterior end. Pharynx present except in *Apopharynx* Luhe; oesophagus short or absent, occasionally moderately long or very long; caeca reaching near posterior extremity. Genital pore submedian, preacetabular, postbifurcal, in level with pharynx or oesophagus or behind intestinal bifurcation. Testes median, tandem, posteequatorial. Cirrus sac well developed, but not very muscular, preacetabular or extending much or a little behind acetabulum. Ovary submedian or median, pretesticular, occasionally in level with anterior testis. Receptaculum seminis usually absent. Laurer's canal present, exceptionally absent. Vitellaria strongly developed, lateral, postacetabular, sometimes confluent behind testes. Uterus long or short, pretesticular. Excretory vesicle Y-shaped with short stem bifurcating behind testes, usually forming subcutaneous network. Eggs a few, moderate in number or numerous.

Type genus : *Psilostomum* Looss, 1899

Subfamilies Apopharynginae Yamaguti, 1958 and Sphaeridiotrematinae Yamaguti, 1958 are dropped; only subfamily Psilostominae Luhe, 1909 is maintained.

XVII. Subfamily *PSILOSTOMINAE* Lühe, 1909

Subfamily diagnosis the same as for the family.

Key to Indian genera of PSILOSTOMINAE

1.	Head collar slightly developed, unarmed . .	*Psilocollaris* Singh, 1954
	Head collar absent.	2
2.	Caudal process present; cirrus sac extending behind acetabulum almost reaching ovary. . .	*Psilochasmus* Luhe 1909
	Caudal process absent; cirrus sac not extending behind acetabulum; extretory stem dividing into four longitudinal branches; ovary preequatorial.	*Mehlisia* Johnston, 1913

Genus 29. **Psilochasmus** Lühe, 1909

Psilostominae. : Body lanceolate with conical anterior region and bluntly pointed protrusible tail-like process with horn-like spike projecting from its depression; cuticle smooth. Acetabulum large, deep, prominently bulging, preequatorial. Oral sucker and pharynx well developed. Oesophagus moderately long; intestinal bifurcation just in front of acetabulum; caeca terminating short of posterior process a little anterior to caudal ends of vitellaria. Genital pore median, immediately preacetabular at about level of intestinal bifurcation. Testes tandem, postequatorial, elongated, moderately lobed or with deeply indented lateral margins. Cirrus sac very long, extending much behind acetabulum, reaching near ovary or about its middle. Vesicula seminalis large enclosed in cirrus sac; pars prostatica long; cirrus protrusible. Ovary median or submedian, pretesticular, subequatorial or equatorial. Mehlis' gland between ovary and anterior testis. Receptaculum seminis absent. Laurer's canal present. Vitellaria lateral. of large follicles, mostly extracaecal and caecal, extending from just behind acetabulum, its posterior margin or its middle to a short distance in front of caudal process, confluent behind testes. Uterus intercaecal, slightly coiled, pretesticular. Metraterm present. Eggs large, a few or moderate in number, 3–50. Excretory vesicle Y-shaped with subcutaneous network; excretory pore on the tip of caudal process. Parasitic in intestine of birds (ducks).

Type-species and single species : *P. oxyurus* (Creplin, 1825) Lühe, 1909

66. **Psilochasmus oxyurus** (Creplin, 1825) Lühe, 1909

(Fig. 49)

Syn. *P. agilis* Travassos, 1921
P. longicirratus Skrjabin, 1913
P. japonicus Ishii, 1935
P. skrjabini Gnedina, 1946
P. indica Gupta, 1957
P. alii Jaiswal, 1957
P. megacetabulus Jaiswal, 1957

Specific diagnosis.—Body 4.52–8.12 long, exceptionally 2.27 long, 0.81–1.8 broad; cuticle unspined. Oral sucker 0.26–0.39×0.28–0.41. Acetabulum 0.52–0.7 or 1.03×0.74, at anterior third or fourth of body. Pharynx 0.135–0.19 or 0.165–0.23; oesophagus of varying length, 0.016 or 0.44–0.48 long, sometimes 0.7–1.61 long depending on concetraction of

body. Anterior testis 0.42–0.48×0.35–0.38; posterior testis 0.5–0.6×0.27–0.37 Cirrus sac very long 0.5–1.144 long, 0.11–0.13 broad. Ovary rounded, 0.2–0.24 in diameter. Uterus with a few, 3 or 40–50 eggs. Eggs 0.08–0.11× 0.056–0.07 Excretory vesicle Y-shaped with subcutaneous network; excretory pore dorsal on the tip of caudal process.

Host.—Ducks, *Nyroca ferna*, *Anas acuta*, *Anas poecilorhyncha*, *Tadorna ferruginea* (*Casaria rutila*), *Sarkidornis melanotus* and Egret, *Ardeola grayi*.

Location.—Intestine.

Locality.—Dharwar near Bombay; Allahabad, Lucknow, U.P.; Hyderabad (Deccan).

This species is cosmopolitan. *P. indica* Gupta has been described from anteriorly twisted specimen. The vitelline follicles meeting in front of ovary or behind acetabulum is due to coming together of caeca in this region. Position of genital pore relatively to intestinal bifurcation is due to contraction of this region and coming together of caeca. It is also effected by bulging out of acetabulum. The species is without any doubt synonymous to *P. oxyurus*. That the shape of body varies due to contraction is also shown by the two synonymous species from Hyderabad described by Jaiswal (1957).

Genus 30. **Psilocollaris** K. S. Singh, 1954

Psilostominae : Body much elongated, smooth. Head collar feebly developed, unarmed. Oral sucker and pharynx weakly developed. Oesophagus very long; caeca extend to posterior extremity. Acetabulum large in posterior fourth of body. Testes oval, tendem in posterior fourth of body. Cirrus sac small, partly overlapped by acetabulum and between it and intestinal bifurcation. Genital pore just postbifurcal. Ovary small, median, postequatorial. Vitellaria lateral from ovarian zone to posterior extremity. Uterus preovarian, intercaecal. Eggs large, many. Excretory vesicle Y-shaped with short arms, posttesticular. Parasitic in intestine of birds.

Type-species : *P. indicus* K. S. Singh, 1954

67 **Psilocollaris indicus** K. S. Singh, 1954

(Fig. 50)

Specific diagnosis.—Body 5.3–16.4 long, 0.384–0.69 in maximum breadth, smooth, with slightly developed non-

muscular collar like the collar of an Echinostome, without spines, 0.26–0.3 across. Oral sucker 0.506×0.024. Acetabulum 0.27–0.4×0.26–0.4, transversally elongated, immediately behind intestinal bufurcation. Prepharynx small; pharynx

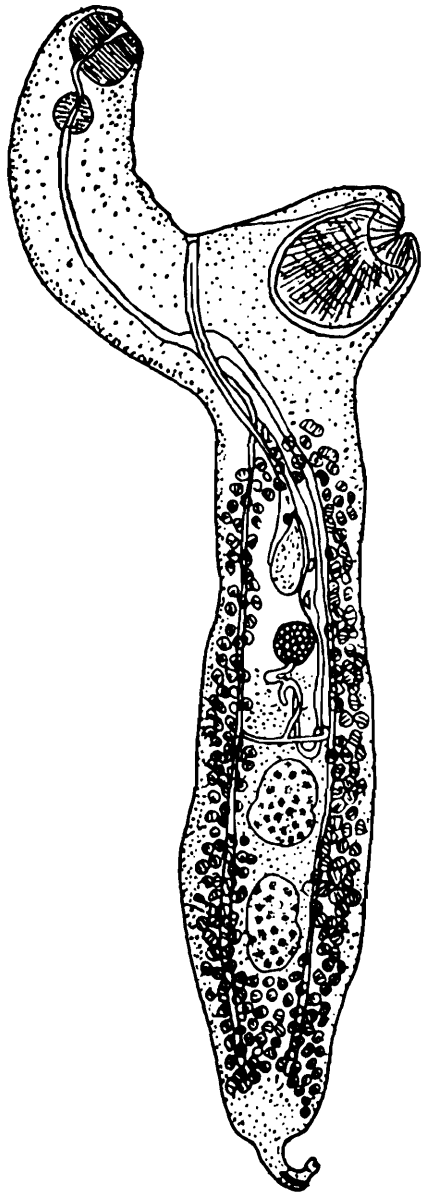


Fig. 49. *Psilochasmus oxyurus* (Creplin, 1825) Luhe, 1909

0.069–0.1×0.04–0.046; oesophagus 0.88–2.0 long. Testes tandem, oval in posterior fourth of body; anterior testis 0.43–0.72×0.19–0.34; posterior testis 0.43–0.83×0.21–0.32. Cirrus sac small, oval, 0.16–0.26×0.069–0.14, between intestinal bifurcation and acetabulum, enclosing large seminal vesicle and ejaculatory duct with prostate cells around it.

Ovary small, rounded, postequatorial, much in front of anterior testis, 0.12–0.184×0.099–0.16. Mehlis' gland slightly smaller than ovary, just postovarian. Vitellaria of small follicles, from level of ovary to posterior end of body, approaching mesially or confluent behind testes. Uterus of ascending

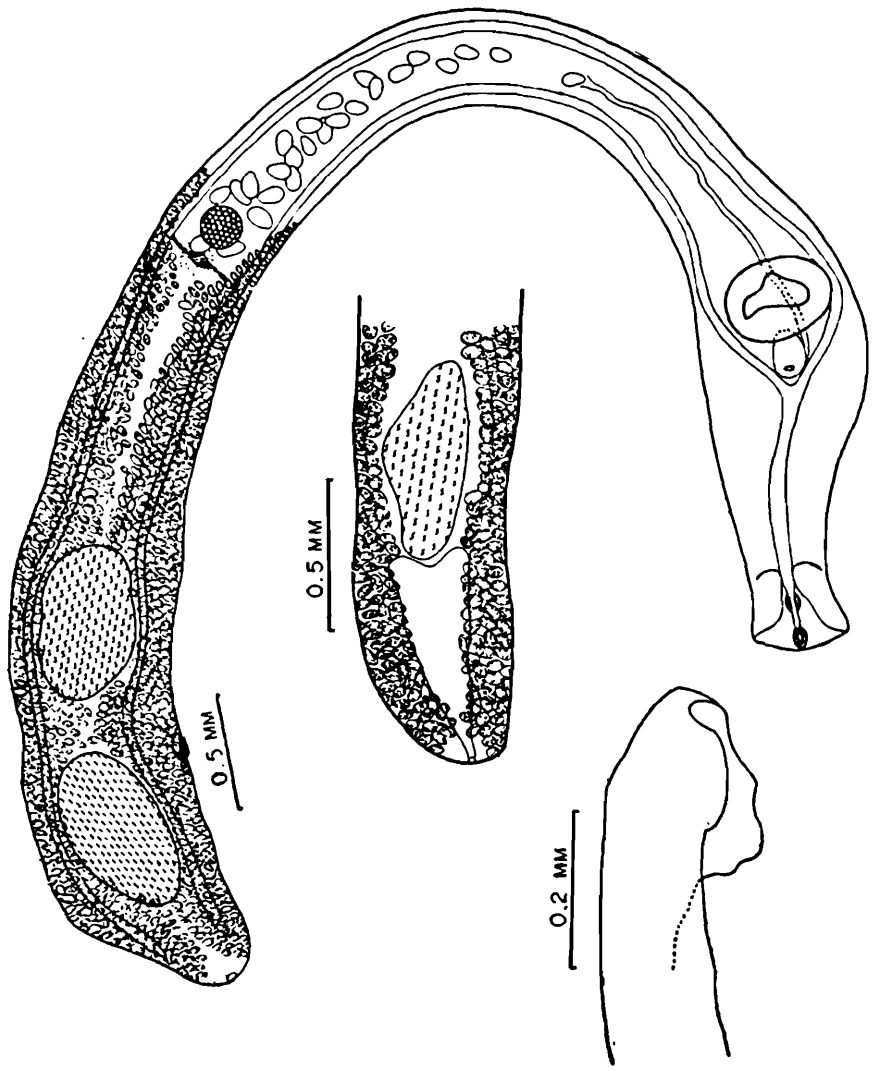


Fig. 50. A—*Psilocollaris indicus* K, S. Singh, 1954. B—Showing posterior end. C—Lateral view of its collar.

limb only more or less straight, of several coils, immediately preovarian. Eggs numerous, 0.092–0.104×0.058. Excretory vesicle Y-shaped, stem reaching posterior end of posterior testis, and arms short, rather wide, not extending the base of posterior testis; pore terminal.

Host.—*Dissura e. episcopua* (Beddzaert)
Location.—Intestine.
Locality.—Lucknow, U.P.

Genus 31. **Mehlisia** Johnson, 1913

Syn. *Sharmaia* Yamaguti, 1958

Psilostominae : Body elongated, fusiform, lanceolate or cylindrical, spinulate with thick cuticle. Oral sucker well developed. Acetabulum large, larger than oral sucker, close to anterior extremity. Prepharynx small; phrynx present; oesophagus short or absent; caeca simple, terminating at posterior extremity. Genital pore median or slightly to left, preacetabular. Testes tandem, sausage-shaped or elongated, quadrangular, anterior or posterior testis equatorial Cirrus sac antero-dorsal to acetabulum or almost preacetabular, containing seminal vesicle, prostatic complex and cirrus. Ovary pretesticular, preequatorial, spherical. Receptaculum seminis absent. Laurer's canal present. Vitellaria lateral, of small follicles, extending from behind acetabulum to posterior end, occupying or not posttesticular median field. Uterus winding, intercaecal between ovary and acetabulum Receptaculum seminis uterinum present. Eggs large, numerous. Excretory vesicle stem reaching posterior testis and dividing into four longitudinal branches, forming cutaneous network and a sinus around each sucker. Parasitic in intestine of marsupials and aquatic birds, ducks.

Type-species : *M. acuminata* Johnson, 1913

68. **Mehlisia gatesi** Sharma, 1943

(Fig. 51)

Syn. *Sharmai a gatesi* (Sharma, 1943) Yamaguti, 1958

Specific diagnosis.—Body 7.8 long, 1.6–1.85 broad, spined with thick cuticle. Oral sucker 0.24–0.257 in diameter. Acetabulum near oral sucker, 0.826–0.84 in diameter, more than three times as large as oral sucker. Average distance between two suckers 0.21. Prepharynx small; pharynx 0.15 in diameter; oesophagus absent; caeca simple, narrow, reaching posterior end. Gonads occupying middle third of body. Testes tandem, median, elongated, quadrangular, somewhat sausage-shaped as seen from figure, 0.49–0.8 × 0.39–0.4. Ovary rounded, anterior to testes. Shell gland mass posterior to ovary but not anterior as the author mentions. Sharma mistook ovary for shell glnad mass. The figure shows globular ovary; shell gland mass lies behind it.

Uterus coiled, intercaecal. Vitellaria lateral from anterior margin of acetabulum to posterior end. Eggs 0.095×0.057.

Host.—Burmese ducks, *Anas boschas.*

Location.—Intestine.

Locality.—Burma.

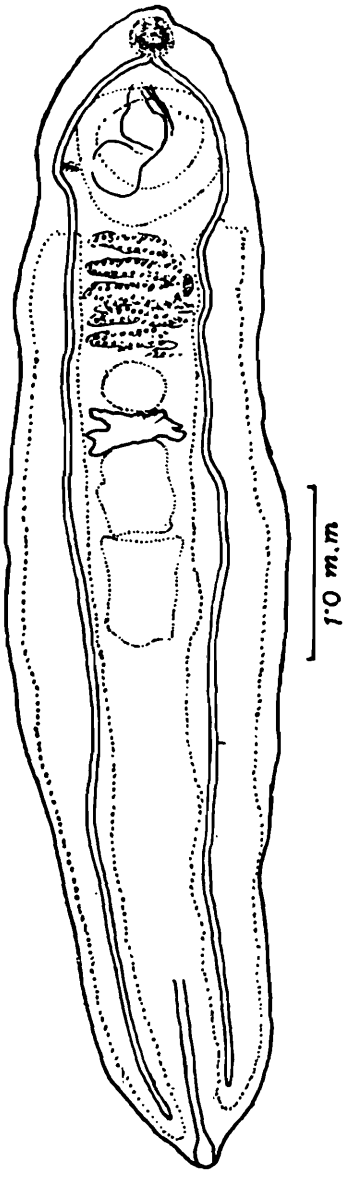


Fig. 51. *Mehlisia gatesi* Sharma, 1943.

Yamaguti (1958) created genus *Sharmaia* for *Mehlesia gatesi* as *Mehlesia* is parasitic in *Dasyurus viverinus* and *Ornithorynchus anatinus* in Australia. It seems that these parasites have established themselves in Burmese ducks also. *Mehlesia gatesi* resembles morphologically other species of the genus closely, therefore, the genus *Sharmaia* has been dropped.

V. Family CATHAEMASIIDAE Fuhrmann, 1928

Echinostomata, Echinostomatoidae : Elongate distomes without head collar and collar spines; exceptionally rudimentary collar with minute spines present in *Cathaemasia mehrai* Wesley, 1940. Testes tandem, lobed, branched or rarely entire near posterior extremity or further in front. Cirrus sac entirely preacetabular, anterodorsal to acetabulum or extending behind it. Genital pore submedian or median, preacetabular, behind intestinal bifurcation. Ovary pretesticular, slightly in front of anterior testis. Vitellaria confined to lateral fields from behind or level of acetabulum or oesophageal region to posterior extremity. Uterus usually large, coiled, pretesticular. Eggs numerous, large. Excretory vesicle Y-shaped with stem bifurcating behind or anterior to testes. Parasitic in birds.

Type genus : *Cathaemasia* Looss, 1899

XVIII. Subfamily *CATHAEMASIINAE* Dollfus, 1950

Cathaemasiidae : Body elongate, rounded at both ends, spinulate. Oesophagus without lateral diverticula; caeca with or without outgrowths. Acetabulum nearer middle of body than anterior end. Genital pore submedian or median between acetabulum and intestinal bifurcation. Testes tandem, lobed, branched or rarely entire, near posterior end in middle or posterior third. Cirrus sac entirely preacetabular, anterodorsal to acetabulum or extending behind it. Vesicula seminalis coiled. Cirrus long, cylindrical, coiled when not protruded. Ovary immediately or some distance in front of anterior testis. Uterus intercaecal or overreaching caeca laterally. Vitellaria from acetabular level or behind acetabulum to posterior end. Parasitic in oesophagus, buccal cavity, proventriculus and intestine of birds Ciconiformes, Cuculiformes.

Genus 32. **Cathaemasia** Looss, 1899

Cathaemasiinae : Body elongate, rounded at both ends, spinulate, ventrally, flesh-coloured in living condition. Acetabulum larger than oral sucker nearer middle of body than anterior end. Testes postequatorial near posterior extremity, lobed or branched. Cirrus sac entierely preacetabular. Ovary median, rounded or transversally oval

just in front of anterior testis. Recepataculum seminis usually present. Eggs numerous, large, embryonated with oculate miracidia. Excretory vesicle Y-shaped with short stem and long cornua, with or without lateral branches; excretory pore terminal. Parasitic in Ciconiformes and Cuculiformes.

Type-species : *C. hians* (Rud., 1809) Looss, 1899

Key to Indian species of **Cathaemasia**

1.	Rudimentary collar with small spines present	*C. mehrai* Wesley, 1940
	Collar and collar spines absent; ratio of suckers 3 : 4 or 9 : 14	2
2.	Testes deeply lobed. .	*C. orientalis* Wesley, 1940
	Testes branched	*C. indicus* Wesley, 1940

69. **Cathaemasia orientalis** Wesley, 1940

(Fig. 52)

Specific diagnosis.—Body 7–13 × 2.5–3.95 maximum breadth in posterior third of body. Collar absent. Oral sucker 0.8 × 0.9. Acetabulum 1.2 in diameter. Ratio of suckers about 3 : 4. Prepharynx 0.35 × 0.56; pharynx 0.55 in diameter; oesophagus moderately long with wavy outline, 1.6 × 0.3. Caeca slightly undulating without outgrowths, terminating 0.2 in front of posterior end. Testes nearly equal, broader than long, deeply lobed with 4–5 prominent rounded or ovoid lobes, 1.25 × 1.625. Cirrus sac thin walled, subpherical, 0.7 × 0.675, median, 0.5 behind intestinal bifurcation. Cirrus 0.75 long, 0.166 broad. Genital pore median at half way between intestinal bifurcation and acetabulum. Ovary small, rounded or oval, median or slightly dextral, a little in front of anterior testis. Receptaculum seminis small, subspherical, 0.35 × 0.25. Metraterm present. Vitellaria of restricted extent, confined to lateral edges, commencing a little behind acetabulum. Eggs oval, 0.096 × 0.04.

Host.—White necked stork, *Dissura episcopa episcopa.*

Location.—Oesophagus.

Locality.—Allahabad, U.P.

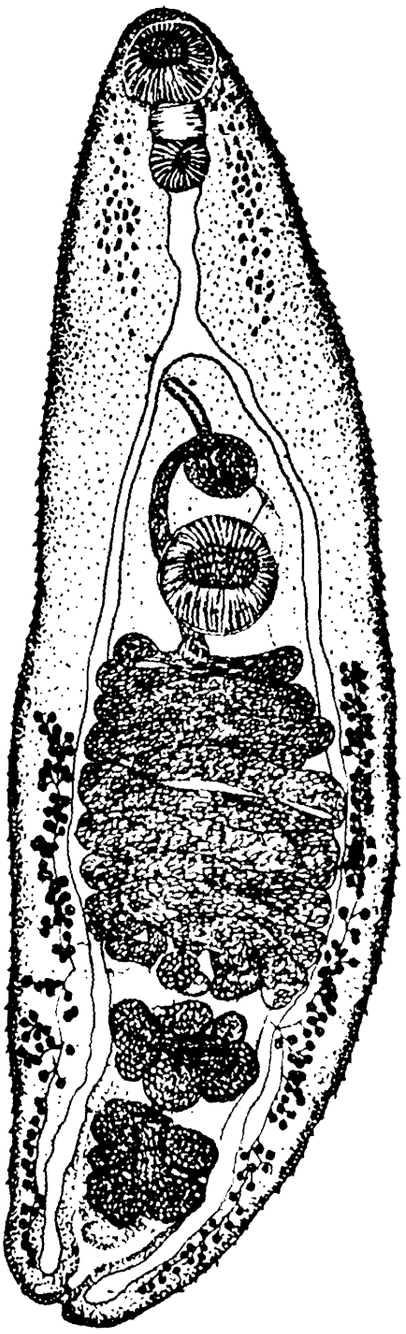


Fig. 52. *Cathaemasia orientalis* Wesley, 1940. Ventral view.

70. **Cathaemasia indicus** Wesley, 1940

(Fig. 53)

Specific diagnosis.—Body elongated with rounded ends, pinkish, 8.9–10.9 × 3.2–3.95 maximum breadth just behind

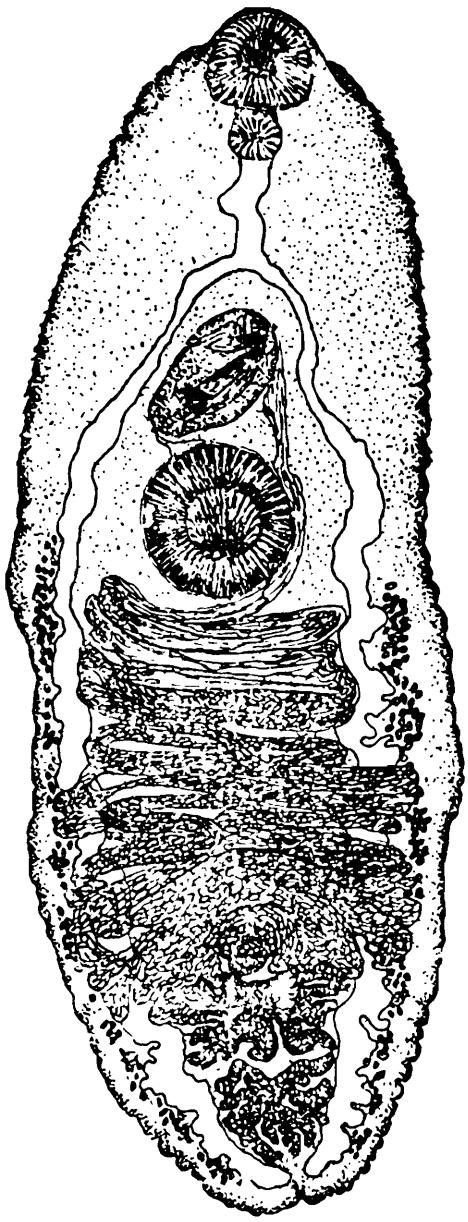


Fig. 53. *Cathaemasia indicus* Wesley, 1940. Ventral view.

acetabulum. Collar and collar spines absent. Oral sucker 0.85×0.95. Acetabulum 1.4 in diameter, at about one third body length from anterior end. Ratio in size of suckers 9 : 14. Prepharynx 0.1 long, 0.4 broad; pharynx 0.45 in diameter; oesophagus with wavy outline 1.0×0.35. Caeca with small outgrowths terminate 0.2 in front of hinder end. Testes more or less deeply branched, 0.8×1.4 and 1.1 respectively. Cirrus sac pear-shaped, 1.4×0.65, obliquely median, 3.5 behind intestinal bifurcation. Cirrus conical, 0.45×0.275. Genital pore nearer intestinal bifurcation. Ovary oval or oblong, 0.55×0.33, median. Receptaculum seminis

0.5×0.33, spherical. Metraterm present. Eggs 0.056–0.08× 0.026–0.04, with miracidia.

Host.—*Ibis leucocephalus leucocephalus* (Painted stork).

Location.—Buccal cavity, nasal cavity, oesophagus, proventriculus.

Locality.—Allahabad and other places in U.P.

71. **Cathaemasia mehrai** Wesley, 1940

(Fig. 54)

Specific diagnosis.—Size 7.0–9.2×3.0–3.5 maximum breadth at about two third length from anterior end. Rudimentary collar with 12 spines on each side present. Collar spines 0.048×0.016. Cutaneous spines present instead of scales, 0.04×0.012. Oral sucker 0.7 in diameter. Acetabulum 1.0 in diameter. Ratio in size of suckers 7 : 10. Prepharynx 0.2×0.3. Pharynx 0.5 in diameter. Testes 0.9×1.25, deeply lobed, number of lobes larger than in *C. orientalis*, but not branched. Cirrus sac oval, 0.6×0.5. Ovary oval, 0.38×0.25, closely in front of anterior testis. Eggs 0.056–0.076× 0.03–0.032 with miracidia.

Host.—Indian Black Ibis, *Pseudibis papilosus.*

Location.—Oesophagus and small intestine.

Locality.—Allahabad, U.P.

VI. Family FASCIOLIDAE Railliet, 1895

Syn. Faciolopsidae Odhner, 1926
Brachycladiidae Faust, 1929

Echinostomata, Echinostomatoidea : Large or very large distomes, flat, spinuous or nonspinuous with closely approximated suckers. Caeca long, simple or dendritic with numerous lateral diverticula having secondary and tertiary branches. Testes much branched except in *Protofasciola.* Cirrus sac present. Genital pore preacetabular. Ovary branched except in *Protofasciola.* Laurer's canal present. Receptaculum seminis absent. Vitellaria lateral, profusely developed, confluent posteriorly. Uterus preovarian, with relatively a few coils. Eggs large, thin walled, moderate in number. Excretory vesicle tubular, with main canals much branched. Parasitic in mammals.

Type genus : *Fasciola* Linnaeus, 1758

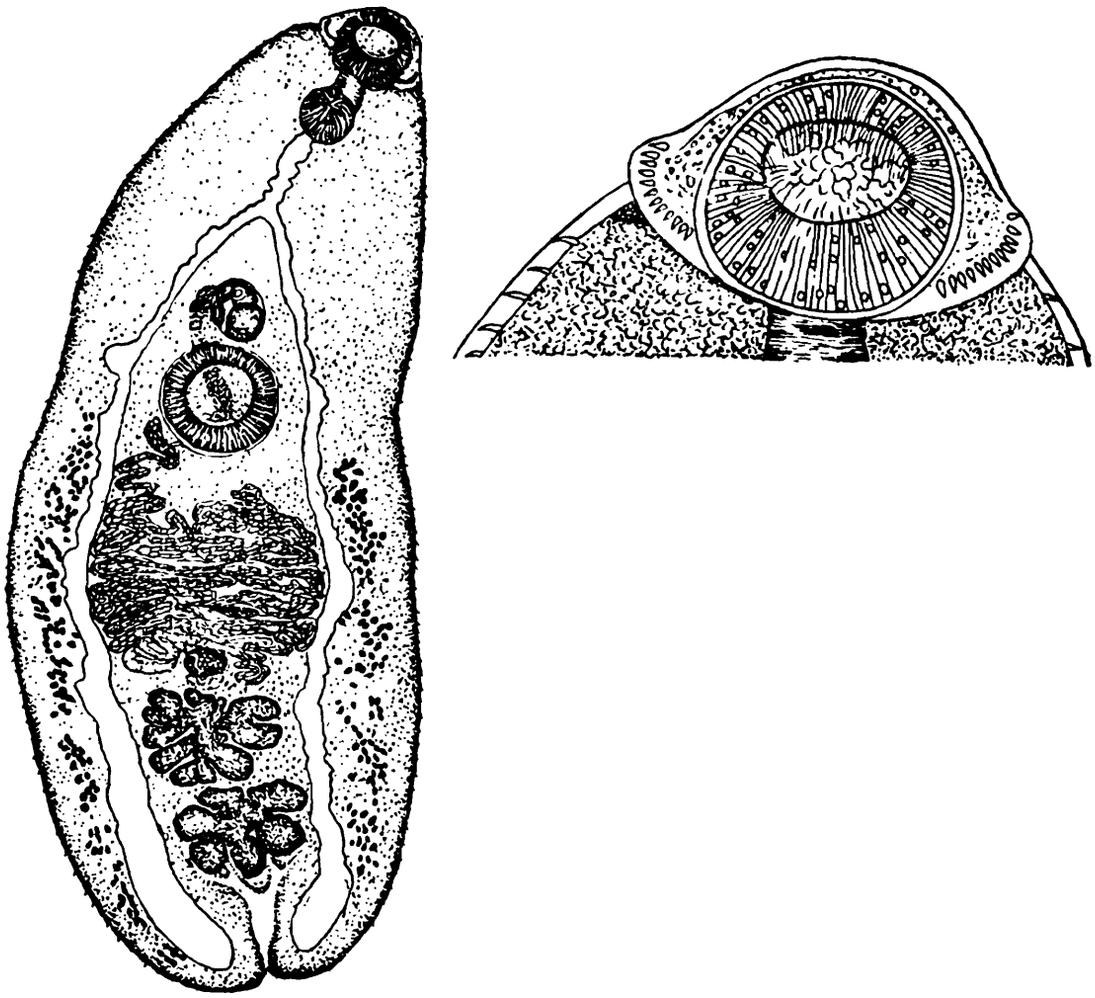


Fig. 54. *Cathaemasia mehrai* Wesley, 1940 (Ventral view) and its anterior end showing collar with spines.

Key to subfamilies of FASCIOLIDAE

1. Caeca simple. .. .	2
Caeca dendritic.	*FASCIOLINAE* Stiles and Hassall, 1898
2. Testes entire.	*PROTOFASCIOLINAE* Skrajabin, 1948
Testes branched.	*FASCIOLOPSINAE* Odhner, 1910

XIX. Subfamily *FASCIOLINAE* Stiles and Hassall, 1898

Fasciolidae : Body very large, broad, oval or foliate, with or without cephalic cone. Oral sucker and pharynx small. Caeca long, dendritic, reaching posterior extremity. Acetabulum small, close to anterior extremity. Testes diagonal

or tandem, profusely branched. Cirrus sac anterodorsal to acetabulum. Genital pore postbifurcal. Ovary submedian, dextral, branched. Receptaculum seminis absent. Vitellaria in lateral fields, dorsal and ventral to caeca or confined to ventral area. Uterus coiled between ovary and acetabulum. Excretory vesicle long with numerous anastomosing branches and subcutaneous network.

Genus 33. **Fasciola** Linnaeus, 1758

Syn. *Cladocoelium* Dujardin, 1845

Fasciolinae : Body large, broad, flat, foliate, with cephalic cone. Cuticle with scale-like spines. Oral sucker subterminal. Prepharynx short; pharynx well developed. Oesophagus short; caeca long, reaching posterior end, provided with numerous long, dendritic outer branches, and fewer shorter inner branches. Acetabulum at base of cephalic cone, larger than oral sucker. Testis profusely branched, diagnoal or tandem occupying greater part of postovarian intervitellarian field. Cirrus sac anterodorsal to acetabulum. Genital pore median, near intestinal bifurcation or midway between it and acetabulum. Ovary much branched, preteaticular, to right side. Receptaculum seminis absent. Laurer's canal present. Vitelline follicles filling up all available space in lateral fields both dorsally and ventrally to caeca from acetabulum or base of cephalic cone to posterior extremity. Uterus coiled in rosette-shaped from between ovary and acetabulum. Excretory vesicle long, slender with numerous lateral branches, dorsal and ventral subcutaneous network. Eggs large. Parasitic in bile ducts of herbivorous mammals and man.

Type-species : *F hepatica* Linnaeus, 1758

Key to species of **Fasciola**

1. Body almost round	*F. jacksoni* (Cobbold, 1869)
Body elongate.	2
2. Shoulders indistinct; caeca diverticulated internally	*F. gigantica* Cobbeld, 1856
Shoulders distinct; caeca not diverticulated internally	*F. hepatica* Linnaeus, 1758

72. **Fasciola hepatica** Linnaeus, 1758

Syn. *Distoma hepaticum* Linnaeus, 1758
Distomum hepaticum Retzius, 1786
Cladocoelium hepaticum (Linn., 1758) Stossich, 1892

Specific diagnosis.—Body oval or foliate, flattened, with conical cephalic cone and distinct shoulders. Length 18–40. Breadth 4–13. Cephalic cone 3–5 long, marked off from the body by prominent shoulders; covered with scales. Caeca profusely branched only on the outer side. Acetabulum larger than oral sucker, 1.6. Oral sucker 1.0. Genital pore median, midway between intestinal bifurcation and acetabulum. Testes much branched. Cirrus sac thin walled. Ovary much branched, to right side in front of testes. Vitellaria filling up all available space between caecal ramifications laterally. Uterus in ascending limb only forming a rosette-like cluster of coils between ovary and acetabulum. Eggs 0.13–0.15×0.06–0.09.

Host.—Sheep, goat, cattle, camel, horse, rarely man.

Location.—Bile ducts.

Locality.—Burma, Sri Lanka, U.P., Himalayas. Almost cosmopolitan.

Intermediate host.—Snails of the genus *Lymnea*, the most widely distributed snail, *Lymnea truncatula.*

73. **Fasciola gigantica** Cobbold, 1856

(Fig. 55)

Syn. *Distoma giganteum* Diesing, 1858
Cladocoelium giganteum Stossich, 1892
Fasciola indica Varma, 1953

Specific diagnosis.—Body larger, more elongated, elliptical, flattened, of typical shape with relatively shorter cephalic cone than in *F hepatica.* Length 25–75. Breadth 3–12. Caeca also branched internally. Acetabulum larger than in *F hepatica*, 1.5–2.0 in diameter. Caeca cover a length of 11.28. Eggs larger, 0.125–0.19×0.06–0.12.

Host.—Cattle, buffalo, sheep, goat, camel, horse, man.

Location.—Bile ducts and liver.

Locality.—Throughout India, Panjab, U.P., Hyderabad, Deccan, Bombay; Burma; South Africa.

Intermediate Host.—*Lymnea acuminata* in India; *Lymnea natalensis* and *Physopsis africana* in South Africa.

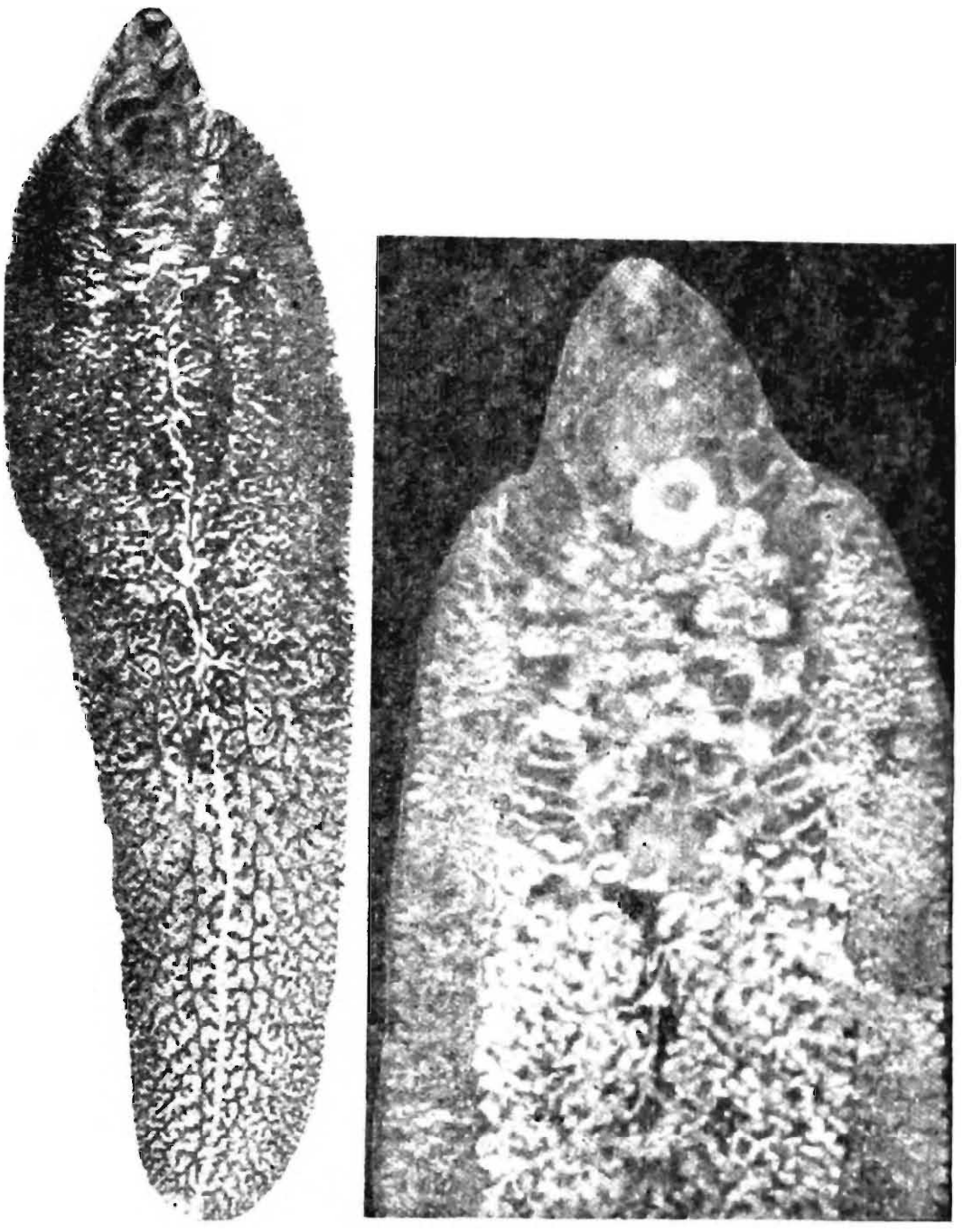


Fig. 55. *Fasciola gigantica* Cobbold, 1825 and its anterior portion.

74. **Fasciola jacksoni** Cobbold, 1869

(Fig. 56)

Syn. *Cladocoelium elephantis* Diesing, 1858
Fasciola jacksoni (Cobbold, 1869) Bhalerao, 1933

Specific diagnosis.—Body pinkish, but olive green when filled with bile, round when flattened or somewhat pear-

shaped; cephalic end distinctly set off with well defined shoulders in some, in others with pear-shaped body cephalic end ill defined and shoulders indistinct or absent. Length 12–14, breadth 9–12.5. Spines in transverse rows over whole body. Oral sucker 0.52–0.64 × 0.33–43. Acetabulum 1.8–1.41 × 0.97–1.07 with triangular cavity. Pharynx 0.38–



Fig. 56. *Fasciola jacksoni* (Cobbold, 1859). Dorsal view.

0.52 × 0.22–0.38. Oesophagus very short; caeca branched externally and internally, branches on outer side more profuse. Cirrus sac pyriform, large, anterior to acetabulum, 0.73 × 0.56. Cirrus very long. Ovary branched, to right side. Vitellaria very extensive, occupying two thirds of body. Uterus comparatively small. Eggs 0.11–0.125 × 0.05–0.075.

Host.—Indian elephant, *Elephas indicus.*

Location.—Bile ducts, liver, duodenum.

Locality.—Burma, Kapurthala, Assam, Madras,

XX. Subfamily *FASCIOLOPSINAE* Odhner, 1910

Fasciolidae : Body large to medium sized, fusiform or linguiform, without cephalic cone. Oral sucker and pharynx small; oesophagus short; caeca simple, reaching near posterior end. Acetabulum much larger than oral sucker, near anterior extremity. Testes tandem, much branched. Cirrus sac long, cylindrical, extending far behind acetabulum, preacetabular in *Parafasciolopsis*. Genital pore immediately preacetabular or postbifurcal. Ovary median or submedian, equatorial or preequatorial, branched. Receptaculum seminis absent. Vitellaria confined to lateral fields along whole length of caeca. Uterus long or short, preovarian.

Genus 34. **Fasciolopsis** Looss, 1899

Fasciolopsinae : Body thick, fleshy, lanceolate or linguiform without cephalic cone, spinulate. Acetabulum strongly muscular, produced backward, much larger than oral sucker, close to anterior end. Prepharynx short; pahrynx globular; oesophagus very short; caeca long, unbranched, sinuous, reaching posterior extremity. Testes with numerous digitiform branches, tandem, postequatorial. Cirrus sac very long, cylindrical, extending in median line far behind acetabulum, enclosing coiled tubular seminal vesicle in its greater posterior part, pars prostatica and finely spinose cirrus. Genital pore immediately preacetabular. Ovary branched, submedian, equatorial. Vitelline follicles small, extending in extracaecal lateral fields both dorsally and ventrally. Uterus coiled transversely, interacaecal, preovarian. Eggs very large, numerous. Excretory stem with numerous branches. Parasitic in intestine of mammals.

Type-species : *F buski* (Lankester, 1857) Looss, 1899

75. **Fasciolopsis buski** (Lankester, 1857) Looss, 1899

(Fig. 57)

Syn. *Distomum buski* Lankester, 1857
Distomum crassum Busk, 1859
Distomum rathouisi (Poirier, 1887) Ward, 1903

Specific diagnosis.—Body pinkish creamy when fresh, broadly ovate, elliptical or linguiform with rounded posterior end, 2.0–7.5 cms. or 55 mm. long, 8–20 mm. broad, spinose. Acetabulum 2–3 in diameter, produced posteriorly into sac-like prolongation. Oral sucker 0.5–0.7 in diameter. Ratio of suckers 1 : 3.2 or 3.4. Prepharynx very short; pharynx

240–670μ in diameter; oesophagus absent or exceedingly short; caeca simple, unbranched, extending from pharynx to subcaudal region in zigzag manner. Cirrus sac sinuous, not straight, 8.5×700μ. Ovary divided into three main branches, much subdivided further. Mehlis' gland median, behind ovary, equatorial. Eggs 0.12–0.16×0'.08–0.095.

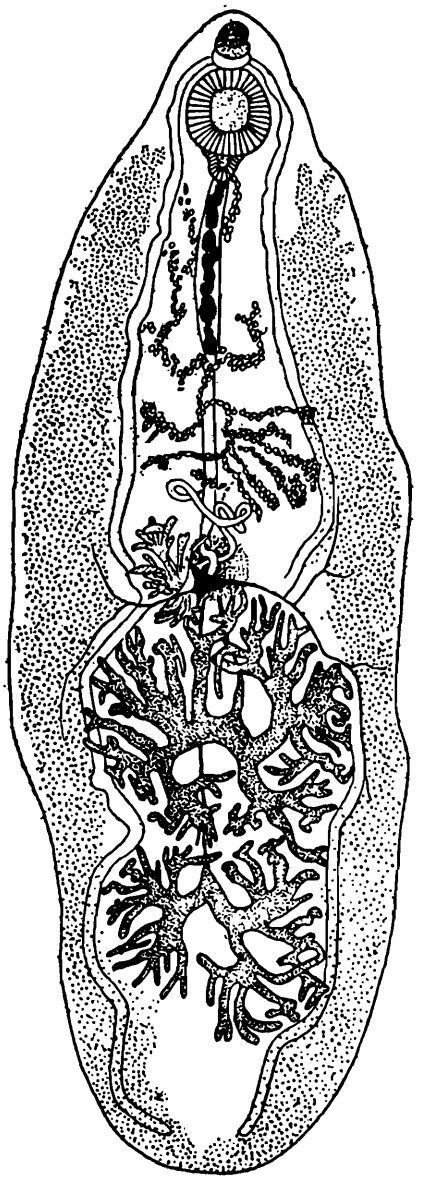


Fig. 57. *Fasciolopsis buski* (Lankester, 1857) Looss, 1899.

Host.—Pig, man.

Location.—Intestine.

Locality.—India, Assam, Bengal, Bihar, Orissa and Madras. Indo China, China, Thailand, Malaya States.

Intermediate Host.—According to Buckley (1930) the intermediate host in Assam is *Segmentina trochoidens*. The metacercariae are known to deposit on the water nuts, Singhara.

B. Superfamily *HAPLOPROIDEA* Nicoll, 1935 emend. Dollfus, 1952 emend. Mehra, 1961

Echinostomata : Intestinal caeca double or single. Genital pore preacetabular. Testes double or single. Cirrus sac absent. Vesicula seminalis free. Hermaphroditic duct rudimentary or well developed. Hermaphroditic sac absent or present. Excretory vesicle Y-shaped, tubular or saccular. Eggs usually contain miracidia. Cercariae distomate, single-tailed, possessing lateral caudal finger-like lobes or paired lateral caudal fins, developing in sporocysts or rediae in marine snails and encyst in the open; second intermediate host absent in the life cycle. Parasitic in marine or fresh water fishes.

Key to Indian families of HAPLOPOROIDEA

Acetabulum large; hermaphroditic sac absent. . .	HAPLOSPLANCHNIDAE Poche, 1925
Acetabulum small; hermaphroditic sac present	HAPLOPORIDAE Nicoll, 1914

VII. Family HAPLOSPLANCHNIDAE Poche, 1925

Echinostomata, Haploporoidea : Body small. Acetabulum large. Oral sucker and pharynx well developed. Caecum single. Testis single in hindbody. Cirrus sac absent. Hermaphroditic sac absent. Vesicula seminalis free in parenchyma. Hermaphroditic duct (genital sinus) tabular. Genital pore median, preacetabular. Ovary pretesticular. Receptaculum seminis present. Vitellaria lateral, much reduced or well developed, consisting of a few or many follicles. Uterus coiled, pretesticular. Eggs large, containing oculate miracidia. Cercariae possess lateral, finger-like caudal lobes, developing in marine snails, encyst in the open on vegetation. Metacercariae eaten by herbivorous fishes.

Type genus : *Haplosplanchnus* Looss, 1902

Subfamilies Haplosplanchninae Skrjabin et Guschanskaja, 1955 and Schikhobalotrematinae Skrjabin et Guschanskaja,

1955 are dropped. We agree with Skrjabin and Guschanskaja (1955) in considering the genus *Laruea* Srivastava, 1939 to be synonymous to *Haplosplanchnus* Looss, 1902. We maintain only two genera under Haplosplanchnidae, *Haplosplanchnus* Looss, 1902 and *Haplosplanchnoides* Nahas and Cable, 1964.

Sogandares and Sogandares (1961) reduced the genera *Schikhobalotrema* and *Laruea* to subgenera in the genus *Haplosplanchnus*. We accept the former as a subgenus, but the latter is merged in the genus *Haplosplanchnus* as done by Skrjabin and Guschanskaja (1955).

Genus 35. **Haplosplanchnus** Looss, 1902

Syn. *Laruea* Srivastava, 1939

Haplosplanchnidae : Body elongated, fusiform, pyriform or Y-shaped with unequal arms, narrow posteriorly with semispiral posterior end. Cuticule aspinose. Acetabulum preequatorial or equatorial (postequatorial in the genus *Haplosplanchnoides*). Oral sucker terminal or subterminal. Prepharynx small; pharynx well developed; oesophagus short; caecum single. Testis single in posterior half of body. Seminal vesicle tubular; pars prostatica surrounded by prostate cells, opening into genital sinus. Genital pore median or submedian. Vitellaria varying in length antero-lateral to testis or lateral extending from level of pharynx or acetabulum to posterior extremity. Uterus pretesticular. Excretory pore dorso-terminal. Excretory vesicle Y-shaped, stem reaching testis, arms extending to anterior extremity. Parasitic in intestine of marine fishes.

Type-species : *H. pachysomus* (Eysenhardt, 1829) Looss, 1902

Key to genera of HAPLOSPLANCHNIDAE

Acetabulum in front of gonads..	*Haplosplanchns* Looss, 1902
Acetabulum behind gonads, near posterior end	*Haplosplanchnoides* Nabhas and Cable, 1964

Key to subgenera of **Haplosplanchnus** Looss, 1902

Vitellaria extensive	*Schikhobalotrema* (Skrjabin and Guschanskaja) Sogandares, & Segandares 1961.
Vitellaria slightly developed anterior to tastis behind acetabulum.	*Haplosplanchnus* (Looss, 1902) Sogandares & Sogandares, 1961

Key to Indian species of **Haplosplanchnus**

Body roughly Y-shaped with unequal arms and broad stem with semispiral end..	*Haplosplanchnus* (*H.*) *caudata* (Srivastava, 1939) Skrjalin and Guschanskaja, 1955.
Body not Y-shaped with broad stem with semispiral end.	*Haplosplanchnus* (*H.*) *pachysomus* (Eysenhardt, 1829) Looss, 1902.

76, **Haplosplanchnus (Haplosplanchnus) pachysemus** (Eysenhardt, 1829) Looss, 1902

(Fig. 58)

Syn. *Distomum pachysoma* Eysenhardt, 1829
Podocotyle pachysolomum, (Eysenhardt, 1829) Stossich. 1898 ;
Haplosplanchnus purii Srivastava. 1939

Specific diagnosis.—Body smooth, varying in spahe, roughly triangular or somewhat pɔar-shaped, 1.6–2.3 × 0.54–1.2 maximum breadth across acetabulum. Oral sucker 0.08–0.22 × 0.25–0.34. Prepharynx small, narrow; pharynx 0.07–0.1 × 0.08–0.14; oesophagus 0.12–0.18 × 0.08-0.12; caecum 0.5–0.9 in length. Acetabulum bowl-shaped, muscular, 0.22–0.34 × 0.22–0.38, at junction of first and second third of body. Testis ovoid, 0.2–0.3 × 0.18–0.28, near hinder end. Vesicula seminalis narrow, tubular and sinuous. Pars prostatica small, surrounded by prostate cells. Genital sinus deep, narrow. Genital pore half way between oral sucker and acetabulum. Ovary 0.18–0.28 in diameter, obliquely in front of testis. Receptaculum seminis small, 0.12–0.22 × 0.12–0.16. Shell gland complex between receptaculum seminis and testis. Vitellarium according to Srivastava scyth-shaped, 0.15–0.43 × 0.04–0.09 is probably due to fixation and flattening. It is really not a compact organ, but consists of separate follicles laterally situated between testis and end of caecum as in the genus. Uterus large, pretesticular, occupying entire space between acetabulum, caecum and ovary. Eggs numerous, containing oculate miracidia, 0.049–0.068 × 0.023–0.034.

Host.—*Mugil waigiensis* Quoy and Gaim.

Location.—Intestine.

Locality.—Puri and Karachi, Bay of Bengal and Arabian Sea.

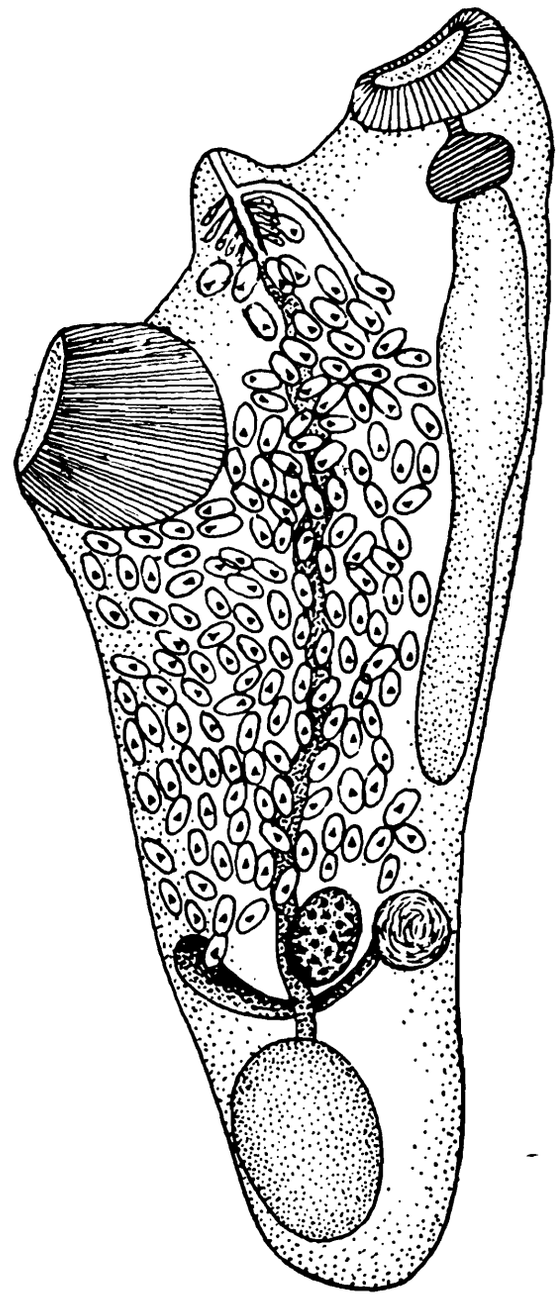


Fig. 58. *Haplosplanchmus* (*Haplosplanchnus*) *pachysomus* (Eysenhardt, 1829) Looss, 1902.

Skrjabin and Guschanskaja (1955) who have provided data on this species give a figure in which the vitellarium of one side is shown as follicular of discrete follicles occupying almost the same position as shown by Srivastava in his figure of the species. Fischthal and Kuntz (1963) have recorded this species from Egypt in *Mugil cephalus* and *M ramada* (Mugilidae). Yamaguti (1934) recorded it from an inland sea in Japan. So this species has wide distribution from the Mediterranean to the inland sea in Japan.

77. **Haplosplanchnus (Haplosplanchnus) caudata**

(Srivastava, 1939) Skrjabin & Guschanskaja, 1955

(Fig. 59)

Syn. *Laruea caudata* Srivastava, 1939

Specific diagnosis.—Body plump, smooth, light brown in living state, roughly Y-shaped with unequal arms, broad anteriorly behind genital pore, narrow posteriorly with semi-spiral posterior end, 3.6–3.8 long from oral extremity to hinder end and 1.2–1.4 from genital pore to acetabular end in perma-

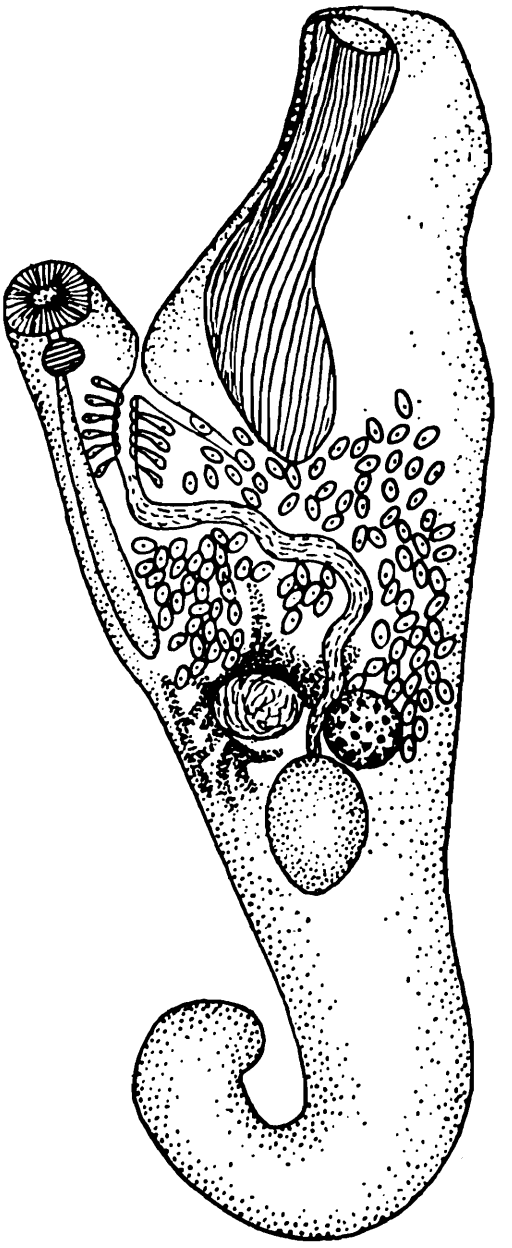


Fig. 59. *Haplosplanchnus* (*H.*) *caudata* (Srivastava, 1939).

nent mounts. Oral sucker transversely oval, 0.2–0.24× 0.28–0.35. Acetabulum long, club-shaped, tubular, 0.96–1.8 ×0.32–0.54, situated in the longer arm of Y-shaped body. Prepharynx small; pharynx 0.12×0.14–0.16; oesophagus 0.32–0.51, caecum 0.4–0.8×0.14–0.16. Testis oval 0.44–0.54× 0.32–0.4 slightly behind anterior half of body, much in front of posterior extremity. Vesicula seminalis long, tubular, sinuous; pars prostatica elongated oval, surrounded by prostate cells. Genital sinus tubular. Genital pore at the bifurcation of the Y Ovary spherical, 0.18–0.28, obliquely in front of testis. Receptabulum seminis 0.16–0.4×0.2–0.5, pretesticular. Laurer's canal small, arises from duct of receptaculum seminis. Shell gland mass diffuse between receptaculum seminis and ovary. Vitellaria slightly developed, of long follicles confined to space between testis and ovary, end of caecum and right bodywall. Uterus coiled between testis and acetabulum. Eggs numerous, contain oculate miracidia, 0.038–0.04×0.019–0.023. Excretory vesicle Y-shaped with short stem and long cornua.

Host.—*Mugil waigiensis* Quoy and Gaim.

Location.—Intestine.

Locality.—Puri, Bay of Bengal.

VIII. Family HAPLOPORIDAE Nicoll, 1914

Syn. Waretrematidae Srivastava, 1939
Megasolenidae Yamaguti, 1942
Megasolenidae Skrjabin, 1942

Echinostomata, Haploporoidea : Body very small, small or medium sized, rather plump or elongate, spined or unspined. Oral sucker terminal or subterminal with or without a dorsal semicircular crown of prominent papillae. Prepharynx present; pharynx well developed; oesophagus moderately long or long; caeca short to long. Acetabulum preqeuatorial, rather small. Testes single or double, postacetabular. Vesicula seminalis externa present. Hermaphroditic sac containing vesicula seminalis interna or the latter with prostatic complex, ductus ejaculatorius, hermaphroditic duct and metraterm present. Cirrus sac absent. Genital pore median or submedian, preacetabular. Ovary pretesticular or in level with testis, usually posterodorsal to acetabulum. Receptaculum seminis present or absent. Laurer's canal present. Vitellaria composed of paired compact lobes or branches behind or beside ovary or posterior, lateral, some-

times more extensive consisting of follicles or tubular acini. Uterus coiled, extending behind testes or preovarian. Eggs large or medium sized, usually containing miracidia. Excretory vesicle tubular, saccular or Y-shaped. Parasitic in marine or fresh water fishes.

Type genus : *Haploporus* Looss, 1902

XXI. Subfamily *WARETREMATINAE* Belouss, 1954*

Syn. Crassetrematinae Skrjabin, 1942
Waretrematinae Yamaguti, 1958

Haploporidae : Body small, elongate, spined or unspined. Eye spots usually absent. Oral sucker terminal or subterminal, with or without a dorsal semicircular crown of conical papillae. Acetabulum preequatorial, small, nearly as large or larger than oral sucker. Prepharynx and phrynx well developed; oesophagus moderately long or long, bifurcating behind acetabulum; caeca of varying length usually short, terminating in front of ovary (*Waretrema*) or at level of hinder margin of ovary (*Skrjabinolecithum* Belouss). Genital pore median or submedian, preacetabular or between pharynx and acetabulum. Testes single or double, postequtatorial. Cirrus sac absent. Vesicula seminalis externa present. Hermaphroditic sac containing vesicula seminalis interna, prostatic complex, ductus ejaculatorius, ductus hermaphroditicus and metraterm present. Ovary pretesticular. Receptaculum seminis present or absent. Laurer's canal prsent. Uterus coiled, preovarian, between ovary and hermaphroditic sac. Vitellaria postacetabular, lateral, consisting of tubular acini or follicular, sometimes extending into acetabular region. Excretory vesicle Y-shpaed. Parasitic in marine and fresh water fishes.

Genus 36. **Waretrema** Srivastava, 1939

Waretrematinae : Body fusiform, medium sized, spined anteriorly. Oral sucker with a dorsal crown of six prominent conical papillae. Acetabulum near anterior end. Prepharynx moderately long; pharynx well developed; oesophagus long; caeca short, terminating in front of ovary. Genital pore median, preacetabular. Testis single, a little in front of posterior extremity. Vesicula seminalis externa present. Hermaphroditic sac elongated, extending to acetabular zone.

*Authorship of the subfamily should go to Srivastava (1939) according to rules.—*Ed.*

Ovary submedian, pretesticlular or in level with testis. Laurer's canal and receptaculum seminis present. Vitellaria composed of tubular acini or lobes confined to posterior half of body. Uterus preovarian. Eggs not numerous, medium sized, thin shelled. Excretory vesicle Y-shaped. Parastic in marine fishes.

Type-species : *W piscicola* Srivastava, 1939

78. **Waretrema piscicola** Srivastava, 1939

(Fig. 60)

Specific diagnosis.—Body fusiform, 2.24–5.36×0.48–0.94 maximum breadth at about middle, with feebly developed cutaneous gland cells and minute spines. Oral sucker 0.15–0.3 in diameter, with a crown of six prominent conical dorsal papillae. Acetabulum 0.24–0.4 in diameter, at end of first third or quarter body length. Ratio of suckers 2 : 3 or 3 : 4. Prepharynx 0.1–0.3 long, tubular; pharynx 0.1–0.2 in diameter; oesophagus 0.3–1.5 long; caeca short, saccular, 0.54–1.2×0.14–0.24, terminating a little in front of testis or up to its middle. Testis 0.32–0.68×0.2–0.38. Vesicula seminalis externa 0.16–0.4×0.1–0.6, extending to level of intestinal bifurcation. Vesicula seminalis interna 0.16–0.4× 0.1–0.16. Pars prostatica small, tubular, coiled 0.15–0.24× 0.01–0.015. Metratern 0.25–0.5×0.04–0.08. Pars prestatica opens into metraterm through small ductus ejaculatorius. Hermaphroditic sac 0.54–0.9×0.16–0.18, to right side of acetabulum and extending behind it. Ovary spherical or oval, 0.08–0.14×0.12–0.18, a little dextral, close in front of testis or in level with its anterior margin. Receptaculum seminis 0.4–0.46×0.1–0.12, usually median, equatorial. Vitellaria composed of ten elongated, spindle-shaped lobes, in equal numbers both in front and behind testis, extending anteriorly to anterior margin of receptaculum seminis and posteriorly to last third of post-testicular space or to almost hinder end. Eggs thin shelled, moderate in number, 0.05–0.07×0.038–0.05.

Host.—*Mugil waigiensis* Quoy and Gaim.

Location.—Intestine.

Locality.—Karachi, Arabian Sea.

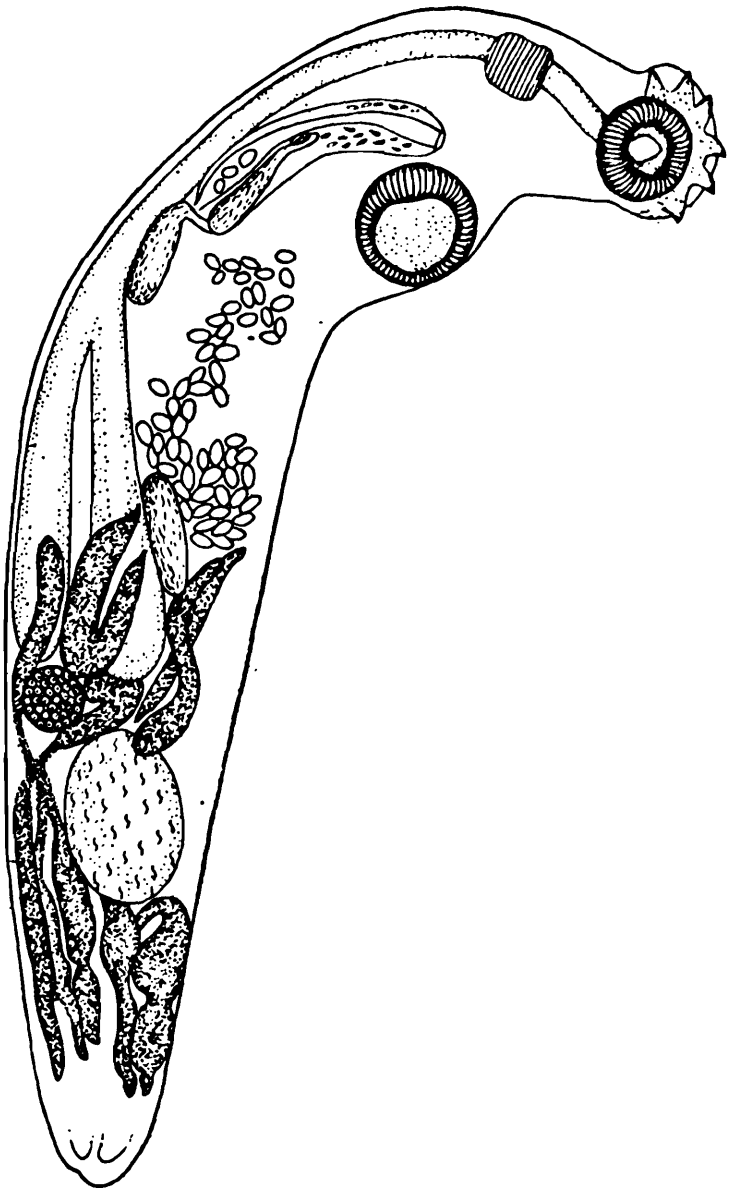


Fig. 60. *Waretrema piscicola* Srivastava, 1939.

II. Suborder PARAMPHISTOMATA Szidat, 1936

Fasciolatoidea : Amphistomate or monostomate. Acetabulum near posterior extremity when present. Genital pore ventral, near anterior extremity. Cirrus sac present or absent. Cercariae amphistomate or monostomate without penetration glands, with heavily pigmented body and two or three eye spots. Cercariae develop in rediae devoid of collar and usually ambulatory appendages, emerge in snail host before completing growth and encyst in the open. Two host life cycle.

Key to superfamilies of PARAMPHISTOMATA

Pharynx present, often replacing oral sucker; two caudal excretory canals in cercaria long, first separate throughout the length of tail with lateral openings near end; eggs without polar filaments	PARAMPHISTOMOIDEA Stiles and Goldberger*, 1910
Pharynx absent; two caudal canals in cercaria running in part of length of tail with lateral openings some distance behind the base; eggs with polar filaments.	NOTOCOTYLOIDEA La Rue, 1957

C. Superfamily *PARAMPHISTOMOIDEA* Stiles and Goldberger* 1910

Paramphistomata : Cercariae amphistomate or monostomate. Pharynx present, often replacing oral sucker. Excretory vesicle saccular or tubular. Two caudal canals in cercaria long, separate first throughout the length of tail with lateral openings near end and then become fused to form the single canal. Protonephridia stenostomate. Eggs medium sized to large without polar filaments. Parasitic in vertebrates mostly terrestrial and fresh water.

IX. Family PARAMPHISTOMIDAE Fischoeder, 1901

Paramphistomoidea : Body thick, elongate, conical, oval, subcylindrical or elliptical, smooth or papillated, exceptionally spined with a few rows of minute spines anteriorly. Ventral sac present or absent. Acetabulum terminal or subterminal, occasionally almost ventral. Oral sucker terminal or subterminal, with or without diverticula. Oesophagus with or without muscular bulb posteriorly. Caeca simple, more or less sinuous, terminating usually near posterior end, occasionally considerably in front of it. Genital pore anterior, midventral with or without genital sucker. Testes usually in middle third of body, exceptionally single. Vesicula seminalis present. Pars musculosa sometimes present. Cirrus sac or hermaphroditic sac present. Vitellaria follicular or acinous, lateral, Uterus coiled mostly intercaecal. Eggs without filament. Excretory vesicle posterior, exceptionally equatorial, intertesticular; saccular or tubular with postero-

* The superfamily authorship should go to Fischoeder (1901). —*Ed.*

dorsal or dorsal aperture. Lymph system present. Parasitic in vertebrates.

Type genus : *Paramphistomum* Fischoeder, 1901

Key to Indian subfamilies of PARAMPHISTOMIDAE

1. Parasitic in warm blooded vertebrates	2
Parasitic in cold blooded vertebrates.	6
2. Ventral sac present; Parasitic in mammals	*GASTROTHYLACINAE* Stiles and Goldberger, 1910
Ventral sac absent.	3
3. Body usually flattened, divided into anterior and posterior portions; paratic in mammals	*GASTRODISCINAE* Monticelli 1892
Excretory vesicle equatorial, intertesticular; parasitic in marine mammals	*SOLENORCHIINAE* Hilmy, 1949
Extretory vesicle posterior, posttesticular; parasitic in vertebrates other than marine mammals.	4
4. Acetabulum divided into two parts, posterior with a projection on each side; parasitic in birds exceptionally in reptiles.	*ZYGOCOTYLINAE* Ward, 1917
Acetabulum not divided into two parts and without projection on each side . . .	5
5. Oral sucker (Pharynx) without paired diverticula; cirrus sac absent; parasitic in mammals.	*PARAMPHISTOMINAE* Fischoeder, 1901
Oral sucker (pharynx) constricted at about middle, with paired pouch-like diverticula; cirrus sac absent; parasitic in mammals.	*PSEUDODISCINAE* Näsmark, 1937
Oral sucker (pharynx) with paired diverticula; cirrus sac present; genital sucker usually present; parasitic in mammals.	*CLADORCHIINAE* Lühe, 1909
6. Testes usually single, exceptionally double; acetabulum large, usually with a central protuberance in the form of papilla or sucker; parasitic in amphibians, reptiles and fishes.	*DIPLODISCINAE* Cohn, 1904
Testes double; parastic in frogs and fishes.	7

7.	Testes tandem .	8
	Testes symmetrical	10
8.	Genital papilla stout in genital atrium; parasitic in frogs.	*PSEUDOCHIORCHIINAE* Yamaguti, 1958
	Genital papilla absent; parasitic in fishes.	9
9.	Genital sucker absent; genital pore immediately postbifurcal; oesophageal bulb present.	*DADAYTREMATINAE* Yamaguti, 1958
	Genital pore bifurcal, surrounded by muscular disc; oesophageal bulb absent. ..	*CLEPTODISCINAE* Skrjabin, 1949
10.	Body conical; oral diverticula small; genital sucker very large; testes extracaecal.	*NICOLLODISCINAE* Skrjabin, 1949
	Body elliptical; oral diverticula forming very prominent claviform appendages; genital sucker not large; testes intercaecal.	*HELOSTOMATINAE* Skrjabin, 1949

XXII. Subfamily *PARAMPHISTOMINAE* Fischoeder, 1901

Paramphistomidae : Body conical, oval, pyriform or elliptical, exceptionally spined anteriorly. Ventral sac absent. Acetabulum ventroterminal. Oral sucker (pharynx) well developed without posterior diverticula. Oesophageal bulb present or absent. Caeca may reach or may not reach acetabular zone. Testes tandem or diagonal. Vesicula seminalis convoluted. Pars musculosa well developed, short or almost absent. Pars prostatica distinct or not. Cirrus sac or hermaphroditic pouch absent. Genital papilla may be present. Genital atrium well developed, sometimes large, muscular, with or without genital sucker. Ovary submedian or median, posterior or posterodorsal to posterior testis. Laurer's canal crossing excretory vesicle or not. Vitellaria lateral, sometimes confluent in front of acetabulum. Uterus winding forward, usually dorsal, occasionally lateral to testes. Metraterm well differentiated, opening at base of genital atrium along with male pore or joining it just before opening. Excretory vesicle dorsal anterodorsal or anterior to acetabulum, opening anterior or posterior to Laurer's canal. Lymph system with a pair of longitudinal trunks. Parasitic in artiodactyle ungulates, exceptionally carnivores.

Type genus : *Paramphistomum* Fischoeder, 1901

Key to Indian genera of PARAMPHISTOMINAE

1. Genital sucker well developed.	*Cotylophoron* Stiles and Goldberger, 1910
Genital pore may be muscular, but genital sucker absent ..	2
2. Laurer's canal crossing excretory vesicle; body conical or pyriform.	3
Laurer's canal not crossing excretory vesicle; body subcylindrical, elliptical or elongate oval.	4
3. Genital papilla surrounded by discoid muscular calyx ..	*Calicophoron* Näsmark, 1937
Genital papilla not surrounded by discoid muscular calyx.	*Paramphistomum* Fischoeder, 1901
4. Body elongate elliptical; vitellaria of small follicles, meeting behind ovary, continuous dorsally in front of acetabulum to genital pore and extending to middle of oral sucker.	*Paramphistomoides* Yamaguti, 1958
Body very much elongated, tapering gradually towards anterior end; vitelline follicles large, extending from level of bifurcal genital pore to anterior end of acetabulum.	*Pseudoparamphistoma* Yamaguti, 1958
Body subcylindrical, tapering towards anterior end; vitellaria of elonbated follicular masses in 12–14 groups of 2–20 follicles, from middle of oesophagus to middle of acetabulum; anterior region with 5 or 6 rings of spines. .	*Paramphistomacotyle* n.gen.
Body cylindrical to elongate oval, slightly curved ventrad; vitellaria along caeca as in *Paramphistomum:* spines absent	*Ceylonocotyle* Näsmark, 1937

Genus 37. **Paramphistomum** Fischoeder, 1901

Syn. *Gigantocotyle* Näsmark, 1937

Paramphistominae : Body conical or pyriform, smooth. Dorsal line evenly to semicircular or curved. Acetabulum ventro-terminal or terminal; acetabulum index between 1 : 4.4 and 1 : 6 (*P. cervi*) and 1 : 2.3 (*P. explanatum*). Oral sucker (pharynx) without diverticula. Oesophagus without

oesophageal bulb. Caeca long, sinuous, reaching acetabular zone. Testes lobate or rounded, tandem or somewhat diagonal. Seminal vesicule convoluted. Pars musculosa well developed. Genital pore may be muscular but not forming sucker. Ovary posttesticular. Uterus winding forward in median field to testes, ventral to vesicula seminalis. Laurer's canal crossing excretory vesicle. Vitellaria lateral between two suckers, extending to acetabular opening. Excretory vesicle close to dorsal surface crossed by Laurer's canal. Excretory pore median or slightly to right, anterior to vesicle. Parasitic in stomach, intestine or bile ducts of mammals

Type-species : *P. cervi* (Zeder, 1790) Fischoeder, 1901

Key to subgenera of **Paramphistomum**

Body conical. Acetabular index between 1 : 4.4 and 1 : 6. Tested tendem.	*Paramphistomum* Yamaguti, 1958
Body conical with large acetabulum of modest dimension and acetabular part strongly developed. Acetabular index 1 : 2.3 (1 : 1.5–1.29)..	*Explanatum* Fukui, 1929

Key to Indian species of subgenus **Paramphistomum**

Oral sucker (pharynx) small, in relation to length of body 1 : 10.5 provided with small internal papillae. Acetabular index 1 : 4.4 (1 : 4.8–1 : 6.6)..	*P. cervi* (Zeder, 1790)
Oral sucker (pharynx) large, in relation to length of body 1.5 : 5.9, provided with gigantic internal papillae. Acetabular index 1 : 3.1 (1 : 4.0–1 : 5.0).	*P. gotoi* Fukui, 1922

79. **Paramphistomum cervi** (Zeder, 1790) Fischoeder, 1901

(Fig. 61)

Syn. *Fistucaria cervi* Zeder, 1790
Paramphistomum indicum (Stiles and Goldberger, 1910) Maplestone, 1923

Specific diagnosis.—Body conical, 5–12 long, 2–3 maximum breadth, concave ventrally and convex dorsally, surface coarsely wrinkled, sometimes anteriorly provided with papillae more numerous in circumoral region. Oral sucker with or without small papillae. Acetabulum terminal, 2.0 in diameter, aperture ventroterminal; acetabular index between 1 : 4.4 and 1 : 6. Genital pore median, opposite or a little behind

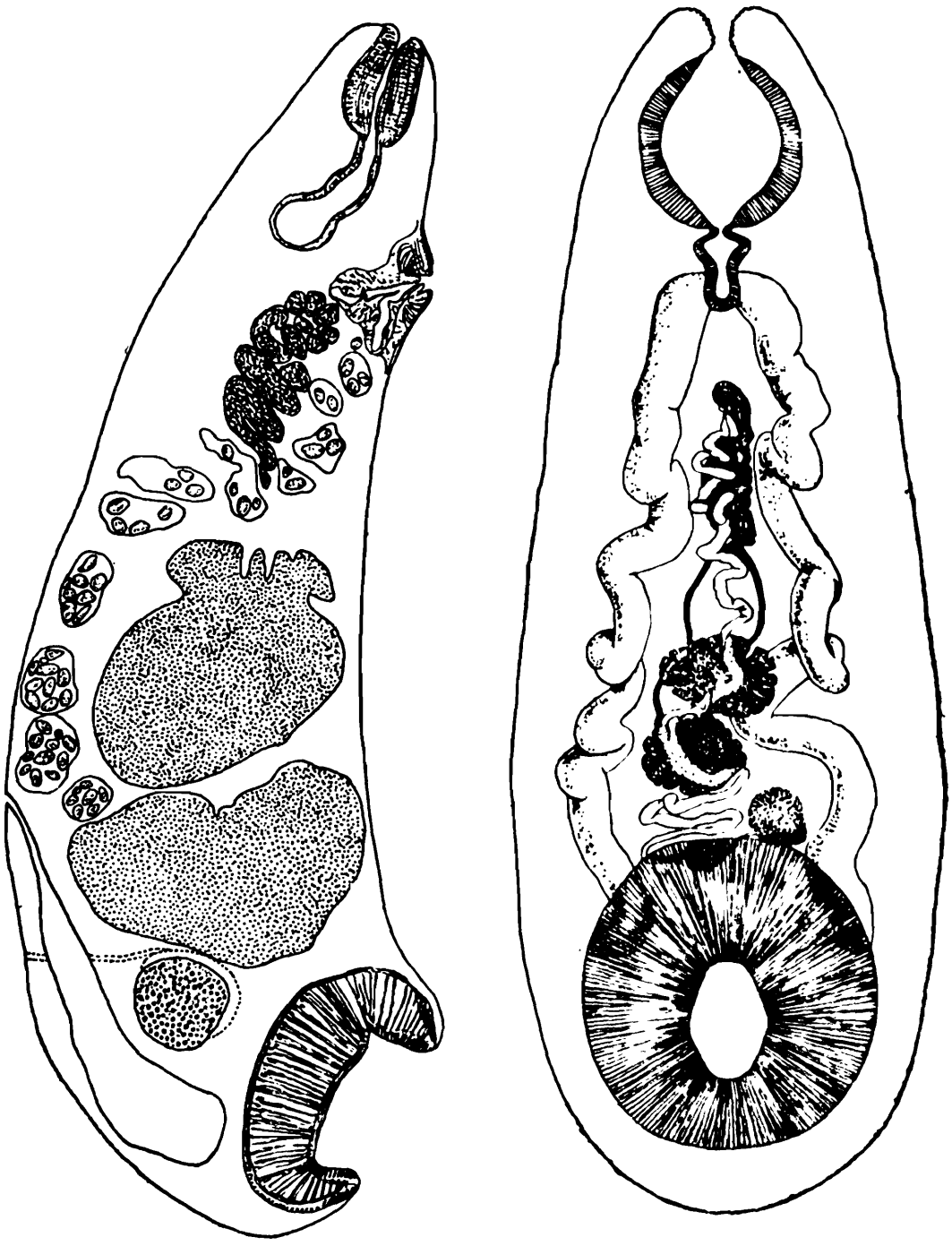


Fig. 61. Anatomy of *Paramphistomum cervi* (Zeder, 1970) from a median sagittal section. *After* Näsmark, 1937 and entire spécimen.

gut-fork, at one third anterior length. Pharynx (oral sucker) 0.84 long, in relation to length of body 1 : 10.5. Oesophagus small, 0.775 long; caeca convoluted, sometimes straight, ending dorsal to acetabulum or to its middle. Testes lobed occasionally lobed, tandem somewhat obliquely behind the

other, slightly on opposite sides of middle line; total form oval, sometimes compressed, wedge-like, 1.6 long and 2 in dorsoventral direction (1.0–2.0 and 2.0–3.5 respectively). Vesicula seminalis and pars musculosa much coiled; pars prostatica short, almost straight. Genital atrium of *Gracile* type. Ovary close behind base of acetabulum, dextral or sinistral. Laurer's canal crosses excretory vesicle, opening 1.2 behind excretory pore. Uterus ventral to shell gland, wavy in front and dorsal to testes, ventral to vesicula seminalis and pars musculose. Vitellaria from hinder end of oral sucker or genital pore to blind ends of caeca or acetabular aperture. Eggs 0.148×0.077 (0.145–0.156×0.075–0.082;.

Host.—Sheep, goat, cattle and other ruminants.

Location.—Rumen and reticulum.

Locality.—India, Burma.

80. **Paramphistomum explanatum*** (Creplin, 1847) Fischoeder, 1901

Syn. *P. crassum* Stiles and Hassall, 1910
Gigantocotyle explanatum (Creplin, 1847) Näsmark, 1937
P. birmiense (Railliet, 1924) syn. *P. explanatum* of Dawes, 1936.

Specific diagnosis.—Body conical, light pink, 6–12 long, 4.27–5.11 maximum breadth, almost half the length of body. Acetabulum 2.95–3.48×2.9 or 4.0 in diameter; aperture of acetabulum elliptical. Acetabular index 1 : 2.3. Oral sucker 0.96–1.95×1.48–1.86 with strong sphincter at anterior end; lumen of sucker spindle-shaped with 12–17 small conical papillae on each side. Oesophagus 0.62 long. Testes diagonal, rounded, one overlapping the other, both laterally and anteroposteriorly slightly lobed or multilobed, cauliflower-like; anterior 0.74–1.3×1.11; posterior 0.93–1.11× 1.11–1.58. Vesicula seminalis short, coiled. Pars musculosa strongly developed with narrow duct, pars intermediat at either end; ductus hermaphroditicus through genital papilla having sphincter papillae. Genital atrium of *Explanatum*

*Srivastava, H. D. (1944-*Proc. Indian Sc. Congr.*, 31 (3) : 142), Singh, K. S. (1950 *J. Parasit.*, 44 (2) 210-224), Mukherjee & Srivaatava, H. D. (1960-*Proc. Indian Sc. Congr.*, 47 (3) : 440) and Mukherjee (1962 *Agra Univ. J. Res. Sc.*, 11 (11) : 131-136) worked out life history of this species. Snail hosts : *Indoplanorbis exustus* and *Gyraullus convexiusculus.*

Cercris cyraulusi Peter & Srivastava, 1945. *Ed.*

type i.e., strengthened by genito-atrial radial muscles; ventral atrium without muscles. Ovary spherical, dextral, 0.42–0.54 ×0.3–0.35. Laurer's canal crósses excretory vesicle, opening slightly to right, a little posterior to excretory pore. Uterus coiled, dorsal to testes; metraterm present. Shell gland complex transversely oval, 0.35–0.45, median behind ovary. Genital pore median, just below intestinal bifurcation. Eggs 0.133×0.078 or 0.104×0.01 (0.104–0.125×0.06–0.075). Excretory vesicle globular; pore posterodorsal.

Host.—*Bos bubalis, Bos taurus.*

Location.—Rumen, liver, bile ducts, gall bladder.

Locality.—India, Lucknow, Allahabad; Pakistan, Lahore; Burma; Sri Lanka.

81. **Paramphistomum gotoi** Fukui, 1922

Specific diagnosis.—Length 4.828–10.6, breadth 1.685–3.21; cuticular papillae numerous at anterior and posterior ends of body; mouth terminal with spines at its margin; thick cuticular lining in oral sucker (pharynx) and a ridge lining oesophagus. Oral sucker (pharynx) large, pear-shaped, 0.87 in length, immensely strengthened by internal papillae, divided into anterior and posterior parts, provided with many large papillae and flattened spines in its anterior two fifth; 20–30 papillae each with 1–7 spines on either side of its lumen, spines hollow triangular with flattened bases; spines also present in posterior part of oral sucker, though smaller than those of anterior part. Length of oral sucker greater than its breadth, 0.77–1.28. Acetabulum slightly larger than oral sucker, 0.975–1.554 in diameter; acetabular index 1 : 4.7 (1 : 3.1 according to Nasmark). Oesophagus slender, short, 0.78 long, bearing muscular pad at its origin. Caeca folded, folds extending inwards up to its middle, terminal ends dilated and curved inwards lying one behind the other, 0.294–0.836 in width. Testes spherical, tandem, with slightly or strongly lobed margin, in middle of body; anterior smaller, 0.77–1.104×0.94–1.54; posterior just behind anterior testis, 0.97–1.31×1.08–1.6. Vesicula seminalis with a few coils; genital papilla elongated opening outside through genital atrium near intestinal bifurcation. Ovary oval, in front of caetabulum. Uterus after making a few coils behind ovary runs forwards. Eggs 0.1085–0.1209×0.0684–0.0744. Genital atrium *Gracile* type. Vitellaria of small follicles, lateral from caecal bifurcation to acetabulum. Laurer's canal opens

anterior to excretory pore according to Dawes and Tandon. Excretory vesicle elongated, preacetabular.

Host.—*Bos bubalis.*

Location.—Rumen.

Locality.—Lucknow, U.P.

Genus 38. **Calicophoron** Näsmark, 1937

Paramphistominae : Body pyriform to rounded conical, sometimes dorsoventrally flattened and curved ventrad. Acetabulum large, ventroterminal surrounded by wreath-like folded or puckered bodywall or not. Acetabular index 1 : 3.0–1 : 3.4 (mean value 1 : 4). Oral sucker (pharynx) without diverticula. Oesophagus without posterior bulb; caeca long. Testes lobate, diagonal, juxtaposed or tandem. Pars prostatica far more strongly developed than in *Paramphistomum.* Genital atrium characteristic, *Calicophoron* type. Genital papilla surrounded by discoid muscular calyx. Ovary dorsal to acetabulum. Laurer's canal crossing excretory vesicle. Vitellaria lateral. Uterine coils dorsal and anterior to testes. Lymph system of one pair of longitudinal trunks. Parasitic in digestive tract of artiodactylid ungulates.

Type-species : *C. calicophorum* (Fischoeder, 1901) Näsmark, 1937

Key to Indian species of **Calicophoron**

1. Testes tandem. . . .	*C. papillosum* (Stiles and Goldberger, 1910)
Testes beside each other, juxtaposed.	*C. cauliorchis* (Stiles & Goldberger, 1910)
Testes diagonal.	2
2. Testes deeply lobed, lobes lobated; body length 10.1 (10–15). .	*C. calicophorum* (Fischoeder, 1901) Näsmark, 1937
Testes small, finely lobed; body length 6.12–6.5.	*C. crassum* (Stiles & Goldberger, 1910)

82. **Calicophoron calicophorum** (Fischoeder, 1901) Näsmark, 1937

Specific diagnosis.—Length 10.1 (10–15). Breadth 5–6. D.V meas. 4.24 (about 4.4). Dorsal line evenly curved.

Acetabulum 3.36 (3.0–4.8) in diameter, in relation to length of body 1 : 3.0 (1 : 3.3–1 : 3.5), of *Calicophoron* type. Pharynx : 2.0 (1.5–2.0) in length, in relation to length of body 1 : 5.1, of *Calicophoron* type (1 : 5.0–1 : 7.5). Oesophagus 0.96 (about 1 mm.) in length. Testes deeply lobed, and the lobes lobated, shape angularly oval, placed diagnonally rather side by side than one behind the other, 2.0 in length and 2.65 in D.V direction. Genital atrium and ventral atrium of *Calicophoron* type. Eggs 0.125×0.07 (0.125–0.135×0.065–0.07).

Host.—*Bos taurus indicus*, stomach, *Bubalus bubalis*, reticulum and rumen; *Ovis aries* or *Bos taurus*, stomach.

Locality.—Sri Lanka, Colombo; Canton, China; Saigon, Indo-China; Congo; Cape Colony and East Africa.

83. **Calicophoron crassum** (Stiles and Goldberger, 1910) (Fig. 62, 63)

Spedific diagnosis.—Length 6.12–6.5. Breadth 4.2–4.7 D.V meas. 3.5. Dorsal line evenly curved. Acetabulum 2.74 in diameter, in relation to length of body 1 : 2.2–1 : 2.4. Pharynx 1.36 in length, in relation to length of body 1 : 4.4–1 : 4.8. Oesophagus without bulb. Testes small, diagonal, finely lobed. Pars prostatica, genital atrium and ventral atrium of *Calicophoron* type.

Host.—*Bos taurus indicus*, stomach.

Locality.—Panjab.

84. **Calicophoron cauliorchis** (Stiles and Goldberger, 1910)

Specific diagnosis.—Length 6–7.5. Breadth 3.66–4.25. D.V meas. about 3.5 from fig. Dorsal line slightly curved at anterior 2/3 of body, sharply bent at extreme posterior 1/3. Acetabulum 2.5 in diameter, in relation to length of body 1 : 2.4–1 : 3.0. Pharynx 1.0–1.1 in length, in relation to length of body 1 : 6–1 : 7.0. Oesophagus without bulb. Testes small, situated side by side or juxtaposed, finely lobed. Pars prostatica, genital atrium and ventral atrium of *Calicophoron* type.

Host.—*Bos taurus indicus*, stomach.

Locality.—Panjab.

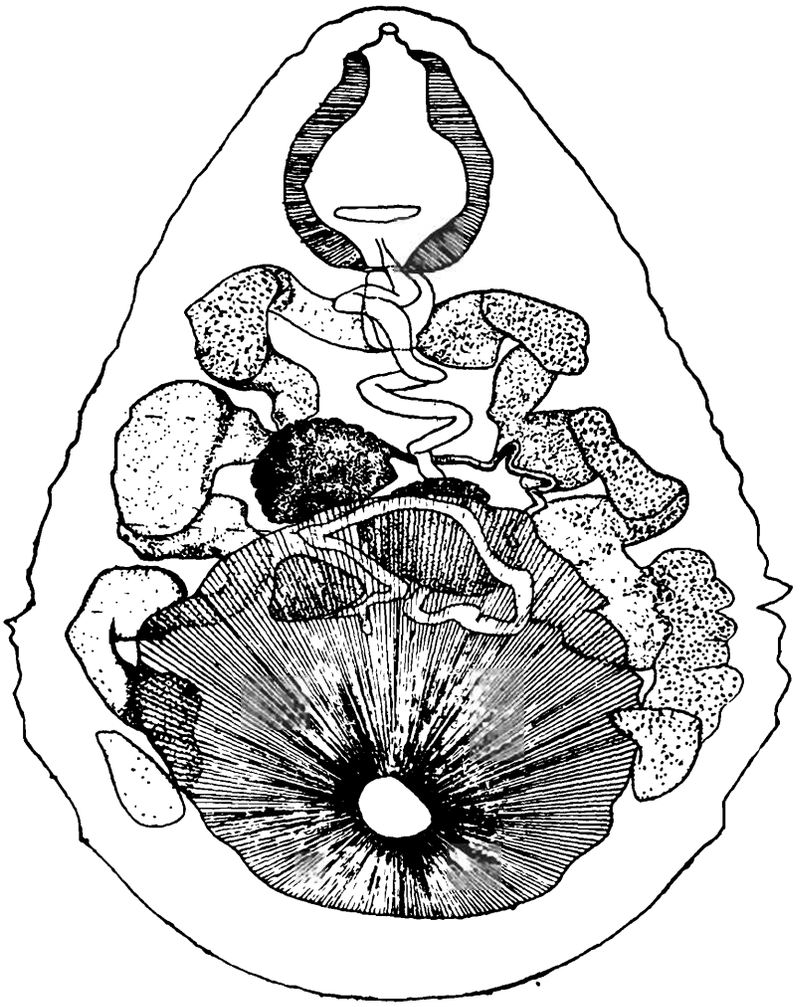


Fig. 62. *Calicophoron crassum* (Stiles and Goldberger, 1910).

85. **Calicophoron papillosum** (Stiles and Goldberger, 1910)

Syn. *Paramphistomum papillosum* Stiles and Goldberger, 1910

Specific diagnosis.—Length 5.12–6.0. Breadth 2.6. D.V meas. 3.0 Dorsal line shallowly curved. Acetabulum 1.8–1.9 in diameter, in relation to length of body 1 : 2.8–1 : 3.2. Pharynx 0.8–0.9 in length, in relation to length of body 1 : 6.4–1 : 6.7 Oesophagus without bulb. Testes small, situated one behind the other, finely lobed. Pars prostatica, genital atrium and ventral atrium of *Calicophoron* type.

Host.—*Bos taurus indicus*, stomach.

Locality.—Panjab.

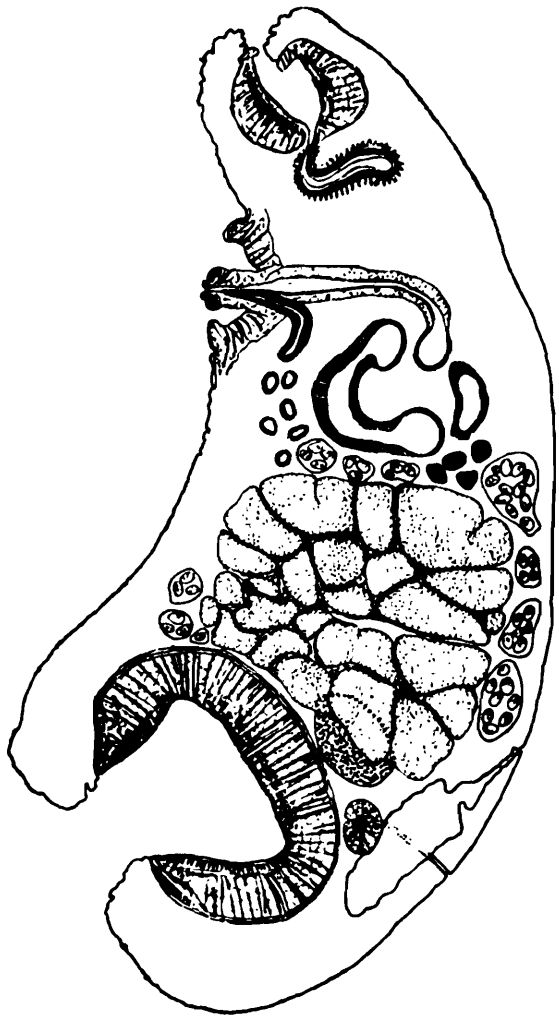


Fig. 63. Anatomy of *Calicophoron ijamai* (Fukui, 1922) (From a median sagittal section). *After* Näsmark, 1937.

Genus 39. **Cotylophoron** Stiles and Goldberger, 1910

Paramphistominae : Body conical or flattened oval. Oral sucker (pharynx) terminal without diverticula. Acetabulum ventroterminal. Acetabular index 1 : 2.7–1 : 4.9. Oesophagus with or without bulb or muscular thickening. Caeca long, undulating. Testes tandem or oblique, entire or lobed. Seminal vesicle convoluted. Pars musculosa, genital papilla and genital sucker well developed. Ovary anterodorsal to acetabulum. Laurer's canal crossing excretory vesicle or not. Vitellaria lateral, overlapping acetabulum laterally. Parasitic in digestive tract of arteodacytle ungulates.

Type-species : *C. cotylophorum* (Fischoeder, 1901) Stiles and Goldberger, 1910

Key to Indian species of **Cotylophoron**

1. Oesophagus with well developed bulb; genital sucker and genital papilla very large; genital atrium deep; testes diagonal, very contiguous, deeply lobed with zones coinciding and overlapping	*C. cotylophorum* (Fischoeder, 1900)
Oesophagus without bulb; testes tandem or oblique. ..	2
2. Testes entire, rounded; cuticle tuberculated or papillated	*C. ovatam* Harshe, 1934
Testes lobed; cuticle smooth	3
3, Testes larger than acetabulum.	*C. elongatum* Harshe, 1934
Testes smaller than acetabulum	4
4. Testes oblique, irregularly lobed.	*C. orientalis* Harshe, 1934
Testes tandem, deeply lobed with thread-like ramifications; oesophagus without bulb or thickening of muscles.	*C. indicum* Stiles and Goldberger, 1910

86. **Cotylophoron cotylophorum*** (Fischoeder, 1901)

(Fig. 64)

Syn. *Paramphistomum cotylophoron* Fischoeder, 1901
Cotylophoron cotylophorum Stiles & Goldberger, 1910
Cotylophoron indicum (Stiles and Goldberger, 1910) Maplestone, 1923

Specific diagnosis.—Body 4.70 (5–6) sometimes up to 8. Breadth 2.5–3.5 D.V meas.: 2.16 (2.2–3.2), somewhat flattened dorsoventrally. Dorsal line curved. Acetabulum 1.76 (1.5–2.0) in diameter, aperture very narrow and surrounded by a folder, pursed up, wreath-shaped ridge. Acetabular index 1 : 2.7 (1 : 2.5–1 : 4.0). Pharynx 0.5 (0.6–1.0) in length, in relation to length of body 1 : 9.5 (1 : 8.0–1 : 10.0) is of *Paramphistomum* type. Oesophagus 0.62 in length, provided with enormous, strongly developed oesophageal bulb. Testes repeatedly strongly lobed, clearly situated diagonally and varying greatly in size, measuring 0.9 (0.6) in length and 1.4 (1.2) in D.V direction. Genital atrium in the shape of a strong genital sucker of *Cotylophoron* type. Eggs 0.125×0.055 (0.140×0.062).

* Srivastava, H. D. (1939—*Indian J. Vet. Sci. anim. Husb.*, 8 : 381—385), Sinha, B. B. (1950—*Ibid.*, 20 : 1—11) worked out life history. Snail host—*Indoplanorbis exustus*—*Ed.*

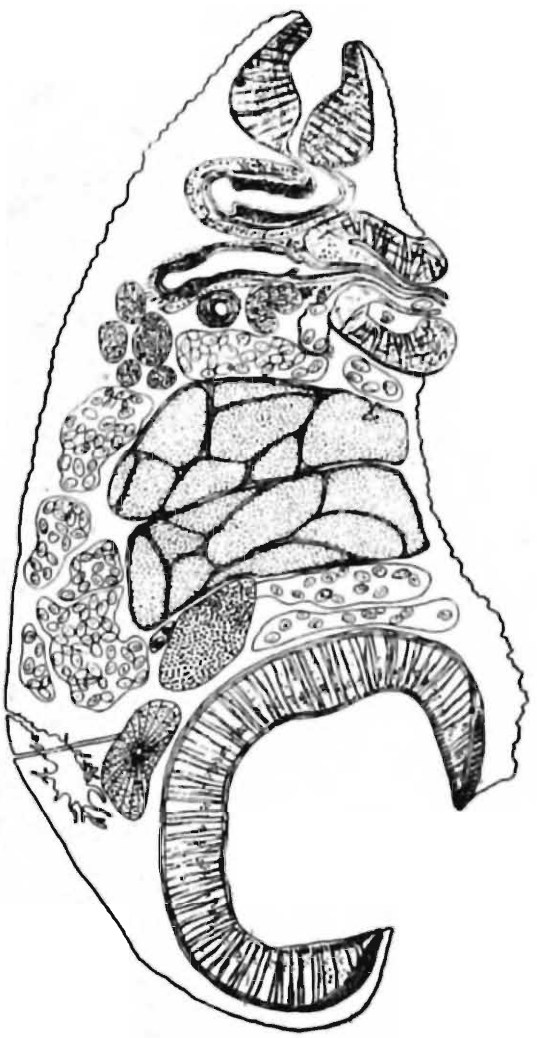


Fig. 64. Anatomy of *Cotylophoron cotylophorum* (Fishoeder, 1901) (From a median sagittal section). *After* Näsmark, 1937

Host.—*Bos taurus*-, stomach, rumen; *Bos taurus indicus*, stomach, rumen; *Bubalus bubalis*, rumen; *Ovis aries*, rumen.

Locality.—Southern Africa, South West Africa, Congo, Indo-China and Philippines.

87. **Cotylophoron indicum**** Stiles and Goldberger, 1910

Syn. *Cotylophoron cotylophorum* (Fischoeder, 1901) Maplestone, 1923
Paramphistoma (Cotylophorum) cotylphorum Fukui, 1929
Cotylophoron cotylophorum Stunkard, 1929
Cotylophoron cotylophorum (Fischoeder) Travassos, 1934
Paramphistomum cotylophorum Fischoeder; Dawes, 1936
Cotylophoron madrasensis N. K. Gupta, 1958
Cotylophoron skrjabini Mukherjee, 1963

** Mukherjee (1960—*Proc. Indian Sc. Congr.*, 47 (3) : 439 ; 1968—*J. zool. soc. India*, 20 (1/2) : 105—122) worked out the life history. Snail host : *Indoplanorbis exustus*.

Cercaria indicae XXVI Sewell, 1922—*Ed.*

Specific diagnosis.—Length 5.8 (3.68–3.85). Breadth 2.0 D.V meas.: 2.0 Dorsal line shallowly curved. Acetabulum 1.55 in diameter (1.43–1.76), in relation to length of body 1 : 2.6–1 : 3.7 Pharynx 0.4–0.6 in length, in relation to length of body 1 : 14.5 or 1 : 6.1–1 : 7.2. according to Gupta, of *Paramphistomum* type. Oesophagus 0.60 (0.59–0.60 according to Gupta), is without bulb or thickening of muscles. Testes relatively deeply lobed with almost thread-like ramifications; almost round in shape; tandem; in size 0.92 long and 1.0 in D.V direction. Genital atrium shaped-like genital sucker of *Cotylophoron* type. Eggs 0.148×0.078 (0.12×0.064 according to Gupta).

Host.—*Ovis aries*, stomach; goat (*Capra hircus*), rumen.
Locality.—Madras, South India; Bareilly (U.P.), North India; Sudan, Africa.

88. **Cotylophoron ovatum,** Harshe, 1934

(Fig. 65)

Specific diagnosis.—Body elongate oval, dorsoventrally thick, 4.32–6.63×2.2–2.3 in maximum breadth at middle of body; bodywall papillated anteriorly. Oral sucker 0.38–0.61 ×0.32–0.44. Oesophagus with thick muscular walls 0.37–0.53 long, 0.88–1.16 in maximum breadth near intestinal bifurcation; limbs of intestinal fork almost at right angles to oesophagus. Caeca sinuous, extending to anterior margin of acetabulum or a little behind. Acetabulum 0.526–0.90 in diameter. Testes almost equal, rounded, close behind each other; anterior 0.88–1.150×1.05–1.41; posterior 0.84–1.284× 1.0–1.39. Vesicula seminalis transversely coiled; pars musculosa highly muscular, transversely coiled. Pars prostatica 0.9 long; ductus ejaculatorius short, unites with metraterm to form ductus hermaphroditicus passing through small genital papilla. Genital sucker 0.24–0.32 in diameter, at 0.16 behind intestinal bifurcation. Ovary entire, slightly to right, between posterior testis and dome of acetabulum, broader than long, 0.22–0.42×0.33–0.42. Eggs 0.13–0.142×0.069.

Host.—Sheep and goat.
Location.—Stomach.
Locality.—Allahabad, U.P.

89. **Cotylophoron orientalis**, Harshe, 1934

Specific diagnosis.—Body elongated, 7.56–9.35×2.98–3.16 in maximum breadth; cuticle smooth, nonpapillated. Oral

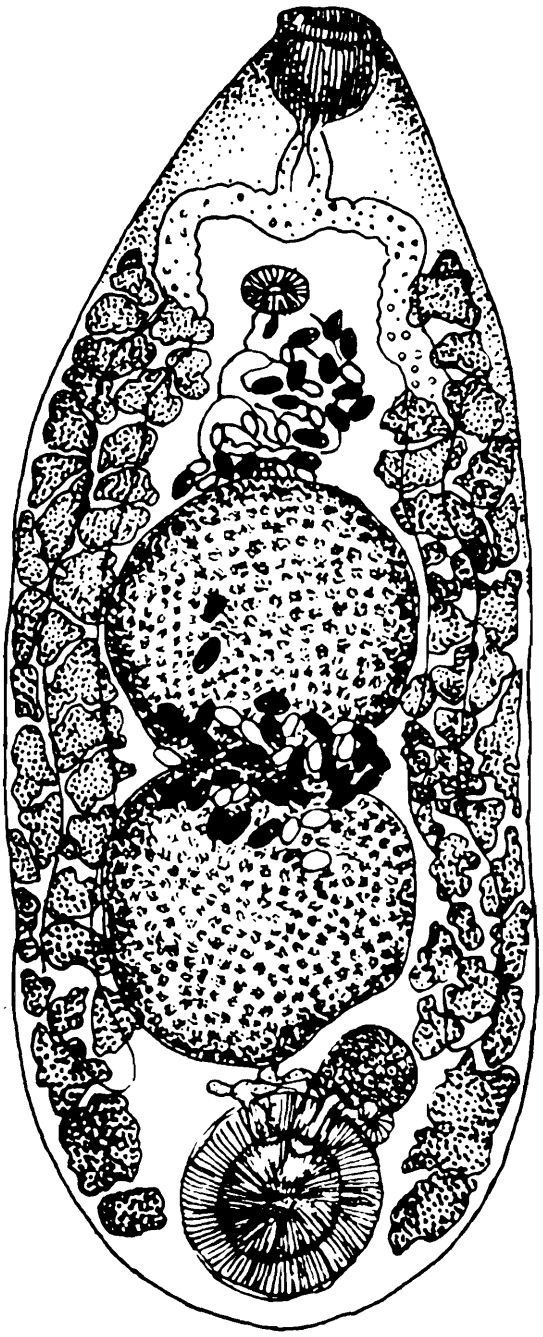


Fig. 65. *Cotylophoron ovatum* Harsho, 1934. Dorsal view.

sucker 0.68–0.93 in diameter. Oesophagus highly muscular, 0.54–0.73 long, 0.17–0.25 uniformly broad; intestinal bifurcation acute angled, 0.68–0.85 anterior to genital pore. Genital sucker 0.25–0.34 in diameter. Testes irregularly lobed, oblique; anterior 0.59–1.39×0.71–1.31; posterior 0.81–1.36× 1.6. Vesicula seminalis shorter than pars musculosa; pars prostatica highly developed. Ovary median or submedian, slightly broader than long, 0.25–0.48×0.34–0.51, at midway

between posterior margin of caudal testis and acetabulum; shell gland mass median behind ovary. Eggs 0.136×0.085. Excretory vesicle median, transversely oval with a transverse canal originating from it on each side and dividing into 3 branches, one running posteriorly and other two long running anteriorly on each side along inner and outer walls of caeca.

Host.—Sheep and goat.

Location.—Stomach.

Locality.—Allahabad, (U.P.).

90. **Cotylophoron elongatum** Harshe, 1934

Specific diagnosis.—Body elongated, 11.58–15.3×2.9–4.65 wide in acetabular zone; cuticle smooth, devoid of papillae. Oral sucker 0.75–0.935 in diameter. Oesophagus muscular, 0.76–1.07 long; intestinal bifurcation acute angled, 1.36 anterior to genital pore. Genital sucker 0.34–0.59 in diameter. Caeca zigzag. Acetabulum 1.97–2.38 in diameter. Testes lobed, tandem broader than long, almost equal, 1.68–2.04×1.78–2.12. Pars musculosa much coiled; pars prostatica highly developed. Ovary 0.68–0.85 in diameter, to right side, almost equidistant from caudal margin of posterior testis and anterior margin of acetabulum. Laurer's canal opening a little anterior to excretory pore. Vitellaria lateral from middle of oesphagus to anterior margin of acetabulum, coalascing behind shell gland mass and around genital sucker. Eggs 0.136–0.17×0.068–0.085. Excretory vesicle large, median between ovary and acetabulum; excretory canals one on each side, intercaecal and almost parallel to bodywall.

Host.—Goat.

Location.—Stomach.

Locality.—Allahabad, U.P.

Genus 40. **Ceylonocotyle** Näsmark, 1937

Paramphistominae : Body subcylindrical to elongate oral, slightly curved ventrad; body musculature poorly developed. Acetabulum ventro-terminal of *Streptocoelium* type. Acetabular index 1 : 6.0–1 : 7.2. Oral sucker (pharynx) without diverticula, with or without lip sphincter. Oesophagus with or without bulb. Testes rounded or transversely elongated, lobed or indented, tandem. Pars musculosa well developed. Genital atrium with or without sphincter. Ovary antero-

dorsal to acetabulum. Laurer's canal not crossing excretory vesicle or canal. Uterus winding dorsal and anterior to testes. Vitellaria along entire length of caeca. Lymph system with one pair of longitudinal trunks. Parasitic in digestive tract of arteodactyle ungulates.

Type-species : *C. scoliocoelium* (Fischoeder, 1904) Näsmark, 1937

Key to species of **Ceylonocotyle**

1.	Oesophageal bulb and lip sphincter present .	2
	Oesophageal bulb and lip sphincter absent. .	3
2.	Genital atrium with genital sphincter.	*C. scoliocoelium* (Fischoeder, 1904)
	Genital atrium without genital sphincter	*C. dicranocoelium* (Fischoeder, 1901)
3.	Genital atrium with genital sphincter; a short oesophagus near posterior end provided with oesophageal sphincter (not to be confused with oesophageal bulb).	*C. streptocoelium* (Fischoeder, 1901)
	Genital atrium without genital sphincter; a long oesophagus without oesophageal sphincter at posterior end	*C. orthocoelium* (Fischoeder 1901),

91. **Ceylonocotyle scoliocoelium*** (Fischoeder, 1904) Näsmark, 1937

(Fig. 66)

Syn. *Paramphistomum scoliocoelium* Fischoeder, 1904
Paramphistomum shipleyi Stiles and Goldberger, 1910
Paramphistomum orthocoelium (Fischoeder, 1901) Maplestone, 1923
Ceylonocotyle dawesi N. K. Gupta, 1958

Specific diagnosis.—Length 5.2; breadth 1.8 D.V. meas. 1.52. Dorsal line shallowly curved. Acetabulum ventroterminal of *Streptocoelium* type, 0.87 in diameter. Acetabular index 1 : 6.0. Oral sucker (pharynx) large, pyriform with lip

* Mukherjee (1960—*Proc. Indian Sc. Congr.*, 47 (3) : 438—439, 1975—*Dr. B.S. Chauhan Comm. Vol.* : 251—266), Jain, S.P. (1969—*Agra Univ. J. Res. Sc.*, 18 (3) : 1—16) worked out the life history. Snail host : *Digoniostoma pulchella.*

Cercaria bulimusci Peter & Srivastava, 1955—*Ed.*

sphincter of *Dicranocoelium* type, 0.5 in length, in relation to length of body 1 : 10.4. Oesophagus 0.86 long provided with oesophageal bulb. Testes smoewhat lobed, rounded elliptically, about 0.6 long and 0.9 D.V meas. Genital atrium of *Scoliocoelium* type provided with prominent genital sphincter around ductus hermaphroditicus opening on vortex of genital papilla. Eggs 0.096–0.128 × 0.056–0.076.

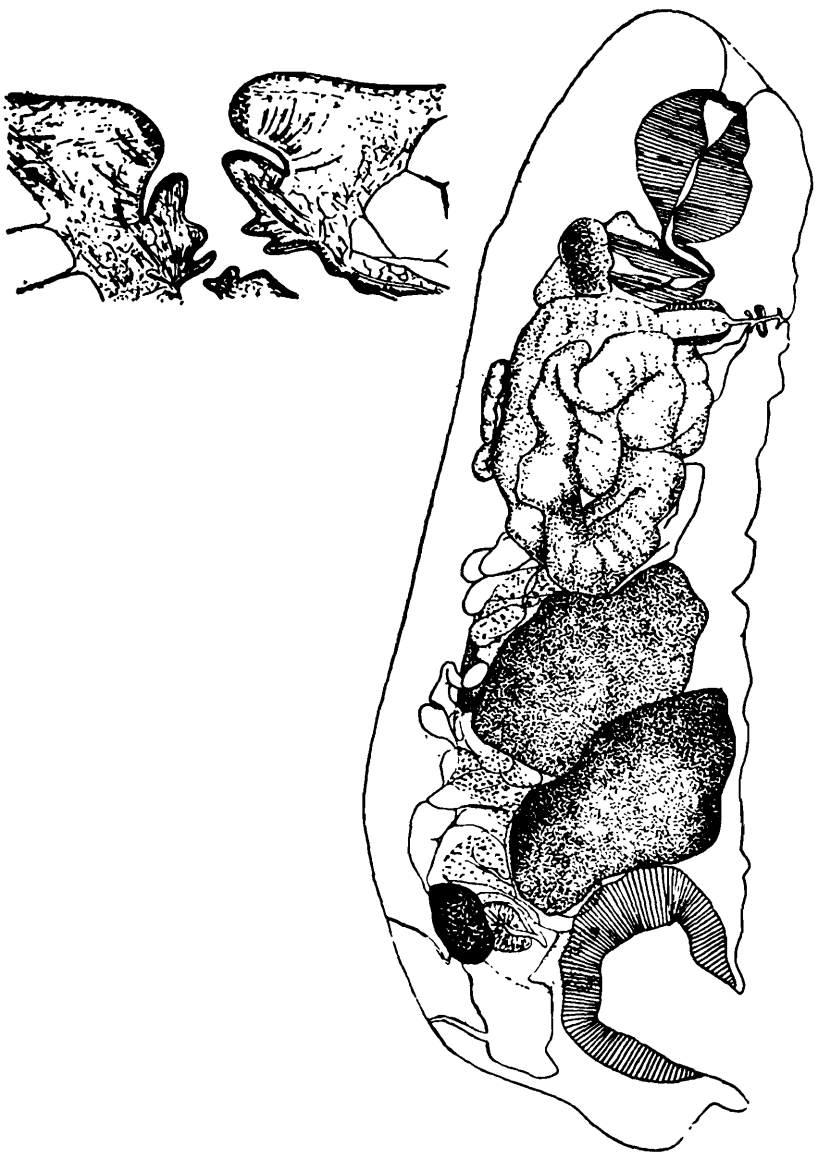


Fig. 66. *Ceylonocotyle scoliocoelium* (Fishoeder, 1901) Näsmark, 1937. Genital atrium Scoliocoelium type. *After* Näsmark, 1937 and sagittal section.

Host.—*Bos taurus*, rumen; *Bos indicus*, *Bubalus bubalis*, stomach.

Locality.—Sri Lanka, Madras, Calcutta, Panjab, French Indo-China.

92. **Ceylonocotyle dicrocoelium** (Fischoeder, 1901) Näsmark, 1937

Syn. *Paramphistomum dicrocoelium* Fischoecder, 1901
Paramphistomum (*Orthocooelium*) *dicrocoelium*Fischoeder : Stiles and Goldberger, 1910
Paramphistomum orthocoelium Fischoeder : Maplestome, 1923
Paramphistomum (*Paramphistoma*) *orthocoelium* (Fischoeder) : Fukui, 1929.

Specific diagnosis.—Length 6.4. Breadth 2.3. D.V meas. 1.8. Dorsal line slightly curved. Acetabulum of *Streptocoelium* type, 1.06 in diameter, in relation to length of body 1 : 6.1. Pharynx 0.68 in length, in relation to length of body 1 : 9.4 of *Dicranocoelium* typ , i.e., provided with a distinct lip sphincter. Oesophagus 0.5 in length, with a strong oesophageal bulb. Testes lobed and rounded elliptically, about 0.9 in length and 1.6 in D.V direction. Genital atrium without genital sphincter, of *Gracile* type.

Host.—*Bos taurus*, rumen.

Locality.—Sri Lanka.

93. **Ceylonocotyle streptocoelium** (Fischoeder, 1901)

Syn. *Paramphistomum streptocoelium* Fischoeder, 1901
Paramphistomum orthocoelium Fischoeder : Maplestone, 1923
Paramphistoma (*Paramphistoma*) *orthocoelium* (Fischoeder) : Fukui, 1929.

Specific diagnosis.—Length 7.6. Breadth 2.0. D.V meas. 1.7 Dorsal line anterior half plane, posterior half curved. Acetabulum 1.05 in diameter, in relation to length of body 1 : 7.2. Pharynx of *Paramphistomum* type without lip sphincter, 0.5 in length. Oesophagus short, 0.77, in relation to length of body about 1 : 10.0 is provided with a sphincter muscle in the part nearest to intestinal bifurcation. Testes a few lobes, total form rounded elliptically, size 0.9 in length and 0.8 in D.V direction. Genital atrium of *Streptocoelium* type with genital sphincter.

Host.—*Bubalus bubalis*, stomach.

Locality.—Sri Lanka.

94. **Ceylonocotyle orthocoelium** (Fischoeder, 1901)

Syn. *Paramphistomum orthocoelium* Fischoeder, 1901

Specific diagnosis.—Length 6.6. Breadth 1.8 D.V meas. 1.8. Dorsal line; anterior half almost straight, posterior half

curved. Cuticle : the middle third of body is transparent, a difference from *C. streptocoelium* which it greatly resembles in habitus. Acetablulum 1.0 in diameter, in relation to length of body 1 : 6.6. Pharynx 0.9 in length of *Paramphistomum* type without lip sphincter, in relation to length of body 1 : 7.7 Oesophagus : in comparison with *C. streptocoelium* it is very long proportionately, measuring 1.4 in length, in relation to length of body 1 : 4.7 (as compared with 1 : 10.0 for *C. streptocoelium*), is without oesophageal sphincter. Caeca straight. Testes very shallowly lobed, few lobes, total form somewhat elliptically rounded : approximate size : 0.65 in length and 0.8 in D.V direction. Genital atrium entirely without musculature, is of *Gracile* type.

Host.—*Bubalus bubalis*, pansen, stomach.

Locality.—Sri Lanka, Indo-China.

Species inquirenda

95. **Ceylonocotyle nasmarki** Mukherjee, 1963

Specific diagnosis.—Length 4.202. Breadth 2.016 at level of midbody. Curved slightly ventrally; anterior part papillated, the rest smooth. Acetabulum 0.858, opening directed ventrally, in relation to length of body 1 : 5.8. Pharynx 0.58 long and 0.52 broad, in relation to length of body 1 : 72. Oesophagus 0.311 long, provided with well developed oesophageal bulb; caeca slightly wavy at posterior end, terminating at level of middle of acetabulum. Testes oblique tandem, triangular in shape, 0.582×0.851; 0.612×0.722. respectively. Ovary rounded at level of middle of acetabulum. Genital pore post-bifurcal. Eggs 0.14×0.07 As the presence or absence of lip sphincter and genital sphincter is not mentioned, the species is held sp. inq.

Host.—Sheep, *Ovis aries.*

Location.—Rumen.

Location.—Izatnagar, U.P. India.

Genus 41. **Paramphistomoides** Yamaguti, 1958

Paramphistominae : Body elongate, elliptical, thick, curved ventrally. Acetabulum ventroterminal, not very large; acetabular index 1 : 6. Oral sucker without diverticula. Oesophagus moderately long, without posterior bulb. Caeca

long, fairly wide, somewhat sinuous, terminating in front of acetabulum. Testes tandem in midbody lobed. Vesicula seminalis coiled in front of anterior testis. Pars musculosa and pars prostatica present. Ductus hermaphroditicus small, opening on genital papilla projecting into genital atrium. Genital pore postbifurcal. Ovary posttesticular, slightly submedian, rounded. Laurer's canal not crossing excretory vesicle, opening just in front of excretory pore. Uterus winding forward dorsal to testes. Vitelline follicles small, extending from middle of oral sucker to anterior border of acetabulum, meeting behind ovary and continuous dorsally in front of acetabulum to genital pore. Excretory vesicle oval, dorsoanterior to acetabulum. Parasitic in intestine of ungulates.

Type-species : *P. maplestonei* (Bhalerao, 1937) Yamaguti, 1958.

96. **Paramphistomoides maplestonei** (Bhalerao, 1937) Yamaguti, 1958

Syn. *Paramphistomum maplestonei* Bhalerao, 1937

(Fig. 67)

Specific diagnosis.—Body thick, elliptical, 4.05–4.6 long, 1.1–1.2 in maximum thickness at about midbody. Acetabulum 0.67 in diameter; acetabular index 1 : 6. Oral sucker 0.46–0.57 × 0.4–0.43. Oesophagus moderately long, 0.2–0.22 in length; intestinal bifurcation at about one fifth or body length. Caeca fairly wide, terminating 0.22 in front of acetabulum. Excretory pore at level of posterior border of ovary, 0.147 in front of posterior end. Genital pore 0.22 posterior to intestinal fork. Testes large, lobate, in midbody, 0.63–0.73 × 0.63–0.77; anterior preequatorial, posterior postequatorial. Ovary immediately behind posterior testis, slightly to left, 0.23–0.32 in diameter. Shell gland mass oval, 0.3 × 0.16 median behind ovary. Metraterm thick, 0.27 × 0.12. Vitelline follicles of either side most centrally on the dorsal aspect anterior to genital pore and posterior to ovary. Eggs 0.115–0.119 × 0.05–0.052.

Host.—Hogdeer, *Heylaphus porcinus.*

Location.—Small and large intestine.

Location.—Calcutta Zoo.

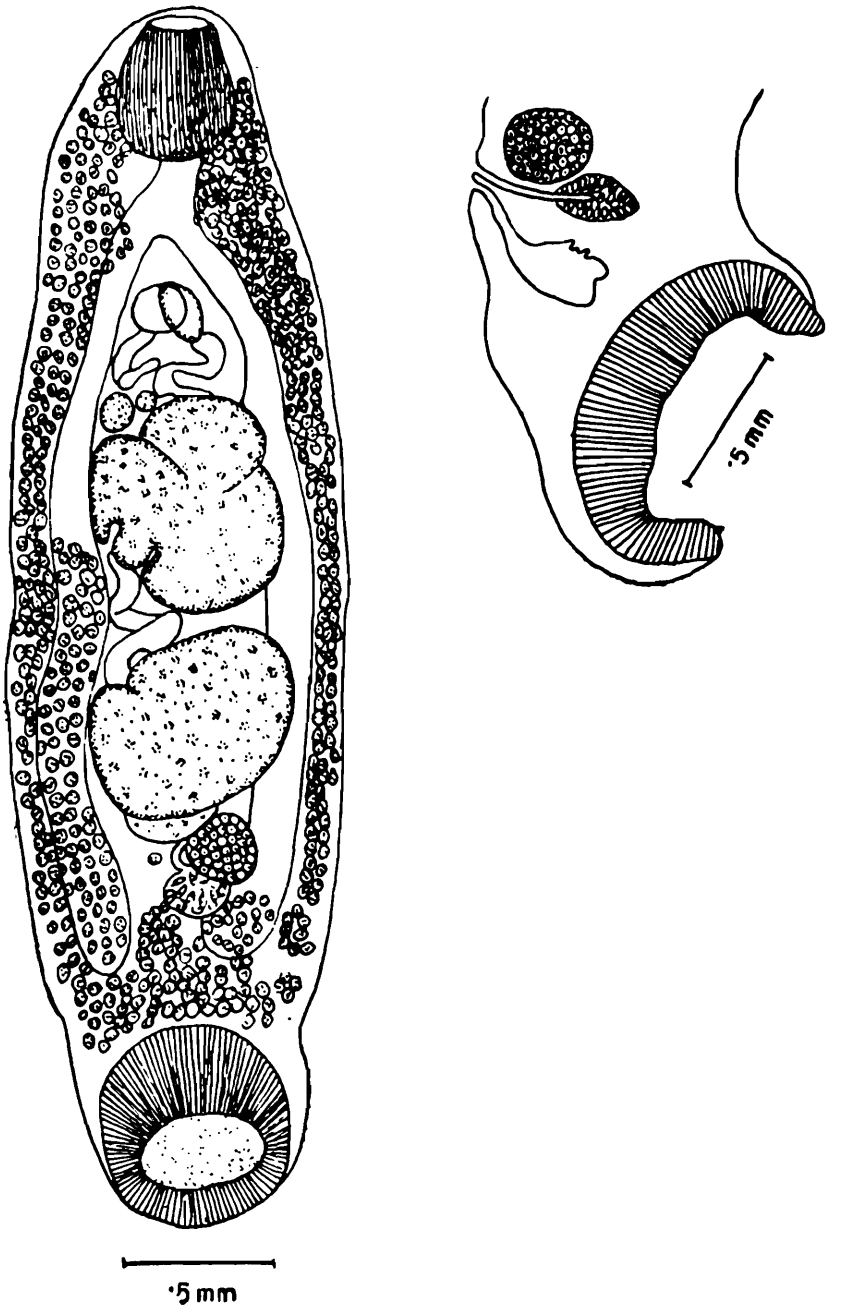


Fig. 67. *Paramphistomoides maplestonei* (Bhalerao, 1937) Yamaguti, 1958. (Ventral view) and its portion showing relation of excretory bladder and opening of Laurer's canal.

Genus 42. **Pseudoparamphistoma** Yamaguti, 1958

Paramphistominae : Body very much elongated, translucent, flat, tapering gradually towards anterior end. Acetabulum ventroterminal ; acetabular index 1 : 6. Oral sucker without diverticula. Oesophagus long without distinct posterior bulb. Caeca moderately wide, terminating some

distance in front of acetabulum. Genital pore median some distance posterior to intestinal fork. Testes lobed, tandem in posterior half of body; posterior testis more or less in level with caecal ends. Seminal vesicle, pars musculosa, pars prostatica present. Ductus hermaphroditicus very short opening on genital papilla projecting into genital atrium. Ovary small, slightly submedian, some distance behind posterior testis, between caecal ends and acetabulum. Laurer's canal passes anteriorly to excretory vesicle, opening a little anterior to acetabulum. Uterus winding forward lateral to testes. Vitelline follicles large, extending from level of postbifurcal genital pore to anterior end of acetabulum. Excretory vesicle preacetabular, oval; pore a short distance posterior to opening of Laurer's canal. Parasitic in stomach and intestine of carnivores.

Type-species : *P. cuonum* (Bhalerao, 1937) Yamaguti, 1958

97 **Pseudoparamohistoma cuonum** (Bhalerao, 1937) Yamaguti, 1958

(Fig. 68)

Specific diagnosis.—Body flat, transluscent, flesh coloured, elongated, tapering towards anterior end, 3.35–5.7 long, 0.06–0.95 in maximum breadth, which varies from fifth to third of body length from posterior end. Acetabulum 0.47–0.55 in diameter; acetabular index 1 : 6. Oral sucker 0.32–0.43 × 0.3–0.32. Oesophagus 0.46–0.58 long; oesophageal bulb very slightly differentiated. Caeca terminating 0.45–0.72 in front of acetabulum. Excretory pore at 0.55 from posterior end; excretory vesicle oval. Testes oval, lobed, 0.47–0.69 × 0.31–0.34; anterior testis close to midbody, posterior near caecal ends. Ovary round, 0.13–0.23 in diameter. Laurer's canal opens 0.35 anterior to excretory pore. Vitellaria extend from genital pore to anterior border of acetabulum; follicles large, caecal, extracaecal and a few intercaecal posterior to ovary. Eggs 0.12–0.123 × 0.054–0.065.

Host.—Wild dog, *Cuon alpinus dukhunensis.*

Location.—Stomach, small intestine.

Locality.—Calcutta Zoo.

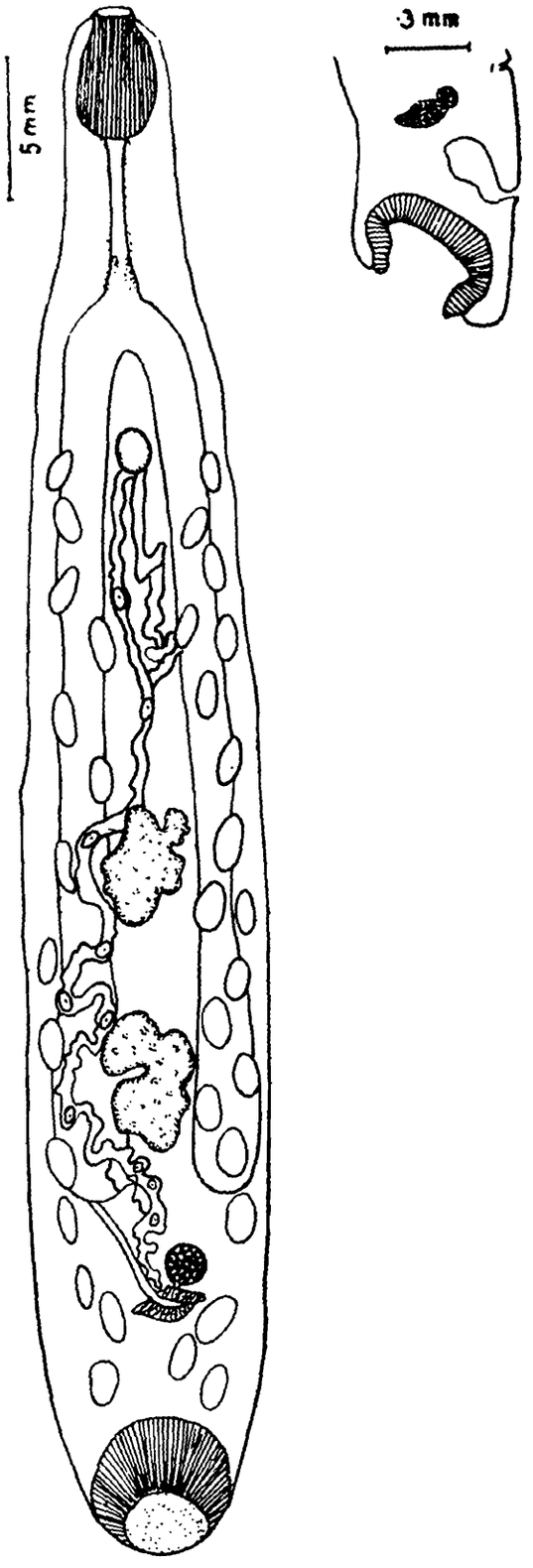


FIG. 68. *Pseudoparamphistoma cuonum* (Bhalerao, 1937) Yamaguti 1958 and its dorsoventral section showing opening of Leurer's canal and exretory pore.

Genus 43. **Paramphistomacotyle** n.gen.

Paramphistominae : Body subcylindrical, tapering towards anterior end, covered with chitinous papillae, and 5 or 6 rows spines at anterior end. Acetabulum ventroterminal; acetabular index probably 1 : 6–7 Oral sucker without diverticula. Oesophagus moderately long without posterior bulb. Caeca long, broad, terminating a little anterior to anterior margin of acetabulum. Genital pore surrounded by a muscular ring, submedian in front of intestinal bifurcation. Excretory vesicle elongated, sac-like extending to anterior margin of acetabulum, hanging posteriorly over the latter as in *Pfenderius* syn. *Tagumaea;* excretory pore postvesicular, posterodorsal near middle of acetabulum far behind opeinging of Laurer's canal; an accessory transverse duct unites two longitudinal excretory ducts near their origin from excretory vesicle. Testes tandem, lobed. Vesicula seminalis much coiled in front of anterior testis. Pars musculosa in front of intestinal bifurcation; pars prostatica short, ejaculatory duct short, opening into genital atrium. Genital atrium muscular; genital pore surrounded by muscular rings. Ovary transversely oval, a little anterior to acetabulum. Laurer's canal opens a little anterior to acetabulum. Uterus first runs transversely behind ovary and then winds forwards. Vitellaria consist of elongated follicular masses in 12–14 groups of 2–20 follicles each, extending from middle of oesophagus to middle of acetabulum mostly ventral to caeca, except behind testes where they are scattered. Parasitic in stomach of cattle.

Type-species: *P. spinicephalus* (Tandon, 1955). n.comb.

98. **Paramphistomacotyle spinicephalus** (Tandon, 1955) n.comb.

(Fig. 69)

Syn. *Paramphistomum spinicephalus* *Tandon, 1955

Specific diagnosis.—Body subcylindrical; cuticular papillae and 5 or 6 rows of small hollow spines at anterior end; body length 7.68–11.625, maximum breadth near acetabulum

*Mukherjee and Chauhan (1967, *J. zool. Soc. India*, **17** (1 & 2) (1965) : 150–225) transforred this species to the genus *Ceylonocotyle* Nasmark, 1937.—*Ed.*

3.062–3.89. Acetabulum ventroterminal; acetabular index probably 1 : 6–7 Oral sucker 0.62–1.10 × 0.87–1.25. Oesophagus 2.187–3 long. Caeca thick, each 1.0 broad, terminating near anterior margin of acetabulum. Excretory pore postvesicular, dorsal at posterior end near middle of acetabulum, far behind opening of Laurer's canal. Excretory vesicle elongated, sac-like, extending to anterior margin of acetabulum, hanging toward posterior end as in *Tagumaea;* an accessory transverse duct connects two longitudinal ducts soon after their origin from excretory vesicle; rest of excretory system similar to that of *Olveria indica* forming anastomosis of tubules round various organs and caeca. Lymphatic system a pair of longitudinal vessels running dorsally to caeca from anterior to posterior ends of body. Testes tandem

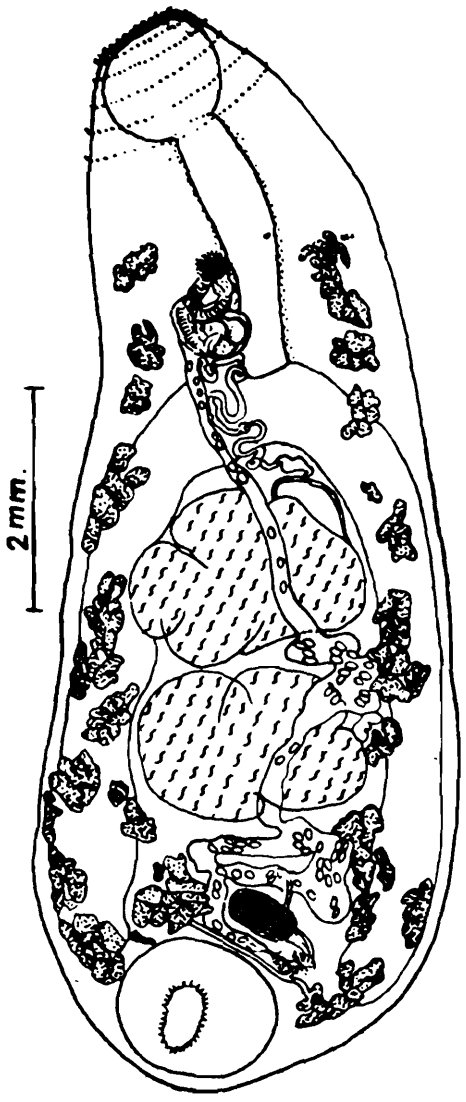


FIG. 69. *Paramphistomacotyle spinicephalis* (Tandon, 1955), n. comb.

in middle of body, two to four lobed; anterior 1.37–2.062 × 1.56–2.312; posterior 1.25–2.062 × 1.625–2.437 Vesicula seminalis coiled in front of anterior testis. Pars musculosa in front of intestinal bifurcation; pars prostatica small, enters genital atrium through short ejaculatory duct. Genital atrium muscular; common genital pore surrounded by a muscular ring. Ovary transversely oval, a little anterior to acetabulum, 0.324–0.576 × 0.694–0.9. Uterus first runs transversely behind ovary before winding forwards. Genital atrium 1.87–2.75 in front of intestinal bifurcation at 1.875–2.75 from anterior end of body. Metraterm slightly muscular. Vitellaria consist of elongated follicular masses of 12–14 groups of 2–20 follicles each, extending from middle of oesophagus to middle of acetabulum, appearing to be in a single row ventral to caeca except behind testes where they are scattered. Eggs 0.1064–0.137 × 0.0588–0.07

Host.—*Bos bubalis.*

Location.—Stomach.

Locality.—Lucknow, U.P.

XXIII. Subfamily *GASTROTHYLACINAE* Stiles and Goldberger, 1910

Paramphistomidae : Ventral sac present. Body conical or much elongated. Ventral sac may or may not reach acetabulum. Oral sucker without diverticula. Oesophagus without bulb. Caeca long or short. Genital pore usually opening into ventral sac, exceptionally outside it, near anterior extremity. Testes symmetrical side by side or median obliquely dorsoventral one being dorsal or antero-dorsal to the other. Cirrus sac and genital sucker absent. Vas deferens, vesicula seminalis, pars musculosa, pars prostatica, ductus ejaculatorious in median dorsal field, but vas deferens near middle crosses uterus and extends into lateral field in *Gastrothylax.* Ovary intertesticular or posttesticular. Laurer's canal anterior to excretory pore. Excretory vesicle preacetabular. Vitellaria extensive, lateral or ventrolateral. Uterus confined to dorsal median field or crossing median line and running opposite male terminalia. Parasitic in stomach of mammals.

Type-genus : *Gastrothylax* Poirier, 1883

Key to genera of GASTROTHYLACINAE according to Yamaguti (1958)

1. Uterus crossing from one side to the other near middle.	*Gastrothylax* Poirier, 1883
Uterus in middle dorsal field throughout its length.	2
2. Testes juxtaposed, one on each side of median line	*Carmyerius* Stiles and Goldberger, 1910
Testes tandem in median line	*Fischoederius* Stiles and Goldberger, 1910

Genus 44. **Gastrothylax** Poirier, 1883

Gastrothylacinae : Body elongated conical, slightly constricted near posterior end, rather flattened ventrally and convex dorsally. Testes symmetrical, side by side, lobed. Vas deferens crossing uterus near equator of body so that cephalic half of uterus and vas deferens lie separated on opposite sides. Parsmusculosa not enormous. Genital pore without sucker a little behind opening of ventral sac, exceptionally outside it, near anterior extremity. Ovary intertesticular. Laurer's canal opening anterior to excretory pore. Vitellaria extending near ventral sac from oral sucker to acetabulum. Excretory vesicle dorsal to acetabulum or between base of ventral sac and acetabulum; pore in acetabular zone. Lymphatic system of one pair of longitudinal vessels. Parasitic in stomach of mammals.

Type-species : *G. crumenifer* (Crepl., 1847) Poirier, 1883

99. **Gastrothylax crumenifer*** (Crepl., 1847) Poirier, 1883

(Fig. 70)

Syn. *Gastrothylax compressus* Brandes, 1892
Gastrothylax compressus; Leiper, 1908
Gastrothylax compressus; Stiles and Goldberger, 1910
Gastrothylax compressus; Maplestone, 1923
Gastrothylax (*Gastrothylax*) *crumenifer* Fukui, 1929

Specific diagnosis.—Body elongate, red when fresh, 9–18 long, 5.0 broad or thick, with large ventral sac opening

* Life history of this species has been worked out by Tandon (1957—*Zeit. fur. Wissen Zool.*, *X*, 160(1/2) : 39-71); Peter & Srivastava (1961—*Parasitology*, 51 : 115-115). Snail host—*Gyraullus convexiusculus*; *Cerbaria chungathi* Peter & Srivasta, 1955—*Ed.*

anteriorly and extending over the whole ventral surface up to acetabulum. Anterior end papillated. Oral sucker and acetabulum 0.82×0.7 and 1.63×2.3 respectively. Genital pore opens into ventral sac half way between pharynx and intestinal bifurcation. Oesophagus S-shaped, 1.12 long. Caeca terminate at about level of anterior border of testes Testes symmetrical, side by side, deeply lobed, between caeca and acetabulum with ovary median between them. Cephalic half of uterus and vas deferens on opposite sides. Laurer's canal opening anterior to excretory pore. Vitellaria of small follicles extend from intestinal fork to acetabulum along entire length and breadth of worm. Eggs 0.115–0.145× 0.06–0.07

Host.—Sheep, cattle, buffalo.

Location.—Stomach.

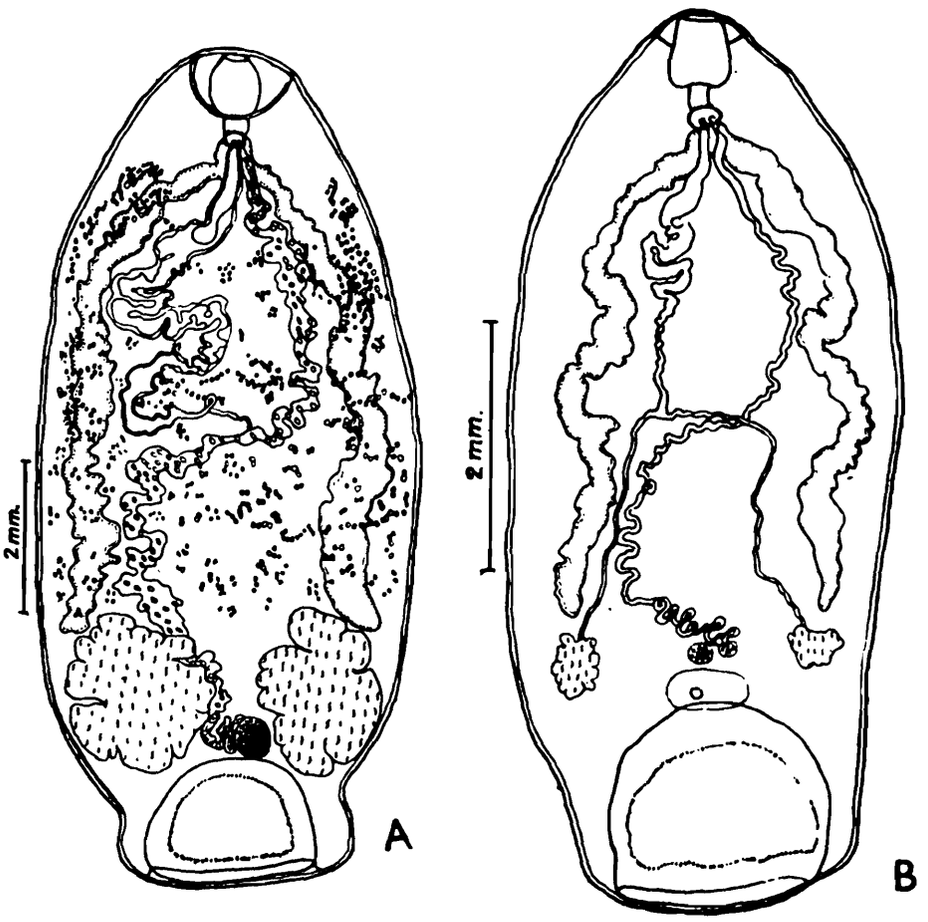


FIG. 70. A—*Gasrothylax crumenifer* (Creplin, 1947). Immature adult.

B – *Gastrothylax crumenifer* (Creplin, 1887). Poirier, 1883. Mature adult.

Locality.—India, Bengal, Panjab, U.P.; Sri Lanka; Burma and China.

Percentage of infection 80–100 per cent.

Intermediate host.—Gyraulus convexiusculus. Life cycle investigated by R. S. Tandon at Lucknow (1957).

Genus 45. **Fischoederius** Stiles and Goldberger, 1910

Gastrothylacinae : Body elongate or rather conical, with or without slight constriction in pretesticular or preacetabular region, greatest transverse diameter near equator. Ventral sac reaching to testicular zone. Caeca long reaching acetabulum beyond ovariotesticular zone or short ending at about middle of body. Testes obliquely dorsoventral or one testis dorsal or anterodorsal to the other in median line, lobed. Cephalic half of uterus and vas deferens both median; vas deferens, vesicula seminalis, pars musculosa, pars prostatica and ductus ejaculatorius all in median field. Genital pore opening into ventral sac at about level of intestinal bifurcation. Ovary intertesticular or posttesticular. Laurer's canal opening anterior to excretory pore. Pretesticular part of uterus in median dorsal field. Vitellaria ventrolateral extending from behind genital pore to ovariotesticular zone. Excretory vesicle preacetabular; pore in acetabular or preacetabular zone, a little posterior to opening of Laurer's canal. Parasitic in stomach of mammals.

Type-species : *P. elongatus* (Poirier, 1883)

Key to species of **Fischoederius**

Caeca short, ending at about middle of body . . .	*F. elongatus* (Poirier, 1883)
Caeca long, reaching acetabulum.	*F. cobboldi* (Fischoeder 1901)

100. **Fischoederius elongatus*** (Poirier, 1883) Stiles and Goldberger, 1910.

(Fig. 71)

Syn. *Fischoederius fischoederi* Stiles and Goldberger, 1910
Fischoederius ceylonensis Stiles and Goldberger, 1910
Fischoederius elongatus Maplestone, 1923
Fischoederius siamensis Railliet, 1923
Fischoederius ceylonesis; Fuhrmann, 1928
Gastrothylax (*Fischoederius*) *elongatus* Fukui, 1929

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*Rao & Ayyar (1932–*Indian J. Vet. Sc. anim. Husb.*, 2 : 402–405), Mukherjee (1966–*Indian J. Helminth.*, 18 : 5–14) ellucidated the life history. Snail hosts : *Lymnea acuminata* : *L. lutcola* ; *Gyraullus euphratibus*. Cercaria *Cercariae indicae* XXIX Sewell, 1922.—*Ed.*

Specific diagnosis.—Body length, 6–20, maximum breadth 2.56–3.0 at junction of equatorial and caudal thirds; surface smooth, except a few papillae around mouth and aperture of ventral sac. Ventral sac with a narrow neck extending to posterior margin of genital atrium; opening of ventral sac 0.62 from oral margin, cavity rather triangular with apex ventrad. Genital pore 1.18 from anterir end, somewhat prebifurcal in oesophageal zone. Acetabulum 1.6×1.0, terminal, slightly sunken in body, aperture 0.46, directed caudad. Mouth terminal; oral sucker elongate pyriform, 0.62×0.33 broad. Oesophagus 0.72 long, longer than oral sucker. Caeca short, not extending beyond junction between third and four fifths of body. Excretory pore dorsomedian at equator of acetabulum and slightly, 0.36 caudad of pore

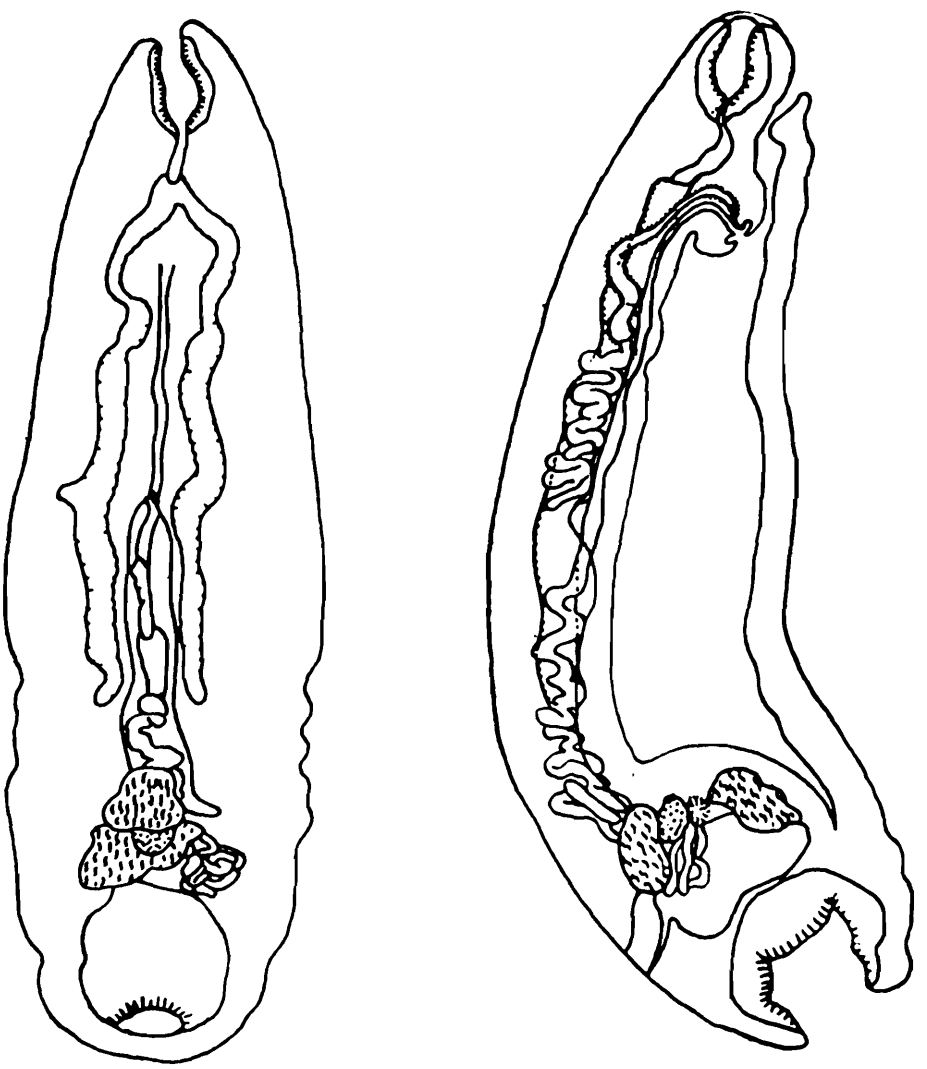


FIG. 71. *Fischoederius elongatus* (Poirer, 1883) seg. Stiles and Goldberger.

of Laurer's canal. Testes large, indented, one dorsal to the other, immediately preacetabular, median, zones coincide, fields overlap, one testis extending more to the right, the other more to the left of median line; vasa efferentia unite at equator of body. Vesicula seminalis and pars musculosa coiled; pars prostatica long, nearly straight; ductus ejaculatorius short, discharges separately from metraterm. Ovary and shell gland ventrocaudad of and much smaller than dorsal testis. Vitellaria in ventrolateral and dorsal body regions, lateral to caeca, extending from level of caudal end of pars prostatica into but not beyond equatorial third. Uterus dextral at origin, dips slightly posteriorly, coils forwards dorsally, ventrally and to right of dorsal testis, passes under vasa efferentia and then in slightly irregular line but without loops ventrally to vas deferens; metraterm just below ductus ejaculatorius. Laurer's canal 0.36 cephalad of excretory pore and 0.11 of cephalic margin of acetabulum. Eggs 0.125–0.135 × 0.065–0.075.

Host.—*Bos kerabaur*, cattle, buffalo.

Location.—Stomach.

Locality.—Sri Lanka; India, U.P. and other provinces.

101. **Fischoederius cobboldi** (Poirier, 1883) Stiles & Goldberger, 1910

Specific diagnosis.—Body 2.7–15.5 long, 1–4.3 broad. Caeca reaching anterior border of acetabulum. Testes 0.8–1.0 in diameter. Ovary 0.33 × 0.3, posterolateral to dorsal testis. Eggs 0.11–0.12 × 0.06–0.065.

Host.—Cattle.

Location.—Stomach.

Locality.—Sri Lanka; India, U.P. (Muktesar).

Genus 46. **Carmyerius** Stiles and Goldberger, 1910

Syn. *Wellmanius* Stiles and Goldberger, 1910
Gastrothylax Näsmark, 1937

Gastrothylacinae : Body conical or subelliptical, straight or curved, circular in transverse section. Ventral sac extending

to near acetabulum, triangular or circular in transverse section with apex directed dorsad or ventrad. Acetabulum terminal. Oral sucker without evagination. Oesophagus without bulb. Caeca lateral long or short, wavy or not. Testes symmetrical, preacetabular, lobed. Vas deferens, vesicula seminalis, pars musculosa, pars prostatica and ductus ejaculatorius in median dorsal field. Genital papilla may be prominent. Ovary intertesticular, prevesicular. Laurer's canal opening anterior to excretory pore. Uterus confined to dorsal median field throughout length. Vitellaria lateral, ventral to caeca from behind intestinal bifurcation to near base of ventral sac. Excretory vesicle immediately pre-acetabular; pore in acetabular zone. Parasitic in stomach of mammals.

Type-species : *C. gregarius* (Looss, 1896)

Key to species of **Carmyerius**

Caeca reaching the posterior fourth of body	*C. spatiosus* (Brandos, 1898)
Caeca short, hardly reacing midbody.	*C. gregarius* (Looss, 1896)

102. **Carmyerius gregarius** (Looss, 1896) Stiles and Goldberger, 1910

Specific diagnosis.—Body length 7–10, breadth 2–2.5. Caeca reaching middle of body. Acetabulum 1–1.5 in diameter.

Host.—Buffalo.

Location.—Stomach.

Locality.—India, exact locality not known. Egypt and West Africa.

103. **Carmyerius spatiosus** (Brandes, 1898) Stiles and Goldberger, 1910

Syn. *Gastrothylax mancupatus* Fischoeder, 1901
G. minutus Fischeeder, 1901
G. synethes Fischoeder, 1901
Wellmanius wellmani Stiles and Goldberger, 1910
G. bubalis Innes, 1912
C. wenyoni (Leiper, 1908)

Specific diagnosis.—Body 6–12 long, 3–4 thick. Caeca reaching as far as testes, a little in front of hinder end. Genital pore postbifurcal on a papilla within ventral sac. Testes immediately anterior to acetabulum, symmetrical side by side, lobed. Ovary intertesticular, usually on left side. Eggs 0.112–0.125×0.06–0.065.

Host.—Cattle.

Location.—Stomach.

Locality.—Sri Lanka ; India, U.P. and Africa.

XXIV Subfamily *GASTRODISCINAE* Monticelli, 1892

Paramphistomidae : Body divided into two parts, anterior short, cylindrical or conical and posterior large, discoid, ventrally excavated with or without numerous papillae; papillated region belongs to anterior large part in *Homalogaster*. Acetabulum small, ventroterminal. Oral sucker with paired posterior diverticula. Genital pore without sucker, bifurcal. Oesophagus with bulb. Testes diagonal or tendem. Cirrus sac absent or rudimentary. Ovary posttesticular. Laurer's canal opening anterior to excretory pore. Uterus mainly posterior and dorsal to testes. Excretory pore postvesicular. Parasitic in intestine, rarely bile ducts of mammals.

Type-genus : *Gastrodiscus* Leukart, 1877

Key to genera of GASTRODISCINAE

1. Anterior part large, flat; posterior part smaller and spherical; testes tandem. *Homalogaster* Poirior, 1883
   Anterior part small, conical or almost cylindrical, posterior part large and flat; testes diagonal. 2

2. Ventral surface of posterior part not covered with papillae; vitellaria extending from level of posterior testis to acetabular zone. . . *Gastrodiscoides* Leiper, 1913
   Ventral surface of posterior part covered with papillae; vitellaria occupying whole of extracaecal fields. *Gastrodiscus* Luekart, 1877

Genus 47 **Gastrodiscus** Leukart, 1877

Gastrodiscinae : Body divided into small, almost cylindrical anterior part and large discoidal, ventrally concave posterior

part with numerous papillae. Acetabulum small, ventroterminal with raised margin. Oral sucker with paired diverticula. Oesophagus with posterior bulb. Caeca long, not wavy, terminating in front of acetabulum. Testes diagonal, deeply lobed or branched in middle third of body. Pars musculosa not enormous. Cirrus sac rudimentary. Genital pore without sucker at or near anterior margin of excavated posterior part, bifurcal or postbifurcal. Ovary lobed, submedian, intercaecal. Laurer's canal opening anterior to excretory pore. Uterus much convoluted, intercaecal, posterior to and winding between testes, ventral to coiled seminal vesicle. Vitellaria occupying entire extracaecal field, partly overlapping caeca. Excretory pore postvesicular in acetabular zone. Parasitic in intestine of mammals.

Type-species : *G. aegyptiacus* (Cobbold, 1876) Railliet, 1893

104. **Gastrodiscus aegyptiacus** (Cobbold, 1876) Railliet, 1893

Specific diagnosis.—Body pink in living condition, 9–17 × 8–11; anterior cylindrical part 4 × 2.5; posterior part saucer-shaped with margins curved inwards, covered with numerous regularly arranged papillae. Acetabulum small, subterminal. Intestinal bifurcation at anterior border of wide part. Testes lobed, slightly diagonal. Genital pore at level of intestinal bifurcation. Eggs oval, 131–139 × 78–90

Host.—*Equus* (*Equus*) *caballus* L.; *E.* (*Mulus*), *E.* (*Asinus*) *asinus* L., pig.

Location.—Large and small intestine.

Locality.—Throughout India.

105. **Gastrodiscus secundus** (Looss, 1907)

Specific diagnosis.—Colour pink when fresh. Body 9.25–11.75 × 5.5–8.0 in greatest breadth. Cephalic cone 1.95 × 1.81; caudal disc 8–10 × 6.76. Small tactile papillae present on cephalic portion and large papillae or 'pseudotubercules' on ventral surface of disc. Genital pore with muscular wall 0.33–0.45 in diameter, postbifurcal, at 0.7–2.0 from anterior border of disc. Oral sucker 0.32–0.45 in diameter, with well developed diverticula, 0.54–0.6 × 0.35–0.4 in size. Oesophagus long and narrow, 1.3–1.7 long. Caeca extend laterally

in broad curve, terminating near acetabular region. Acetabulum 1.2–1.7×0.98–1.08; acetabular index 1 : 5. Testes lobed, diagonal, 0.98–1.2×0.88–0.98; anterior usually dextral, but always on ovarian side. Vas deferens coiled, opening on genital papilla. Ovary 0.4–0.48×0.38–0.43. Shell gland lateral to ovary. Vitellaria extend from anterior margin of disc to middle of acetabulum, occupying all available space in body. Male and female ducts open separately on genital papilla situated in genital atrium. Eggs operculate, ovoid, 0.119–0.191×0.087–0.118.

Host.—Equines (mules and horses) and elephant, *Elephas indicus.*

Location.—Caecum and colon or intestine.

Locality.—Throughout India, Assam, U.P., Madras; Burma.

Cercaria gastrodisci secundi Peter and Mudaliar.—Amphistomate, "Diplocotylea" group of Sewell closely related to *C. fresteri*, 1939 brownish opaque with simple transparent tail; with excretory system characterized by the absence of cross connection between the two main canals and excretory pore behind level of anterior border of acetabulum.

Intermediate host.—Indoplanorbis exustus.

Genus 48. **Gastrodiscoides** Leiper, 1913

Gastrodiscinae : Anterior part small, conical; posterior part discoidal, excavated ventrally, convex dorsally, without ventral papillae; aspinose. Acetabulum small, ventroterminal. Oral sucker with a pair of lateral pouches. Oesophgus with bulb. Caeca lateral extending to level of anterior margin of acetabulum. Genital pore ventral to oesophageal bulb without sucker, median just prebifurcal. Testes intercaecal, tandem, ventral, lobate; anterior at junction of two regions; posterior in anterior half of discoidal region. Cirrus sac absent. Ovary intercaecal, rounded, posttesticular, ventral, median, much smaller than testes near equator of discoidal part. Receptaculum seminis absent. Laurer's canal opening anterior to excretory pore. Uterus coiled dorsal to testes and dorsolateral to seminal vesicle. Metraterm coiled. Vitellaria in lateral fields of posterior discoidal region, extending from level of

anterior margin of posterior testis to hinder end of acetabulum Parasitic in large intestine and caecum of mammals.

Type-species : *G. hominis* (Lewis and McConnel, 1876) Leiper, 1913

106. **Gastrodiscoides hominis*** (Lewis and McConnel, 1876) Leiper, 1913

(Fig. 72)

Syn. *Amphistomum hominis* Lewis and McConnel, 1876
Amphistomum hominis; Sonsino, 1895
Gastrodiscus hominis Fischoeder, 1902

Specific diagnosis.—Body pyramidal, aspinose, reddish orange when living, divided into anterior conical and posterior discoidal regions, 5–14.0 long, 4–8.0 broad (flattened); anterior part 2 long, flattened dorsoventrally, its junction with disc gradual, not well defined. Discoidal part with ventral concavity and dorsal convexity with posterior margin cleft in middle. Genital cone prominent slightly behind middle of conical portion. Acetabulum 2.5–4.5 in diameter. Oral sucker subterminal, globular, 0.2 in diameter with a pair of lateral pouches arising at its slightly constricted posterior margin. Oesophagus 0.5–1.4 long; oesophageal bulb 0.25× 0.3. Caeca lateral, extending to level of anterior margin of acetabulum. Testes tandem, lobate; anterior at junction of two regions; posterior in anterior half of discoidal region. Seminal vesicle much coiled; pars prostatica absent, prostate cap-like at base of short ejaculatory duct before its entering genital atrium. Genital atrium well developed, hemispherical with terminal genital ducts capable of being everted as a conical genital papilla, male pore anterior to female pore. Ovary rounded, 0.3 in diameter, median. Mehlis' gland 0.4 in diameter, dextral, slightly posterior to ovary. Receptaculum seminis uterinum present. Vitellaria lateral, fan-shaped groups of minute follicles in lateral margins of discoidal region. Uterus coiled, dorsal to testes and dorsolateral to seminal vesicle before continuing as metraterm. Eggs 150–170μ × 60–70μ rounded rather than ovoidal, pale greenish

*Life history worked out by Dutt & Srivastava, H.D. (1966–*J. Helminth.*, 40 : 45–52 ; 1972–*Ibid.*, 46 : 35–46). Snail host ; *Helicorbis coenosus.–Ed.*

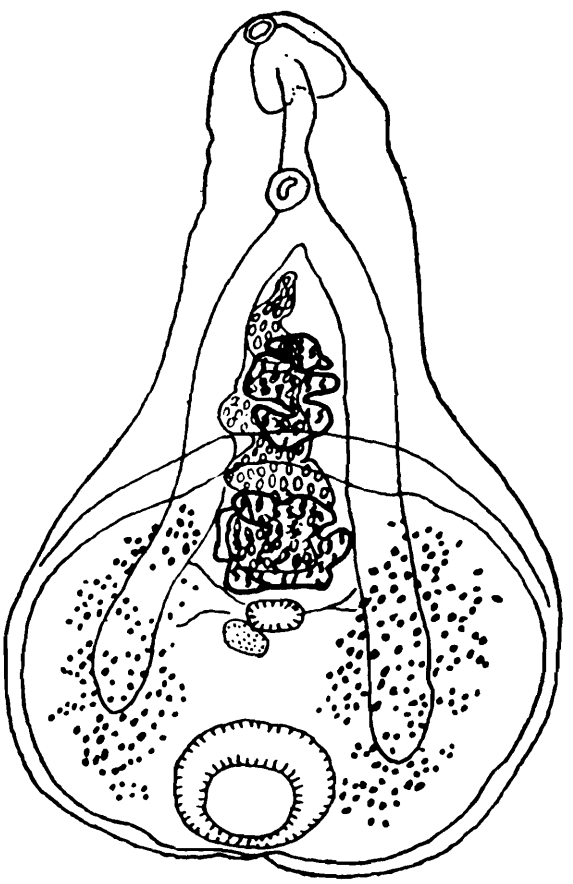


FIG. 72. *Gastrodiscoides hominis* (Lewis & McConnel, 1876) Leiper, 1913.

brown in contrast to yellow brown eggs of *Fasciolopsis buski*. Excretory pore dorsal at level of middle of acetabulum.

Host.—*Homo sapiens*, pig *Sus scrofa*, *Trangulus napu* (Napu mouse deer).

Location.—Large intestine, caecum and colon.

Locality.—U.P. Aligarh in pigs; Bihar and Orissa in man; in pigs in Bengal; Assam in man and pigs; in *Trangulus napu* in Malay States.

Genus 49. **Homalogaster** Poirier, 1883

Gastrodiscinae : Body divided into large flattened, ventrally papillated anterior part and small spherical or cylindrical posterior part. Acetabulum large, ventroterminal. Oral sucker with diverticula. Oesophagus with bulb. Caeca somewhat undulating reaching acetabular zone. Genital pore without sucker, prebifurcal. Testes tandem, lobed,

occupying anterior intercaecal field. Cirrus sac absent. Ovary between caecal ends. Uterus winding in intercaecal field, posterior and dorsal to testes. Vitellaria extracaecal from level of intestinal bifurcation to ovarian zone. Excretory vesicle dorsal to acetabulum; pore postvesicular. Parasitic in intestine, rarely bile ducts of mammals.

Type-species : *H. paloniae* Poirier, 1883

107. **Homalogaster paloniae** Poirier, 1883

Syn. *H. philippinensis* Stiles and Goldberger, 1910

Specific diagnosis.—Body 7.5–9 long × 4.5–6 broad, canoe-shaped; anterior end narrow, posterior end rounded. Genital pore at 1.0 from anterior end, about one ninth to one seventh of body length from mouth and at quarter of oesophagus, surrounded by depressed circular area having numerous small papillae. Venter with alternating longitudinal rows of large papillae, extending from 2–2.5 from oral margin to acetabulum. Margins curved ventrally and sharp. Acetabulum 2.5–2.7 × 3 with its margin projecting beyond body parenchyma. Oral sucker and evaginations in well marked perisuctorial space. Oesophagus moderately long; oesophageal bulb 280–670μ. Caeca narrow, slightly tortuous, extending to acetabulum. Excretory pore postvesicular, dorsomedian at about quarter of acetabulum behind Laurer's canal opening. Testes lobate, tandem in cephalic half of intercaecal region. Vesicula seminalis coiled; pars musculosa distinct; pars prostatica not prominent; ductus ejaculatorius present. Ovary submedian near end of one caecum; shell gland behind ovary. Vitellaria extending from intestinal bifurcation to posterior end of ovary. Uterus with many coils, winding forwards dorsally to testes, ventrally in front. Laurer's canal opens dorsomedian at about level of caecal ends. Genital papilla when extruded resembles human penis with glans with pore of short ductus hermaphroditicus at its apex; when retracted the papilla resembles partially enclosed cirrus sac. Eggs oval, operculated with small knob at opposite pole, 125–139μ × 67–86μ.

Host.—*Bos indicus, Bos taurus, Ovis aris, Capra hircus.*

Location.—Intestine, bile ducts.

Locality.—Burma, India, Philippines.

XXV Subfamily *PSEUDODISCINAE* Näsmark, 1937

Paramphistomidae : Body subellipsoid, oval, elongate conical or pyriform, flattened or slightly concave ventrally. Acetabulum ventroterminal. Oral sucker constricted at about middle, with paired pouch-like diverticula. Oesophagus with or without muscular thickening. Caeca straight or sinuous. Testes symmetrical or tandem. Pars musculosa well developed. Cirrus sac absent. Genital sucker absent. Ovary posttesticular. Laurer's canal opening anterior to excretory pore. Vitellaria lateral. Uterus winding posterior and dorsal to testes. Excretory vesicle dorsal to acetabulum; pore caudad of vesicle, postacetabular or in acetabular zone. Parasitic in small or large intestine of mammals.

Type genus : *Pseudodiscus* Sonsino, 1895

Key to genera of PSEUDODISCINAE

Testes symmetrical; oesophagus without muscular thicknening; caeca bent inwards at about middle. .	*Pseudodiscus* Sonsino, 1895
Testes tandem; oesophagus with muscular thickening posteriorly. .	*Watsonius* Stiles and Goldberger, 1910.

Genus 50. **Pseudodiscus** Sonsino, 1895

Syn. *Pseudodiscus* ; Stiles and Goldberger, 1910
Pseudodiscus (*Pseudodiscus*) Stiles and Goldberger, 1910
Pseudodiscus; Maplestone, 1923
Pseudodiscus; Fuhrmann, 1928
Pseudodiscus: Fukui, 1929

Pseudodiscinae : Body conical or ovoid, slightly concave ventrally and convex dorsally. Acetabulum ventroterminal, small with prominent projecting border. Oral sucker constricted at equator, with paired pouches. Oesophagus without bulb or muscular thickening. Caeca long, sinuous or converging slightly in their middle course. Testes symmetrical, multilobed. Pars musculosa well developed. Ovary anterior to acetabulum and excretory vesicle. Uterus intercaecal, convoluted posterior to testes. Vitellaria extracaecal, extending from behind oral pouches to middle of acetabuulum. Excretory vesicle dorsal to acetabulum; pore postacetabular. Parasitic usually in colon of horses, rarely in Indian elephants.

Type-species : *P. collinsi* (Cobbold, 1875) Sonsino, 1895

108. **Pseudodiscus collinsi** (Cobbold, 1875) Sonsino, 1895

(Fig. 73)

Syn. *Amphistomum collinsi* Cobbold, 1875
Amphistomum collinsi; Fischoeder, 1903
Amphistomum collinsi var. *stanleyi* Fishoeder 1903
Pseudodiscus collinsi Stiles and Goldberger, 1910
Pseudodiscus collinsi; Maplestone, 1923
Pseudodiscus collinsi; Nicoll, 1923
Pseudodiscus stanleyi Nicoll, 1923
Pseudodiscus collinsi; Baylis, 1929
Pseudodiscus (*Pseudodiscus*) *collinsi* Fukui, 1929
Pseudodiscus collinsi; Sprehn, 1932
Pseudodiscus collinsi; Bhalerao, 1933

Specific diagnosis.—Bright pink when fresh resembling pomegrenate seeds. Body ovoid or conical, oral end narrower, acetabular end broad, rounded, convex dorsally, ventral side concave, 3.7–9.33 long, 2.2–5.1 broad, 1.8–4.2 thick. Acetabulum 1.4–1.8 in diameter, ventral in front of posterior end with prominent raised margin. Oral sucker 0.85–1.06 in diameter, constricted in the middle and with two well defined globular pouches of 0.6–0.9 diameter. Oesophagus without bulb or muscular thickening. Caecal bifurcation at one fourth body length from anterior end; caeca long, sinuous or converging slightly in their middle course outside testes, extending nearly to one seventh body length from posterior end. Testes symmetrical, deeply lobed, cauliflower-like at about middle of body length. Pars musculosa not much coiled. Ovary 0.25–0.27 in diameter, anterior to acetabulum and excretory vesicle, to right or left. Genital pore median just anterior middle of body length. Vitellaria extending from behind oral pouches to about middle of acetabular level, follicles extracaecal but extending intercaecally at posterior end up to level of ovary. Uterus intercaecal, coiled posterior to testes. Eggs oval, operculated, with anterior end narrower, posterior end wider, 0.14–0.16×0.079–0.089.

Host.—Equines and elephants.

Location.—Large intestine.

Locality.—Throughout India, Assam, U.P., Madras; Burma.

Peter and Srivastava (1960) investigated life cycle. Cercaria of "Diplocotylea" group of Sewell with dark isolated patches of pigment in anterior third of dorsum of body, a pair of

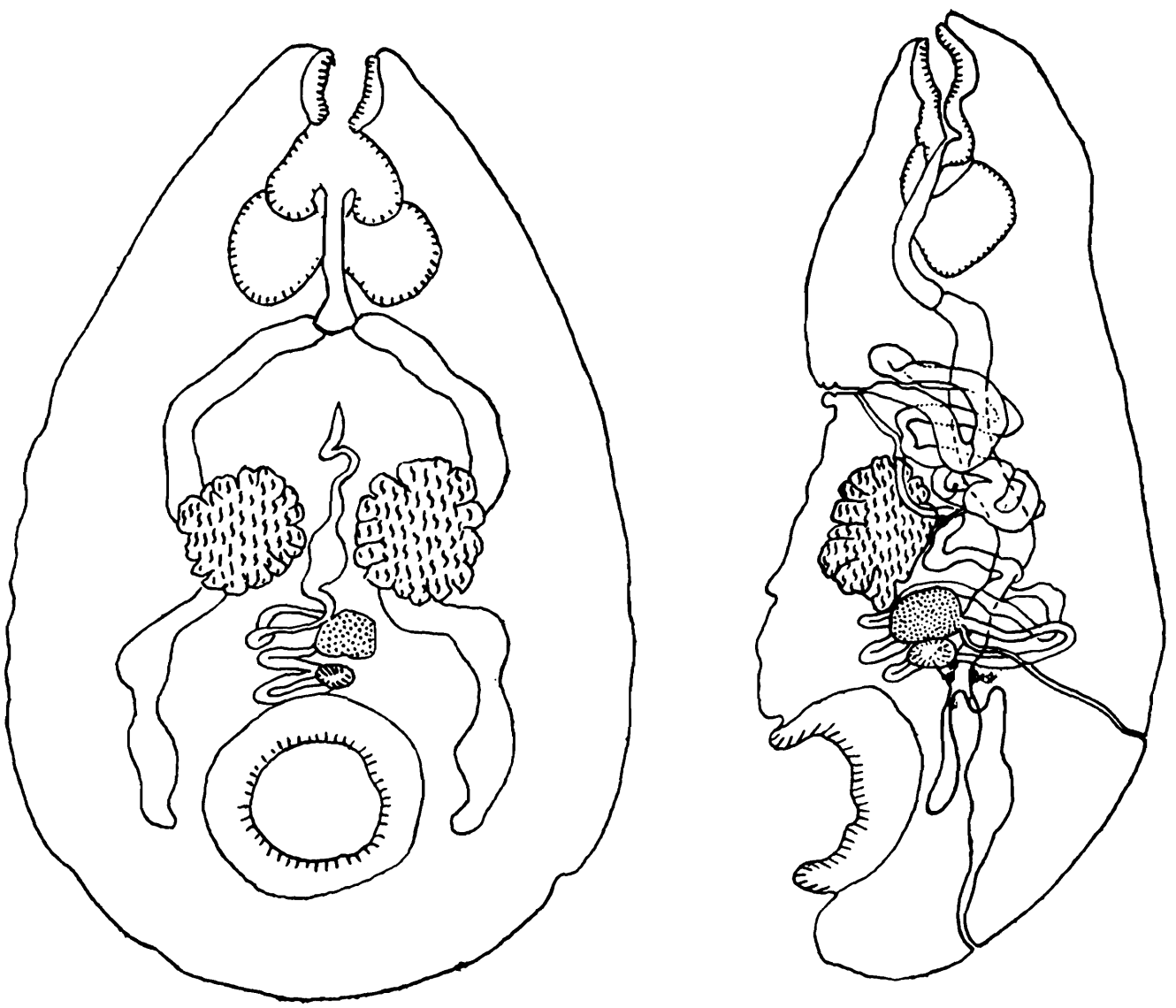


FIG. 73. *Pseudodiscus collinsi* (Cobbold, 1875) Sonsino, 1895. seg. Stlies and Goldberger, 1910.

oral pouches, oesophagus without bulb and bifurcated intestine; main excretory trunks without transverse cross connection.

Snail host.—Indoplanorbis exustus (Deshayes).

Genus 51. **Watsonius** Stiles and Goldberger, 1910

Syn. *Pseudodiscus* (*Watsonius*) Fukui, 1929
Hawkesius Stiles and Goldberger, 1910

Pseudodiscinae : Body pyriform to oval, flattened ventrally, convex dorsally. Acetabulum ventroterminal with small aperture. Oral sucker with paired pouch-like evaginations.

Oesophagus with posterior muscular thickening. Caeca straight, terminating at level of acetabulum or further in front. Genital pore prebifurcal or postbifurcal. Testes tandem, lobed. Pars musculosa not enormously developed. Ductus hermaphroditicus apparently absent. Ovary posttesticular, sometimes dorsal to acetabulum. Laurer's canal opening anterior to excretory pore. Uterus intercaecal, winding, posterior and dorsal to testes. Vitellaria lateral outside caeca from intestinal bifurcation to acetabulum. Excretory pore caudad of vesicle in acetabular zone. Parasitic in intestine of man and monkey exceptionally in colon of elephants.

Type-species : *W. watsoni* (Conyngham, 1904) Stiles and Goldberger, 1910

109. **Watsonius watsoni** (Conyngham, 1904) Stiles & Goldberger, 1910

Syn. *Amphistomum watsoni* Conyngham, 1904
Cladorchis watsoni (Conyngham, 1904) Shipley, 1905
Pseudodiscus (*Watsonius*) *watsoni* Fukui, 1929
Pseudodiscus hawkesi (Cobb., 1875) Bhalerao, 1933

Specific diagnosis.—Body 8–10 long, 4–5 in maximum breadth, pyriform, broadest near the junction of median and posterior thirds of body. Acetabulum 1.0 in diameter. Oral sucker 1.2 in transverse diameter, about one fifth of body length, provided with a pair of lateral posterior pouches. Oesophagus short, with muscular thickening. Caeca straight, terminating just behind anterior margin of acetabulum. Except vitellaria all genital organs lie in median plane. Testes squarish, lobed with sharply notched fissures, tandem, contiguous in middle third of body. Vas deferens in front of anterior testis as intricately coiled vesicula seminalis; pars musculosa differentiated; pars prostatica bulbous; ejaculatory duct short, joins metraterm at base of genital papilla. Ovary small, ovate, close behind posterior testis, slightly to left. Laurer's canal opens anterior to excretory pore. Vitellaria of very small follicles confined to caecal region and outside caeca. Uterus winding forwards; metraterm present; ductus hermaphroditicus in genital papilla. Eggs 112–130 × 75–80 μ.

Host.—*Homo sapiens*, monkeys (*Cercopithecus*, *Papio*).

Location.—Small intestine.

Locality.—Singapore; Africa.

XXVI. Subfamily *CLADORCHIINAE* Lühe, 1909

Paramphistomidae : Body pyriform, conical, elliptical or subcylindrical. Acetabulum ventroterminal, papillated or unpapillated. Oral sucker with paired posterior diverticula. Oesophagus with or without posterior bulb, occasionally very long and divided into anterior long muscular part and a posterior small glandular part. Caeca long, simple or winding. Testes tandem, diagonal or symmetrical. Cirrus sac present, enclosing seminal vesicle, prostatic complex and cirrus. Ductus hermaphroditicus short, if present. Genital sucker usually present, sometimes absent. Ovary posttesticular. Laurer's canal opening anterior to excretory pore. Vitellaria lateral, variable in extent. Uterus largely posterior and dorsal to testes. Excretory pore posterior or dorsal to excretory vesicle. Lymph system usually with three pairs of longitudinal vessels, one pair in *Olveria*.

Key to Indian genera of CLADORCHIINAE

Oesophagus usually long, divided into a long anterior muscular and a short posterior glandular portions; testes oblique, sometimes tandem.	*Olveria* Thapar and Sinha, 1945
Oesophagus not divided into muscular glandular portions; testes symmetrical.	*Pfenderius* Stiles and Goldberger, 1910

Genus 52. **Olveria** Thapar and Sinha, 1945

Cladorchiinae : Body elongate pyriform or somewhat conical, unspined, papillated in region of oral sucker and genital sucker. Acetabulum subterminal, moderately large. Oral sucker terminal with diverticula fused with it on either side. Oesophagus J-shaped, consisting of elongated long anterior muscular portion forming only elongated bar of J and the short posterior glandular portion forming the curve of the J connecting oesophagus with intestinal bifurcation. Caeca long forming two or three longitudinal loops, terminating anterior to acetabulum. Testes oblique, sometimes tandem, entire or slightly lobed, in posterior half of body. Cirrus sac thin walled, containing prostatic complex and cirrus. Vesicula seminalis outside cirrus sac. Pars musculosa absent or present. Genital sucker well developed; genital pore prebifurcal. Ovary posttesticular, preacetabular. Laurer's canal opening anterior to excretory pore. Uterus

winding from right to left and then to right, dorsal to testes. Vitellaria lateral from genital sucker to acetabulum or a little in front. Excretory vesicle dorsal to acetabulum. Lymphatic system of one pair of longitudinal vessels, running medial to caeca. Parasitic in mammals.

Type-species : *O. indica* Thapar and Sinha, 1945

Key to species of **Olveria**

Caeca curved inwards at their posterior ends; pars musculosa present	*O. bosi* Tandon, 1951
Caeca not curved at their ends; pars musculosa absent.	*O. indica* Thapar and Sinha, 1945

110. **Olveria indica** Thapar and Sinha, 1945

(Fig. 74)

Specific diagnosis.—Body 6.14–7.07long, 2.35–3.35 in maximum breadth in middle, gradually tapering towards anterior end. Cuticular papillae in oral region and region of genital sucker. Oral sucker with posterolateral pouches fused with it. Acetabulum oval, 1.3×0.73. Oesophagus 3.6 long, J-shaped consisting of long muscular and short glandular parts. Caeca long, slender, coiled making two or three antero-posterior loops, ending near ovary in front of acetabulum. Excretory pore dorsal immediately preacetabular, a little behind Laurer's canal opening. Excretory vesicle rounded, dorsal, slightly overlapping acetabulum. Longitudinal excretory canals connected by transverse anastomosis at level of bend of J-shaped oesophagus. Testes slightly oblique, rounded, slightly indented; anterior 1.2×0.9; posterior 1.33×0.14. Cirrus 0.57×0.22 enclosed in cirrus sac. Ovary rounded, 0.4–0.43 in diameter, slightly to left. Uterus makes a few coils, anteriorly S-shaped crossing from right to left and then to right as in *Gastrothylax*. Genital pore at 1.42 from anterior end, surrounded by suker, prebifurcal. Eggs oval, operculated, 0.068–0.085×0.075–0.119.

Host.—Buffaloes and cattle.

Location.—Rumen.

Locality.—Lucknow, Etawah, Bareilly, U.P.

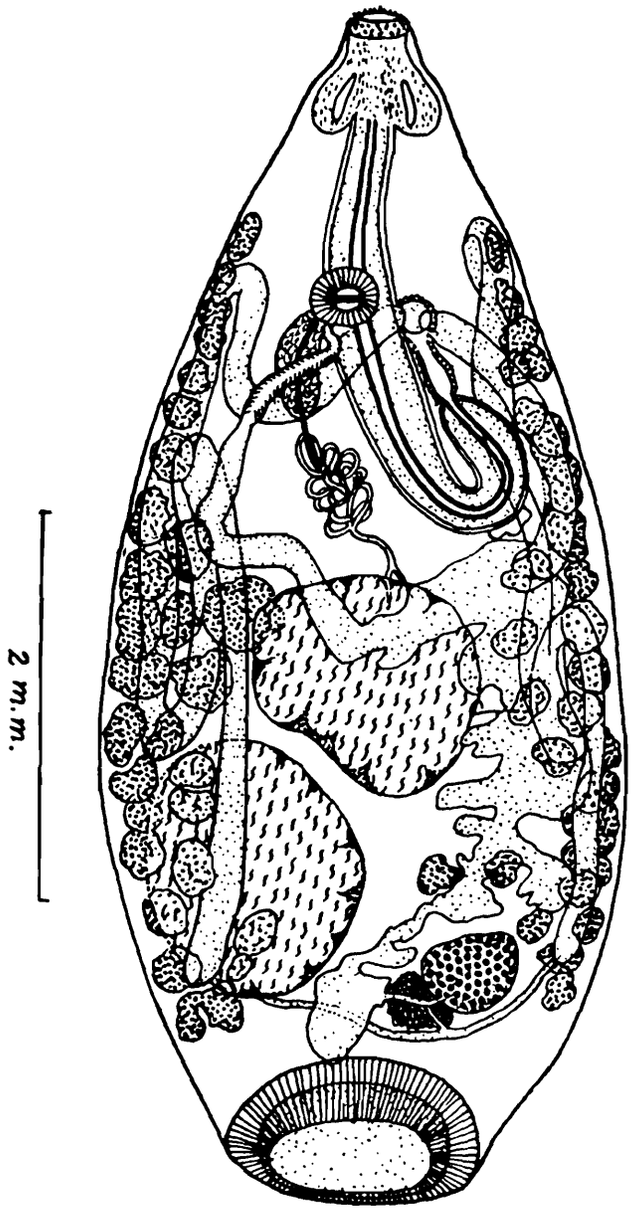


FIG. 74. *Olveria indica* Thaper and Sinha, 1945.

111. **Olveria bosi** Tandon, 1951

Specific diagnosis.—Body conical, flattened, 7.63–8.04× 0.829–3.01 just in front of acetabulum; cuticular papillae present in region of mouth, genital sucker and acetabulum. Oral sucker with rounded pouches; papillae in anterior 2/3 of pouches. Acetabulum oblong, 1.159–1.892×1.508–2.339. Long muscular and short non-muscular parts of oesophagus 2.171–2.25 and 0.92–0.056 long respectively. Caeca long, coiled making three loops, terminating in front of acetabulum, always curved at posterior extremity. Testes tandem in mature specimens and diagonal in immature specimens;

anterior 1.26–1.47 × 1.559–1.83; posterior 1.176–1.948 × 1.396–1.612, just behind anterior testis, slightly overlapping or touching the latter. Vesicula seminalis coiled; pars musculosa elongated; pars prostatica small. Pars prostatica and cirrus enclosed in cirrus sac. Ovary 0.276–0.368 × 0.46–0.496. Genital pore at 1.71–2.04 from anterior end, with sucker. Eggs oval, operculated, 0.11–0.117 × 0.065–0738. Excretory vesicle elongated, conical between acetabulum and posterior testis.

Host.—Buffalo, *Bos bubalis.*

Location.—Rumen.

Locality.—Lucknow, U.P.

Genus 53. **Pfenderius** Stiles and Goldberger, 1910

Syn. *Tagumaea* Fukui, 1926

Cladorchiinae : Body conical, oval or pyriform, dorsally convex. Acetabulum subterminal, relatively large with prominent projecting margin and shallow wide cavity provided with prominent papillae; aperture large. Oral sucker with anterior sphincter and paired posterior evagination. Oesophagus without muscular bulb. Caeca wavy, terminating laterally to anterior third of acetabulum. Testes symmetrical, equatorial, lobed. Cirrus sac present, enclosing vesicula seminalis, pars prostatica and cirrus. Genital sucker absent. Ovary posttesticular, anterior to excretory vesicle. Laurer's canal opening anterior to excretory vesicle, does not cross excrectory vesicle or canal. Uterus forming dorsoventral coils. Vitellaria lateral extending along caeca from intestinal bifurcation to caecal ends with sparsely scattered follicles. Excretory vesicle dorsal to acetabulum; pore in acetabular zone. Parasitic in intestine of elephants.

Type-species : *P. papillatus* (Cobbold, 1882) Stiles and Goldberger, 1910

Key to species of **Pfenderius**

Caeca diverticulated internally.	*P. birmanicus* Bhalerao, 1935
Caeca not diverticulated	*P. papillatus* (Fukui, 1926) Stiles and Goldberger, 1910

112. **Pfenderius papillatus** (Cobb., 1882) Stiles and Goldberger, 1910

Syn. *Pfenderius heterocerca* (Fukui, 1926) Bhalerao, 1935
Tagumaea heterocerca Fukui, 1926

Specific diagnosis.—Body 4.5–5.5 long, 2.5–3.0 broad; pearl tint or opaque olive green in colour (alcohol specimens), conical, but bent slightly ventrad, greatest diameter between third and fourth of body; drosum convex. Genital pore in oesophageal zone at about one fourth body length from oral margin. Acetabulum terminal or ventroterminal with projecting margin, 1.7×1.4, aperture slightly ventrad, 1.29×1.2, cavity shallow, surface with prominent papillae. Mouth terminal at bluntly pointed anterior end with small papillae. Oral sucker with two caudal lateral lobes and with a well defined sphincter. Oesophagus markedly curved dorsad, convexity ventro-caudad. Caeca wavy, short, extending to acetabular zone, curving slightly cephalad. Excretory pore dorsomedian; excretory duct almost transverse. Excretory vesicle dorsal in cephalic half of acetabulum. Testes equatorial, ventral to caeca, fields separate, zones nearly coincide, irregularly globular, 0.4. Vesicula seminalis coiled. Cirrus sac pyriform, large, 0.44–0.82 long, 0.25–0.34 in greatest diameter. Ductus hermaphroditicus present. Ovary posttesticular, preacetabular or anterolateral to acetabulum or median at junction of equatorial and caudad third of body. Shell gland caudo-lateral to ovary. Vitellaria with sparsely scattered small follicles, from intestinal bifurcation to caecal ends external, ventral and to some extent dorsal of caeca. Eggs 150×70μ operculated at one pole and bearing short knob at the opposite pole. Lymphatic system of three pairs of trunks.

Host.—Elephant, *Elephas indicus.*

Location.—Colon or intestine.

Locality.—India, Andamans; Burma.

113. **Pfenderius birmanicus** Bhalerao, 1935

Specific diagnosis.—Body oval, 2.3 long, 2.1 broad. Mouth subterminal, surrounded by papillae. Acetabulum rounded, 0.92–1.01; diameter to body length 1 : 2.5. Genital pore 0.48 from anterior end. Oral sucker 0.39×0.465; oral diverticula 0.2×0.24. Oesophageal bulb with circular muscles,

0.52×0.38. Caeca diverticulated internally, terminating laterally to acetabulum. Testes anterolateral to acetabulum, lobed, 0.28–0.33×0.31–0.46. Ovary oval, median, immediately in front of acetabulum, 0.25×0.2. Vitellaria lateral to caeca and acetabulum. Eggs elliptical, 0.158–0.168×0.09–0.098.

Host.—Indian Elephant, *Elephas indicus.*

Location.—Intestine.

Locality.—Burma (Toungoo).

XXVII. Subfamily *ZYGOCOTYLINAE* Ward, 1917

Paramphistomidae : Body elongate oval, elliptical or lanceolate. Acetabulum ventroterminal, divided into two parts, the posterior with a caudal overhanging lip produced into horn-like projection on either side. Oral sucker with small posterior diverticula. Oesophagus with posterior bulb. Caeca terminating in front of acetabulum. Testes tandem. Cirrus sac absent. Genital sucker absent. Ovary post-testicular, submedian or median. Vitellaria lateral. Uterus intercaecal, winding mostly dorsal to testes and ovary. Lymphatic system with two or three pairs of longitudinal vessels. Parasitic in intestine and rectum of birds and reptiles (Chelonians).

Type genus : *Zygocotyle* Stunkard, 1917
(no record from India)

Other genus : *Stunkardia* Bhalerao, 1931

Genus 54. **Stunkardia** Bhalerao, 1931

Zygocotyiinae : Body elongate. Acetabulum large, divided into two parts, anterior semicircular, posterior funnel-like, separated by a septum, with a projection on each side posteriorly. Oral sucker with small diverticula. Oesophageal bulb present. Caeca sinuous, terminating just anterior to acetabulum. Genital pore at intestinal bifurcation. Testes lobed, tandem, median in middle third of body. Cirrus sac absent. Ovary submedian about halfway between posterior testis and acetabulum. Uterus convoluted, occupying entire preovarian field when gravid. Vitellaria forming groups of follicles, extracaecal, from oesophageal bulb to caecal ends.

Lymphatic system consisting of two pairs of longitudinal vessels. Parasitic in rectum of fresh water turtles.

Type-species : *S. dilymphosa* Bhalerao, 1931

114. **Stunkardia dilymphosa** Bhalerao, 1931

(Figs. 75)

R. C. Chatterji (1936) also described this species, which he obtained from different host *Morenia ocellata*. Bhalerao (1931) had obtained from *Batagur baska*. Chatterji writes "present form is identical with *Stunkardia dilymphosa* Bhalerao 1931, except in the size of various organs and in the nature of the vitellaria and uterus" He thinks that his specimens are more mature.

Specific diagnosis.—Body elongate, 20–20.3×5–5.6 according to Bhalerao, 13.5–20×3.8–7 maximum breadth according to Chatterji; cuticle thick, smooth. Oral sucker 2.52–2.87× 2.11–2.14 (Bhalerao), 1.8–2.7×1.4–1.8 (Chatterji) with a pair of small diverticula, 0.7–0.8 long (Bhalerao). Acetabulum 3.88–3.9×3.15–3.5 (Bhalerao), 2.5–4.1×1.7–3.2 (Chatterji); its anterior half semicircular, posterior funnel-like, two parts separated by a septum; its posterolateral border produced into two stout muscular processes. Oesophagus zigzag, with posterior oesophageal bulb of 0.75–0.89×0.585–0.685 (Bhalerao). Caeca long, sinuous, curved into four bracket-like loops, terminating anterior to acetabulum with vesicula seminalis and metraterm in the foremost bracket, anterior testis in second, posterior testis in third and ovary and shell gland in the last bracket of the loops. Excretory pore anterior to acetabulum; excretory vesicle elongated, broad anteriorly. Lymph system of two pairs of vessels, one dorsal and one ventral. Testes 0.73–0.94×0.45–0.7 (Bhalerao), equal, deeply lobed. Vesicula seminalis extends from behind intestinal bifurcation to posterior border of oesophageal bulb. Genital pore just prebifurcal. Cirrus sac absent. Ovary 0.5–0.53×0.39–0.48 (Bhalerao), lobed, slightly sinistral, anterior to excretory vesicle. Shell gland median. Laurer's canal opens dorsally. Receptaculum seminis near ovary. Uterus much coiled, intercaecal anterior to ovary. Metraterm to left of vesicula seminalis. Eggs 0.132×0.117 (Bhalerao). Vitellaria lateral of small

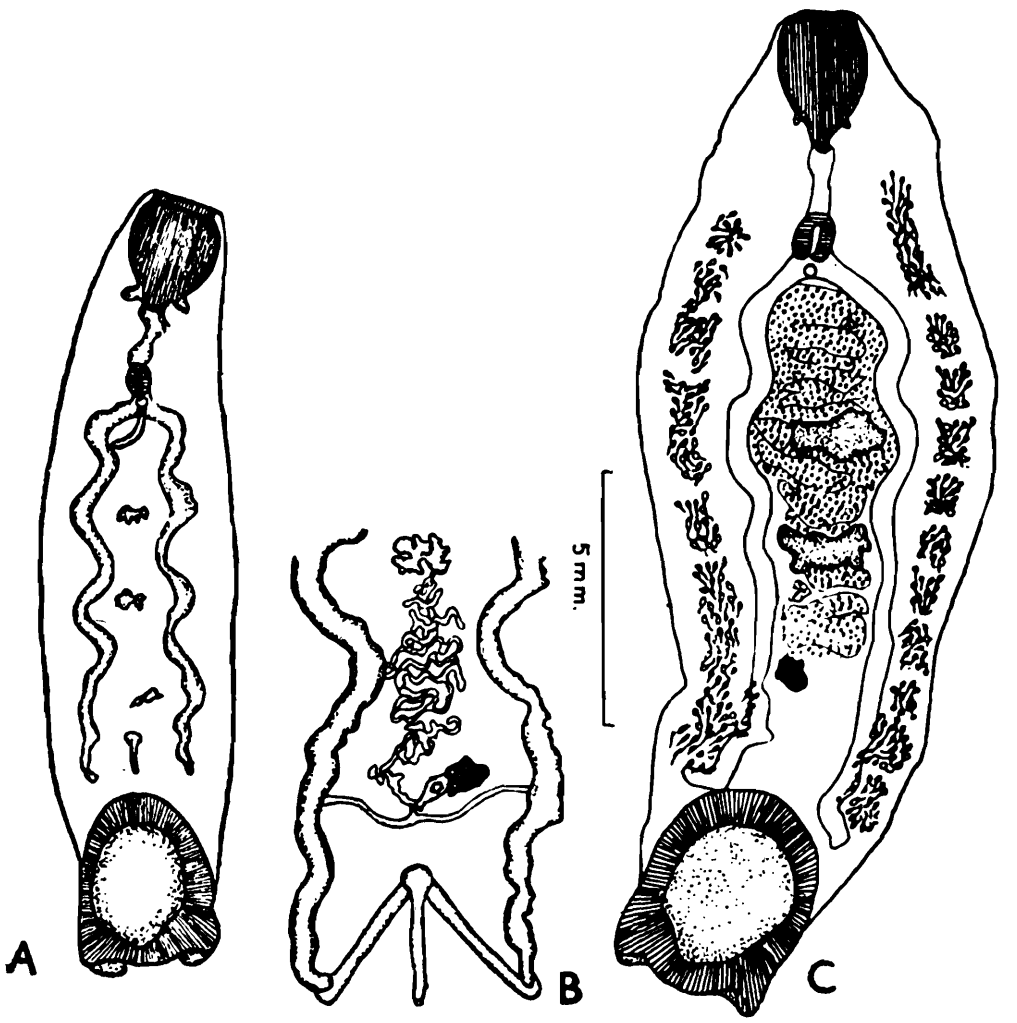


FIG. 75. *Stunkardia dilymphosa* Bhalerao, 1931.
A—Ventral view; B—Female genitalia; C—*After* R. C. Chatterji, 1936.

follicles from level of oesophageal bulb almost to anterior border of acetablum.

Host.—Fresh water turtles, *Batagur baska, Morenia ocellata.*

Location.—Rectum.

Locality.—Rangoon, Burma.

XXVIII. Subfamily *DIPLODISCINAE* Cohn, 1904

Paramphistomidae; Body conical. Acetabulum ventro-terminal, large with or without central prominence which may assume a sucker like appearance. Oral sucker with paired diverticula. Oesophagus with muscular bulb. Caeca long or short. Testis single, occasionally double in middle

third of body. Cirrus sac small. Genital pore median usually postbifurcal. Ovary posttesticular, usually submedian. Vitellaria of large follicles, extending along caeca or grouped at or behind caecal ends. Uterine coils usually intercaecal, occasionally are extensive. Excretory pore anterior or dorsal to acetabulum. Lymph system with one or two pairs of longitudinal vessels.

Type genus : *Diplodiscus* Diesing, 1836

Genus 55. **Diplodiscus** Diesing, 1836

Diplodiscinae : Body more or less conical, oculate or not. Acetabulum ventroterminal with central papilla. Oral diverticula not very prominent. Oesophagus with bulb. Caeca wide, reaching near acetabulum or not. Testis single (double in young), equatorial or postequatorial, median or slightly submedian. Vesicula seminalis externa and interna present. Cirrus sac small, subglobular to elongate, enclosing seminal vesicle and ejaculatory duct. Genital pore median in level with intestinal bifurcation or posterior to it. Ovary posttesticular, submedian. Vitellaria follicular along caeca and turning inwards at caecal ends, occasionally postcaecal. Uterine coils intercaecal. Excretory vesicle saccular with paired collecting vessels arising at its anterior end, each of which turns back on itself near anterior extremity, running backwards to acetabulum. Excretory pore dorsal, postacetabular. Parasitic in endgut of amphibians, rarely fishes.

Type-species : *D. subclavatus* (Pallas, 1760) Diesing, 1836

Key to Indian species of **Diplodiscus**

Genital pore postbifurcal.	.. *D. amphichrus* Tubangui 1933,
Genital pore prebifurcal.	*D. mehrai* Pande, 1937

115. **Diplodiscus amphichrus** Tubangui, 1933

Syn. *Diplodiscus amphichrus* var *magnus* Srivastava, 1934

Specific diagnosis.—Body conical, 1.38–6.7; maximum breadth 0.98–2.1. Oral sucker 0.32–0.56; oral pouches 0.1–0.26. Oesophagus 0.2–0.56 long; oesophageal bulb 0.1–0.26×0.1–0.17 or 0.11–0.13 in diameter. Acetabulum 0.55–1.5 in diameter with a central accessory sucker 0.1–0.35. Testis single, subspherical, entire, median, 0.37–0.95×

0.37–0.95×0.25–0.4 with anterior margin in equatorial region of body. Cirrus sac 0.1–0.22. Genital pore postbifurcal almost median, at about end of anterior third of body, a little behind intestinal bifurcation. Ovary oval or rounded, dextral, 0.17–0.4 or 0.21–0.22×0.16–0.22. Vitelline follicles large scattered on either side and posterior part of body, reaching anteriorly to intestinal fork or middle of oesophagus, posteriorly turning inwards at about caecal ends, not meeting mesially. Eggs 0.122–0.14×0.05–0.071.

Host.—Rana tigrina.

Location.—Rectum.

Locality.—Allahabad, Lucknow, Bombay.

116. **Diplodiscus mehrai** Pande, 1937

(Fig. 76)

Syn. *D. amphichrus* (Tubangui, 1933) Singh, 1954

Specific diagnosis.—Body conical, 2.1–3.2 long, 1–1.3 in maximum breadth a little in front of acetabulum, transluscent with excretory vessels as black wavy tubes in living condition. Oral sucker 0.36×0.2–0.32 broad in region of diverticula; the latter 0.2×0.18. Oesophagus 0.38–0.5 long, arises ventrally to evaginations from bottom of oral sucker; oesophageal bulb 0.11–0.14×0.07–0.1. Caeca terminate a little in front of acetabulum. Acetabulum 0.56–0.74×0.9–1.1 with accessory sucker dividing acetabulum into two halves. Genital pore just behind oesophageal bulb, prebifurcal. Excretory pore dorsal, midway between extreme posterior end and central sucker of acetabulum. Excretory vesicle tubular, obliquely situated above acetabulum between it and shell gland. Lymph vessels two outside and dorsally to caeca on each side. Testis single, almost globular, 0.23–0.4× 0134–0.45. Cirrus sac 0.18×0.16, enclosing coiled vesicula seminalis interna and ejaculatory duct surrounded by prostate cells. Ovary spherical. 0.16–0.18 in diameter. Laurer's canal opens dorsally immediately in front of shell gland. Receptaculum seminis absent. Uterus passes posteriorly on right side of ovary and reaching anterior border of acetabulum travels forwards dorsally to testis, occupying entire intercaecal space. Metraterm thick walled, convoluted, provided with gland cells. Vitellaria extend from a little

behind oral evaginations to anterior border of acetabulum, meeting mesially in acetabular part of body; follicles large, 35–40 in all, laterally and ventrally to caeca except in hinder region, where they pass mesially forming a dorsally placed row. Eggs 0.14×0.09.

Kaw (1950) collected mature forms of smaller size and the young with testes separated from each other. His measure-

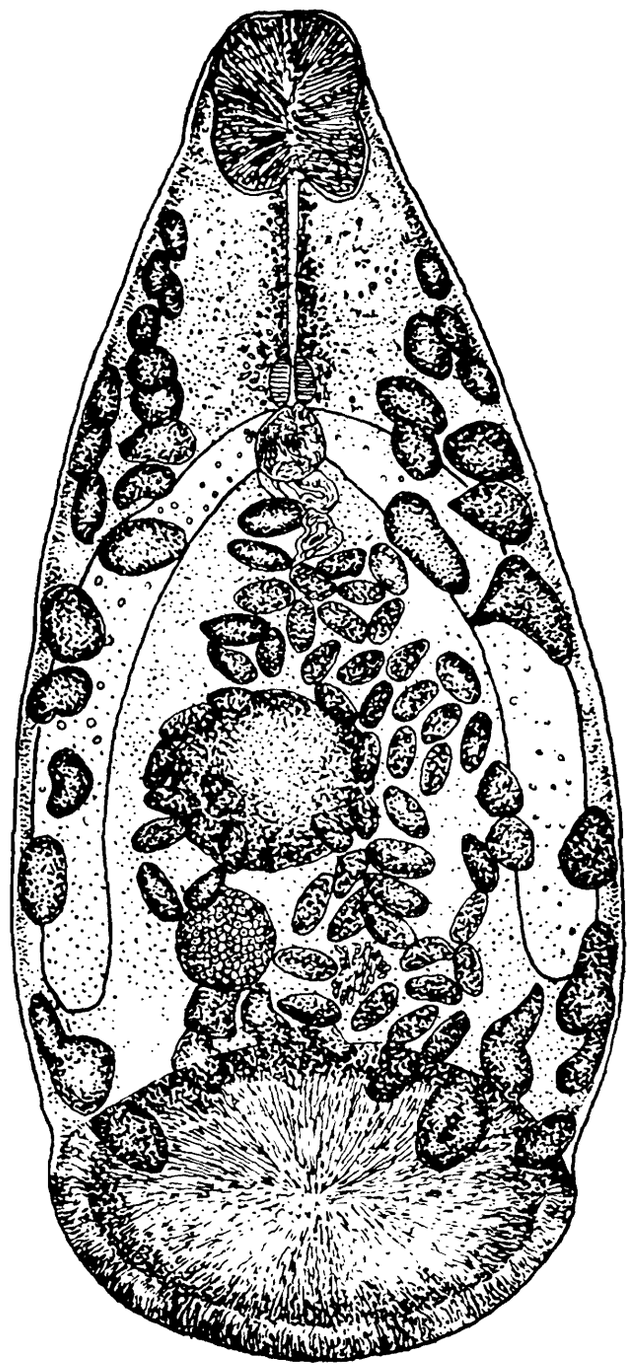


FIG. 76. *Diplodiscus mehrai* Pande, 1937. Dorsal view.

ments : Body 1.7–2.26×0.84–1.08. Oral sucker 0.17–0.28. Acetabulum 0.51–0.75×0.7–0.96. Accessory sucker 0.15–0.22 ×0.18–0.29. Oral evagination 0.12–0.17×0.1–0.15. Oesophagus 0.2–0.35 long; oesophageal bulb 0.1–0.16×0.13. Testis 0.17–0.45×0.26–0.45. When testes are separate, anterior testis 0.18×0.15, posterior testis 0.19×0.14. Cirrus sac 0.12–0.16×0.09–0.14. Ovary 0.13–0.24×0.1–0.17 Eggs 0.112–0.135×0.054–0.086.

Host.—*Rana cyanophlyctis, Bufo viridis* and *Rana* sp.

Location.—Rectum and intestine.

Location.—Almora (Kumaon Hills), Srinagar (Kashmir), Punch.

XXIX. Subfamily *PSEUDOCHIORCHIINAE* Yamaguti, 1958

Paramphistomidae : Body subcylindrical. Acetabulum ventroterminal, not very large, pear-shaped. Oral sucker with two posterior diverticula. Oesophagus with strongly muscular posterior bulb. Caeca narrow, undulating dorsoventrally, terminating near acetabulum. Genital pore immediately postbifurcal. Genital sucker absent. Testes tandem in middle third of body. Cirrus sac present. Genital atrium shallow with stout papilla. Ovary posttesticular, median. Vitellaria extending nearly entire length of caeca laterally as well as ventrally. Excretory vesicle small, pore preacetabular between caecal ends. Parasitic in frogs.

Type genus : *Pseudochiorchis* Yamaguti, 1958

Genus 56. **Pseudochiorchis** Yamaguti, 1958

Pseudochiorchiinae : Body small, subcylindrical, slightly concave ventrally, strongly convex dorsally, with very small papillae around mouth. Oral sucker preceded by short vestibule, with two posterior diverticula. Oesophagus with strongly muscular posterior bulb. Caeca narrow, undulating dorsoventrally, reaching near anterior end of acetabulum. Acetabulum ventro-terminal. not very large, pear-shaped with ventral aperture. Testes tandem, indented or slightly lobed. Seminal vesicle coiled. Cirrus sac thin walled, containing very small part of vesicula seminalis, pars prostatica and ejaculatory duct. Genital papilla stout in shallow

genital atrium with male and female pores opening through it. Ovary median, midway between posterior testis and acetabulum. Receptaculum seminis absent. Vitellaria lateral and ventral to caeca. Uterus anterior to ovary, dorsal and anterior to testes. Genital pore immediately postbifurcal. Eggs large. Excretory vesicle small; pore midway between caecal ends, preacetabular. Parasitic in frogs.

Type-species : *P. burti* (Prudhoe, 1944) Yamaguti, 1958

117. **Pseudochiorchis burti** (Prudhoe, 1944) Yamaguti, 1958

(Fig. 77)

Syn. *Chiorchis burti* Prudhoe, 1944

Specific diagnosis.—Body 3.7 or 5.1 long, maximum breadth between 1.1 and 1.3. Acetabulum almost pear-shaped, 0.63–0.76 × 0.51–0.64. Anterior tip of body surrounded by a number of very small papillae, more numerous around oral aperture; latter connected with oral sucker by a short canal. Oral sucker 0.42–0.48 × 0.36–0.43. Oral pouches 0.13–0.16 long, arise from postero-dorsal border of oral sucker and directed posteriorly. Oesophagus 0.15–0.21 long; oesophageal bulb 0.24–0.27 × 0.18–0.21. Caeca narrow, undulating dorsoventrally, extending to near anterior border of acetabulum. Excretory pore dorsal, midway between caecal ends; excretory vesicle small, with two vessels arising from it, diverging to caecal ends and extending to anterior region. Lymphatic vessels four, one dorsal and ventral on each side to inner border of caeca. Genital pore immediately postbifurcal. Genital atrium shallow with a stout papilla through which male and female pores open, the former being anterior. Cirrus sac thin walled, enclosing very small portion of seminal vesicle and ejaculatory duct, part of which is differentiated as pars prostatica. Testes tandem in middle of body, slightly lobed, 0.22–0.45 × 0.31–0.67 Ovary median about midway between posterior testis and anterior border of acetabulum, almost rounded, 0.12–0.18 in diameter. Shell gland behind ovary. Vitelline ducts open into rounded receptacle, 0.062 in diameter. Vitellaria lateral and ventral along caeca. Uterine coils confined to area between caeca and anterior to ovary, passing testes dorsally. Eggs 0.157–0.17 × 0.105–0.11.

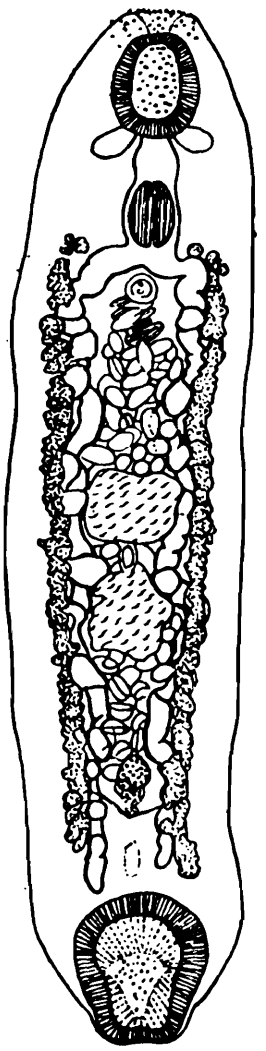


FIG. 77. *Pseudochiorchis burti* (Prudhoe, 1944) Yamaguti, 1958.

Host.—*Rana hexadactyla.*

Locality.—Colombo, Sri Lanka.

XXX. Subfamily *DADAYTREDATINAE* Yamaguti, 1958

Paramphistomidae : Body elliptical, lanceolate or oval. Acetabulum ventroterminal, not very large. Oral sucker with posterior diverticula. Oesophagus with posterior bulb. Caeca narrow, somewhat sinuous, terminating a little in front of posterior extremity. Testes tandem, intercaecal, lobed, rarely entire. Cirrus sac present. Genital sucker present or absent; genital papilla absent. Genital pore

immediately postbifurcal. Ovary postequatorial. Vitellaria extending along whole caeca or their posterior portion. Excretory pore dorsal or anterior to acetabulum. Parasitic in fishes.

Type genus : *Dadytrema* A Travassos, 1931

Key to Indian genera of DADYTREMATINAE

Genital sucker absent; Lymphatic vessels three pairs	*Orientodiscus* Srivastava, 1938
Genital sucker present; lymphatic vessels two pairs.	*Protocladorchis* Willey, 1935

Genus 57 **Orientodiscus** Srivastava, 1938

Dadaytrematinae : Body fusiform or cylindrical, smooth. Acetabulum strongly muscular, cup-shaped, subterminal. Oral sucker with posterolateral pouches. Oesophagus with elongate spindle-shaped bulb. Caeca long, somewhat undulating, terminating anterior to acetabulum. Testes large, spherical or lobed, tandem, intercaecal, anterior almost equatorial. Cirrus sac present. Genital sucker absent. Genital pore immediately postbifurcal. Ovary submedian, between caecal ends at about midway between posterior testis and acetabulum. Laurer's canal present. Vitellaria lateral from level of oesophageal bulb to level of anterior end of acetabulum. Uterus intercaecal, preovarian. Eggs very large. Excretory vesicle antero-dorsal to acetabulum. Lateral vessels forming loops around caeca. Lymphatic system consisting of three pairs of longitudinal vessels. Parasitic in large intestine or rectum of fishes.

Type-species : *O. lobatum* Srivastava, 1938

Key to species of **Orientodiscus**

Gonads lobed.	*O. lobatum* Srivastava, 1938
Gonads entire.	*O. jumnai* Srivastava, 1938

118. **Orientodiscus lobatum** Srivastava, 1938

Specific diagnosis.—Length 5–7, maximum breadth 1.12–1.82 across level of testes. Oral sucker 0.22–0.24×0.26–0.3; postero-lateral pouches 0.1–0.12 in diameter. Acetabulum 0.68–0.76 in diameter. Oesophagus narrow, 0.44–0.54 long; oesophageal bulb 0.3–0.5×0.14–0.22, spindle-shaped. Caeca

long with crenated outer margin, somewhat sinuous extending to posterior level of ovary. Testes tandem, lobed, massive, intercaecal; anterior 0.7–1.04×1.14, at end of anterior half of body; posterior 0.64–1.12×1.66. Vesicula seminalis transversely coiled. Cirrus sac egg-shaped, 0.22–0.3×0.12–0.2, enclosing small vesicula seminalis interna, small tubular pars prostatica and small ductus ejaculatorius. Ovary slightly triangular with deep notch at its base directed towards right caecum, 0.24–0.3×0.22–0.38, slightly to right, at one fourth to one seventh of body from hinder end. Uterus transversely coiled, preovarian. Eggs 0.144–0.129×0.064–0.075. Vitellaria of irregular follicles from level of anterior margin of acetabulum to middle of oesophageal bulb, extending a little towards median line at posterior end.

Host.—Fresh water fish, *Silundia gangetica* Cuv. and Val.

Location.—Rectum.

Locality.—Allahabad, U.P.

119. **Orientodiscus jumnia** Srivastava, 1938

Specific diagnosis.—Body cylindrical, smooth, 5.45 long, 1.2 in maximum breadth in region of testes. Oral sucker 0.24×0.26. Acetabulum 0.66 in diameter. Oesophagus narrow, 0.32 long; oesophageal bulb 0.3×0.16. Caeca wavy, extending to level of ovary. Testes spherical, entire, tandem, intercaecal in middle of body, 0.66–0.75 in diameter. Vesicula seminalis externa long, coiled. Ovary spherical, 0.24 in diameter, slightly to left, at commencement of last quarter of body. Eggs 0.114–0.12×0.072–0.076. Vitellaria from posterior level of oesophageal bulb to anterior level of acetabulum.

Host.—Silundia gangetica Cuv. and Val.

Location.—Rectum.

Locality.—Allahabad, U.P.

Genus 58. **Protocladorchis** Willey, 1935

Syn. *Maccallumia* R. C. Chatterji, 1938

Dadaytrematinae : Body oval to elliptical, papillated anteriorly, convex dorsally, flattened ventrally. Acetabulum

small, ventroterminal. Oral sucker terminal with posterior diverticula in the form of saccular appendages. Oesophageal bulb elongate, muscular. Caeca terminating in front of acetabulum. Testes large, irregularly lobed, intercaecal, tandem or somewhat diagonal; anterior testis preequatorial. Cirrus sac and genital sucker present. Genital pore median near intestinal bifurcation. Ovary submedian, much in front of acetabulum behind middle of body. Laurer's canal opening anterior to excretory pore. Vitellaria lateral from intestinal bifurcation or testicular zone to beyond caecal ends. Uterine coils inercaecal, dorsal to testes, extending posterior to ovary. Excretory vesicle small, dorsal; pore immediately anterior to acetabulum. Lymphatic system of two pairs of longitudinal vessels dorsal and lateral to caeca. Parasitic in intestine of freshwater fishes.

Type-species : *P. pangasi* (MacCallum, 1905) Willey, 1935

120. **Protocladorchis burmanica** (Chatterji, 1938)

(Fig. 78)

Syn. *Protocladorchis burmanicus* (Chatterji, 1938) Yamaguti, 1954
Maccallumia burmanica Chatterji, 1938

Specific diagnosis.—Body oval, flattened, 3.5–7.2 long; 1.43–2.7 in maximum breadth. Anterior extremity to just posterior to oral pouches surrounded by transverse rows of papillae. Mouth small, terminal, surrounded by a row of papillae. Oral sucker 0.212–0.334×0.24. Acetabulum 0.4–0.835×0.45–0.9. Muscular oral evaginations slightly smaller than oral sucker, 0.15–0.27 in diameter. Oesophagus 0.132–0.62 long; posterior muscular bulb 0.14–0.25 long. Genital pore median near intestinal bifurcation, 0.55–1.65 from anterior end. Caeca sinuous, ending a short distance anterior to acetabulum. Testes deeply lobed, almost equal; anterior 0.763–1.2×0.87–1.7; posterior testis 0.8–1.34× 0.87–1.7, occupying one third body length partly in anterior third and partly in middle third. Vesicula seminalis much coiled opens into cirrus sac enclosing pars prostatica and coiled ductus ejaculatorius. Ovary almost spherical, 0.267–0.48 in diameter, almost median. Vitellaria of lateral lobulated masses from a little behind anterior margin of anterior testis to end of caeca or slightly beyond. Uterus much coiled, extending behind ovary, most tortuous in posterior part of body behind testes. Eggs thin walled, oval, 0.08–0.097×

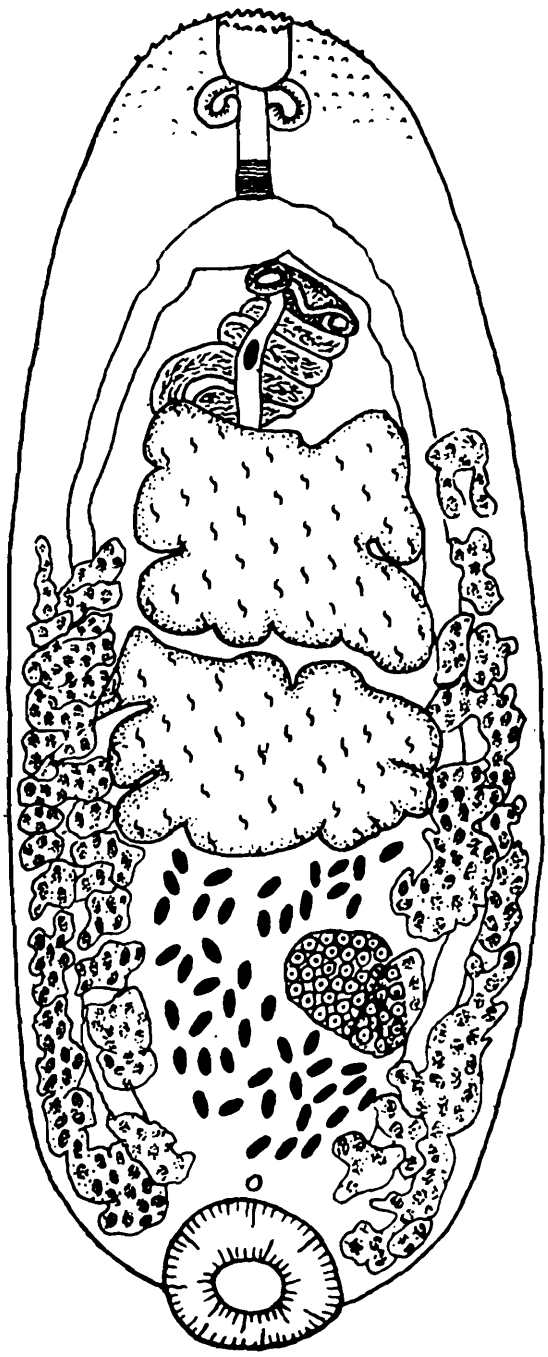


FIG. 78. *Protocladorchis burmanica* (Chatterji, 1938) Yamaguti, 1958.

0.056–0.06. Excretory vesicle small, spherical; pore median, immediately anterior to acetabulum.

Host.—Siluroid fish, *Pangasius pangasius* (Ham.)

Location.—Intestine.

Locality.—Rangoon, Burma.

XXXI. Subfamily *NICOLLODISCINAE* Skrjabin, 1949

Paramphistomidae.—Body conical, Acetabulum very large, occupying whole breadth of expanded posterior end of body. Oral diverticula small. Oesophageal bulb present. Testes extracaecal, symmetrical. Cirrus sac present. Genital sucker very large. Genital pore prebifurcal. Ovary near left caecal end. Vitellaria limited to posttesticular extracaecal field, confluent behind ovary. Uterine coils intercaecal. Excretory system H-shaped. Lymphatic system of three pairs of longitudinal vessels. Parasitic in fresh water fishes.

Type genus : *Nicollodiscus* Srivastava, 1938

Genus 59. **Nicollodiscus** Srivastava, 1938

Nicollodiscinae : Body conical, smooth. Acetabulum very large, circular, papillose at base of body. Oral sucker with small paired diverticula. Oesophagus with posterior bulb. Caeca follow a typical course, ending at base of body. Testes almost symmetrical, lobed, extracaecal at about middle of body. Cirrus sac present. Male and female pores lie close together in shallow but large genital atrium surrounded by feebly muscular wall forming the large prebifurcal genital sucker. Ovary submedian, near left caecal end. Vitellaria of small follicles, lateral, posttesticular outside caeca, meeting mesially behind ovary. Uterus intercaecal. Eggs large. Excretory system H-shaped. Lymphatic vessels three pairs. Parasitic in intestine of fresh water fishes.

Type-species : *Nicollodiscus gangeticus* Srivastava, 1938

121. **Nocollodiscus gangeticus** Srivastava, 1938

Specific diagnosis.—Body 9.0–10.4 long, 7.0–8.2 in maximum breadth across acetabulum. Oral sucker 0.76–0.88 × 0.76–0.98; lateral diverticula small, 0.16–0.5 × 0.16–0.24. Acetabulum large, circular, 6.2–7.5 in diameter, studded on inner surface with many prominent papillae. Oesophagus narrow, 1.3–1.4 long; oesophageal bulb oval, 0.52–0.84 × 0.26–0.4. Caeca follow a typical course ending at base of body. Testes deeply lobed at about middle of body, almost symmetrical outside caeca; left testis 1.54–1.84 × 0.76–1.02; right testis 1.8–1.9 × 0.88–1.08, a little posterior to left one. Cirrus sac bulb-shaped, 0.34–0.46 × 0.24–0.28. Vesicula seminalis coiled; pars

prostatica and coiled ductus ejaculatorius all enclosed in cirrus sac. Genital sucker 1.0–1.4 in diameter; genital pore slightly sinistral, in level with oesophageal bulb. Ovary ovoid, 0.46–0.64×0.38–0.52, close to end of left caecum. Laurer's canal conspicuous. Vitellaria of small follicles arranged in the form of U, extracaecal, posttesticular, meeting mesially behind ovary. Eggs 0.114–0.152×0.053–0.072.

Host.—*Silundia gangetica* Cuv. and Val.

Location.—Large intestine.

Locality.—Allahabad, U.P.

XXXII. Subfamily *HELOSTOMATINAE* Skrjabin, 1949

Paramphistomidae : Body elliptical. Oral diverticula forming very prominent claviform appendages. Oesophagus with posterior bulb. Acetabulum large, wider than posterior end of body proper with a dorsal hood. Testes symmetrical, intercaecal. Cirrus sac and genital sucker present. Genital pore behind oral sucker. Ovary postequatorial. Vitellaria lateral, extending whole length of caeca. Uterus passing between two testes. Parasitic in fishes.

Type genus : *Helostomatis* (Fukui, 1929) Travassos, 1934

Genus 60. **Helostomatis** (Fukui, 1929) Travassos, 1934

Helostomatinae : Body elliptical. Acetabulum large, ventroterminal with a dorsal hood anteriorly. Oral diverticula long, in form of claviform appendages. Oesophagus with bulb. Caeca terminating at anterior border of acetabulum short of posterior extremity. Testes symmetrical, intercaecal in midregion of body. Cirrus sac and genital sucker present. Genital pore prebifurcal, immediately behind oral sucker. Ovary postequatorial. Vitellaria lateral, extending from intestinal bifurcation or oesophageal bulb to caecal ends. Uterine coils intercaecal passing between testes. Excretory vesicle bifurcating anteriorly; excretory pore dorsal. Three lymphatic vessels on each side. Parasitic in intestine of fishes.

Type-species : *H. helostomatis* (MacCallum, 1905) Travassos, 1934

122. **Helostomatis sakrei** Bhalerao, 1937

(Fig. 79)

Specific diagnosis.—Body almost elliptical, smooth, 1.57 long, 0.73 in maximum breadth at about midbody. Oral sucker 0.185×0.17 with ventroterminal mouth; diverticula large and stout, diverging posteriolaterally, each 0.215 long, divided into thin anterior and bulb-like posterior parts lined with thick cuticle and having powerful musculature. Acetabulum large, 0.6 in diameter with anterior half bounded by a hood-like margin, posteriorly simple, rounded unlike the genotype. Oesophagus 0.3 long. Caeca characteristically sinuous, terminating dorsally to anterior face of acetabulum. Excretory pore dorsal, almost above the centre of acetabulum. Lymphatic vessels three on each side, two lying internally and third externally to caeca. Testes oval, lobed, 0.3–0.32× 0.135–0.16, symmetrical, immediately behind intestinal fork in contact with caeca externally. Vesicula seminalis externa

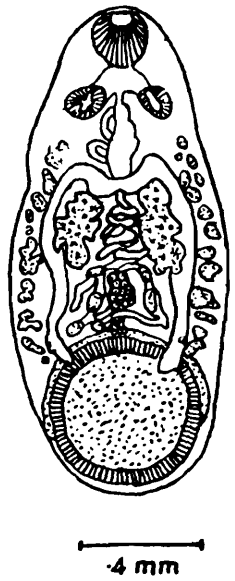


FIG. 79. *Helostomatis sakrei* Bhalerao, 1937.

to right side of oesophageal bulb. Cirrus sac almost pear-shaped, 0.094×0.0525. Visicula seminalis interna tubular, slightly curved; pars prostatica flask-shaped. Genital pore median, slightly posterior to the bifurcation from which oral diverticula diverge towards sides, surrounded by genital sucker. Ovary trilobed, 0.13×0.08 immediately behind testicular zone. Shell gland median behind ovary, slightly overlapping anterior border of acetabulum. Laurer's canal

present. Uterine coils fill intercaecal space, except that occupied by gonads passing anteriorly to left side of oesophageal bulb. Vitellaria extracaecal, from level of anterior border of oesophageal bulb to slightly short of caecal ends, a few follicles overlapping caeca posteriorly. Eggs large, a few, 0.074–0.82×0.042–0.044.

Host.—*Labeo calbasu.*

Location.—Intestine.

Locality.—Poona, Maharashtra.

XXXIII. Subfamily *CLEPTODISCINAE* Skrjabin, 1949

Paramphistomidae : Body subcylindrical or somewhat fusiform. Acetabulum ventroterminal, not very large. Oral sucker with small diverticula. Oesophagus without bulb. Testes tandem in midregion of body. Cirrus sac present. Genital pore bifurcal, surrounded by muscular disc. Ovary between caecal ends, slightly in front of acetabulum. Vitellaria postequatorial along posterior part of caeca in testiculo-ovarian zone. Excretory vesicle small with dorsal pore and arms united anteriorly. Lymphatic vessels three on each side. Parasitic in marine and fresh water fishes.

Type genus : *Cleptodiscus* Linton, 1910

Genus 61. **Cleptodiscus** Linson, 1910

Syn. *Neocladorchis* Bhalerao, 1937

Cleptodiscinae : Body small cylindrical or fusiform with bluntly pointed or rounded extremities. Acetabulum not very large. Mouth terminal. Oral diverticula small. Oesophagus without bulb. Caeca reaching to near posterior extremity. Testes slightly oblique tandem, contiguous, equatorial or preequatorial for the most part. Vesicula seminalis coiled. Cirrus sac present. Genital pore at intestinal bifurcation, surrounded by muscular disc. Ovary median or submedian closely anterior to acetabulum with shell gland behind it. Vitellaria posttesticular, postequatorial along posterior part of caeca. Uterus coiled, intercaecal, preovarian. Eggs large. Excretory vesicle small, with dorsal pore and arms united dorsal to anterior part of oesophagus. Parasitic in marine and fresh water fishes.

Type-species : *C. reticulatus* Linton, 1910

123. **Cleptodiscus poonensis** (Bhalerao, 1937)

(Fig. 80)

Syn. *Neocladorchis poonensis* Bhalerao, 1937

Specific diagnosis.—Body subcylindrical with most anterior part sharply attenuated and distinct, 1.8–5.85 long × 0.6–1.4 broadest part immediately in front of acetabulum; small papillae on anterior part, rest of cuticle smooth. Oral sucker 0.22–0.33 × 0.24–0.38; posterolateral diverticula 0.225–0.3 × 0.185–0.235, oval and together broader than width of oral sucker. Acetabulum 0.63–1.07 in diameter. Oesophagus 0.36–0.68 long, 0.125–0.175 wide. Caeca somewhat sinuous, reaching anterior border of acetabulum, sometimes overlapping it. Excretory vesicle oval, dorsal to acetabulum; pore dorsal,

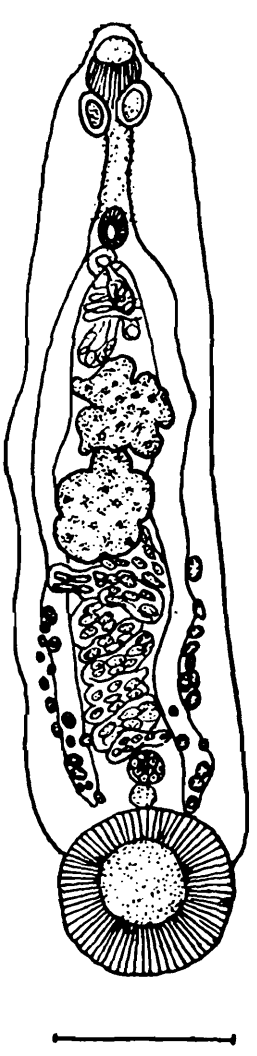


FIG. 80. *Cleptodiscus poonensis* (Bhalerao, 1937).

slightly behind middle of acetabulum. Three lymphatic vessels on each side of body. Testes slightly oblique tandem, almost preequatorial, touching or overlapping each other, 0.36–0.825×0.28–0.67 Vesicula seminalis externa much coiled. Cirrus sac small, 0.285–0.33×0.17–0.18; vesicula seminalis interna coiled at base of cirrus sac; pars prostatica straight. Genital pore on intestinal fork. Ovary round, 0.13–0.28 in diameter, median slightly in front of acetabuulum; shell gland immediately behind ovary. Laurer's canal present. Uterus fills up intercaecal space between ovary and posterior testis, passing dorsally to testes, terminal part muscular opening into genital atrium posterior to opening of cirrus sac. Vitellaria extracaecal and partly caecal, extending from some distance behind posterior testis to caecal ends. Eggs 0.15–0.17×0.056–0.06.

Host.—*Barbus dobsoni.*

Location.—Intestine.

Locality.—Poona, Maharashtra.

XXXIV Subfamily *SOLENORCHIINAE* Hilmy, 1949

Paramphistomidae : Body elongate, with lip-like terminal lobe. Acetabulum subterminal, with semilunar muscular cushion anterodorsally. Oral sucker elongate with or without two inconspicuous diverticula. Oesophageal bulb present or absent. Caeca long with distal ends curved. Testes tandem in midregion of body. Cirrus sac present or absent. Cirrus opening into genital atrium immediately in front of uterus. Ovary posttesticular, median. Laurer's canal opening posterior to excretory pore. Vitellaria lateral, extensive. Uterine coils dorsal and anterior to testes. Excretory vesicle intertesticular, opening dorsally at about level of vesicle. Lymph system with two pairs of longitudinal vessels. Parasitic in Sirenia.

Type genus : *Solenorchis* Hilmy, 1949

Key to genera of SOLENORCHIINAE

Oesophogeal bulb and cirrus sac absent.	*Solenorchis* Hilmy, 1949
Oesophageal bulb and cirrus sac present.	*Indosolenorchis* Crusz, 1951

Genus 62. **Indosolenorchis** Crusz, 1951

Solenorchiinae : Body fusiform, flattened or slightly curved ventrally, convex dorsally, with postacetabular muscular lip. Acetabulum subterminal, with semilunar muscular cushion anterodorsally. Oral sucker preceded by vestibule, with two inconspicuous dorsolateral pouches. Oesophagus with posterior bulb. Caeca ribbon-shaped, flattened from side to side, terminating divergently in front of acetabulum. Testes tandem in middle third of body, separated from one another by excretory vesicle. External seminal vesicle much coiled. Cirrus sac well developed containing coiled internal seminal vesicle and straight cirrus. Cirrus opening immediately in front of uterus in spacious genital atrium. Genital pore at level of intestinal bifurcation. Ovary immediately post-testicular, median. Laurer's canal opening middorsally at level of posterior testis. Vitellaria from region of oral sucker to a little behind caecal ends. Uterine coils mainly dorsal and anterior to testes. Eggs large. Excretory vesicle inter-testicular, with large posterior diverticulum ending in coils between ovary and acetabulum. Just behind ovary this diverticulum gives off two lateral arms, which run ventrally and merge into two main lateral longitudinal ducts. Lymphatic system of two pairs of longitudinal vessels. Parasitic in caecum of Sirenia.

Type-species : *I. hirudinaceus* Crusz, 1951

124. **Indosolenorchis hirudinaceus** Crusz, 1951

(Fig. 81)

Specific diagnosis.—Length 10–12, maximum breadth 3.2–4 about the middle, narrower anteriorly than posteriorly with convex lateral margins, ventral surface flattened or concave, dorsal surface convex; posterior end bluntly broad, frayed out into a distinct postacetabular muscular lip. Acetabulum subterminal, large, deep, almost spherical, 1–2 in diameter, 1.18 in depth, with strongly developed, semilunar muscular cushion in its antero-dorsal aspect. Postacetabular lip dorsally along posterolateral margin of acetabulum 15 long, 3 in width. General body shape, acetabulum fringed by flattened lip and transverse straitions of cuticle all make the fluke leech-like in appearance and hence the specific name *hirudinaceus*. Mouth terminal, longitudinal slit; oral vestibule 0.61 long, rudimentary. Oral sucker (pharynx) accord-

ing to Hilmy, 1.26×0.85, with sphincters at ends, stronger posterior sphincter at oesophageal end provided with two inconspicuous dorsolateral pouches at posterior end. Oesophagus short, straight, 1.02 long, 0.37 in diameter with oesophageal bulb at posterior end. Caeca ribbon-shaped, flattened from side to side, sinuous, terminating divergently in front of acetabulum with posterior end narrow and curved outwards. Excretory pore dorsal at level of posterior testis or just behind. Excretory sac large, equatorial between testes, with its posterior margin close to posterior testis, 1.4 long, 0.65 broad with its large three pronged diverticulum arising from dorsal

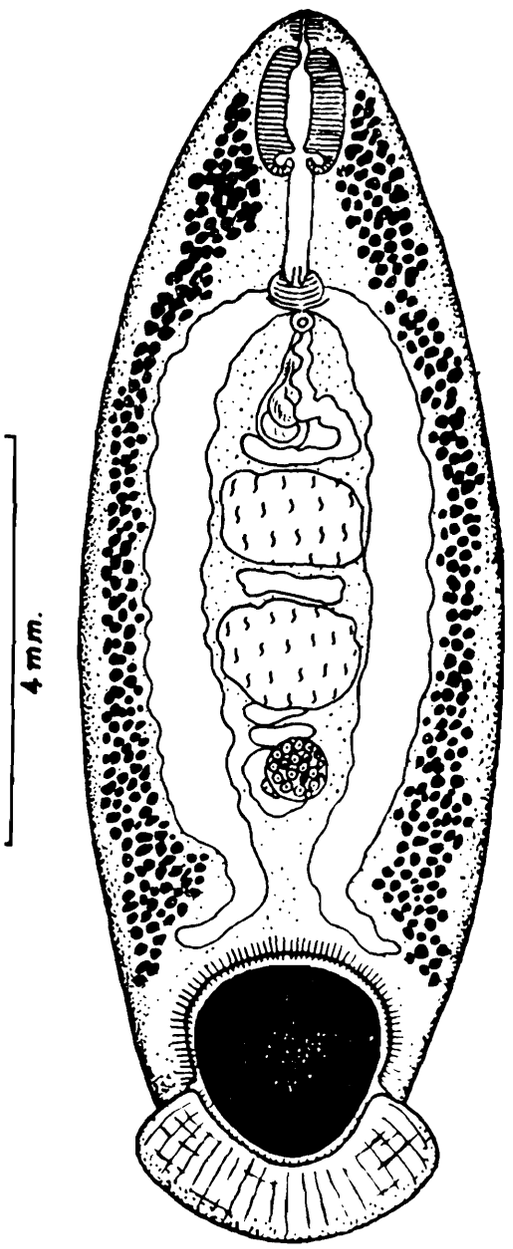


FIG. 81. *Indosolenorchis hiradinaceus* Crusz, 1951.

right or left side, extending posteriorly and giving off two lateral arms, ventrally merging into two longitudinal excretory ducts. Genital pore without sucker, median at 3–3.5 from anterior end, bifurcal. Genital atrium spacious. Cirrus sac just behind atrium, 0.85×0.35–0.44. External seminal vesicle much coiled. Testes in middle third of body, tandem, almost equal, separated by excretory vesicle, lobed ventrally, 0.82–1.03×0.6 from side to side, 1.35–1.47 dorsoventrally; posterior testis 2.4 in front of acetabulum. Ovary immediately behind posterior testis, subspherical, 0.44–0.52× 0.35–0.44. Laurer's canal opens middorsally at about level of posterior testis, much behind excretory pore. Vitellaria large follicles, lateral outside caeca from middle of oral sucker to behind tips of caeca, more crowded and massive at level of oesophagus and near posterior curvature of caeca. Uterus first winds slightly posteriorly and then proceeds forwards dorsal to testes and to right and left of middle line on the side opposite the posterior diverticulum of excretory vesicle, forming the sets of convolutions one dorsal to posterior testis and the other between anterior testis and cirrus sac, running ventral to the latter. Eggs ovoid, operculated, 0.09–0.13× 0.05–0.08.

Host.—*Dugong dugong* (Muller, 1776), male.

Location.—Caecum.

Locality.—Indian ocean, off Colombo.

D. Superfamily *NOTOCOTYLOIDEA* La Rue, 1957

Paramphistomata : Cercariae monostomate without acetabulum. Pharynx absent. Excretory vesicle V-shaped or Y-shaped with long arms united anteriorly or short tubular with lateral branches. Caudal excretory canals running in part of length of tail in cercaria with lateral openings some distance behind the base. Protrusible cup-shaped attaching structures situated posterolaterally. Eggs small, with polar filaments.

Key to Indian families of NOTOCOTYLOIDEA

1. Large monostomes, provided ventrally with curved bluntly pointed papillae or spines in quincunx; parasitic in Sirenia. .. RHABDIOPOEIDAE Poche, 1925

Small or medium sized monostomes without ventral papillae or spines in quincunx; parasitic in turtles, birds and mammals rarely fishes... .	2	
2. Genital pore median, at posterior extremity; parasitic in Sirenia.		OPISTHOTREMATIDAE Poche, 1925
Genital pore near intestinal bifurcation or far behind it but never near posterior extremity. ..	3	
3. Head collar, absent; parasitic in birds and mammals		NOTOCOTYLIDAE Lühe, 1909
Head collar present; parasitic in turtles, rarely fishes.		PRONOCEPHALIDAE Looss, 1902

X. Family NOTOCOTYLIDAE Lühe, 1909

Notocotyloidea : Small elongate or oval monostomes with somewhat rounded ends, sometimes a little concave ventrally or body margins turned over ventrally in the form of a canoe; cuticle spined ventrally or without spines. Longitudinal rows of glands or longitudinal ridges on ventral surface present or absent. Oral sucker small. Pharynx absent. Oesophagus short. Caeca simple, long ending near posterior extremity or more forwards. Genital pore median or submedian, bifurcal, postbifurcal or more posterior to intestinal bifurcation, just preequatorial or equatorial. Testes symmetrical one on each side of terminal part of caeca or posterior to caeca. Vesicula seminalis externa present or absent. Cirrus sac very long or curved C-shaped, enclosing part of or whole vesicula seminalis, prostatic complex and long eversible ductus ejaculatorius. Ovary median between testes or posttesticular. Shell gland complex in front of ovary. Receptaculum seminis absent. Laurer's canal usually present. Vitellaria follicular, mostly extracaecal, anterior, lateral or dorsal to testes. Uterus intercaecal, transversely coiled, preovarian. Eggs with polar filament at each pole. Excretory vesicle Y-shaped with short stem and long arms united anteriorly. Parasitic in intestine of birds or mammals.

Type genus : *Notocotylus* Diesing, 1839

Key to Indian subfamilies of NOTOCOTYLIDAE

Genital pore submedian, far behind intestinal bifurcation, just preequatorial. Cirrus sac curved, C-shaped; vesicula seminalis external present or absent.	OGMOCOTYLINAE Skrjabin & Schulz, 1933

Genital pore median near anterior end, bifurcal or postbifurcal. Cirrus sac usually elongate, not curved; vesicula seminalis externa present. . . .	NOTOCOTYLINAE Kossack, 1911

Key to Indian genera of NOTOCOTYLINAE

1. Ventral surface without glands	*Paramonostomum* Lühe, 1909
Ventral surface with three longitudinal rows of glands	2
2. Three rows of weakly developed, non-protrusible glands, the median row forming a continuous solid ridge.	*Catatropis* Odhner, 1905
Three rows of well developed, more or less protrusible ventral glands, the median row consisting of isolated glands like outer rows. . .	*Notocotylus* Diesing, 1839

Genus 63. **Notocotylus** Diesing, 1839

Syn. *Hindia* Lal, 1935
Naviformia Lal, 1935
Kossackia U. Szidat, 1936
Hindolana Strand, 1942

Notocotylinae : Body elongate. Ventral glands in three longitudinal rows. Oral sucker subterminal or terminal. Caeca terminating near posterior extremity. Testes outside terminal part of caeca. Vesicula seminalis externa tubular, winding in median field. Cirrus sac elongated, claviform. Genital pore prebifurcal, bifurcal or immediately postbifurcal. Ovary intertestcular. Shell gland complex preovarian. Vitellaria lateral, pretsticular. Uterus forming close transverse coils between shell gland and cirrus sac; metraterm well differentiated. Excretory vesicle Y-shaped, cornua long, united dorsal or oesophagus, with numerous anastomosing lateral branches. Parasitic in intestine of birds, rarely of mammals.

Type-species : *N attenuatus* (Rud., 1809) Diesing, 1839

Dubois (1951) divided *Notocotylus* into two subgenera, *Notocotylus* Dubois, 1951 and *Hindia* Lal, 1935, Syn. *Kossackia* U. Szidat, 1936 on the basis of length of body relatively to breadth, ventral glands of median row being protrusible or non-protrusible and their number, and presence or absence of cuticular spines.

1. Subgenus **Notocotylus** Dubois, 1951

Notocotylus : Body long, elliptical, more than 22 times longer than broad; ventral glands in median row 10–25, evaginable in the form of hemispherical papillae; spined ventrally.

Types-species : *N attenuatus* (Rud., 1809) Diesing, 1839

2. Subgenus **Hindia** Lal, 1935

Syn. *Kossackia* U. Szidat, 1936

Notocotylus : Body oval, up to 22 times as long as broad; ventral glands in median row 4–6 or eventually up to 8; non-protrusible or feebly evaginable and consisting of groups of diffused cells; cuticular spines absent; parasitic in Ralliformes.

Type-species : *N. gibbus* (Mehlis in Creplin, 1846) Kossack, 1911

Key to Indian species of genus **Notocotylus**

Ventral glands 8 in lateral rows and 6 in middle row.	*N.* (*Hindia*) *gibbus* Mehlis in Creplin) Kossack, 1911
Ventral glands 18 in each lateral row, 14 in middle row..	*N.* (*N.*) *attenuatus* (Rud., 1809)
Ventral glands 17 in each lateral row, 15 or 16 in middle row	*N.* (*N.*) *babai* Bhaleroa, 1935
Ventral glands 16 in each lateral row, 15 in middle row.	*N.* (*N.*) *imbricatus* (Looss, 1899) Szidat, 1935
Ventral glands 23–25 in each lateral row, 20 or 21 in median row ..	*N.* (*N.*) *parviovatus* Yamaguti, 1934

125. **Notocotylus (Notocotylus)** *attenuatus* (Rud, 1809) Diesing, 1839

(Fig. 82)

Syn. *N. trisenalis* Diesing, 1839)
N. attenuatus (Rud., 1809) Nath and Pande, 1963

Specific diagnosis.—Body light pink, elongate, slightly concave ventrally, 4.86 long, maximum breadth 1.57 at

anterior end of vitellaria (mounted specimen). Ventral glands 18 in each lateral row and 14 in middle row. First and last pairs of lateral glands smaller, the other almost equal; first gland of middle row 0.76 from anterior end; first pair of lateral glands at 0.67 and 0.53 from anterior end. Cuticle spined ventrally. Oral sucker subterminal, 0.19×0.25. Oesophagus 0.12 long. Caeca terminate 0.39–0.42 in front of posterior end. Testes symmetrical, deeply lobed, 0.63×0.35 (L). External seminal vesicle 2.12 long, initially straight, median, forming two loops near cirrus sac. Cirrus sac club-shaped, 1.27×0.12. Internal seminal vesicle coiled; pars prostatica 0.38 long; ejaculatory duct nearly half as long as cirrus sac. Genital pore at intestinal bifurcation. Ovary deeply lobed, 0.26×0.42. Mehlis' gland irregular, 0.19×0.35.

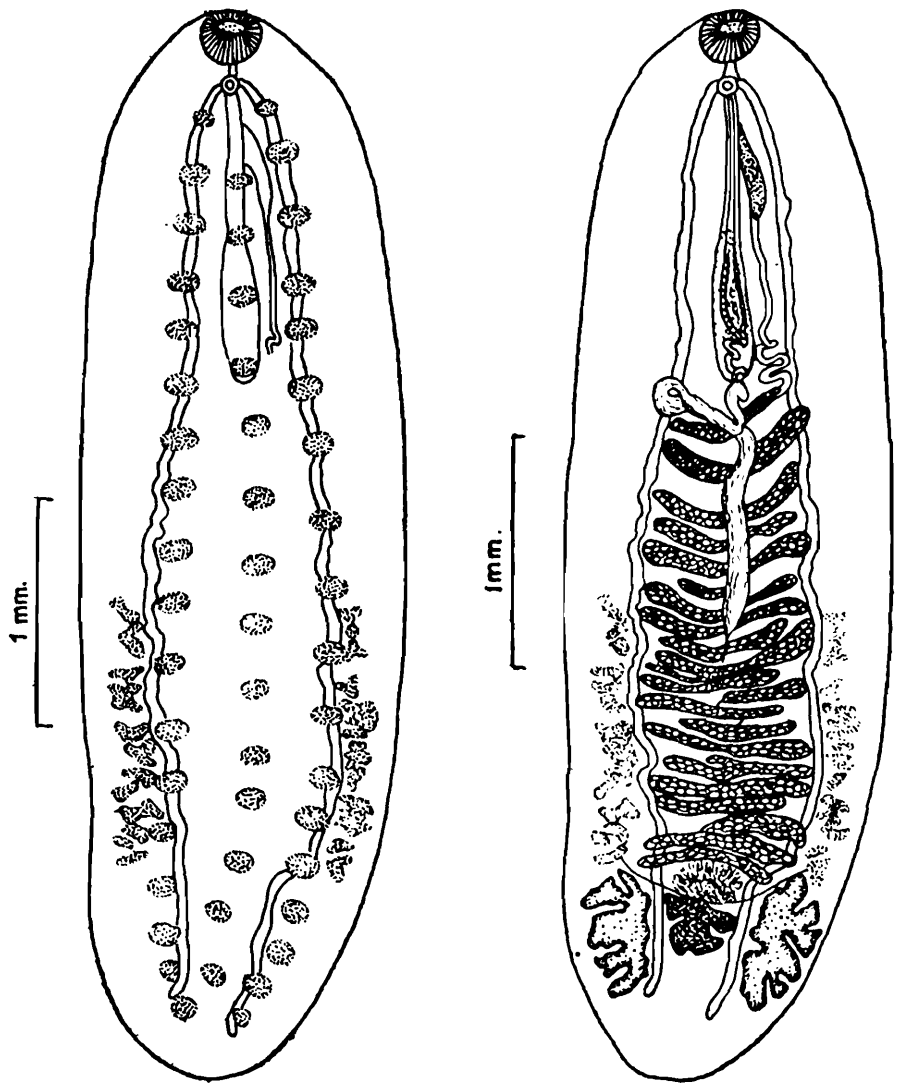


FIG. 82. Left: *Notocotylus* (*N*) *attenuotus* (Rud.) Ventral glands. Right: *Notocotylus* (*N.*) *attenuatus* (Rud., 1809.)

Uterus coiled in about 20 transverse loops, seven loops previtellarian. Metraterm two fifths of cirrus sac in length, with unicellular glands around it. Eggs with polar filaments, 11–14.5×8.5–10μ excluding filaments. Vitellaria extracaecal, 1.53 long, just in front of gonads in posterior half of body. Excretory pore subterminal.

Host.—Domestic fowl.

Location.—Caecum.

Locality.—Mathura, U.P.

A single specimen was described by Dharmendra Nath and B. P. Pande (1963).

126. **Notocotylus (Notocotylus) babai** Bhalerao, 1935

Syn. *Notocotylus indicum* (Lal, 1935) Dubois, 1951
Notocotylus solitaria (Singh, 1954) Dubois, 1955

Specific diagnosis.—Body elliptical, spined ventrally, 2–3.83 ×0.45–0.93. Ventral glands in middle row 15 or 16. In each lateral row 17 Oral sucker 0.12–0.2×0.15–0.16. Oesophagus 0.075–0.12 long. Caeca terminate 0.2–0.26 in front of posterior end. Testes deeply lobed 0.25–0.54× 0.12–0.24. Cirrus sac 0.58–1.09 long. Genital pore bifurcal or immediately postbifurcal. Ovary deeply lobed, 0.114–0.3 ×0.144–0.31. Eggs 0.014–0.018×0.07–0.11. Anterior limit of vitellaria 60–64/100.

Host.—*Milvus migrans govinda, Mereca penelope, Anas acuta.*

Location.—Intestinal caeca or intestine.

Locality.—Rangoon (Burma), Lucknow (U.P.).

This species appears to be closely related to *N.* (*N.*) *attenuatus* (Rud). It may be even identical and synonymous to it. I, however, follow Dubois in maintaining it.

127 **Notocotylus (Notocotylus) imbricatus** (Looss, 1893) Szidat, 1935.

Syn. *Notocotylus lucknowensis* (Lal, 1935) Ruiz, 1946
Hindia lucknowensis Lal, 1935
N. anatis Ku, 1937.

Specific diagnosis.—Body elongate, spined, 2.63×0.74. Ventral glands 15 in middle row and 16 in each lateral row.

Oral sucker 0.15 in diameter. Testes deeply lobed along their outer margin, inner margin entire, left testis 1.375×0.2; right testis 0.35×0.175. Cirrus sac 0.825 long. Geneital pore bifurcal at 0.25 from anterior end. Ovary 5-lobed, 0.175×0.15. Cirrus armed with several rows of small spines on its entire outer surface, 0.3 long. Vitellaria 0.525 long. Eggs 0.02×0.01.

Host.—*Mereca penelope.*
Location.—Intestinal caeca.
Locality.—Lucknow, U.P.

128. **Notocotylus (Notocotylus) parviovatus** Yamaguti, 1943

Specific diagnosis.—Body elongated, spined, broadly round at anterior end, 2.9–4.28 long, 0.879–1.06 broad. Ventral glands 23–25 in each lateral row; 20 or 21 glands in median row. Oral sucker 0.108–0.148×0.162–0.170. Oesophagus short, 0.067–0.089 long; caeca extend to posterior end of testes. Testes elongated lobed, equal or unequal; right testis 0.498–0.697×0.249–0.332; left testis 0.464–0.614×0.248–0.282. Cirrus sac club-shaped, 0.91–1.49 long. Vesicula seminalis interna in basal part of cirrus sac; ductus ejaculatorius long; cirrus beset with minute spines. Ovary irregularly lobed, 0.21–0.3×0.18–0.26. Vitellaria extracaecal, extending from middle of body to anterior end of testes. Shell gland immediately preovarian. Uterine coils compact, 18-20, intercaecal. Metraterm with glandular coat outside, half as long as cirrus sac, 0.41–0.66 long. Eggs 0.013×0.0093, provided with long filament at each pole. Excretory pore dorsal behind ovary; excretory vesicle with short stem dividing into two cornua.

Host.—*Anser anser* (Linn.)
Location.—Caeca.
Locality.—Hardoi, U.P.

Recorded by Baugh (1958) from India.

129. **Notocotylus (Hindia) gibbus** (Mehlis in Creplin, 1846) Kossack, 1911

(Fig. 83)

Syn. *N. pacifer* (Noble, 1933) Harwood, 1939

Specific diagnosis.—Body ovoid, spined, with more rounded posterior end, 1.63–2.52, 0.702–1.44 in width. Ventral glands

eight in each lateral row and six in median row. Oral sucker terminal, 0.14–0.19×0.16–0.21. Oesophagus 0.12 long. Genital pore immediately behind intestinal bifurcation.

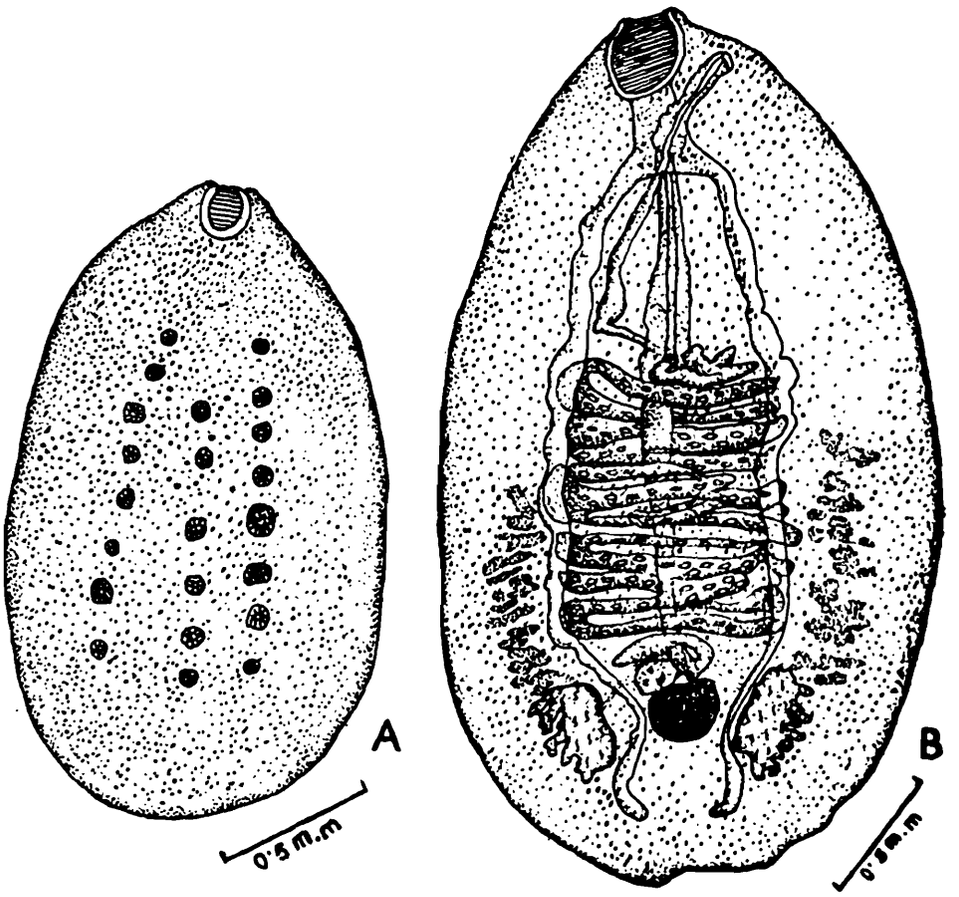


FIG. 83. A—*Noocotylus* (*Hindia*) *gibbus* (Mehlis in Crepln). Ventral glands.
B—*Notocotylus* (*Hindia*) *gibbus* (Mehlis in Creplm, 1896).

Testes slightly lobed, 0.27–0.36×0.18–0.25. Cirrus sac elongated, club-shaped, 0.702–0.72 long × 0.09–0.14 wide with internal seminal vesicle, pars prostatica and ejaculatory duct; cirrus 0.22 long. External seminal vesicle coiled, in level with posterior end of cirrus sac. Ovary 0.14–0.21× 0.09–0.21, entire margined. Vitellaria in posterior half, occupying a total area of 0.666 length. Uterus with three pre-vitelline loops. Metraterm nearly two third of cirrus sac. Intrauterine eggs without filaments, 0.020×0.008.

Host.—Indian Coot, *Fulica atra.*
Location.—Caeca.
Locality.—Mathura, U.P.
Recorded by S. C. Srivastava and B. P. Pande (1965) from India.

Genus 64. **Catatropis** Odhner, 1905

Notocotylinae : Body elongate with anterior extremity attenuated and posterior rounded. Cuticle smooth or spined. Ventral glands in three rows, weakly developed, nonprotrusible; median ventral glands forming a continuous ridge, those of the outer rows distinct and separate. Caeca reaching between testes, terminating near hinder end. Testes symmetrical at posterior end of body. Cirrus sac elongated, median. Genital pore median immediately postbifurcal, close behind oral sucker. Ovary median, intertesticular. Vitellaria lateral, posttesticular. Uterus intercaecal; metraterm alongside cirrus sac. Eggs with long filament at each pole. Excretory vesicle Y-shaped, with long arms with short lateral branches. Parasitic in intestine of birds, rarely mammals.

Type-species : *C. verrucosa* (Froelich, 1789) Odhner, 1905

Key to Indian species of **Catatropis**

Genital pore far anterior, prebifurcal, close behind oral sucker.	*C. indicus* Srivastava, 1925
Genital pore postbifurcal.	*C. orientalis* Harshe, 1933

130. **Catatropis orientalis** Harshe, 1932

Specific diagnosis.—Body almost oval tapering anteriorly, rounded at posterior end, strongly concave ventrally, 3.3–4.87 long, 1.18–1.5 in maximum breadth in anterior region of testes; cuticle unspined except minute spiny indentations hardly projecting from surface anteriorly. Ventral glands of lateral rows 7 or 8, separate from one another, three of the middle row continuous forming a ridge extending from saccular part of cirrus sac to posterior margin of ovary. Oral sucker 0.16–0.2 in diameter. Oesophagus short, 0.16–0.32 long. Caeca without diverticula throughout, terminating near hinder end. Testes much lobed, 1.09×0.49, longer than broad. Cirrus sac median, flask-shaped, 0.69×0.21. Genital pore median, immediately postbifurcal. Ovary lobed, median, intertesticular, 0.32×0.49; shell gland preovarian, 0.23×0.28–0.34. Uterine coils about 20 filling intercaecal region, overlapping caeca to a certain extent. Vitellaria 1.04–1.45 long, in middle third of body, commencing 0.54 behind cirrus sac, terminating at anterior margin of testes or a little behind. Eggs 0.024–0.026×0.011–0.013 with a polar filament at each end.

Host.—*Dafila acuta* (pintail duck).
Location.—Rectal caeca.
Locality.—Allahabad, U.P.

131. **Catatropis indicus** Srivastava, 1935

(Fig. 84)

Specific diagnosis.—Body 4.2–4.6 long, 1.2 broad across anterior end of vitellaria, spined; ventral surface concave, dorsal surface convex. Ventral glands in three rows, non-protrusible, continuous in median row, 10–12 in each lateral

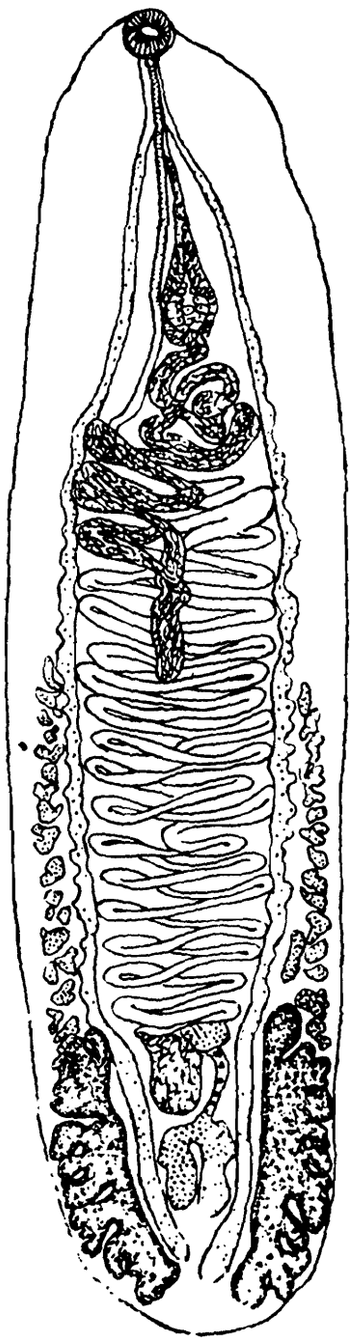


FIG. 84. *Catatropis indicus* Srivastava, 1935. Ventral view.

row. Oral sucker 0.14–0.2 in diameter. Oesophagus 0.2–0.26 long. Caeca provided with numerous minute diverticula. Testes deeply lobed, 0.75–0.99×0.2–0.3. Vesicula seminalis externa enormous, coiled. Cirrus sac median, flask-shaped with long neck, 0.87–1.2×0.17–0.2 in maximum breadth across bulb. Genital pore median, close behind oral sucker. Ovary irregularly lobed, 0.26–0.35; shell gland 0.23–0.26× 0.17–0.26, triangular, preovarian. Vitellaria from behind middle of body to a little beyond anterior end of testes, 1.2–1.5 long. Eggs 0.017–0.02×0.008–0.01.

Host.—Indian fowl, *Gallus bankiva murghi.*

Location.—Rectal caeca.

Location.—Allahabad, U.P.

Genus 65. **Paramonostomum** Lühe, 1909

Syn. *Neoparamonostomum* Lal, 1936

Notocotylinae : Body flattened oval to elliptical, without ventral glands or ridges. Caeca passing medial to testes, terminating at or near posterior extremity. Testes indented or lobed, symmetrical, outside terminal part of caeca. Cirrus sac well developed. Genital pore median, immediately post-bifurcal or bifurcal. Ovary median, intertesticular, with shell gland complex in front. Vitellaria pretesticular, lateral, uterus transversely coiled, not extending laterally beyond caeca. Eggs with polar filaments. Parasitic in small intestine or caeca of birds and mammals.

Type-species : *P. alveatum* (Mehlis in Creplin, 1846) Lühe, 1909.

Key to Indian species of **Paramonostomum**

1. Ovary round, elliptical smaller than shell gland . . . . . *P. microstomum* Moghe, 1932

Ovary lobed, larger than shell gland. . 2

2. Genital pore bifurcal. . . . . *P. fulicai* Baugh, 1958
Genital pore prebifurcal midway between intestinal bifurcation and oral sucker or nearer the latter. . . . . *P. querquedulum* Lal, 1936

132. **Paramonostomum microstomum** Moghe, 1932

(Fig. 85)

Specific diagnosis.—Body elongated, anterior part incurved ventrally with obtuse anterior end and bluntly pointed posterior end, 1.348–1.624 long × 0.475–0.409 maximum breadth anterior to testes. Oral sucker 0.063 in diameter. Oesophagus very short; intestinal bifurcation at acute angle. Caeca extend to 0.05 from posterior end. Testes elongated, lobed, extracaecal, 0.13–0.15 long. Cirrus sac 0.413 long. Genital pore immediately postbifurcal, near anterior end. Ovary median, intertesticular, small between ends of caeca, rounded. Shell gland complex elliptical, larger than overy,

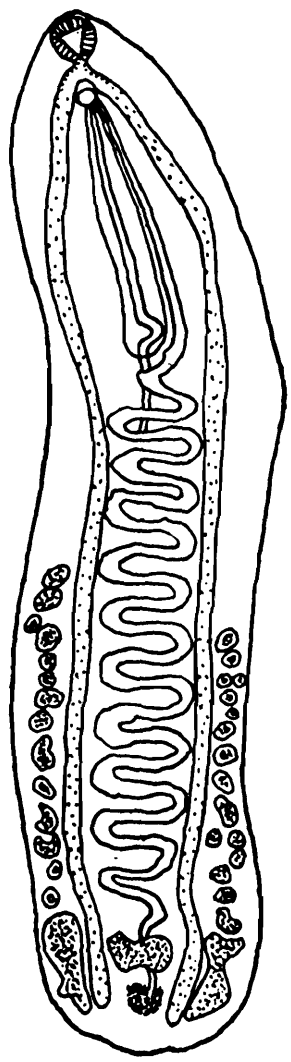


FIG. 85. *Paramonostomum microstomum* Moghe, 1932. Ventral view.

preovarian. Uterus intercaecal forming 13–15 loops, occupying more than half body length; metraterm half as long as cirrus sac and alongside it. Vitellaria from middle of uterine region to anterior end of testes. Eggs with polar filaments, 0.051 in length without filaments.

Host.—*Philomachus pugnux.*

Location.—Small intestine.

Locality.—Nagpur, Maharashtra.

133. **Paramonostomum querquedulum** Lal, 1936

(Fig. 86)

Syn. *Paramonostomum casarcus* Lal, 1936
Paramonostomum nettioni Baugh, 1958
Paramonostomum harwoodi Dharmendra Nath and Pande, 1963

Specific diagnosis.—Body 1.66–3.8 long × 0.05–1.11 maximum breadth in mid or preequagorial region. Oral sucker 0.067–0.17 × 0.086–0.12. Oesophagus 0.12–0.165 long; intestinal bifurcation acute-angled; caeca with or without small outgrowths in anterior part, terminating a little in front of hinder end. Testes elongated, extracaecal, deeply lobed in their outer margin; right testis 0.332–0.8 × 0.149–0.24; left testis 0.265–0.76 × 0.149–0.235. Cirrus sac somewhat pear-shaped with long narrow neck or club-shaped, 0.49–0.93 long. Genital pore prebifurcal, midway between oral sucker and intestinal bifurcation, near or close behind oral sucker. Ovary lobate, 0.155–0.38 × 0.099–0.22. Metraterm runs parallel to cirrus sac. Eggs 0.015–0.2 × 0.009–0.011.

Host.—*Querquedula circis, Casarca rutila, Nettion crecca* (Linn.), wild duck, *Anas crecca.*

Location.—Intestinal caeca, rectum.

Locality.—Lucknow, Mathura, U.P.

134. **Paramonostomum fulicai** Baugh, 1958

Specific diagnosis.—Body oval, round at posterior end, 2.4 long, 1.16 broad in middle region, armed with scale-like spines. Oral sucker 0.215 in diameter. Oesophagus short, 0.078 long; caeca terminate at 0.2 from posterior extremity,

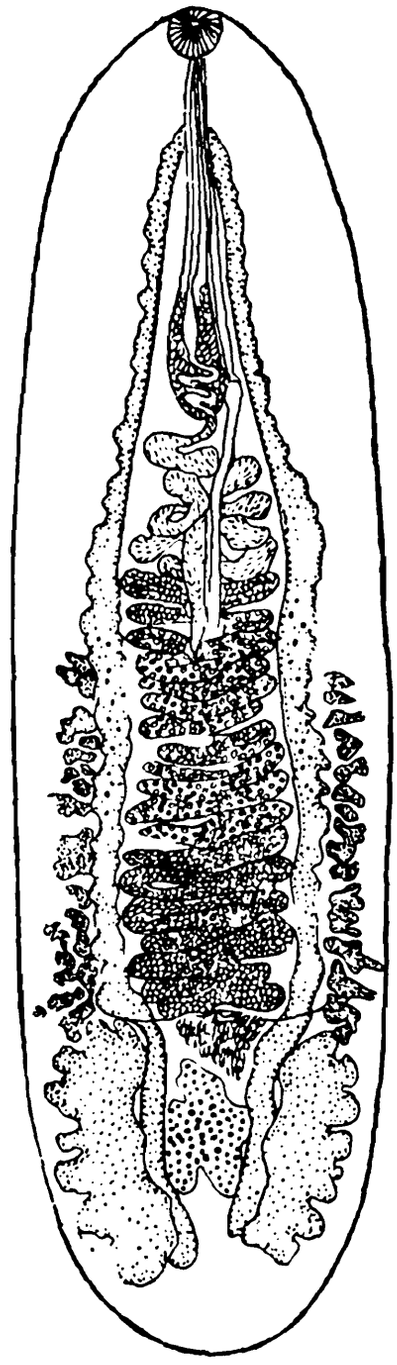


FIG. 86. *Paramonostomum guerquedulum* Lal, 1936.

greatly concealed before their termination by dense uterine coils and testes. Testes symmetrical on either side of ovary, ovoid with crenated margins, 0.33×0.2. Vesicula seminalis externa present. Cirrus sac elongated, club-shaped, extending from level of intestinal bifurcation to a short distance in front of middle of body. Cirrus tuberculated, everted through genital pore, 0.20×0.07 Ovary median, intertesticular

posteriorly notched, 0.182×0.15. Shell gland mass preovarian. Laurer's canal present. Uterine coils dense, mostly intercaecal, partly overlapping caeca, extending to posterior end of cirrus sac. Metraterm 0.318 long, two third of length of cirrus sac. Genital pore below intestinal bifurcation. Eggs with long filaments, 0.0182–0.0208×0.0104–0.0130 exclusive of filaments.

Host.—Common coot, *Fulica atra* Linnaeus.
Location.—Caeca.
Locality.—Lucknow, U.P.

XXXV Subfamily *OGMOCOTYLINAE* Skrjabin and Schulz, 1933

Notocotylidae : Lateral margins of body turned over ventrally in form of a canoe. Ventral glands or ridges absent. Cirrus sac very strongly developed, curved in the form of C. Genital pore submedian far behind intestinal bifurcation, just preequatorial. Vesicula seminalis externa present or absent. Vitellaria partly anterior, partly dorsal to testes. Parasitic in intestine of mammals.

Type genus : *Ogmocotyle* Skrjabin and Schulz, 1933 (March).

Genus 66. **Ogmocotyle** Skrjabin and Schulz, 1933

Syn. *Cymbiforma* Yamaguti, 1933

Ogmocotylinae : Body elongate, canoe-shaped. Cuticle unspined. Ventral glands or ridges absent. Oral sucker terminal. Oesophagus narrow; caeca long, terminating short of posterior extremity. Testes elongate, more or less lobed, one on each side of posterior end. Cirrus sac large, almost curved in form of C, enclosing seminal vesicle, prostatic complex and long eversible ductus ejaculatorius. Genital pore submedian, preequatorial, far bhind intestinal bifurcation. Ovary lobed or entire, median, at level of posterior end of testes or immediately behind. Shell gland complex preovarian. Vitellaria partly anterior, partly dorsal to testses, convergent posteriorly. Uterus preequatorial, closely coiled transversely between shell gland and metraterm, overlapping caeca laterally. Metraterm well developed. Eggs with filament at each pole. Excretory vesicle Y-shaped with short stem and long lateral branches with numerous anastomosis and united anteriorly. Parasitic in intestine and bile duct of mammals.

Type-species : *O. pygargi* Skrjabin and Schulz, 1933

135. **Ogmocotyle indica** (Bhalerao, 1942) Ruiz, 1946

(Fig. 87)

Syn. *Cymbiforma indica* Bhalerao, 1942

Specific diagnosis.—Body slightly curved dorsally, margins turned ventrally, thus boat-shaped when viewed ventrally, 0.8–2.715 long, 0.31–0.96 in maximum breadth in region of cirrus sac; cuticle smooth; longitudinal muscles prominent underneath cuticle. Oral sucker 0.067–0.14 in diameter.

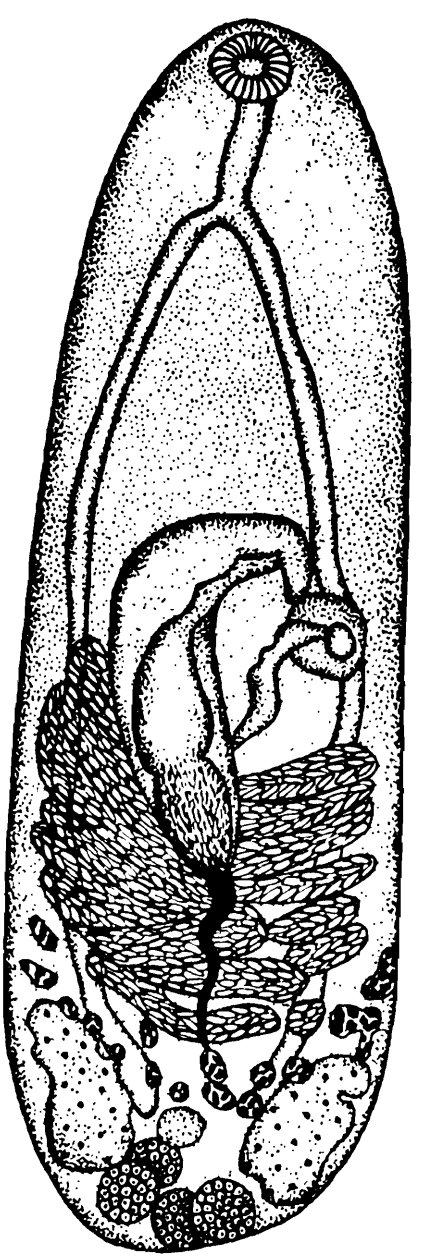


FIG. 87. *Ogmocotyle indica* (Bhalerao, 1942) ruiz, 1946.

Oesophagus slender, 0.05–0.148 long. Caeca slender, passing gradually towards periphery, parallel to each other for a short distance in front of vitellaria, gradually converging thereafter and terminating in intertesticular region, opposite middle or posterior third of testes. Excretory pore slightly dorsal, subterminal. Excretory vesicle Y-shaped with tubular stem bifurcating into two arms at level of anterior third of testes; arms diverge laterally as far as anterior level of vitellaria; excretory duct arising from each arm bifurcates into two branches just in front of level of cirrus sac passing as far as oral sucker and giving numerous side branches forming intricate network between oral sucker and anterior border of cirrus sac. Testes irregularly lobed, opposite near posterior end of body, 0.168–0.55×0.068–0.26, lobes sometimes well defined, giving cauliflower shape, occasionally ill defined giving sausage-shaped form. Vas deferens almost median, zigzag, enlarged into convoluted vesicula seminalis externa. Cirrus sac 0.46–0.75×0.125, C-shaped. Vesicula seminalis interna in basal part of cirrus sac; pars prostatica large, constricted off from vesicula seminalis by a small narrow duct. Ductus ejaculatorius and cirrus convoluted. Everted cirrus covered with large papillae, 0.12 long by 0.03 thick. Genital pore sinistral, slightly in front of mid-body. Ovary at extreme posterior end, 4-lobed, lobes connected anteriorly, each lobe 0.077–0.145×0.063–0.08; lobes often entire, sometimes subdivided. Laurer's canal present. Receptaculum seminis absent. Vitellaria of large follicles arranged in form of horse-shoe or semicircle; some follicles dorsal to testes, some lateral and some in front of them, but large number intercaecal. Uterine coils extend from shell gland to middle of cirrus sac. Metraterm on left side of cirrus sac, 0.14–0.37×0.06–0.165. Eggs numerous, oval with filaments at ends, 0.008–0.0198 long.

Host.—Goat, sheep, cattle.

Location.—Whole of alimentary canal following oesophagus, bile ducts.

Locality.—Mukteswar-Kumaon, U.P.

XI. Family PRONOCEPHALIDAE Looss, 1902

Notocotyloidea : Elongated monostomes, deeply concave ventrally and convex dorsally or canoe-shaped. Head collar usually present. Oral sucker simple. Caeca simple or

sinuous, sometimes provided with lateral branches or diverticula, terminating at or near posterior extremity, occasionally some distance in front of it. Testes symmetrical, diagonal or tandem, near posterior end or in middle third of body, sometimes divided into a number of follicles. Vesicula seminalis externa present. Cirrus sac well developed. Genital pore preequatorial at various levels, usually to left, exceptionally median. Ovary submedian, pretesticular, intertesticular or posttesticular. Receptaculum seminis absent. Vitellaria lateral, rarely medial to caeca, usually pretesticular, exceptionally posttesticular. Uterus coiled transversely anterior to ovary, exceptionally extending between two testes and behind ovary. Eggs small with polar filaments Excretory vesicle V- or Y-shaped, arms long, united anteriorly or not, sometimes with transverse anastomosis; pore dorsal near posterior end. Parasiti cin turtles, rarely fishes.

Type genus : *Pronocephalus* Looss, 1899

Key to Indian subfamilies of PRONOCEPHALIDAE

1.	Testes divided into follicles in linear series at each side or arranged in a horse-shoe or U	*CHARAXICEPHALINAE* Price, 1931
	Testes not divided into follicles.	2
2.	Ovary pretesticular	*PRONOCEPHALINAE* Looss, 1899
	Ovary posttesticular	*NEOPRONOCEPHALINAE* Mehra, 1932

Subfamilies Teloporiinae Stunkard, 1934 and Cetiosaccinae Yamaguti, 1958 are valid, though they are not represented in India.

XXXVI. Subfamily *PRONOCEPHALINAE* Looss, 1899

Syn. *Choanophorinae* Caballero, 1942
Macravestibulinae Yamaguti, 1958
Metacetabulinae Yamaguti, 1958

Pronocephalidae : Body elongate, cylindrical or plump. Head collar with ventral incision, interrupted ventrally or indistinct. Oral sucker usually small. Oesophagus short, exceptionally moderately long. Caeca usually with small outgrowths, occasionally more or less undulating, terminating near posterior end or some distance in front. Genital pore median, submedian, submarginal at varying levels

posterior to intestinal bifurcation, occasionally anterior to it. Testes two, symmetrical, rarely diagonal, at or near posterior extremity, extracaecal, caecal or intercaecal. Cirrus sac long or short, divided or undivided. Vesicula seminalis externa winding. Ovary pretesticular, median or submedian. Vitellaria variable in extent, lateral, usually pretesticular, extracaecal, occasionally just medial to caeca. Uterus preovarian in close transverse coils, sometimes overlapping caeca laterally. Excretory vesicle V- or Y-shaped, arms united anteriorly or not, often with anastomoisis.

Type genus : *Pronocephalus* Looss, 1899

Key to Indian genera of PRONOCEPHALINAE

1. Genital pore anterior to intestinal bifurcation, parasitic in fresh water turtles; eggs without polar filaments..	*Renigonius* Mehra, 1939
Genital pore posterior to intestinal bifurcation; parasitic in marine turtles; eggs with polar filaments.	2
2. Testes symmetrical, extracaecal at or near posterior extremity....	*Pleurogonius* Looss, 1901
Testes diagonal, intercaecal in posterior fourth of body.	*Pronocephalus* Looss, 1899

Genus 67 **Pronocephalus** Looss, 1899

Pronocephalinae : Body broadest in uterine zone or uniformly broad. Head collar deeply incised midventrally. Oral sucker small. Oesophagus moderately long. Testes diagonal, intercaecal, in posterior fourth of body. Vesicula seminalis long, strongly coiled. Cirrus sac long. Genital pore submedian, a little behind intestinal bifurcation. Ovary pretesticular, submedian, dextral. Vitellaria extending from level of posterior end of seminal vesicle to testicular zone. Metraterm strongly muscular. Excretory vesicle Y-shaped with short stem and long arms reaching oral sucker. Parasitic in intestine of marine turtles.

Type-species : *P. obliquus* Looss, 1901

136. **Pronocephalus obliquus** Looss, 1901

(Fig. 88)

Syn. *Pronocephalus trigonocephalus* (Rud., 1809) Looss, 1899
Pronocephalus obliquus; Oguro, 1936
Pronocephalus obliquus; R. K. Mehra, 1939

Specific diagnosis.—Body 3.6–6.5 × 1.53 in maximum breadth in front of ovary. Oral sucker 0.16–2.0. Oesophagus long. Caeca straight to anterior end of anterior testis, where they bend inwards terminating in level with the "Rippen" or a little behind. Testes 0.16–0.414 in diameter, entire, rounded, lobed sometimes, equal or unequal, oblique or nearly parallel. Vesicula seminalis transversely coiled, behind cirrus sac. Cirrus sac 0.72–1.44 long, 0.18–0.32 in maximum breadth in posterior half with its long axis parallel to body length and its anterior end bent twice forming a U-shaped loop. Cirrus 0.072 in maximum breadth. Ovary slightly in front of testes, rounded or oval, entire or lobed, 0.125–0.234 in diameter. Shell gland mass rounded or irregular, in level with or slightly behind ovary. Uterine coils

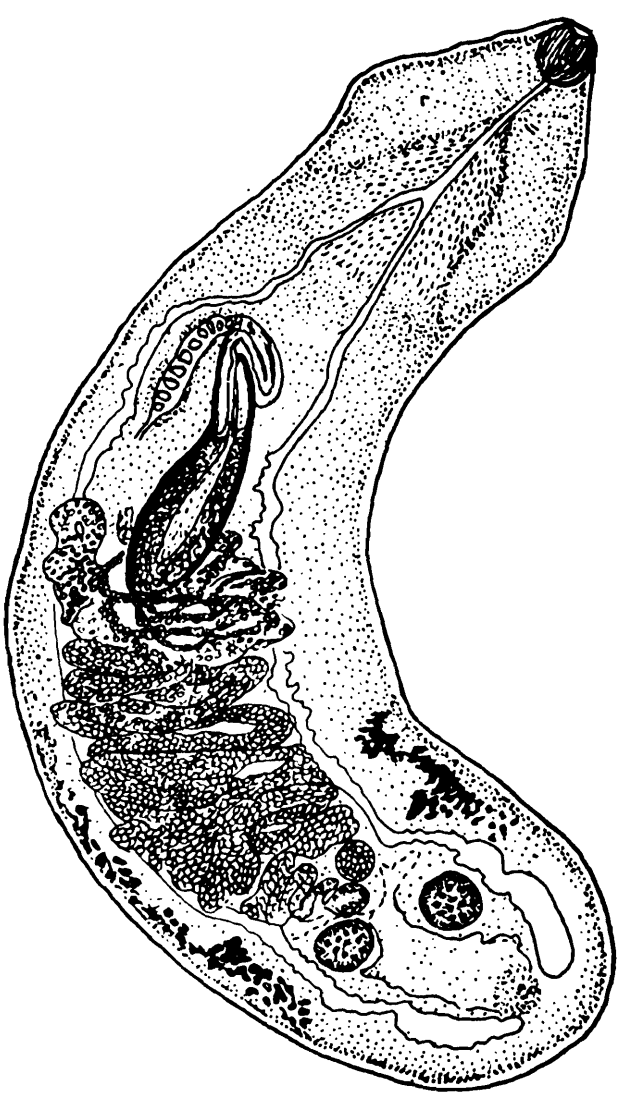


FIG. 88. *Pronocephalus obliquus* Looss, 1901. Dorsal view.

between ovary and cirrus sac, sometimes extending outside caeca. Metraterm 0.45–0.72 long, 0.126 in maximum breadth, parallel to last one third of cirrus sac. Male and female pores lie close together in shallow genital atrium. Eggs with polar filament at each end, 0.017–0.02×0.01. Vitellaria of equal length in posterior half of body, outside caeca, terminating at posterior end of hinder testis; in a few cases left gland much longer than the right, extending much in front of the latter.

Host.—*Chelone mydas.*

Location.—Small intestine.

Locality.—Karachi, near Port Keamari.

Genus 68. **Pleurogonius** Looss, 1901

Syn. *Glyphicephalus* Looss, 1901
Barisomum Linton, 1910
Himasomum Linton, 1910
Medioporus Oguro, 1936
Pleurogonius Looss, 1901 emend. Mehra, 1939

Pronocephalinae : Body elongated, sometimes slender. Subventral collar lobes usually connected by a dorsal ridge, separately ventrally, exceptionally united. Oral sucker small to medium sized. Oesophagus moderately long, exceptionally with rudimentary pharynx. Caeca with irregular outline or outpocketings. Testes symmetrical, outside terminal part of caeca, indented or lobged. Cirrus sac elongated, claviform or elliptical. Genital pore submedian, sinistral, a little behind intestinal bifurcation. Ovary submedian, dextral, pretesticular. Vitellaria extending from testes to vesicula seminalis or behind. Metraterm short or as long as cirrus sac. Excretory vescile V-shaped or Y-shaped, arms not united anteriorly in Indian species. Parasitic in intestine of marine turtles.

Type-species : *P. longiusculus* Looss, 1901

Key to Indian species of **Pleurogonius**

1. Genital pore outside left caecum. *P. mehrai* (Mehra, 1939) Ruiz, 1946

   Genital pore intercaecal near left caecum 2

2. Cirrus sac extremely small; uterus strictly intercaecal	*P. karachii* Mehra, 1939
Cirrus sac larger; uterus not strictly intercaecal, overlapping caeca. .	3
3. Rudimentary pharynx present; cirrus sac transverse	*P. sindhii* Mehra, 1939
Pharynx absent; cirrus sac elongated constricted in the middle..	*P. keamarii* Mehra, 1939

137. **Pleurogonius karachii** R. K. Mehra, 1939

(Fig. 89)

Specific diagnosis.—Body delicate, 4.4×0.79 maximum breadth in collar region. Head collar 0.554 long, triangular with anterior end bluntly pointed. Oral sucker 0.125 in diameter. Oesophagus narrow, long, extending far behind collar, 0.8 long. Caeca with a few outgrowths in anterior region, run straight to anterior limit of testes, where they bend inwards, passing medial to testes, separated by median excretory vesicle. Genital pore inside left caecum, 0.45 behind intestinal bifurcation. Testes slightly indented, 0.25×0.18, symmetrical, outside caeca. Vesicula seminalis close to right caecum, 1.548 behind anterior end. Cirrus sac very small 0.324×0.065. Ovary rounded, entire, in front of right testis, 0.09 in diameter. Uterus strictly confined to intercaecal region, coils not closely packed. Metraterm slightly differentiated, small. Vitellaria extracaecal, from posterior two fifth part of body length to middle of ovary. Eggs 0.02×0.012.

Host.—Chelone mydas.

Location.—Middle part of small intestine.

Locality.—Arabian Sea, near Port Keamari, Karachi.

138. **Pleurogonius sindhii** R. K. Mehra, 1939

Specific diagnosis.—Body thick, small, 2.5–2.78 long; 0.7–0.81 broad in collar region, 0.81–0.98 broad in region of cirrus sac. Collar with ventral lappets united ventrally, continuous dorsally forming a thickened ridge resembling that of *Pronocephalus*. Oral sucker 0.162. Very small rudimentary pharynx

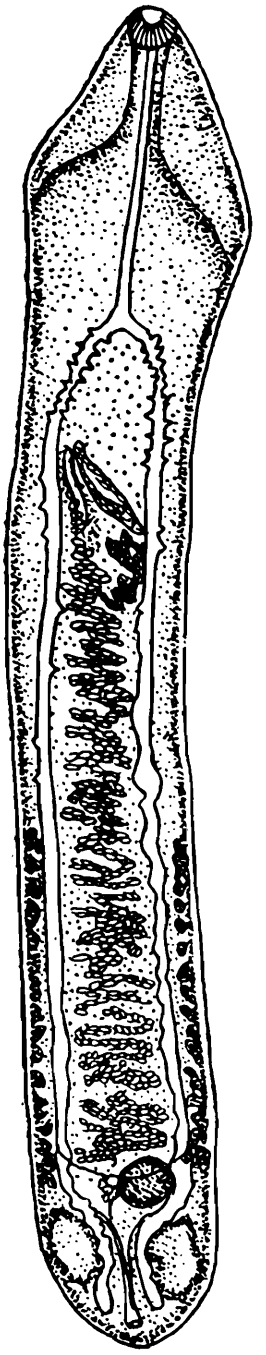


Fig. 89. *Pleurogonius karachii* R. K. Mehra. Dorsal view.

behind oral sucker, 0.045 in diameter. Oesophagus narrow, 0.36–0.57 long. Caeca provided with sac-shaped outgrowths. Genital pore far behind anterior end, at one third body length, 0.36–0.45 behind intestinal bifurcation, close inside left caecum. Testes deeply indented, almost equal, 0.23–0.26 $\times$ 0.25–0.4, outside caeca. Cirrus sac small, 0.18–0.45 $\times$ 0.062 in maximum breadth in middle, transversely situated with small distal part bent anteriorly. Ovary slightly lobed,

0.108–0.27×0.215, in front of right testis, 0.36–0.61 from hinder end. Shell gland mass large, irregular in shape, to left closely in contact with inner margin of ovary. Uterine coils overlapping caeca; metraterm 0.145 long. Eggs 0.0225×0.0125. Vitellaria band-like from middle of body length to just in front of testes.

Host.—*Chelone mydas.*

Location.—Small intestine.

Locality.—Arabian Sea, near Port Keamari.

139. **Pleurogonius keamarii** R. K. Mehra, 1939

Specific diagnosis.—Body 4.5–4.8×0.96–1.03 maximum breadth in region of cirrus sac. Collar triangular with bluntly pointed anterior end, leaf-shaped ventrolateral lappets connected dorsally by a dorsal ridge, but not meeting in ventral region. Oral sucker 0.162 in diameter. Oesophagus narrow, extending a little behind collar, 0.36–0.66 long. Caeca with small outpocketings, terminate a little in front of hinder end, terminal parts medial to testes. Genital pore almost median slightly to left, at 1.1–1.145 behind anterior end, at almost one fourth body length. Testes small, rounded, 0.252–0.306 in diameter. Cirrus sac relatively large, nearly one fifth of body length, 0.702–1.062 long, 0.216 in maximum breadth near base, parallel to body length, in hinder part of anterior half, constricted in the middle, posterior part enclosing prostatic complex, anterior part enclosing ductus ejaculatorius and cirrus with serrated surface. Ovary rounded, entire, in front of right testis, 0.144–0.18 in diameter, just in front of bent terminal part of right caecum. Eggs 0.03×0.015. Vitellaria from middle of body length at base of cirrus sac to a little in front of testes.

Host.—*Chelone mydas.*

Location.—Small intestine.

Locality.—Arabian Sea, near Port Keamari, Karachi.

140. **Pleurogonius mehrai** (R. K. Mehra, 1939) Ruiz, 1946

(Fig. 90)

Syn. *Pleurogonius chelonii* R. K. Mehra, 1939

Specific diagnosis.—Length 2.5–3.9 maximum breadth 0.63–0.97 in middle of body, a little in front of vitellaria.

Body slightly constricted behind collar. Ventrolateral lapperts of collar united by a dorsal ridge, having triangular shape as in *P. karachii*, quite apart ventrally. Oral sucker 0.12 in diameter. Oesophagus narrow, extending a little behind collar, 0.42–0.68 long. Caeca devoid of outgrowths in anterior half. Genital pore outside left caecum, a little behind intestinal bifurcation, 0.81–1.02 behind anterior end.

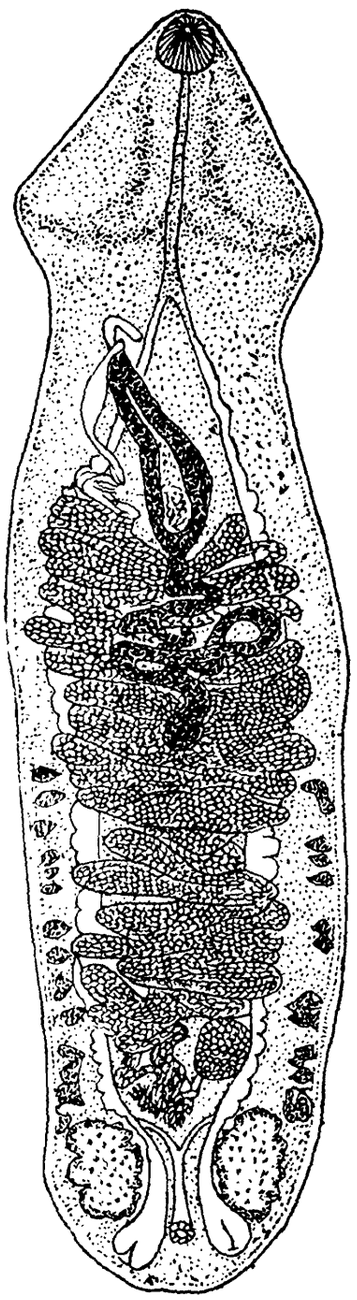


FIG. 90. *Pleurogonius mehrai* (R. K. Mehra, 1939) Ruiz, 1946. Dosral view.

Testes slightly lobed, sometimes rounded or ovoid, equal, 0.216–0.36×0.27. Cirrus sac relatively large, 0.55–0.72 long, nearly one fifth of body length, 0.15 in maximum breadth in its posterior half; posterior half median, almost parallel to body length, curving a little just in front towards left side passing outside left caecum. Ovary rounded, entire, 0.144–0.18 in diameter, close inside right caecum just before it bends towards its termination, 0.67 in front of hinder end. Uterine coils transverse, closely packed, overlapping caeca at places. Metraterm small, outside left caecum, 0.125 long. Eggs 0.25×0.125.

Host.—*Chelone mydas*

Location.—Small intestine.

Locality.—Arabian Sea near Port Keamari, Karachi.

Genus 69. **Renigonius** R. K. Mehra, 1939

Pronocephalinae : Body small, tapering anteriorly in the form of attenuated cone. Head collar not prominent, continuous dorsally and ventrally, without lateral lappets. Oral sucker moderately developed. Pharynx absent Oesophagus moderately long. Caeca with small outpocketings, terminating convergently at about middle of testicular zone. Genital pore lateral to left side, prebifurcal. Testes elongate, reniform, with distinct indentations, situated obliquely in form of V at posterioe end, outside caeca. Cirrus sac small, tubular, extracaecal for the most part. Vesicula seminalis externa tubular, convoluted behind intestinal bifurcation. Ovary pretesticular, submedian, dextral. Shell gland complex median, postovarian. Vitellaria extracaecal, extending from middle of body to testes. Uterus forming closely packed transverse coils in whole intercaecal space between shell gland complex and seminal vesicle. Eggs without polar filaments. Parasitic in intestine of fresh water turtles.

Type-species : *R. orientalis* R. K. Mehra, 1939

141. **Renigonius orientalis** R. K. Mehra, 1939

(Fig. 91)

Specific diagnosis.—Body tapering anteriorly to head collar in the form of attenuated cone with bluntly pointed anterior end, posterior end broad rounded, 2.28 long×0.953 maximum breadth in posterior half at commencement of

vitellaria. Collar not prominent, entirely devoid of lateral lappets. Oral sucker 0.135×0.153. Oesophagus 0.432 long, narrow; intestinal bifurcation at anterior one fourth body length. Caeca with small lobelike outgrowths on their outer as well as inner side, terminating medially to testes 0.27 in front of hinder end. Genital pore prebifurcal, close to left body margin, opposite hinder part of oesophagus, 0.126 behind collar. Testes elongated, reniform, their convex side lobed, opposite with their diverging anterior end and posterioly close to one another near median line, situated in the form of V at posterior end, 0.54×0.25. Cirrus sac

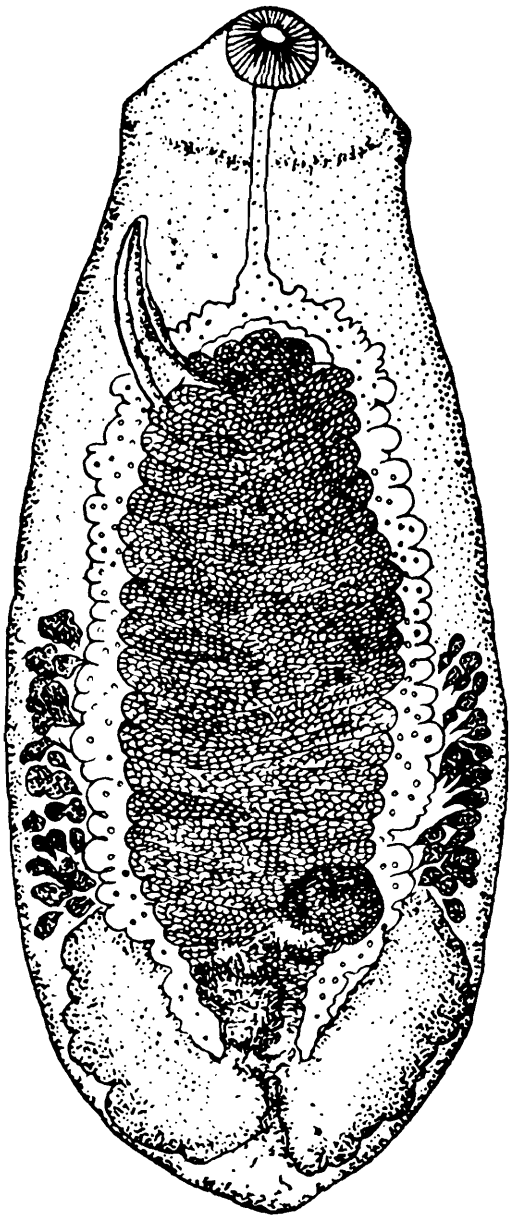


FIG. 91. *Renigonius orientalis* R. K. Mehra. Dorsal view.

small, slightly curved, 0.324×0.0475 greatest breadth near its middle with proximal part dorsal to left caecum, extracaecal for two third of its length. Vesicula seminalis straight proximally, but much coiled forming a knot-shaped mass before entering cirrus sac. Ovary lobed, 0.16×0.2, closely inside right caecum; in level with anterior end of testes, 0.47 in front of posterior extremity. Shell gland mass rounded, median, a little behind ovary between caecal ends, 0.12 in diameter. Uterus first passes backwards forming a few coils between testes and then turns forwards forming a huge mass of closely packed transverse coils, occupying entire intercaecal space slightly overlapping caeca. Metraterm narrow, slightly curved, closely outside along cirrus sac. Vitellaria short, extracaecal from proximal end of vesicula seminalis to anterior end of testes. Eggs without filaments, 0.0225×0.01.

Host.—Fresh water turtle, *Kachuga dhongoka.*
Location.—Stomach.
Locality.—Allahabad, U.P.

XXXVII. Subfamily *CHARAXICEPHALINAE* Price, 1931

Syn. *Desmogoninae* Yamaguti, 1958
Diaschistorchiinae Yamaguti, 1958

Pronocephalidae : Body elongate, almost elliptical. Head collar well developed or reduced, less conspicuous. Oral sucker moderately well developed. Oesophagus short. Caeca with numerous outgrowths or branches. Testes divided into follicles arranged in two linear series or in U-shaped manner. Cirrus sac small, fusiform or claviform. Genital pore submedian, sinistral, postbifurcal. Ovary submedian, dextral, near posterior extremity, in testicular zone. Vitellaria lateral and partly in testicular zone. Uterus intercaecal. Eggs with polar filaments. Parasitic in marine and fresh water turtles.

Type genus : *Charaxicephalus* Looss, 1901

Key to Indian genera of CHARAXICEPHALINAE

Testes follicles arranged in two longitudinal rows inside caeca in middle region of body.	*Charaxicephalus* Looss, 1901
Testes follicles arranged in the form of horse-shoe or U in posterior part of body	*Diaschistorchis* Johnston, 1913

Genus 70. **Charaxicephalus** Looss, 1901

Charaxicephalinae : Body elongate, nearly uniform in breadth with a small projection or protuberance on each side at truncate-posterior extremity. Head collar with indistinct ventro-lateral lappets separated by a narrow median groove. Oral sucker moderately well developed. Oesophagus short. Caeca with numerous outer and inner diverticula throughout their length, terminating in caudal projections. Testes divided into follicles arranged in two longitudinal rows inside caeca in middle region of body. Cirrus sac small, fusiform, containing part of seminal vesicle, prostatic complex and ductus ejaculatorius. Genital pore slightly to left side a little behind intestinal bifurcation. Ovary slightly to right side near posterior extremity. Vitellaria ventral to caeca from about middle of body to ovarian zone. Uterus intercaecal, winding between testes; metraterm shorter than cirrus sac. Eggs with tuft of filament at each pole. Excretory vesicle Y-shaped with stem and long arms giving off numerous branches. Parasitic in intestine of marine turtles.

Type-species : *C. robustus* Looss, 1901

142. **Charaxicephalus loossi** R. K. Mehra, 1939

(Fig. 92)

Specific diagnosis.—Body thick, stout, 7–7.6 long × 1.89–2.202 breadth in collar region; breadth 1.51–1.64 in region of cirrus sac. Collar thick surrounding body on all sides unlike that of the type species; rectangular depression between oral sucker and ventral part of collar; collar smaller than that of *C. robustus*. Oral sucker 0.5 in diameter. Oesophagus narrow, 0.68–0.77 long. Caeca run transversely first and then bend backwards occupying lateral position, provided throughout their length with long lateral diverticula notched at ends, inner diverticula almost transverse, outer slightly inclined backwards, equal in number and showing symmetrical arrangement on the sides of body. Genital pore almost median slightly to left at one fourth body from anterior end. Testes follicles in two lateral rows inside caeca, 7 on left side and 8 of right side, varying in size and shape, usually lobed irregularly, 0.18–0.306 × 0.162–0.324. Right testes commence more anteriorly than left ones, but they terminate at the same level, 2–2.34 in front of posterior end. Vesicula seminalis externa coiled as knot between cirrus sac and

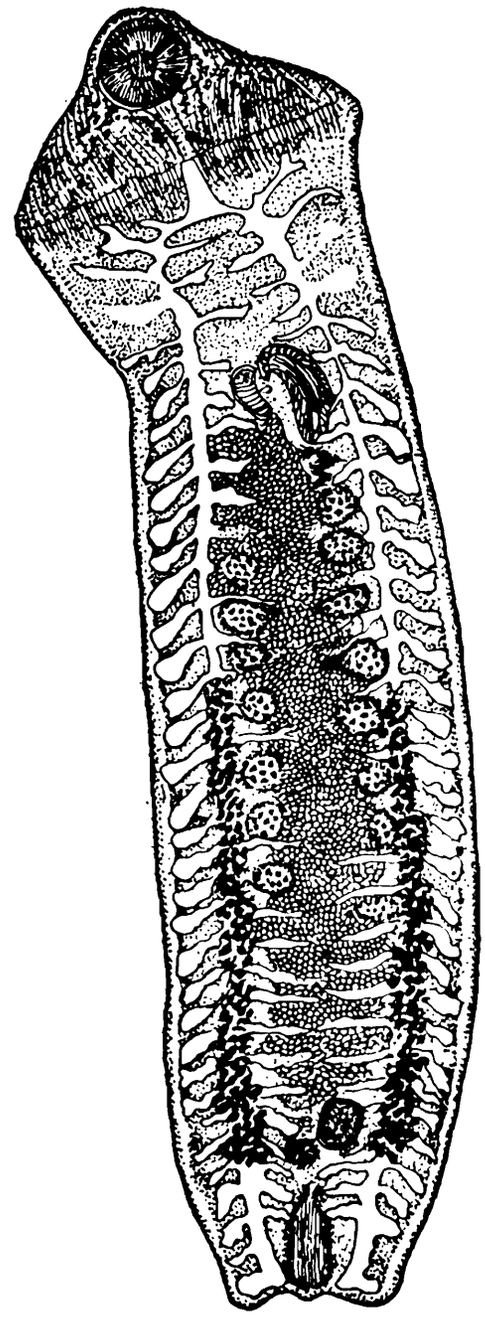


FIG. 92. *Charaxicephalus loossi* R. K. Mohra. Dorsal view.

anteriormost right testis. Vesicula seminalis interna 0.1–0.12 ×0.04. Cirrus sac 0.63–0.72×0.216–0.324, parallel to body length inside right caecum, at 1.76–1.89 behind anterior end, 0.21–0.32 in front of anteriormost right testis; small terminal part bent and directed backwards containing ductus ejaculatorius and cirrus. Ovary entire, oval, 0.32–0.36×0.25, slightly dextral, far behind the last right testis, 0.77–1.03 from it, 0.65–0.83 in front of hinder end. Metraterm well

developed, its proximal part 0.2–0.221 long and distal thinner part bent backwards, 0.08–0.1 long. Eggs 0.025×0.015. Vitellaria band-shaped, extending from fourth or between fourth and fifth testes to posterior margin of ovary. Small stem of excretory vesicle giving off two pairs of cornua in contrast to single pair of the type species.

Host.—*Chelone mydas.*
Location.—Small intestine.
Locality.—Arabian Sea near Port Keamari, Karachi.

Genus 71. **Diaschistorchis** Johnston, 1913

Syn. *Wilderia* Pratt, 1914
Synechorchis Barker, 1922
Diaschistorchis Johnston, 1913 emend. H. R. Mehra, 1932

Charaxicephalinae : Body elliptical, thick. Collar less conspicuous than in many genera, in the form of low swelling around head. Oral sucker well developed. Oesophagus short. Caeca provided with numerous outer and inner outgrowths in different degrees of development. Testes divided into a large number of separate entire or irregularly lobed follioles arranged in the form of horse-shoe or U in posterior part of body. Vesicula seminalis externa more or less winding. Cirrus sac claviform, oblique or transverse, enclosing terminal part of seminal vesicle, prostatic complex and cirrus. Genital pore to left, postibifurcal at about one quarter of body length from anterior end. Ovary submedian, entire or lobed, near posterior end in level with anterior end of testes or some distance behind. Vitellaria extending from middle of body or from about one quarter of body length from anterior end to immediately in front of ovary, ventral to caeca. Uterine coils intercaecal, preovarian. Metraterm shorter than cirrus sac. Eggs with polar filaments. Excretory vesicle Y-shaped with short sac-like stem provided with lateral outgrowths dividing into two long cornua, undulating forwards as far as head end and giving off anastomosing branches. Parasitic in intestine of marine and fresh water turtles.

Type-species : *D. pandus* (Braun, 1901) Johnston, 1913

143. **Diaschistorchis gastricus** H. R. Mehra, 1932

(Fig. 93)

Specific diagnosis.—Body somewhat skiff-like with strongly concave ventral and convex dorsal sides and rounded ends,

6–11 long × 1.5–1.57 broad in collar region; breadth 1.8–2.6 in region of cirrus sac. Collar not prominent; semicircular thick elevation behind sucker, continuous dorsally, incomplete ventrally, lappets indistinct, in some specimens less distinct than in others without any indication of lappets. Oral sucker 0.68–0.78 × 0.72–0.77; in smallest specimens 0.61–0.68. Oesophagus 0.3–0.4 long, in collar region. Caeca pass downwards after bifurcation provided with short outgrowths throughout their length, terminating near posterior end and converging mesially. Genital pore ventral to left caecum at one third to one fourth body length from anterior end. Testes split into 16–18 follicles of varying size and shape usually lobed, sometimes entire, 0.21–0.5 × 0.27–0.43, lateral

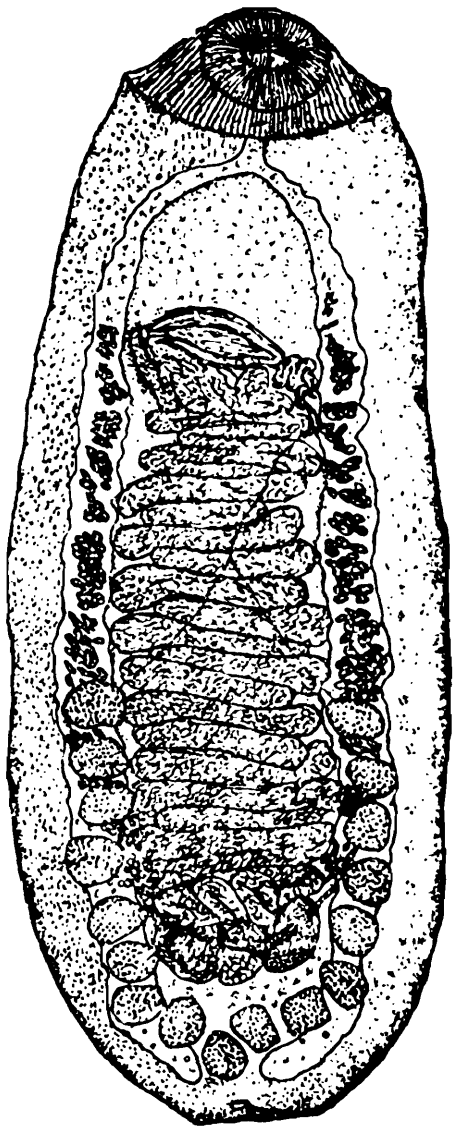


FIG. 93. *Diaschistorchis gastricus* H. R. Mehra.

and meeting mesially behind, arranged in the form of horse-shoe. Vesicula seminalis externa convoluted, to right, some distance behind anterior end of vitellaria, becomes narrow muscular duct before entering cirrus sac. Cirrus sac arched in front, concave behind, lies transversely 2.5 behind anterior end, at first quarter body, 0.66–0.83×0.27–0.34. Pars prostatica long, tubular in entire length of sac except small terminal part containing ductus ejaculatorius; protrusible cirrus absent. Ovary lobed or entire, rounded or oval, close inside right caecum 1–1.5 behind anterior testis in level with fourth or fifth testis of its side. Metraterm semilunar with convex side anterior, 0.35 long, to left side, close inside anterior end of left vitellarium. Eggs 0.034–0.04×0.017–0.02, with polar filament at end. Vitallaria between cirrus sac and ovary, of follicles in 9–20 compact groups, commencing much in front of testes behind anterior quarter of body, parallel to testes, ventral to caeca in between or close outside testes, except last two groups on each side, which converge inwards.

Host.—Fresh water turtles, *Kachuga smithii, Kachuga tectum, Hardella thurgi.*

Location.—Stomach.

Locality.—Allahabad, U.P.

XXXVIII. Subfamily *NEOPRONOCEPHALINAE* H. R. Mehra, 1932

Pronocephalidae : Body small, thick, truncate at posterior end. Head collar interrupted ventrally. Oral sucker small. Oesophagus long; caeca simple, terminating much in front of posterior end. Testes two, symmetrical, lateral and ventral to caeca in midregion of body. Cirrus sac long, oblique. Genital pores separate sinistral or ventral to left caecum, a little postbifurcal. Ovary posttesticular, slightly dextral, postequatorial. Vitelline follilcles massed together behind testes, lateral to caeca. Uterus extending posterior to ovary and ends of caeca, passing forwards between testes. Eggs without filaments. Excretory vesicle V-shaped, pore dorsal, subterminal. Parasitic in intestine of turtles.

Type genus : *Neopronocephalus* H. R. Mehra, 1932

Genus 72. **Neopronocephalus** H. R. Mehra, 1932

Neopronocephalinae : Body small, plump, truncate at posterior end. Head collar interrupted ventrally. Oral

sucker small. Oesophagus long; caeca simple, terminating at about one third body length from posterior end. Testes two, symmetrical and ventral to caeca in midregion of body. Cirrus sac thick, oval or pear-shaped, obliquely placed in front of testes. Vesicula seminalis externa coiled. Genital pores separate to the left a little behind intestinal bifurcation. Ovary slightly to right behind testes. Vitelline follicles massed together immediately behind each testis outside caeca. Uterine coils behind ovary, passing between ovary and left testis and then between two testes. Metraterm well differentiated. Excretory vesicle V-shaped with short arms. Parasitic in intestine of turtles.

Type-species : *N triangularis* H. R. Mehra, 1932

144. **Neopronocephalus triangularis** H. R. Mehra, 1932

Specific diagnosis.—Length 2.9–4, greatest breadth 1.02–1.4 in testicular region, anterior end bluntly pointed, 0.14 in breadth; triangular cephalic region 0.4 long, encircled by collar, continuous dorsally, incomplete ventrally enclosing a median depressed region; hinder end thick, muscular, broad flat. Oral sucker 0.1–0.12×0.12–0.16. Oesophagus long, narrow, 0.67 long; intestinal bifurcation 0.56–0.7 behind anterior end. Caeca narrow, entirely without diverticula, terminating immediately behind vitellaria on a level with middle or posterior limit of ovary. Testes symmetrical, outside and ventral to caeca, 1.69 or 2 in front of hinder end, subspherical or ovoid, entire, 0.35–0.44×0.33–0.39. Cirrus sac oblique, pear-shaped, 0.53×0.23–0.3 broadth at its middle; its small terminal part tubular, 0.07–0.09 long opening at genital pore immediately outside left caecum a little behind intestinal bifurcation. Ovary slightly inwards to right caecum, 0.3 behind testes, 0.7–1 in front of hinder end, spherical, 0.23–0.26 in diameter, shell gland complex large, oval, 0.23 in diameter to right close behind ovary. Small Laurer's canal present. Metraterm 0.33–0.4×0.09–0.12, outside and partly overlapping left caecum. Male and female pores separate. Eggs oval, operculated, 0.023–0.027×0.0136; polar filaments not visible. Vitellaria composed of 11–17 follicles in close mass immediately behind testes, close outside caeca.

Host.—Kachuga dhongoka.

Location.—Small intestine.

Locality.—Allahabad, U.P.

145. **Neopronocephalus gangeticus** H. R. Mehra, 1932

Specific diagnosis.—Body 2–2.4 long, 1.2 broad in testicular region; anterior end bluntly pointed, posterior end rounded, produced laterally into a lobe-like process on each side; triangular cephalic region not defined. Collar larger, more prominent than in type species; lateral prolongations enclosing large median ventral fold 0.3 broad at posterior end, 0.1 broad immediately behind sucker. Sucker 0.12–0.16 in diameter. Oesophagus 0.34 long; intestinal bifurcation 0.46–0.58 behind anterior end. Caeca overlapped ventrally by inner margin of testes at middle of body, terminating at two third body length from anterior end. Testes ovoid or slightly pear-shaped, occupying entire space between bodywall and caeca, 0.35–0.46×0.28–0.4. Cirrus sac oval or somewhat pear-shaped, 0.4–0.52×0.25-0.28, immediately pretesticular with its basal part encroaching intertesticular zone. Vesiculla seminalis externa coiled into two large, separate loops lying dorsally and ventrally to basal part of cirrus sac, between it and right testis. Ovary slightly dextral, 0.13–0.17 behind testes, somewhat oval, 0.16–0.25×0.26–0.32. Shell gland behind ovary. Uterus fills entire body behind ovary, overlapping caeca between and behind testes, approaching vitellaria. Metraterm 0.3–0.35 long, 0.14 broad. Vitellaria of 13–15 follicles massed together behind testes. Eggs 0.023–0.0272×0.01–0.013.

Host.—*Kachuga dhongoka.*

Location.—Small intestine.

Locality.—Allahabad, U.P.

146. **Neopronocephalus mehri** Chatterji, 1936

(Fig. 94)

Specific diagnosis.—Body thick, 1–1.5 long, maximum breadth just behind ovary 0.5–0.6. Cephalic region triangular, separated from body by prominent constriction enrircled by characteristic collar complete dorsally and laterally, but incomplete ventrally. Sucker 0.1–0.11×0.11–0.12. Oesophagus narrow, 0.2–0.3 long; intestinal bifurcation 0.3–0.38 from anterior extremity. Caeca dorsal to testes, ending a little behind vitellaria. Genital pore separate, sinistral, intercaecal, close to intestinal bifurcation. Testes oval, equal, 0.18–0.3×0.17–0.2, at the same level near middle

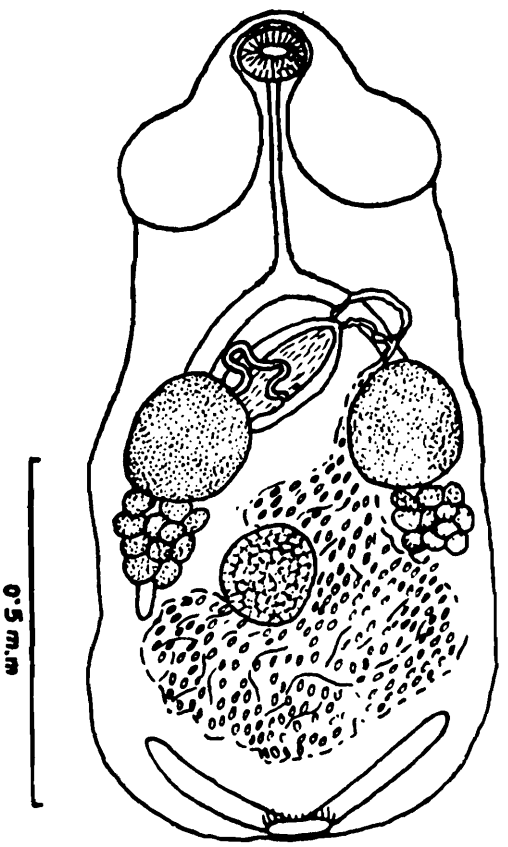


FIG. 94. *Neopronocephalus mehri*, Chatterji, 1936.

of body. Cirrus sac oval, 0.25-0.27×0.1–0.12 maximum breadth. Vesicula seminalis coiled, external to cirrus sac. Ovary almost median, spherical 0.13–0.15 in diameter. Vitelline follicles 11–13 closely packed behind testis on each side. Uterus much coiled, anterior and posterior to ovary. Metraterm present. Eggs 0.023–0.027×0.0134–0.0154. Excretory vesicle V-shaped, the limbs extending a little more than half distance between ovary and posterior extremity. Excretory pore prominent, subterminal, ventral.

Host.—*Morenia ocellata.*

Location.—Intestine.

Locality.—Rangoon, Burma.

Key to species of **Neopronocephalus**

1. Genital pores intercaecal near left caecum; cephalic region entirely separated.	*N. mehri* Chatterji, 1936
Genital pores extracaecal near left caecum; cephalic region not separated..	2

2. Posterior end broad, produced into two prominent lobe-like processes one on each side; uterus large filling entire space behind ovary overlapping caeca between and behind testes. *N. gangeticus* H.R.Mehra, 1932

Posterior end narrow, not produced into prominent lobes; uterus small not filling postovarian region, not overlapping caeca behind and between testes.. . .. . *N. triangularis* H.R.Mehra, 1932

XII. Family RHABDIOPOEIDAE Poche, 1925

Notocotyloidea : Large monostomes provided ventrally with curved blunt-pointed papillae or spines in quincunx. Excretory opening dorso-terminal, large, into which project several muscular processes, each arising from the base of a tubular diverticulum; of four longitudinal excretory stems the outer are united anteriorly and give off numerous outer diverticula. Oral sucker subterminal. Pharynx absent Caeca with short posterior diverticula or distinctly sinuous walls, united together or separated at posterior end. Testes symmetrical, near posterior extremity. Currus sac long. Genital pore near oral sucker. Ovary intertesticular or posttesticular. Vitellaria follicular or acinous, posttesticular or pretisticular. Uterus forming close transverse coils between testes and cirrus sac. Eggs small, filamented at each pole. Parasitic in sirenia.

Type genus : *Rhabdiopoeus* Johnston, 1913

XXXIX. Subfamily *TAPROBANELLINAE* Yamaguti, 1958

Rhabdiopoeidae : Body boat-shaped, spined ventrally, with a pair of broad muscular caudal lobes. Oral sucker large. Oesophagus short. Caeca with distinctly sinuous walls, not united posteriorly. Testes symmetrical, just medial to caeca, near posterior extremity. Currus sac large, enclosing distal part of seminal vesicle, prostatic complex and long, strongly muscular ejaculatory duct. Genital pore beside oral sucker. Ovary median immediately posttesticular. Laurer's canal absent. Vitelline follicles pretesticular, extracaecal. Uterus overlapping caeca laterally. Eggs filamented at each pole. Excretory system unknown.

Type genus : *Taprobanella* Crusz and Fernand, 1954

Genus 73. **Taprobanella** Crusz and Fernand, 1954

Rhabiopoeidae, Taprobanellinae : Body boat-shaped, prolonged backward into two short broad, flat, unspined muscular lobes, covered ventrally with curved spines, smootn dorsally. Oral sucker large with ventral aperture. Oesophagus narrow, short. Caeca with short diverticula, extending to posterior end of body. Testes symmetrical, lobed, medial to caeca near posterior extremity. Cirrus sac large. Vesicula seminalis externa coiled at posterior end of cirrus sac. Genital pore near left margin of oral sucker. Ovary immediately posttesticular, median. Shell gland preovarian. Laurer's canal absent. Vitelline follicles in two short pretesticular extracaecal lateral fields. Uterus transversely coiled between testes and cirrus sac as well as to the left side of the latter. Eggs operculate, small with 1–3 filaments at opercular pole and 2–3 at other end. Excretory pore median, dorsal, at or near level of ovary. Parasitic in stomach and pyloric caeca of Sirenia.

Type-species : *T. bicaudata* Crusz and Fernand, 1954

147. **Taprobanella bicaudata** Crusz and Fernand, 1954

(Fig. 95)

Specific diagnosis.—Body boat-shaped, 6.3–12.2 long, narrowest at anterior end, 1.8–3.0 across middle of oral sucker, broadest at posterior end 2.2–4.2. Dorsal convexity and ventral concavity pronounced. Posterior end prolonged into two broad, flattened, muscular lobes, 0.62–1.57 long, 1.29–2.28 broad. Cuticle dorsally smooth. Ventral surface except that of posterior lobes armed with backwardly curved cuticular spines. Oral sucker large, deep, 1.33–1.9 in diameter, 0.54–0.96 deep. Oesophagus narrow, 0.69–1.03 long. Caeca provided with short branches, lateral, stopping short of posterior lobes, 3.8–7.95 long, 0.24–0.59 broad at posterior end. Testes 5–8 lobed, 0.38–0.65 apart, 1.41–3.09 from posterior extremity, 0.29–1.06 × 0.22–0.66 broad. Genital pore ventrolateral to left side below midlevel of oral sucker. Cirrus sac large, elongate, thin walled, extending from equatorial region or posterior to it to left anterior end, containing coiled vesicula seminalis, large pars prostatica, long undulating ducts ejaculatorius and attenuated cirrus. Vesicula seminalis externa large, coiled. Ovary 3–5 lobed, median, immediately posttesticular, 0.16–0.56 × 0.12–0.52. Mehlis' gland preovarian

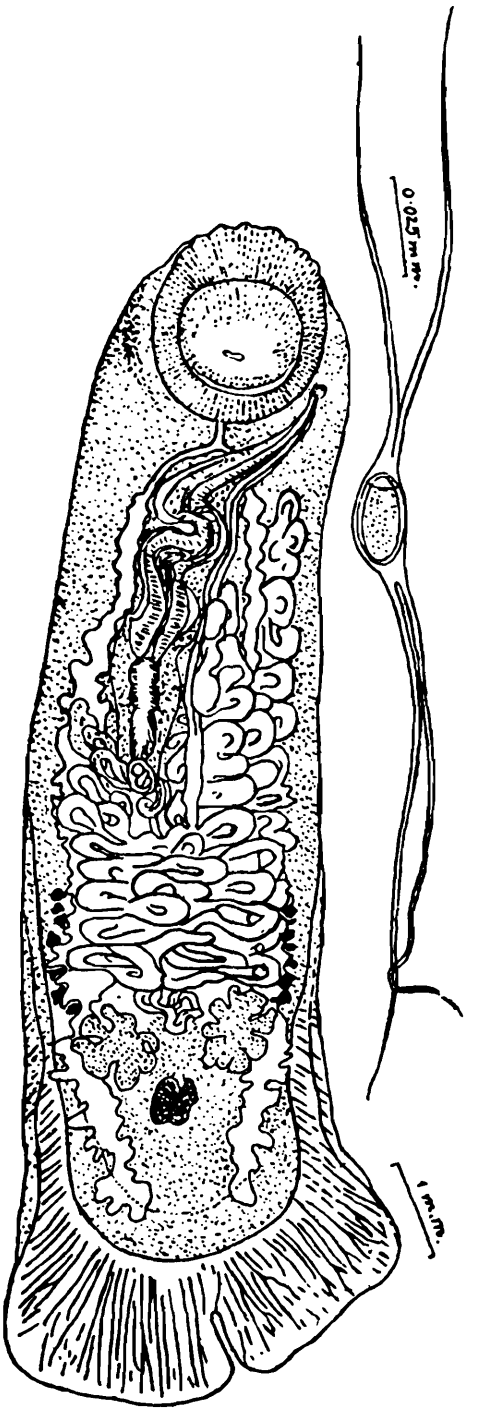


FIG. 95. *Taprobanella bicaudata* Cruz and Fernand, 1954.

between testes. Vitellaria short, extracaecal, anterior to testes, of 18–20 irregular follicles. Uterus narrow initially, broadens into coils to right and left. Metraterm long alongside cirrus sac. Eggs ovoid, operculate, 0.019–0.026×0.01–0.014, opercular end carrying 1–3 filaments, other end 2–3 polar filaments. Excretory pore median, dorsal, immediately opposite ovary or slightly posterior to it.

Host.—Dugong dugong (Muller, 1776).

Location.—Stomach and pyloric caeca.

Locality.—Gulf of Mannar, Ceylonese waters.

XIII. Family OPISTHOTREMATIDAE Poche, 1925

Notocotyloidea : Body spoon-shaped or ovoid, spinulate ventrally or unspinulate. Pharynx absent. Oesophagus slender, short or moderately long; caeca simple or without diverticula. Genital pore median, at posterior extremity. Testes symmetrical, in posterior half of body, just lateral or medial to caeca or postcaecal, at posterior extremity. Cirrus sac small. Ovary median or submedian, posttesticular. Receptaculum seminis and Laurer's canal present. Uterus intercaecal or overlapping caeca laterally. Eggs with long polar filaments. Vitellaria follicular, posttesticular. Excretory vesicle short, with partly anastomosing lateral branches, V-shaped in *Lankatrema* Crusz & Fernand, 1954. Parasitic in Sirenia.

Type genus : *Opisthotrema* Fischer, 1883

XL. Subfamily *LANKATREMATINAE* Yamaguti, 1958

Opisthotrematidae : Body ovoid, concave ventrally, convex dorsally, unspined. Oral sucker small. Oesophagus short. Caeca terminating short of posterior extremity. Testes symmetrical, postcaecal at posterior extremity. Cirrus sac very small. Genital pore median, ventroterminal. Ovary large, branched, extending transversely in front of testes between vitellaria. Laurer's canal absent. Vitelline follicles large, extending along lateral margins of body anterior to testes. Uterus occupying most of body anterior to ovary, forming a large terminal reservoir in front of ovary; metraterm thick walled; eggs with a very long filament at each pole. Excretory vesicle V-shaped.

Genus 74. **Lankatroma** Crusz and Fernand, 1954

Opisthotrematidae, Lankotrematinae: Body ovoid, flattened, concave ventrally, convex dorsally, unspined. Oral sucker small Oesophagus short. Caeca simple terminating short of posterior extremity. Testes symmetrical, postcaecal, lobed, at posterior extremity. Cirrus sac very small. Cirrus minute, coiled. Genital pore median, ventroterminal. Ovary

large, branched, transversely elongated in broad pretesticular median area and reaching as far laterally as vitellaria. Laurer's canal absent. Receptaculum seminis absent. Vitellaria of large follicles along lateral margins of body in posterior half anterior to testes. Uterus much coiled forming a tangled mass of ascending and descending coils in most of anterior two third of body, finally swelling into a large elongated egg reservoir in front of ovary; metraterm thick walled. Eggs very small with very long filament at each pole. Excretory pore at extreme posterior end; excretory vesicle V-shaped, bifurcated near its pore, arms running forward medial to vitellaria. Parasitic in stomach of Sirenia.

Type-species : *L. mannarensis* Crusz and Fernand, 1954

148. **Lankatrema Mannarensis** Crusz and Fernand, 1954

(Fig. 96)

Specific diagnosis.—Body small, broadest in middle, somewhat tapering towards ends, ventrally concave, dorsally convex, 2.8–5.3 long, 1.4–3.9 broadest, unspined. Oral sucker 0.16–0.34 in diameter. Oesophagus 0.31–9.6 long, 0.03–0.1 broad, surrounded by a layer of gland cells. Caeca unbranched, almost reaching ovarian region, mostly hidden by extensively coiled uterus. Excretory vesicle V-shaped from terminal excretory pore, bifurcating near pore, limbs extending far forward medial of vitelline follicles. Testes lateral along postero-lateral margins, 0.23–0.79 × 0.13–0.37, deeply lobed with 4–7 lobes, rarely entire, ovoid. Cirrus sac very small, 0.11–0.17 long, 0.05–0.09 broadest at base, containing pars prostatica and minute coiled cirrus. Ovary large, much lobed, digitate or dendritic, extending from side to side anterior to testes, laterally reaching vitelline follicles, 0.74–2.21 in width, ovarian lobes directed anteriorly or laterally, posterior margin smooth. Mehlis' gland mostly postovarian between testes. Vitellaria composed of two groups of about 12 spherical to ovoid follicles, ventral, near lateral margins of body, extending from near testes to well below the equator; vitelline reservoir slightly dextral , postovarian. Uterus large, much coiled mass of ascending and descending folds, occupying most of anterior two thirds of body, swelling at about equator into a long dorsal receptacle distended with eggs, narrowing much at level of overy. Metraterm thick walled, slender. Eggs operculated, 0.017–0.022 × 0.008–0.01, with very long filament at each end. Filament of opercular

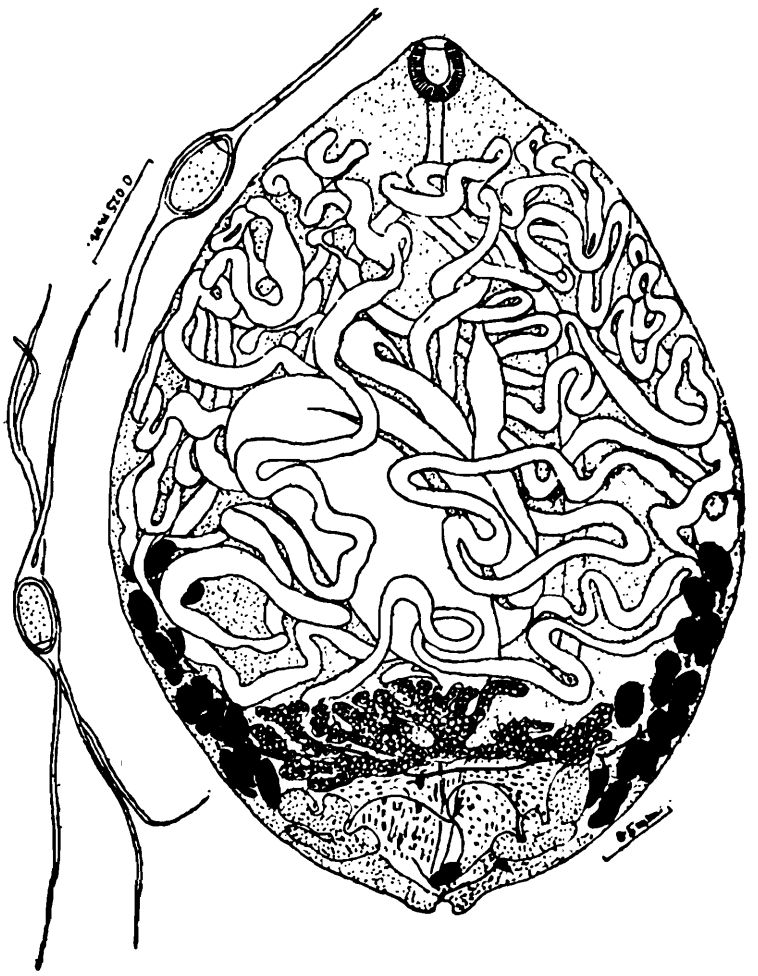


FIG. 96· *Lankatrema mannarensis* Crusz and Fernand, 1954.

end almost half the thickness of other filament specially proximally.

Host.—*Dugong dugong* (Muller, 1776).

Location.—Cardiac stomach, pyloric stomach and pyloric caeca.

Locality.—Gulf of Mannar, Ceylonese waters.

III. Suborder FELLODISTOMATA Singh, 1960

Fasciolatoidea : Distomate; suckers well apart. Genital pore preacetabular. Cirrus sac present or absent. Cercariae furcocercous with short tail stem, slightly longer or much longer furca and caudal canal running through tail without flame cells, or cercariae simple, nonbifid tailed, setiferous (trichocercous) or trichofurcocercous (furcosetiferous) with lateral finlets composed of setae with caudal canal extending

throughout tail stem and furcae without flame cells; rarely microcercous. Excretory vesicle U-shaped, lyre-, V-shaped with long broad arms or Y-shaped with short stem and long arms. Protonephridia stemnostomate. Cercariae develop in sporocysts in marine lamellibranchs, rarely gastropods. Metacercaiae unencysted in molluscs. Two or three host life cycle.

E. Superfamily *FELLODISTOMOIDEA* Mehra, 1963

Diagnosis the same as for suborder Fellodistomata Singh, 1960.

XIV Family FELLODISTOMIDAE Woolcock, 1912

Syn. Fellodistomidae Nicoll., 1913
Steringophoridae Odhner, 1911

Fellodistomoidea : Body rather stout, usually elongated, oval or pyriform. Oral sucker and acetabulum well developed and well apart. Acetabulum large, usually larger than oral sucker, sometimes equal. Prepharynx usually absent, pharynx present; oesophagus short or moderately long; caeca short or of moderate length, sometimes long. Genital pore median, submedian or lateral, preacetabular. Testes symmetrical, oblique or tandem. Cirrus sac small usually not extending behind acetabulum. Ovary usually pretesticular, sometimes intertesticular or posttesticular. Vitellaria preacetabular or postecetabular, rarely both preacetabular and postacetabular but never reaching posterior end. Uterus usually large, coiled with many eggs, postacetabular. Excretory vesicle V- or U-shaped with long broad arms or Y-shaped with short stem and long arms reaching pharynx and not united anteriorly; protonephridia stenostomate. Cercariae develop in simple sporocysts in marine lamellibranchs, rarely gastropods; metacercariae unencysted in molluscs. Parasitic in marine or brackish water fishes.

Type genus : *Fellodistomum* Stafford, 1904

Key to Indian subfamilies of FELLODISTOMIDAE

1.	Body long slender; caecum single usually opening into excretory vesicle.	*MONASCINAE* Yamaguti, 1958
	Body not slender; caeca double.	2
2.	Ovary pretesticular . .	*FELLODISTOMINAE* Nicoll, 1909
	Ovary posttesticular ..	*ANTORCHIINAE* Yamaguti, 1958

XLI. Subfamily *FELLODISTOMINAE* Nicoll, 1909

Syn. *Discogasteroidinae* Srivastava, 1939

Fellodistomidae : Body small, muscular, usually plump, elongate or oval, spinulate or unspinulate. Suckers well developed. Acetabulum large, usually equatorial or post-equatorial, sometimes modified into a specialized discoid adhesive organ. Caeca short saccular to long, terminating anterior or posterior to acetabulum or at acetabular level. Genital pore preacetabular, behind pharynx, submedian, lateral or submarginal. Testes usually symmetrical, post-acetabular. Cirrus sac preacetabular; cirrus usually present; vesicula seminalis winding or bipartite. Ovary pretesticular or partly intertesticular. Vitellaria largely or entirely pre-acetabular or acetabular. Uterus occupying mostly hind-body and acetabular zone. Excretory vesicle V-shaped or Y-shaped. Parasitic in marine or brackish water fishes.

Type genus : *Fellodistomum* Stafford, 1904

Key to Indian genera of FELLODISTOMINAE

1.	Genital pore lateral near right body margin.	*Yamagutia* Srivastava, 1939
	Genital pore median or submedian. .	2
2.	Acetabulum very large	*Pseudodiscogasteroides* Gupta, 1953
	Acetabulum not very large. . ..	*Fellodistomum* Stafford, 1904

Genus 75. **Fellodistomum** Stafford, 1904

Syn. *Steringophorus* Odhner, 1905

Fellodistominae : Body small, smooth. Acetabulum large, well apart from oral sucker. Caeca terminating in hindbody at about testicular level or near hinder end. Testes symmetrical or oblique one on each side behind acetabulum. Cirrus sac small, preacetabular. Genital pore median or submedian, preacetabular. Ovary pretesticular, submedian. Vitellaria follicular, in acetabular, bifurco-acetabular or acetabulo-testicular zone. Uterus reaching posterior extremity; eggs numerous. Excretory vesicle Y-shaped with terminal pore. Parastic in marine fishes.

Type-species : *F incisum* (Rud., 1809) Stafford, 1904

149. **Fellodistomum lethrini** (N. K. Gupta, 1956)

(Fig. 97)

Syn. *Steringophorus lethrini* N. K. Gupta, 1956

Specific diagnosis.—Body smooth, 2.2–2.28 long, 1.14–1.33 in breadth across testicular region, rounded at ends, posterior end broader. Oral sucker 0.2–0.24×0.25–0.35. Acetabulum 0.24–0.27×0.22–0.25, globular, peculiarly shaped, at 0.41–0.46 from anterior end. Excretory pore terminal; excretory vesicle Y-shaped, stem bifurcating a little behind acetabulum. Testes postequatorial far behind acetabulum, one on each side, close to caecum of their side; left testis slightly in advance of the right, 0.22–0.27×0.19–0.27; right one 0.22–0.25× 0.2–0.27 Cirrus sac very elongated, extending in front, behind and along lateral side of acetabulum; cirrus prominent. Genital pore median or slightly submedian ventral to intestinal

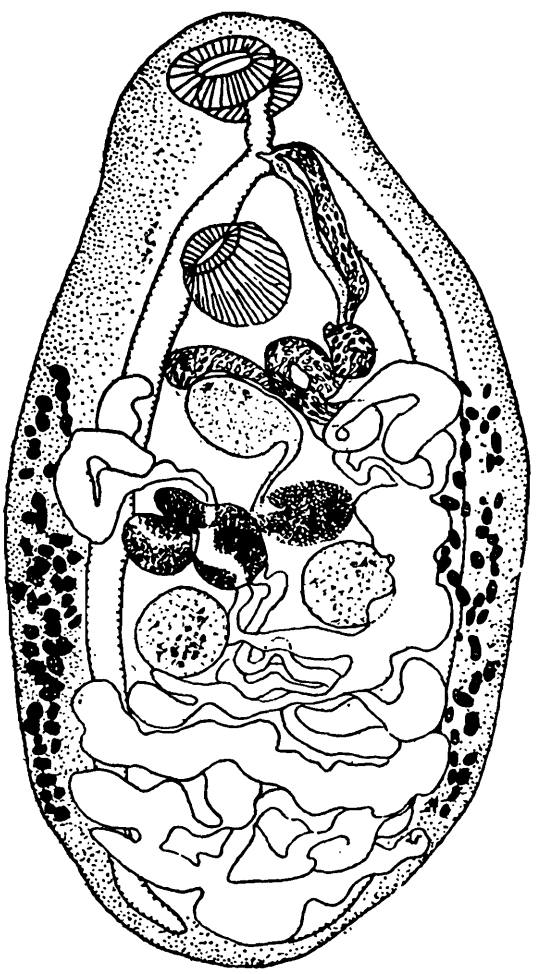


FIG. 97. *Fellodistomum lethrini* N. K. wupta, 1956).

fork. Ovary trilobed, closely in front of right testis, close to right caecum, 0.12×0.16; lobes extraordinarily prominent. Mehlis' gland complex in front of left testis, 0.14–0.18× 0.22–0.28. Receptaculum seminis anterior to Mehlis' gland complex, 0.24–0.16. Vitelline follicles extracaecal, extending from level of acetabulum to a little in front of posterior extremity. Uterus much coiled in transverse folds in post-testicular region. Eggs operculate, 0.014–0.019×0.007

Host.—*Lethrinus* sp.

Location.—Intestine.

Locality.—Gulf of Mannar, Indian Ocean.

Genus 76. **Pseudodiscogasteroides** S. P. Gupta, 1955

Syn. *Discogasteroides* Srivastava, 1939

Fellodistominae : Body plump, small, spinulate. Oral sucker smaller than acetabulum. Acetabulum very large, cup-shaped with a large cavity, equatorial and postequatorial with usual musculature. Prepharynx small. Pharynx moderate sized. Oesophagus absent. Caeca short, club-shaped, terminating just in front of acetabulum. Genital pore median, preacetabular, just behind pharynx or bifurcal. Testes almost equatorial, postacetabular at about half distance between acetabulum and hinder end. Cirrus sac elongated, tubular, obliquely directed, extending to middle or hinder end of acetabulum. Vesicula seminalis bipartite; cirrus small. Ovary intertesticular or pretesticular in front of right testis. Receptaculum seminis and Laurer's canal present. Uterus coiled behind acetabulum and in acetabular level. Vitellaria follicular, anterior between caeca and middle of oral sucker. Excretory vesicle Y-shaped. Parasitic in intestine of marine fishes.

Type-species : *P. indicus* (Srivastava, 1939) S.P. Gupta, 1955

Key to species of **Pseudodiscogasteroides**

Ovary intertesticular in contact with right margin of right testis; cirrus sac elongated, median	*P. indicus* (Srivastava, 1939)
Ovary pretesticular in front of right testis; cirrus sac consisting of obliquely directed main oval part and bent attenuated neck...	*P. caranxi* (Srivastava, 1939)

150. **Pseudodiscogasteroides indicus** (Srivastava, 1939) Gupta, 1955

(Fig. 98)

Syn. *Discogasteroides indicus* Srivastava, 1939

Specific diagnosis.—Body plump, somewhat pear-shaped with its lateral margins prominently incised at junction of pre- and post-acetabular parts, yellowish brown in living conditions, 0.86–0.98 long × 0.54–0.65 maximum breadth across base of acetabulum, spinulate. Oral sucker 0.2–0.25 × 0.18 with slit-like opening. Acetabulum cup-shaped, 0.2–0.28 × 0.32–0.4, behind caeca towards end of anterior half of body. Prepharynx small; pharynx oval, 0.04–0.065 × 0.03–0.05; oesophagus absent; caeca small, 0.18–0.22 × 0.07–0.08, club-shaped extending in straight horizontal line in front of acetabulum. Testes two, spherical, 0.1–0.14 in diameter, symmetrical on either side of median line in front of last sixth or seventh part

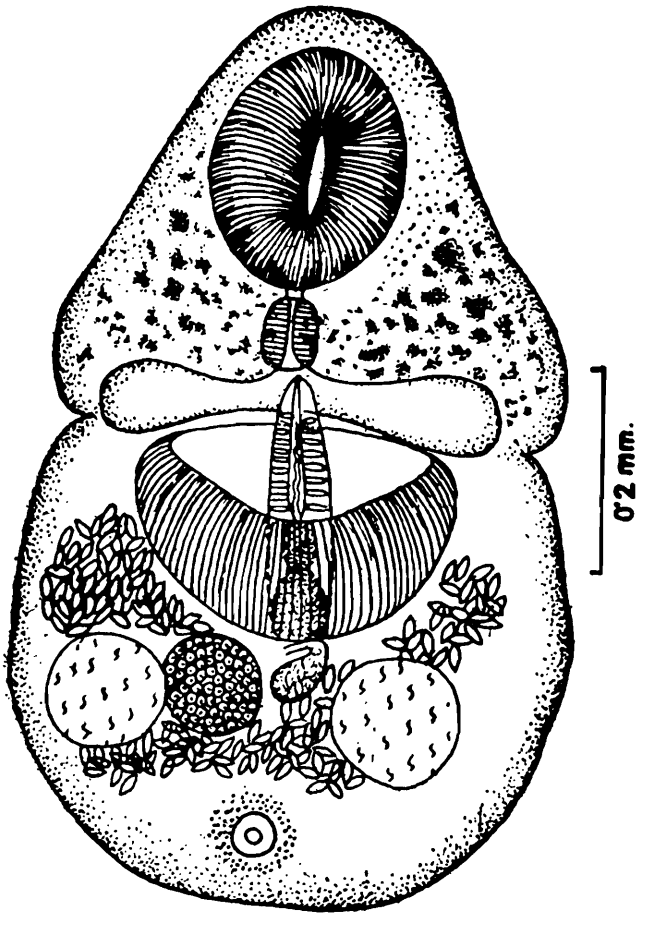


Fig. 98. *Pseudodiscogasteroides indicus* Srivastava, 1939).

of body length. Cirrus sac elongated, median from just behind pharynx to posterior margin of acetabulum or a little in front, 0.16–0.28×0.06–0.1. Vesicula seminalis bipartite, 0.07–0.1×0.03–0.08; pars prostatica small, tubular; ductus ejaculatorius and cirrus small. Ovary spherical, 0.08–0.15 in diameter, in contact with inner margin of right testis. Receptaculum seminis small, retort-shaped, 0.065–0.076× 0.03–0.06, immediately behind acetabulum between ovary and left testis. Laurer's canal present. Vitellaria confined to space between caeca and middle of oral sucker. Eggs 0.029–0.03×0.015.

Host.—*Caranx kalla* Cuv. and Val.

Location.—Intestine.

Locality.—Puri, Bay of Bengal.

151. **Pseudodiscogasteroides caranxi** (Srivastava, 1939) S. P. Gupta, 1955

Syn. *Discogasteroides caranxi* Srivastava, 1939

Specific diagnosis.—Body oval, often constricted into pre- and post-acetabular parts, 0.98–1.4×0.62–0.73 maximum breadth across ovary; spinulate; cutaneous glands present all over, well developed in preacetabular region. Oral sucker 0.24–0.3×0.2–0.26. Acetabulum 0.25–0.36×0.48–0.56, equatorial. Prepharynx small; pharynx oval, 0.06–0.08×0.05–0.07; oesophagus absent; caeca small, 0.22–0.3×0.08–0.12, straight or bent, saccular, confined mostly to preacetabular region. Testes small, somewhat symmetrical on either side of median line close behind acetabulum; anterior testis 0.08–0.14×0.06–0.12, sinistral; posterior testis 0.1–0.18× 0.1–0.16 on right side. Cirrus sac consists of an obliquely directed main part and a bent attenuated neck, 0.24×0.1; vesicula seminalis bipartite; pars prostatica small; ductus ejaculatorius and cirrus present. Genital pore median at anterior margin of acetabulum. Ovary pear-shaped, 0.09–0.13×0.07–0.1, a little in front of right testis. Receptaculum seminis bulb-shaped, obliquely situated between ovary and right testis; shell gland complex in front of ovary. Laurer's canal present. Uterus consists of intricate transversely coiled loops occupying entire space between middle of acetabulum and posterior end of body. Eggs 0.027–0.03×0.015–0.019. Vitellaria extending transversely across intestinal bifurcation

and laterally from level of anterior third of acetabulum to posterior third of oral sucker.

Host.—*Caranx kalla* Cuv. and Val.

Location.—Small intestine.

Locality.—Puri, Bay of Bengal.

Genus 77 **Yamagutia** Srivastava, 1939

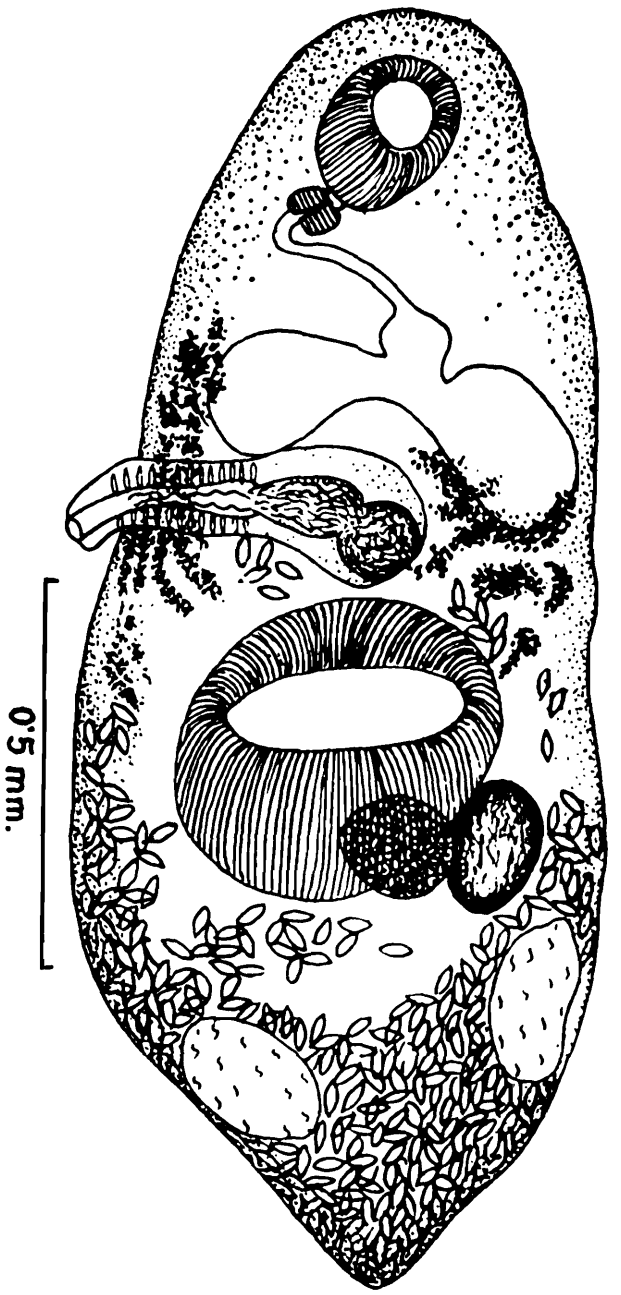
Fellodistominae : Body plump, rounded anteriorly, pointed posteriorly, unspinulate. Acetabulum large, much larger than oral sucker, typical with cavity, immediately post-equatorial. Prepharynx and pharynx small. Oesophagus long with a posterior bulb-shaped part. Caeca small, saccular, horizontal. Genital pore lateral near right body margin just behind right caecum, immediately preacetabular Testes post-acetabular, lateral, slightly asymmetrical near posterior end. Cirrus sac horizontal, club-shaped. Vesicula seminalis bi-partite; cirrus present. Ovary pretesticular, slightly sinistral partly overlapping acetabulum. Receptaculum seminis and Laurer's canal present. Uterus large, coiled, mostly post-acetabular and in acetabular zone. Vitellaria lateral of long irregular follicles extending from level of intestinal bifurcation to middle of acetabulum. Excretory vesicle Y-shaped with short median stem. Parasitic in intestine of marine fishes.

Type-species : *Y lateroporus* Srivastava, 1939

152. **Yamagutialaterporus** Srivastava, 1939

(Fig. 99)

Specific diagnosis.—Body plump, oval with broadly rounded anterior and posterior ends, entirely aspinose, 1.66 long$\times$0.7 in maximum breadth across acetabular region. Oral sucker 0.22$\times$0.16. Acetabulum 0.45 in diameter, immediately post-equatorial. Prepharynx inconspicious; pharynx 0.05$\times$0.07 Oesophagus narrow, sinuous, 0.3 long with a small oeso-phageal bulb at end; caeca small, succular, 0.24$\times$0.14. Testes oval, asymmetrical near lateral sides in postacetabular part; anterior testis 0.24$\times$0.1. sinistral a little behind acetabulum; posterior testis 0.2$\times$0.14 close to right bodywall, in front of last one tenth of body length. Cirrus sac 0,46$\times$0,16 broad,



99. *Yamagutia lateroporus* Srivastava, 1939.

horizontal, club-shaped, between intestinal caeca and acetabulum. Vesicula seminalis bipartite, 0.2×0.1; pars prostatica elongated oval; ductus ejaculatorius small; cirrus fairly long. Genital pore a little behind anterior third of body length, at a little distance from right body margin. Ovary spherical, 0.12×0.14, slightly sinistral partly overlapping acetabulum. Receptaculum seminis oval, 0.16×0.12, to left of ovary. Laurer's canal present. Shell gland mass diffuse, behind ovary. Eggs numerous, operculate, 0.034–0.038×0.015–0.019.

Uterus occupies whole space between genital pore and posterior end. Vitellaria extending laterally from level of oesophageal bulb to middle of acetabulum.

Host.—*Chatessus nasus* (Bloch).

Location.—Small intestine.

Locality.—Karachi, Arabian Sea.

XLII. Subfamily *ANTORCHIINAE* Yamaguti, 1958

Fellodistomidae : Body plump or flattened, elongate, oval or pyriform. Acetabulum preequatorial, subequatorial or equatorial. Caeca short, terminating at about middle of body. Genital pore submedian or median, just preacetabular, near intestinal bifurcation or prebifurcal. Testes symmetrical, anterolateral to acetabulum, in acetabular or postacetabular zone, just medial or posterior to caecal ends. Ovary posttesticular, submedian or median. Vitelline follicles lateral, massed together outside caeca. sometimes overlapping them, mostly preequatorial from intestinal bifurcation or pharynx to acetabular zone or a little further behind to a little in front of caecal ends. Uterus large mostly posttesticular. Excretory vesicle V- or Y-shaped. Parasitic in fresh water, brackish water or marine fishes.

Type genus : *Antorchis* Linton, 1911 Indian genus :

Faustula Poche, 1925

Key to genera of ANTORCHIINAE according to Yamaguti, 1958

Caeca shorter than oesophagus; testes preacetabular, postcaecal.	*Antorchis* Linton, 1911
Caeca longer than oesophagus; testis mainly postacetabular, intercaecal.	*Faustula* Poche, 1925

Genus 78. **Faustula** Poche, 1925

Syn. *Orientophorus* Srivastava, 1935

Antorchiinae : Body small, thick or plump, oval or pyriform, spinulate. Suckers quite apart from one another, nearly equal. Pharynx large; eoesophagus moderately long, short or absent. Caeca terminating at about midbodyor a little more posteriorly. Testes lateral, symmetrically opposite,

in acetabular or postacetabular zone just medial to caeca. Cirrus sac large, anterior or dorsal to acetabulum or extending behind it, containing sigmoid or slightly coiled vesicula seminalis, well developed prostatic complex and short cirrus. Genital pore submedian or median, preacetabular, near intestinal bifurcation or behind pharynx. Ovary strongly lobed, posttesticular. Laurer's canal present. Receptaculum seminis absent. Receptaculum seminis uterinum present. Uterus much coiled, mostly posttesticular. Metraterm feebly muscular. Vitellaria follicular, outside caeca, sometimes overlapping them. Parasitic in fresh water or brackish water fishes.

Type-species : *F keksooni* (MacCallum, 1919) Poche, 1925.

Key to Indian species of **Faustula**

1. Genital pore prebifurcal, at or near posterior end of pharynx.	*F. clupii* (Srivastava, 1935)
2. Genital pore bifurcal.	*F. brevichrus* (Srivastava, 1935) Manter, 1953
Genital pore postbifurcal.	3
3. Oesophagus absent.	*F. ilishii* (Srivastava,1935)
Oesophagus moderately long	*F. gangeticus* (Srivastava, 1935)

153. **Faustula brevichrus** (Srivastava, 1935) Manter, 1953

(Fig. 100)

Syn. *Faustula chauhani* Gupta and Srivastava, 1960

Specific diagnosis.—Body ovoid or pyriform, 1.088–1.7 × 0.048–0.09 maximum breadth across testes, spinulate. Oral sucker 0.13–0.19 in diameter. Acetabulum 0.13–0.25 in diameter equatorial or just behind one third body length. Pharynx oral, 0.045–0.14 × 0.04–0.135. Oesophagus 0.114–0.2 long. Caeca terminate some distance behind testes, at about middle of ovary. Genital pore at level of intestinal bifurcation. Testes oval or reniform, sometimes partly overlapped by caeca in middle third of body, 0.14–0.21 × 0.064–0.12. Cirrus sac flask-shaped or pyriform with broad basal part and narrow anterior part, 0.144–0.36 × 0.084–0.21, overlapping acetabulum to posterior end of testes. Cirrus knob-like.

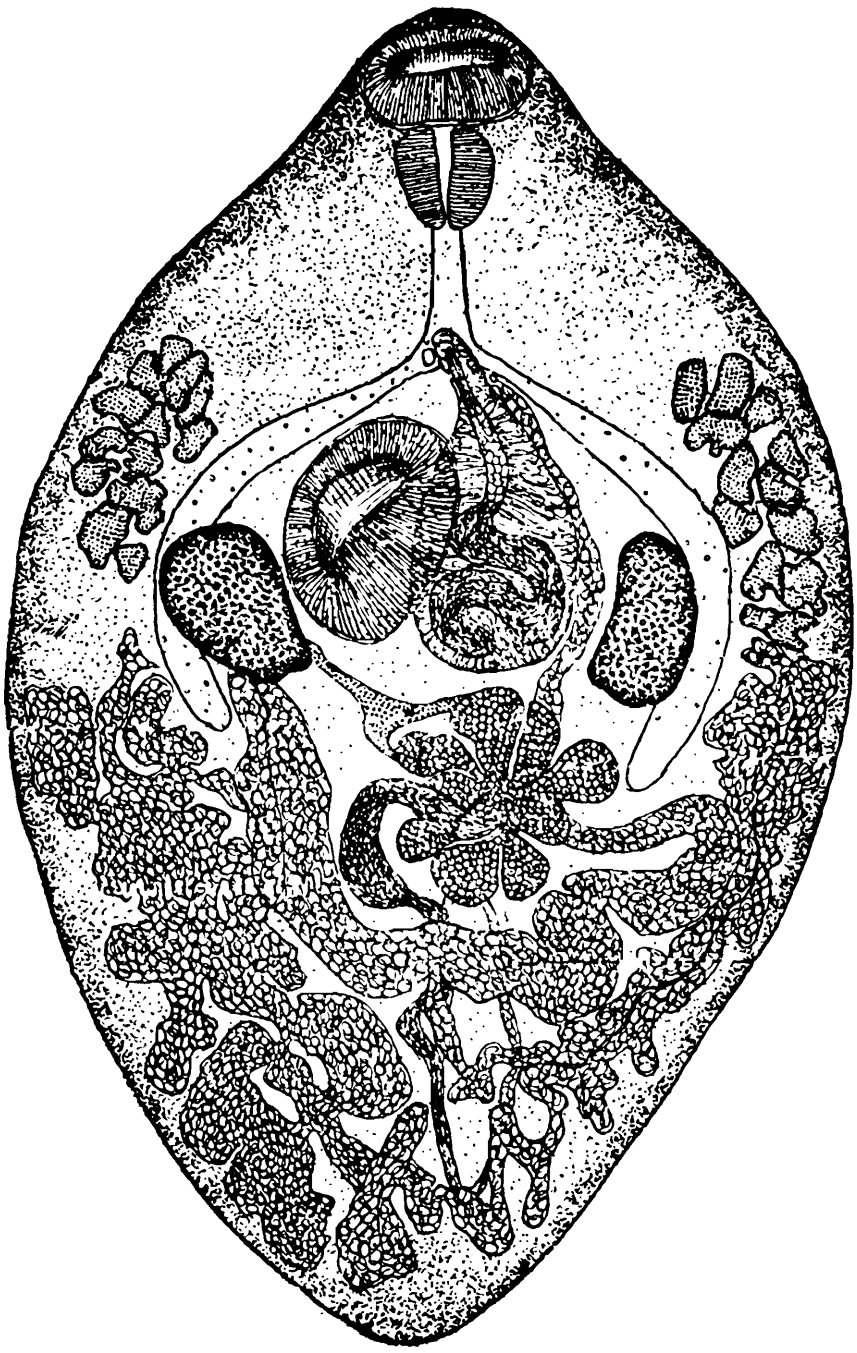


FIG. 100. *Faustula brevichrus* Srivastava (1935) Manter, 1953.

Ovary 0.13–0.31 in diameter. Vitelline follicles from level of intestinal bifurcation to posterior margin of acetabulum or middle of testes. Receptaculum seminis uterinum present. Uterus fills body behind testes. Eggs 0.013–0.02×0.01–0.012.

Host.—*Clupea ilisha*=*Hilsa ilisha.*
Location.—Intestine.
Locality.—Allahabad, U.P.

154. **Faustula gangeticus** (Srivastava, 1935)

Specific diagnosis.—Body ovoid, spinose up to ovarian region, 1.34–1.65×0.79–0.97 broad across testes. Suckers equal. Oral sucker terminal, 0.17–0.18. Acetabulum 0.17–0.2, close behind anterior third body length. Pharynx pyriform, 0.11–0.15×0.08–0.12. Oesophagus 0.16–0.18 long; caeca diverging out into an arc to enclose genitalia, terminating anterior to posterior third body length. Genital pore half way between intestinal bifurcation and acetabulum. Testes 0.2–0.34×0.12–0.2. Cirrus sac 0.36–0.4×0.17–0.2, nearly twice as long as broad. Ovary 0.26–0.28×0.24–0.26, close behind cirrus sac. Vitelline follicles outside caeca from posterior third of oesophagus to caecal ends. Receptaculum seminis uterinum present. Eggs oval, 0.016–0.025×0.017

Host.—Clupea ilisha.
Location.—Intestine.
Locality.—Allahabad, U.P.

155. **Faustula ilishi** (Srivastava, 1935)

Specific diagnosis.—Body plump, tapering posteriorly, uniformly spined, 0.75–1.04×0.62–0.71 across testes. Oral sucker terminal, broader than long, 0.1–0.12×0.12–0.14. Acetabulum 0.14–0.15 in diameter. Pharynx elongated oval, 0.11–0.13×0.067–0.07 Oesophagus absent; caeca broad, divergent into a semicircle, ending at middle of ovary. Genital pore immediately behind intestinal bifurcation. Testes one on each side of acetabulum partly overlapping caeca; right 0.28–0.3×0.12, larger than the left, 0.17–0.2×0.15. Cirrus sac oval, 0.20–0.31×0.17, to right side of acetabulum, extending to level of hinder margin of left testis. Ovary 0.17–0.2×0.19. Receptaculum seminis uterinum present. Metraterm poorly developed. Eggs oval, 0.02×0.012. Vitelline follicles lateral, partly overlapping caeca extending from anterior border of pharynx to anterior margin of ovary.

Host.—Clupea ilisha.
Location.—Intestine.
Locality.—Allahabad, U.P.

156. **Faustula clupii** (Srivastava, 1935)

Specific diagnosis.—Body elongated oval, spinose, 1.3–1.5× 0,7–0.8 across testes. Suckers broader than long. Oral

sucker 0.1–0.12×0.13–0.15. Acetabulum slightly larger, 0.14–0.16×0.16–0.17. Pharynx oval, 0.17×0.19. Oesophagus 0.08-0.1 long; caeca fairly long, ending in level with posterior border of ovory. Genital pore at posterior end of pharynx. Testes oval, symmetrical, one on each side of acetabulum partly overlapping caeca, 0.28×0.14. Cirrus sac claviform, 0.28×0.17, extending from anoterior border of acetabulum to genital pore. Cirrus minute, bow-shaped. Ovary 0.26 in diameter. Uterine coils between middle of acetabuum and hinder end of body; metraterm feebly muscuiar. Eggs 0.015×0.01. Vitellaria never overlapping caeca, extending from intestinal bifurcation to middle of testes

Host.—Clupea ilisha.

Location.—Intestine.

Locality.—Allahabad, U.P.

XLIII. Subfamily *MONASCINAE* Yamaguti, 1958

Syn. *Haplocladinae* Odhner, 1911

Fellodistomidae ; Body long slender. Caeca single to right side, opening into excretory vesicle at hinder end. Acetabulum rather small near anterior extremity. Genital pore median, preacetabular. Testes tandem, in posterior half of body. Cirrus sac preacetabular. Vesicula seminalis bipartite; ductus ejaculatorius small; pars prostatica well developed. Ovary pretisticular in anterior half of body. Uterus filling up entire body. Vitellaria extending along each side between acetabulum and anterior or posterior testis. Excretory vesicle Y-shaped. Parasitic in intestine of marine fishes.

Type genus : *Monascus* Looss, 1907

Genus 79. **Monascus** Looss, 1907

Syn. *Haplocladus* Odhner, 1911

Monascinae : Body much elongated, nearly cylindrical. Oral sucker subterminal. Prepharynx extremely small; pharynx elongated oval; intestinal caecum single to right side of median line, usually opening into excretory vesicle. Genital pore submedian, preacetabular. Testes tandem, postequatorial. Cirrus sac small, preacetabular or partly to one side of acetabulum. Vesicula seminalis bipartite; pars prostatica followed by small ductus ejaculatorious. Ovary

pretesticular, preequatorial. Vitellaria of small folilicles, lateral, from behind acetabulum to anterior or posterior testis. Uterus large, much coiled, filling up almost entire postacetabular body. Excretory vesicle Y-shaped, arms along reachig oral sucker. Parasitic in marine fishes.

Type-species : *M filiformis* (Rud., 1819) Looss, 1907

157 **Monascus orientalis** (Srivastava, 1941) Yamaguti, 1958

Syn. *Haplocladus orientalis* Srivastava, 1941

Specific diagnosis.—Body long narrow, of nearly uniform breadth, light brown when alive, 6.14–7.16 long×0.52–0.64 uniform breadth, spinulate. Oral sucker inverted pear-shaped, 0.28–0.34×0.22–0.24. Prepharynx extremely small; pharynx elongated oval, 0.28–0.3×0.12–0.16; oesophagus 0.28–0.4 long, continued in a single straight caecum opening outside at hinder end of body. Acetabulum small poorly muscular, cup-shaped, 0.22–0.26 in diameter, at the end of first eighth or fifth of body length. Testes oval, tandem, separated by 0.42–0.7 distance; anterior testis 0.34–0.38×0.3–0.38, just postequatorial; posterior testis 0.3–0.4×0.24–0.34. Cirrus sac ovoid, 0.36–0.46×0.28–0.34, on one side of acetabulum with its greater part in front of the latter. Vesicula seminalis bipartite, 0.17–0.18×0.07–0.08; pars prostatica small opening to outside through small ductus ejaculatorius. Ovary oval or spherical, 0.24–0.26×0.2–0.22, 0.6–0.76 in front of anterior testis. Shell gland mass diffuse, preovarian. Receptaculum seminis absent. Vitellaria of small oval follicles along each side of body from behind acetabulum to level of posterior testis. Uterus occupies whole postacetabular space of body. Eggs numerous, operculate, 0.034–0.038×0.019–0.023.

Host.—*Synaptura orientalis* (Bloch and Schn.)

Location.—Intestine.

Locality.—Bay of Bengal.

XV. Family MONODHELMINTHIDAE Dollfus, 1937

Fellodistomoidea : Body small, oval, pyriform or ellipsoid, rather plump, spinulate or nonspinose. Acetabulum well developed, but usually small, smaller than oral sucker, exceptionally large, imbeded in parenchyma and complex (*Proso-*

gonarium Yamaguti). Prepharynx usually present; pharynx small; oesophagus short or moderately long; caeca reaching some distance in front of hinder end or terminating a little behind acetabulum much in front of hinder end. Genital pore submedian or median, postbifurcal. Genital atrium or sinus median or submedian, large and plaited (*Monodhelmns* Dollfus) or rather of complicated structure with genital sucker (*Mehratrema* Srivastava), sometimes modified to atrial or accessory sac (copulatory sac) or with a coupulatory papilla. Testes two, intercaecal, symmetrical or not (testes extracaecal in *Atractotrema* Goto and Ozaki). Cirrus sac present or absent. Vesicula seminalis free or enclosed in cirrus sac. Pars prostatica free or enclosed in cirrus sac. Ovary pretisticular or partly intertesticular. Vitellaria follicular, lateral, postequatorial or postacetabular or preequatorial composed of a few large follicles lateral to testes or ovary (*Prosogonarium*). Uterus in postacetabular median field or rarely extensive in whole body. Uterus in *Atractotrema* perforating cirrus sac to open at genital pore. Eggs small, sometimes moderately large, numerous. Excretory vesicle U- or V-shaped with long arms reaching to level of pharynx. Cercaria possible trichocercous as mentioned for *Tandanicola* by Johnston and Angel. Parasitic in marine and fresh water fishes.

Type genus : *Monodhelmins* Dollfus, 1937

XLIV Subfamily *MEHRATREMATINAE* Srivastava, 1939

Monodhelminthidae : Body small, elongated, smooth or spined. Oral sucker a little or much larger than acetabulum. Acetabulum small, preequatorial or postequatorial, pretesticular, partially or completely posttesticular. Prepharynx small; pharynx well developed; oesophagus short; caeca terminating near or much in front of posterior extremity. Genital sucker well developed around genital pore, median or submedian, postbifurcal. Testes immediately preacetabular, partially or completely postacetabular, symmetrical or oblique, intercaecal. Vesicula seminalis externa absent. Cirrus sac elongated, tubular, enclosing vesicula seminalis and prostatic complex. Genital atrium thick muscular, large, median with large basal part bearing prominent muscular papilla, surrounded by gland cells and opening through genital sucker. Ovary pretesticular, entire or lobed immediately behind cirrus sac. Uterus large, coiled, intercaecal,

reaching posterior extremity. Vitellaria lateral, short, from level of ovary to level of posterior testis or last quarter of body. Excretory vesicle U-shaped with long arms reaching oral sucker. Parasitic in intestine of marine fishes.

Type genus : *Mehratrema* Srivastava, 1939

Key to genera of MEHRATREMATINAE

Testes almost symmetrical, preacetabular; caeca terminating near posterior extremity; acetabulum equal to or slightly smaller than oral sucker.	*Mehratrema*	Srivastava, 1939
Testes oblique, partially or completely postacetabular; caeca terminating much in front of posterior extremity; acetabulum much smaller than oral sucker.	*Buckleytrema*	Gupta, 1956

Genus 80. **Mehratrema** Srivastava, 1939

Mehratrematinae : Acetabulum almost equal to or slightly smaller than oral sucker. Genital pore surrounded by genital sucker, submedian, postbifurcal. Genital atrium large with thick muscular walls with basal part bearing muscular papilla, surrounded by gland cells. Oesophagus short; caeca reaching near posterior extremity. Testes almost symmetrical, preacetabular at about middle of body. Cirrus sac elongated, tubular, to left of genital atrium. Ovary pretsticular, preacetabular. Vitellaria lateral, extending from level of anterior margin of ovary to last quarter of body length. Uterus large, much coiled behind genital atrium and cirrus sac. Excretory vesicle U-shaped with long arms reaching oval sucker converging in testicular region. Parastic in intestine of marine fishes.

Type-species : *M. dollfusi* Srivastava, 1939

158. **Mehratrema dollfusi** Srivastava, 1939

(Fig. 101)

Syn. *Mehratrema polynemusinis* Chauhan, 1943

Specific diagnosis.—Body elongated, spinulate, 1.46–3.52 long ×0.4–0.78 in maximum breadth at level of testes. Suckers nearly equal or oral sucker slightly larger, 0.12–0.32 ×0.25–0.33. Acetabulum immediately postequatorial, 0.22×

0.19–0.2. Prepharynx small; pharynx 0.04–0.09 in diameter; oesophagus 0.08–0.09 or 0.1–0.25 long; caeca terminate a little in front of hinder end. Testes preacetabular, intercaecal, spherical, 0.08–0.26×0.08–0.22, almost symmetrical at about middle of body length. Cirrus sac elongated, tubular, 0.26–0.56×0.06–0.14. Vesicula seminalis bulb-shaped, 0.15–0.19×0.03–0.04; pars prostatica 0.04–0.08× 0.01–0.02. Genital pore guarded by feebly muscular genital

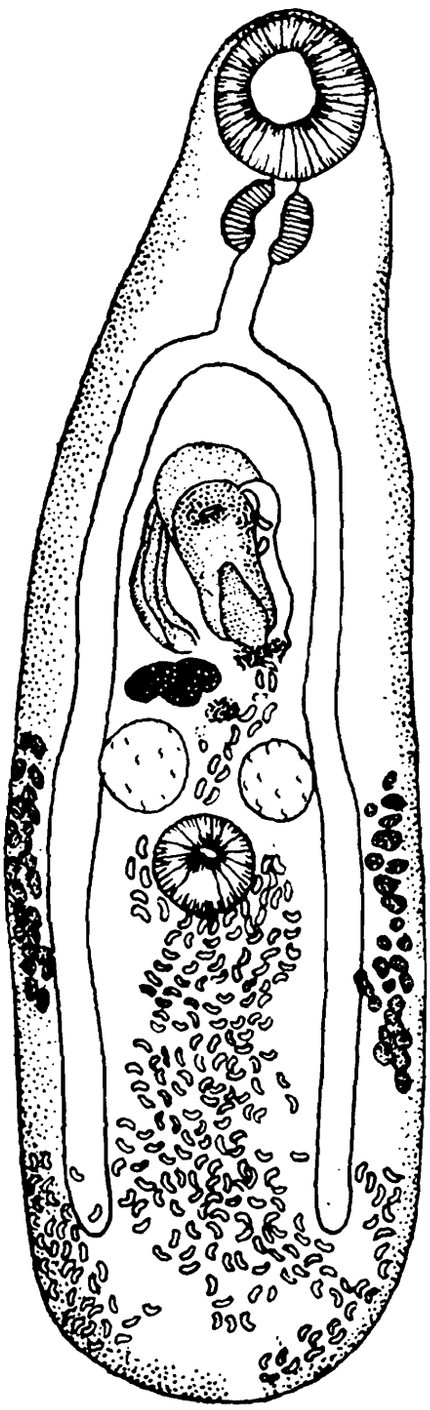


FIG. 101. *Mehrantrema dollfusi* Srivastava, 1939, Ventral view.

sucker of about one third size of acetabulum, at junction of anterior and middle thirds of body length. Genital atrium (genital sinus) large with highly muscular walls, surrounded by gland cells around its basal part with muscular papilla inside. Ovary trilobed or spherical, 0.08–0.4×0.06–0.18, in front of left testis. Vitellaria of small follicles from level of anterior margin of ovary to almost last quarter of body. Eggs numerous, operculate, 0.03–0.06×0.019–0.026.

Host.—*Scatophagus argus* (Bloch.), *Polynemus indicus*, *Muraenesox talabonoides* and *Sciaena* sp.

Location.—Small intestine.

Locality.—By of Bengal, Arabian Sea, Puri, Karachi and Bombay, Krusadai Island, Gulf of Manaar, Indian Ocean.

According to Chauhan (1943) genital atrium "measures 0.16–0.23×0.85–0.21" N. K. Gupta (1956) obtained this species from a marine cat-fish from gulf of Manaar dissected at Krusadai Island. Srivastava'a account of the peculiar metraterm applies to the genital atrium.

Genus 81. **Buckleytrema** K. N. Gupta, 1956

Monodhelminthidae, Mehratrematinae : Body elongate, smooth without spines. Oral sucker large, much larger than acetabulum. Acetabulum small, partially or completely pretesticular, a little in front of midbody. Prepharynx distinct; oesophagus moderately long; caeca terminate in posterior half of body far in front of posterior extremity. Testes oblique near one another, almost equatorial; posterior testis definitely equatorial, postacetabular; antrior testis partially or completely overlapped by acetabulum. Cirrus sac elongated, tubular, enclosing vesicula seminalis and prostatic complex. Ovary pretsticular, preequatorial, median, immediately behind cirrus sac. Genital atrium (genital sinus) large, muscular median, with large basal part bearing prominent genital papilla and surrounded by gland cells. Genital pore median, postbifurcal, surrounded by sucker. Vitellaria lateral, short, extracaecal and intercaecal, extending from level of ovary to level of posterior testis. Uterus much coiled behind testes. intercaccal reaching posterior extremity. Excretory vesicle U-shaped with long arms.

Type-species : *B. indica* N. K. Gupta, 1956

159. **Buckleytrema indica** N. K. Gupta, 1956

(Fig. 102)

Specific diagnosis.—Body elongated, smooth, 2.69–4.94 long, 0.53–1.06 in maximum breadth in testicular region. Oral sucker very large, much larger than acetabulum, 0.28–0.4 × 0.28–0.46. Acetabulum small, slightly preequatorial or almost equatorial, postovarian, 0.08–0.13 × 0.08–0.12, pretesticular. Prepharynx 0.032–0.048 × 0.08; pharynx 0.08–0.14 in diameter; oesophagus 0.17–0.48 long, 0.064–0.08 in width; caeca terminate in second half of body, far in front of hinder end.

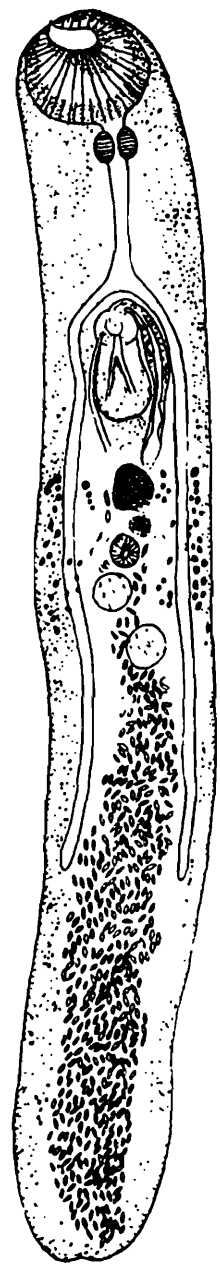


FIG. 102. *Buckleytrema indica* N. K. Gupta, 1956. Ventral view.

Testes oblique, spherical, near one another, behind acetabulum, sometimes anterior testis partly covered by the latter; anterior testis 0.096–0.28×0.096–0.24; posterior testis 0.096–0.28× 0.096–0.22. Cirrus sac elongated. Vesicula seminalis dumbel-shaped, posterior part completely filling basal part of cirrus sac, distal part slightly separated from cirrus sac wall; pars prostatica long surrounded by prostate cells, narrow anteriorly to open into genital atrium. Genital atrium 0.064–0.076 long, 0.064–0.079, wide, surrounded by concentric layers of thick muscle fibres, continued behind into accessory organ or copulatory organ of 0.14–0.33×0.16–0.19 size containing prominent muscular papilla. Base of accessory organ surrounded by gland cells. Genital pore sucker-like, median, postibifurcal. Ovary 0.08–0.17×0.08–0.14, median, pre-acetabular. Mehlis' gland complex posterior to ovary. Receptaculum seminis present. Uterus much coiled behind testes, intercaecal, reaching posterior extremity; in front of ovary it extends along accessory organ on the side opposite to cirrus sac to open into genital sinus. Vitellaria short, of small follicles, extracaecal and intercaecal, extending from level of anterior border of ovary to level of posterior testis. Eggs operculate, 0.038–0.057×0.019–0.026.

Host.—Marine cat-fish.

Location.—Intestine.

Locality.—Gulf of Manaar, Indian Ocean.

IV Suborder CYCLOCOELATA La Rue, 1957

Fasciolatoidea : Genital pore near anterior end. Cirrus sac present in superfamily Cyclocoeloidea Nicoll, 1914, absent in Eucotyloidea n.spf. Cercariae tailless or with very short bilobed tail; encysted metacercariae in snail host, reaching the final bird host when the snail infected with metacercariae is ingested. Adults usually monostomes without acetabulum, but immature stages in Eucotyloidea n.spf. possess acetabulum.

F Superfamily *CYCLOCOELOIDEA* Nicoll, 1914

Cyclocoelata : Cercariae tailless or with rudimentary bilobed tail produced in mother rediae possessing collar, ambulatory appendages and large intestine resembling rediae of Echino-stomatidae. Actively moving miracidium containing well developed redia; no daughter rediae produced. Cercariae

never swim out of aquatic snail host, but encyst near rediae in the snail, reaching the definitive bird host when the snail containing metacercariae is ingested. Adults parasitic in body cavity, air sacs, trachea, nasal cavity, infra-orbital cavity and rarely intestine of birds.

XVI. Family CYCLOCOELIDAE Kossack, 1911

Cyclocoeloidea : Medium sized or large, usually without acetabulum; small vestigial acetabulum sometimes present. Mouth terminal or subterminal. Oral sucker usually absent or rudimentary. Pharynx well developed; oesophagus short, rarely moderately lōng. Caeca united posteriorly to form an arc, simple or with diverticula. Genital pore median, ventral to pharynx or bifurcal near anterior extremity. Testes oblique or sometimes behind one another, intercaecal usually in posterior part of body. Cirrus sac small. Ovary between two testes or anterior to both or behind testes. Receptaculum seminis present or absent. Uterus large in close transverse coils filling almost whole of intercaecal region, sometimes overlapping caeca or even extending outside. Eggs numerous without filament. Vitellaria lateral, outside caeca from behind pharynx to posterior extremity, usually approaching mesially at hinder end. Excretory pore dorso-terminal; excretory vesicle between posterior intestinal arc and bodywall. Parasitic in body cavity, air sacs, trachea, nasal fossae, infraorbital cavity and rarely intestine of birds.

Type genus : *Cyclocoelum* Brandes, 1892

Key to subfamilies of CYCLOCOELIDAE

Body linguiform or lanceolate, three to six times longer than broad; caeca simple without diverticula; acetabulum vestigial sometimes present between fifth and seventh parts of body length, behind intestinal bifurcation.	*CYCLOCOELINAE* Stossich, 1902
Body elliptical or oval, two of three times longer than broad with maximum breadth in anterior half or at mid-length; caeca usually with 9–13 diverticula; vestigial acetabulum sometimes present between first third and mid-length of body; hosts Ansoriformes by predetermination and the chosen habitat trachaea of these birds.	*TYPHLOCOELINAE* Harrah, 1922

We follow Dubois (1959, 1965) in admitting two genera in the subfamily Cyclocoelinae, *Cyclocoelum* Brandes, 1892 and *Ophthalmophagus* Stossich, 1902.

Key to genera of CYCLOCOELINAE

Ovary anterior or lateral to testes or sometimes between them.	*Cyclocoelum* Brandes, 1892
Ovary posterior to testes; normal habitat, the orbit, nasal fossae and infra-orbital cavity	*Ophthalmophagus* Stossich, 1902

Ophthalmophagus Stossich is not reported from India. Dubois (1959) has divided genus *Cyclocoelum* into three subgenera, Subgenus *Cyclocoelum** Witenberg, 1928, Subgenus *Haematotrephus* Stossich, 1902 and Subegenus *Hyptiasmus* Kossack, 1911.

Key to subgenera of **Cyclocoelum**

Ovary at the summit of a triangle, the base of which is a line joining the centres of non-contiguous testes; uterine coils transverse without strong inflection or generally in posteroextrnal direction; uterine coils entirely intercaecal or more or less encroaching on caeca without crossing obviously their external border	subgenus *Cyclocoelum** Witenberg, 1928
Testes continuous or placed very close to ovary; ovary at the summit of a triangle the base of which is a line joining their centres and this summit is pretesticular or in level with anterior border of foremost testis; uteriene coils generally and sufficiently clearly inflected in postero-external direction or disposed more or less regularly in chevrons, the latter may embrace testes (descending coils); coils enclosed between caeca or overlapping the latter, transgressing the same, sometimes the vitellaria.	*Cyclocoelum* (*Haematotrephus* Stossich, 1902)
Ovary always intertesticular, exactly or almost exactly in the line joining the centres of the testes, more often close to posterior testis or even touching it.	*Cyclocoelum* (*Hyptiasmus* Kossack, 1911)

Characteristics of the valid Indian species and their synonymies.

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*The author for nominal Subgenus should be Brandes 1892, according to rules—*Ed,*

XLV Subfamily *CYCLOCOELINAE* Stossich, 1902

Genus 82. **Cyclocoleum** Brandes, 1892

3. Subgenus **Cyclocoleum** Witenberg, 1928

160. **Cyclocoelum (Cyclocoelum) mutabile** (Zeder, 1800)

(Fig. 103)

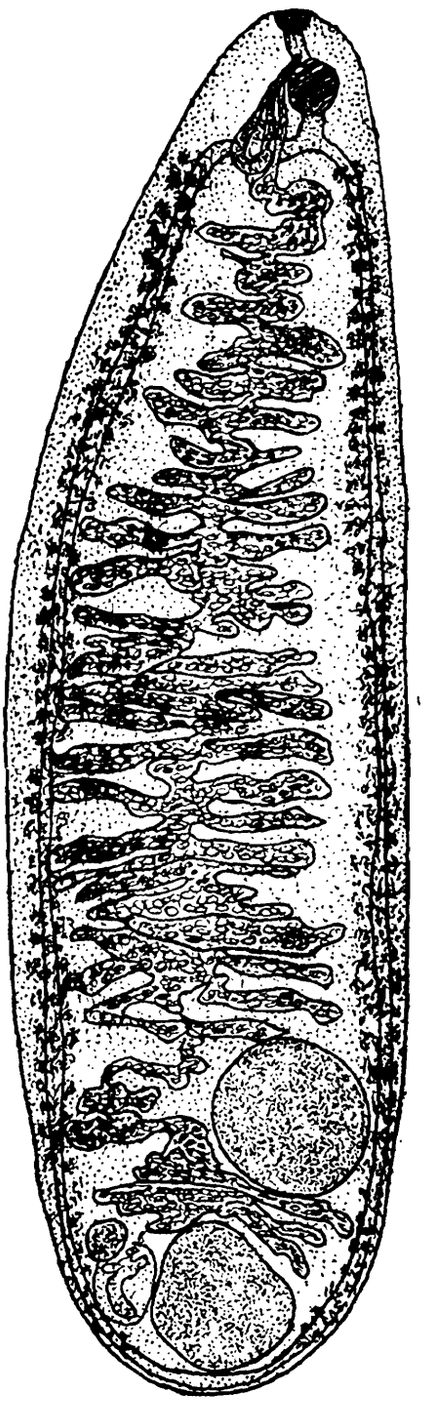


FIG. 103. *Cyclocoelum (C.) mutabile* Zeder, 1 00).

The type-species, *C.* (*C.*) *mutabile* was recorded in India by Srivastava and Pande (1964) at Mathura, U.P. from Indian coot, *Fulica atra*, but no account was given.

Specific diagnosis.—Length up to 27 mm. Pharynxlarge, 500–1270μ. Genital pore in level with anterior border of pharynx or in front of it. Eggs 96–132$\times$51–77μ. Vitellaria profusely developed, enveloping caeca ventrally and dorsally, not confluent posteriorly. Parasitic in *Ralloidea* (*Fulica* and *Gallinula*).

161. **Cyclocoelum (Cyclocoleum) obscurum** (Leidy, 1887)

(Fig. 104)

Syn. *Monostomum obscurum* Leidy, 1887
Cyclocoelum problematicum Stossich, 1902
C. exile Stossich, 1902
C. obliquum Harrah, 1922
C. leidyi Harrah, 1922
C. cuneatum Harrah, 1922
C. macrorchis Harrah, 1922
C. toratsogami Morishita, 1924
C. orientale Witenberg, 1923
C. orientale var. *eurhinus* Tubangui, 1932
C. makii Yamaguti, 1933
C. capellum Khan, 1935
C. indicum Khan, 1935
C. erythropis Khan, 1935
C. mehrii Khan, 1935
C. lobatum Khan, 1935
C. allahabadi Khan, 1935
C. mutabile Bychowskaja-Pawlowsakja, 1953 nec Zedar, 1800

Specific diagnosis.—Length up to 29 (*C. mahrii*). Pharynx small, 120–300/120–280 or 150–310μ. Eggs 100–168/50–96μ. Genital pore in level with middle or posterior boarder of pharynx. Vitellaria marginal throughout length of caeca, non confluent posteriorly. Parasites of *Charadrii* (*Scolopacidae* almost exclusively).

Host.—*Capella gallinago, Tringa erythropus, Glottis nebularia* (common green shank snipe), *Capella gallinago gallinago* (common fan-tail snipe).

Location.—Air sacs, body cavity.

Locality.—Allahabad, U.P.

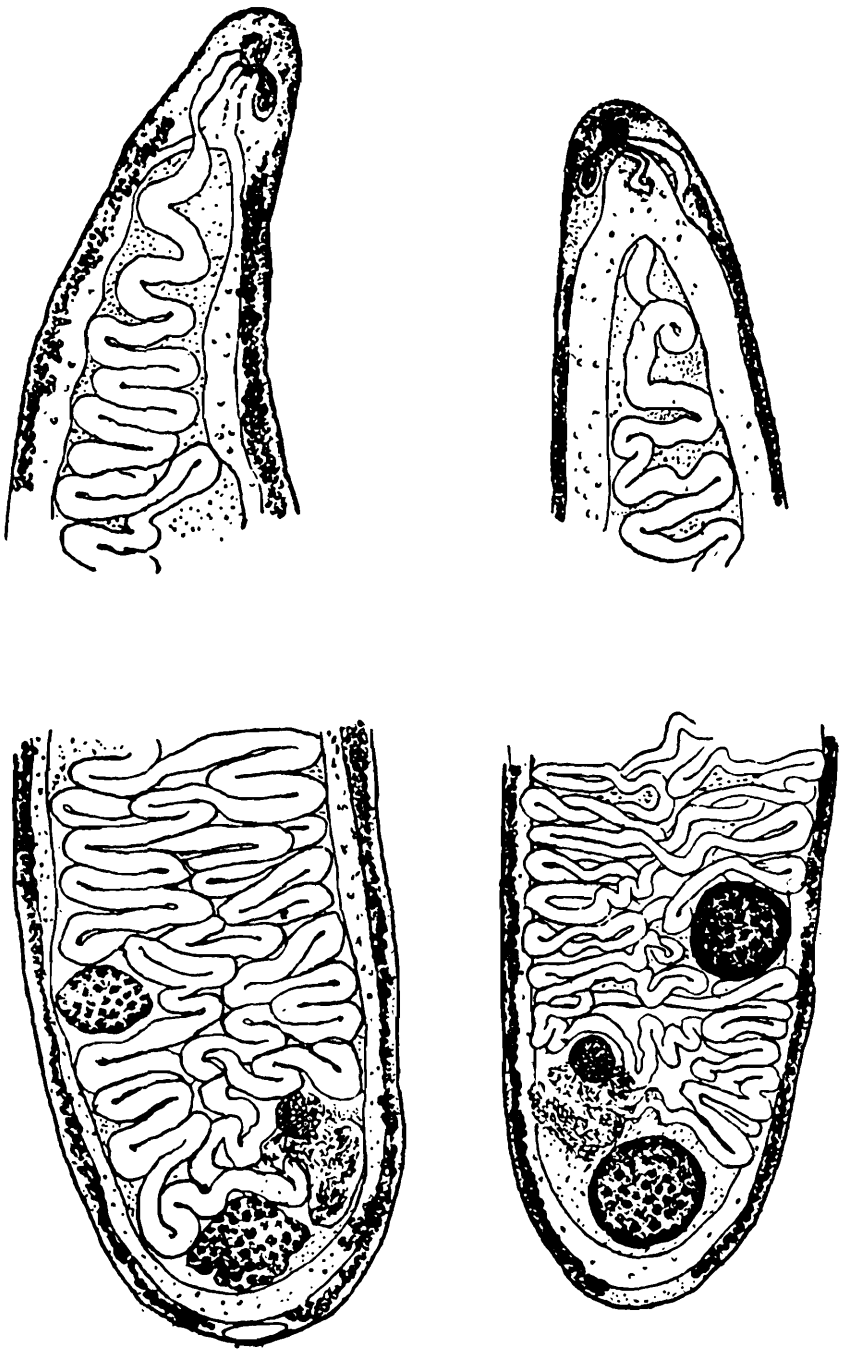


FIG. 104. *Cyclocoelum* (*C.*) *obscurum* (Leidy, 1887).

162. Cyclocoelum (Cyclocoelum) ovipunctatum Stossich, 1902

(Fig. 105)

Syn. *Haematotrephus fasciatus* Stossich, 1902
Monostomum vicarium Arnsdorff, 1908
Cyclocoelum orientale Skrjabin, 1913
C. straightum Khan, 1935
C. turusigi Yamaguti, 1939
Morishitium straightum (Khan, 1935) Yamaguti, 1958

Specific diagnosis.—Length up to 25. Pharynx medium, 390–460/270–420 or 340–440/μ. Eggs 102–178/69–93/μ. Genital pore in level with middle or posterior border of pharynx. Vitellaria marginal along caeca, not confluent posteriorly. Parasitic in Charadrii.

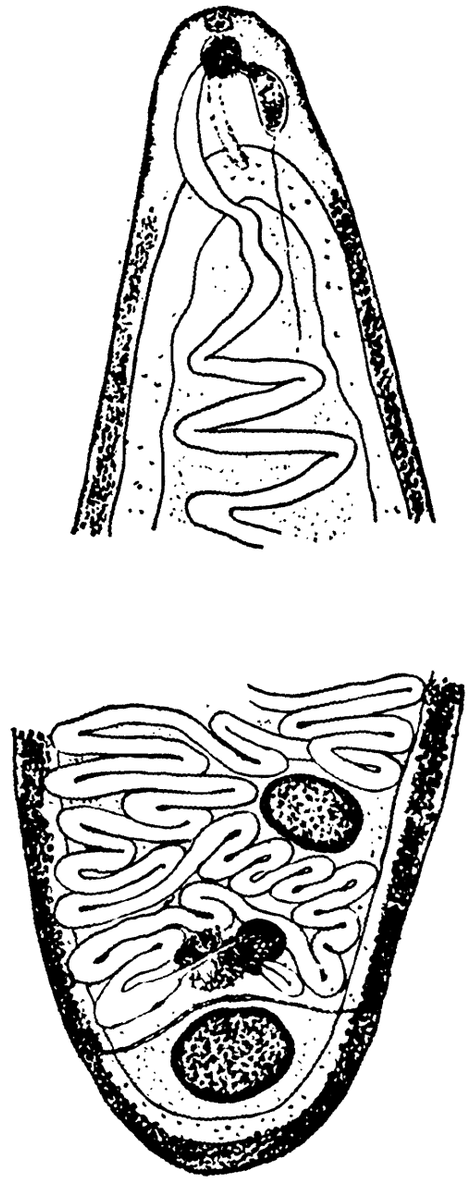


FIG. 105. *Cyclocoelum (C.) ovipunctatum* Stossich, 1902.

Host.—Glottis nebularia.
Location.—Abdominal air sac.
Locality.—Allahabad, U.P.

163. **Cyclocoelum (Cyclocoelum) odeningi** Dubois, 1965

(Fig. 106)

Syn. *Cyclocoelum capellum* Jaiswal, 1957 nec Khan, 1935; Odening, 1962 (in reserve).
Cyclocoelum sp. Odening, 1964

This Indian species was discovered by Jaiswal (1957) in body cavity of *Nettopus coromandelianus* (Gm.) : single specimen, afterwards found again by Odening (1962) 7 specimens; 1964 (1 specimen) in the air sacs and the body cavity of two *Nettopus* imported from the Indian Union in 1960 and 1964. Dubois (1965) says that it is not *Cyclocoelum capellum* Khan, 1935, which was considered by him (1959) as a synonym of *Cyclocoelum obscurum* (Leidy, 1887), the pharynx of which is relatively small (275μ for the worm of 17–25 length). The new species is characterized on the contrary by possessing a huge pharynx measuring 290–530/500–740μ for a worm measuring only 9–10.3/2.5–3.2. However, the host is one anatide, whereas those of *C. obscurum* and its numerous synonyms are scolopacids almost exclusively.

Specific diagnosis.—Length upto 13.8. Pharynx very large, ellipsoidal, 380–550/620–740 or spherical, 530μ. Eggs 120–154/59–75μ. Genital pore in level with posterior border of pharynx. Vitellaria marginal, along caeca, non-confluent posteriorly.

	Jaiswal, 1957	Odening, 1962	Dubois in the material of Odening
Length	13.6	9–11	9–10.3
Breadth	2.3	2.8–3.5	2.5–3.2
Pharynx	550/710μ	381–484/630–682μ	390–530/530–740μ
Ovary	330μ	——	335–400/445–490μ
Testes	550–600/570–580μ	——	490–960/840–1175μ
Eggs	130/66μ	132–147/66–73μ	120–145/60–75μ

Host.—Common teal, *Nettopus corommandelianus* (Gm.) Antidae.

Location.—Air sacs and body cavity.

Locality.—Hyderabad, India.

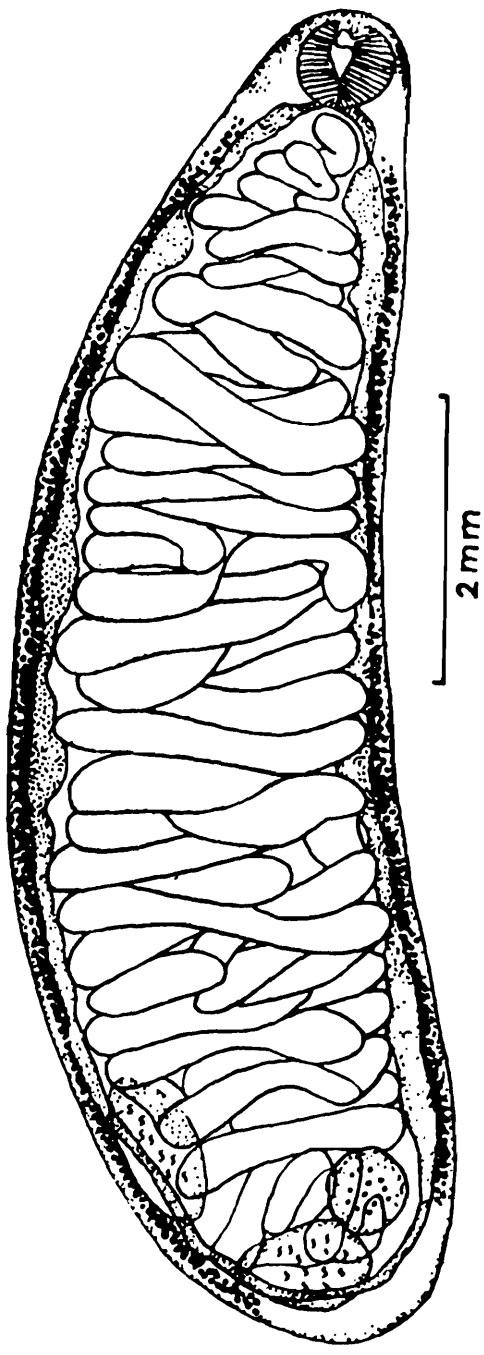


FIG. 106. *Cyclocoelum (C.) odeningi* Dubois, 1965.

4. Subgenus **Haematotrephus** Stossich, 1902

164. **Cyclocoelum (Haematotrephus) vanelli** (Rudolphi, 1819) (Fig. 107)

Syn. *Monostomum vanelli* Rudolphi, 1819
Monostomum lanceolatum Wedl, 1858
Haematotrephus similis Stossich, 1902

Haematotrephus adelphus S. J. Johnston, 1916
Uvitellina pseudocotylea Witenberg, 1923
Uvitellina magniembria Witenberg, 1923
Cyclocoelum (*Uvitellina*) *dollfusi*, Tseng, 1930
Uvitellina keri Yamaguti, 1933
Uvitellina tageri Yamaguti, 1933
Uvitellina macroisophaga Hannon et Wilson, 1934
Cyclocoelum obscurum Houdemer, 1938 nec Leidy, 1887
Haematotrephus (*Uvitellina*) *vanelli* (Rud.) Dollfus, 1948
Uvitellina adelpha (Johnson) Bychov. Pavlov., 1953
Cyclocoelum titiri P. N. Chatterji, 1958
Haematotrephus (*H.*) *lobivanelli* N. K. Gupta, 1958
Haematotrephus (*Uvitellina*) *kaniharensis* P. D. Gupta, 1958
Uvitellina vanelli (Rud.) Macko, 1959
Uvitellina indica Siddiqi et Jairajpuri, 1962

Specific diagnosis.—Body up to 20 long, usually 9–16 long.

1. Pharynx of sufficiently large size (average diameter 330–550μ) according to the figures or descriptions of the authors Dollfus, Yamaguti, Mme Bychovskaja-Pavlovskaja and Macko indicating the same specific characters;

2. The narrowness of intercaecal field (one third to three fifth of body breath);

3. Contiguity or promixity of testes ;

4. Vitellaria always confluent posteriorly, of small follicles along external border of their ventral face;

5. Uterine coils overlapping caeca from anterior fourth of body length, inflected more or less with a tendency to be disposed in chevrons, the last enveloping more or less the gonads according to the intestinal arc;

6. Uterus containing free miracidia at least in its distal part.

7 Eggs of large dimensions (upto 250/115μ), reniform in lateral view, with very thin and fragile shell.

8. Genital pore opisthopharyngeal, *i.e.*, in level with posterior border of pharynx.

These points were mentioned by Dubois for the diagnosis of the species,



FIG. 107. *Cyclocoleum* (*Haematotrepous*) *vanelli* Rudolphi. 107).

Host.—*Glottis nebularia*, *Lobivanellus indicus* (Boddaert) *Haplopterus ventralis.*

Location.—Air sacs or body cavity.

Locality.—Allahabad, U.P.; Hoshiarpur, Panjab,

165. **Cyclocoelum (Haematotrephus) kossacki** (Witenberg, 1923) Dubois, 1965

(Fig. 108)

Syn. *Corpopyrum kossacki* Witenberg, 1923
Haematotrephus lanceolatum Stossich, 1902 nec Wedl, 1 58 et Bychov.-Pavlov, 1953
Haematotrephus lanceolatum Macko, 1960, nec Macko et Folge, 1960 nec Wedl, 1858
Cyclocoelum nebularium Khan, 1935

Specific diagnosis.—Length 9–13. Pharynx medium 200-250μ. Intercaecal field large. Vitellaria marginal, nonconfluent

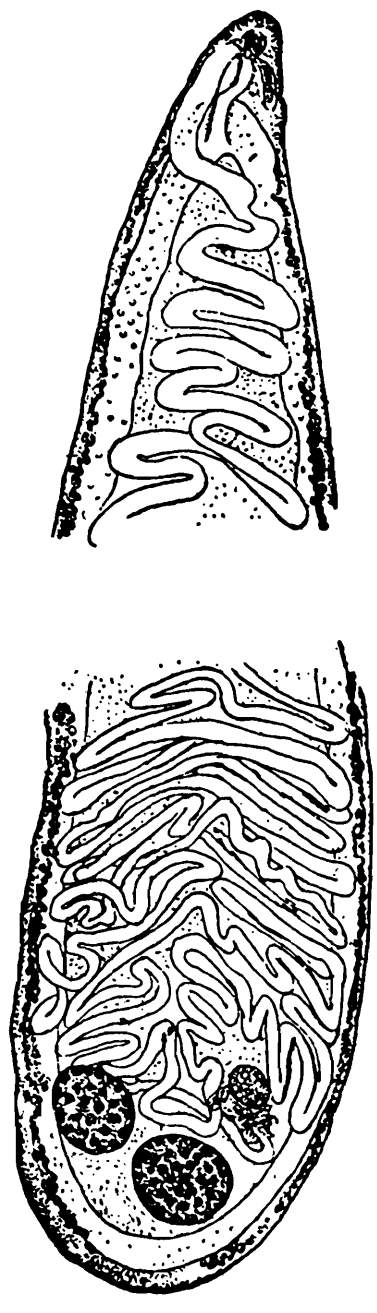


FIG. 108. *Cyclocoelum* (*Haematotrephus*) *kossacki* Witenberg, 1923).

posteriorly, but approaching, well developed. Genital pore in level with middle or posterior border of pharynx, *i.e.*, opistho- or mesopharyngeal. Uterine coils reaching the external border of caeca or overpassing the caeca inflected in postero-external direction, many constituting the descending coils and the last enveloping more or less the gondas. Eggs with thick shell, 120–136/67–87μ, not hatched in the uterus; parasitic in *Charadrii : Scolopacidae* (*Tringa* and *Erolia*) and Recurvirostridae (*Himantopus*). Eurasia.

Host.—The common green shank, *Glottis nebularia.*

Location.—Air sacs, mostly from abdominal ones.

Locality. Allahabad, U.P.

5. Subgenus **Hyptiasmus** Kossack, 1911

Diagnosis.—*Cyclocoelum*Ovary : always intertesticular, exactly or almost exactly to the line joining the centres of the testes, more often close to posterior testis or often touching it.

Dubois (1959) has distributed the numerous species belonging to this subgenus in three groups. The Indian species are all considered by Dubois as synonymous to *Cyclocoleum* (*Hyptiasmus*) *elongatum* Harrah, 1921 which belongs to this third group which is synonymous to subgenus *Pseudhyptiasmus* Dollfus, 1948.

Third group (subgenus *Pseudhyptiasmus* Dollfus, 1948).

Diagnosis.—Genital pore opisthopharyngeal (in level with the posterior border of pharynx) or peranpharyngeal (distinctly beyond the pharynx or in level with intestinal bifurcation); uterine coils are confined to intercaecal field.

166. **Cyclocoelum** (**Hyptiasmus**) **elongatum** Harrah, 1921

(Fig. 109)

Syn. *Cyclocoelum sharadi* **Bhaleroa, 1935**
C. dumetellae **Zeliff, 1943**
C. bivesiculatum **Prudhoe, 1944**
C. (*Pseudhyptiasmus*) *dollfusi* **Timon-David, 1950**
C. (*Pseudhyptiasmus*) *sinhaladvipa* **Fernando, 1950**

Specific diagnosis.—Length up to 20. Pharynx 251–400μ. Eggs 100–140/51–81μ. Genital pore in level with posterior

extremity of pharynx or a little behind. Vitellaria marginal or submarginal outside caeca, non-confluent posteriorly. Uterine coils clearly confined to intercaecal field. Ovary deviated often from the line joining the centres of the testes. Excretory vesicle bicornuate (formed of two pouched joined

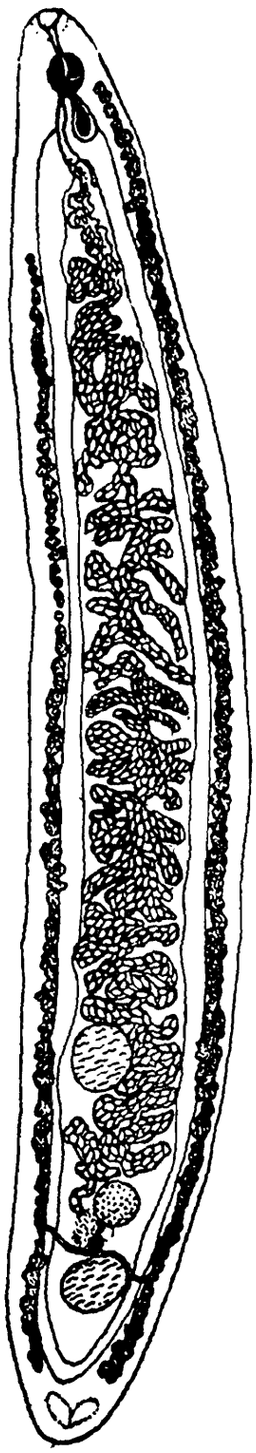


FIG. 109. *Cyclocoelum* (*Hyptiasmus*) *elongatum* Harrah, 1921.

together). Parasites of Passeres (*Pica*, *Cyanopica* and *Urocissa*, *Dumetella* and *Myophonus*) of *Pici* and of *Galli*.

C. sharadi Bhalerao 10.5–11 long; *C. bivesiculatum* Prudhoe 8–13.2 long; *C. sinhaladvipa* Fernando 7.5–8.7 long; *C. dollfusi* Timon-David 15–20 long.

Hosts and localities of Indian synonyms of *C.* (*H.*) *elongatum* :

C. sharadi Bhalerao, 1935

Host.—*Uracissa favirostris*.

Location.—Thoracid cavity.

Locality.—Muktesar, U.P.

C. bivesiculatum Prudhoe, 1944

Host.—Ceylon Green barbet, *Thereiceryx zeylonicus zeylonicus*.

Locality.—Sri Lanka.

C. (*Pseudhyptiasmus*) *sinhaladvipa* Fernando, 1950

Host.—Ceylon jungle fowl, *Gallus lafavetti*.

Location.—Nasal sinus.

Locality.—Kalawewa district, Sri Lanka.

XLVI. Subfamily *TYPHLOCOELINAE* Harrah, 1922

Cyclocoelidae : Body elliptical or oval, two to three times longer than broad, with maximum breadth in anterior half or at midlength; caeca usually with 9–13 diverticula on inner side or sometimes without diverticula; acetabulum vestigial situated between anterior third and mid-length of body; hosts Anseriformes by predetermination and the chosen habitat the trachae.

Type genus : *Typhlocoelum* Stossich, 1902 with

Type-species : *T. cucumerinum* (Rudolphi, 1809). Other genus : *Neivaia* Travassos, 1929

Neivaia is distinguished from *Typhlocoelum* Stossich, 1902 by the absence of intestinal diverticula.

Genus 83. **Typhlocoelum** Stossich, 1902

Syn. *Tracheophilus* Skrjabin, 1913
Typhlophilus Lal, 1936

Typhlocoelinae : Body elliptial, linguiform or oval. Caeca with simple, usually 9–13 diverticula on inner side. Acetabulum vestigial or absent. Testes oblique in posterior part of body, separated or not one from the other by uterine coils; posterior testis median, just in front of posterior caecal arc, anterior testis just inside right or left caecum; testes globular (*T. sinowi* Skrjabin, 1913)), testes strongly lobed (*T. cucumerinum* Rudolphi, 1809). Genital pore in level with middle or posterior border of pharynx (*T. cucumerinum*) or in level with anterior border of pharynx or a little in front of it (*T. sinowi*). Ovary rounded, opposite anterior testis, a little in front of it or behind it. Uterine coils intercaecal. Vitellaria lateral, ventral and dorsal to caeca, not united posteriorly. Parasitic in air sacs, trachea or intestine of aqueatic birds.

Type-species : *T. cucumerinum* (Rudolphi, 1809) Stossich, 1902.

Other species : *T. sinowi* (Skrjabin, 1913) Dubois, 1959.

167 **Typhlocoelum cucumerinum** (Rudolphi, 1809)

(Figs. 110 & 111)

Syn. *Distoma cucumerinum* Rudolphi, 1809
Monostomum flavum Mehlis, 1831
Monostomum asperum Nitzsch in Leuckart 1842
M. sarco diornicola Megnin, 1890
Typhlocoelum obovale Neumann, 1903
T. reticulare S. J. Johnston, 1913
T. americanum Manter and Williams, 1928
Typhlophilus shovellus Lal, 1936

Specific diagnosis.—Body 4–13/1.8–6. Pharynx 190–520μ. Eggs 107–195/60–95μ. Intestine with 9–13 diverticula. Genital pore in level with middle or posterior border of pharynx. Testes strongly lobed or ramified. Vitellaria along caeca. Uterine coils confined to intercaecal field. Parasites of Anseres (ducks).

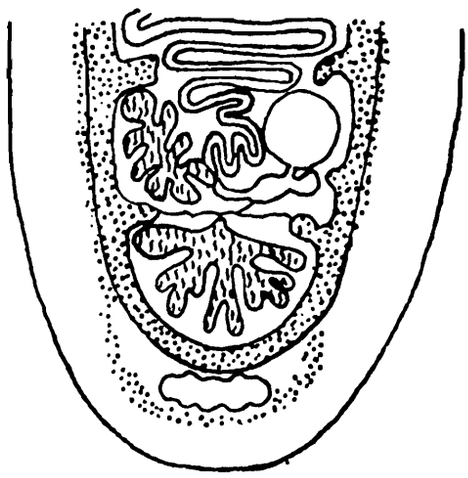


FIG. 110. *Typhlocoelum cucumerinum* (Rudolphli, 1809).

ii. Indian synonym of *Typhlocoelum cucumerinum* (Fig. 111)

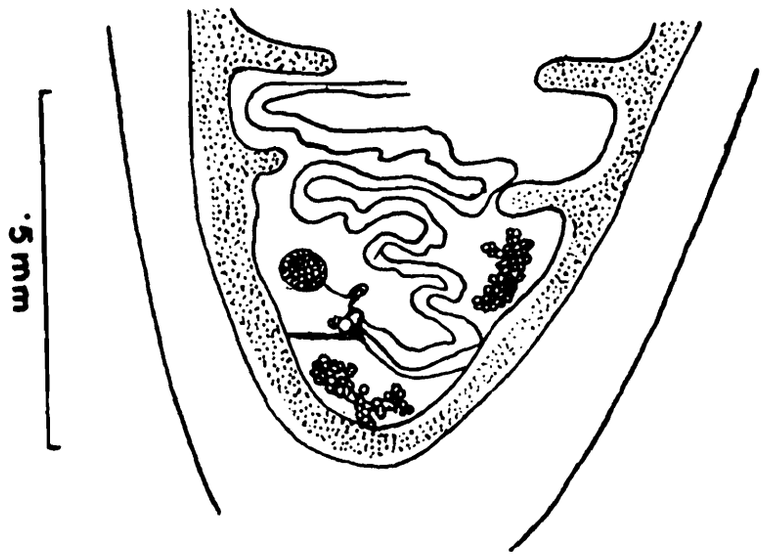


FIG. 111. *Typhlophilus shovellus* M. B. Lal, 1236.

168. **Typhlophilus shovellus** Lal, 1936

Specific diagnosis.—Length 3.6, maximum breadth behind acetabulum 1.15. Oral sucker feeble as funnel-shaped depression. Acetabulum circular, 0.125 in diameter, at about middle of body. Prepharynx small; phrynx globular, 0.19×0.21; oesophagus extremely small; caeca with 13 diverticula on their inner side. Testes lobed in grape-like bunched, one lying in intestinal arc and the other in

front of it on the left side behind last diverticulum. Ovary dextral, in level with left testis, oval, almost globular, 0.055×0.07. Receptaculum seminis small, behind ootype. Genital pore ventral to intestinal bifurcation. Eggs 0.02×0.01.

Host.—Shoveller duck, *Spatula clypeata.*

Location.—Small intestine.

Locality.—Lucknow, U.P.

G. Superfamily *EUCOTYLOIDEA* n. supf.

Cyclocoelata : Cercariae tailless, produced in daughter sporocysts, in terrestrial snails. Ciliated miracidia hatch when eggs are swallowed by terrestrial snails, become metamorphosed into small mother sporocysts. Daughter sporocysts ovoid or spherical produce tailless cercariae which encyst within them, waiting transfer to definitive bird host (Maldonado, 1945; life history of *Tanaisia bragai*). Excretory vesicle tubular, undulating, bifurcating at level of acetabulum into two main trunks, each of which divides into anterior and posterior ducts, the former extending to oral sucker and turning back on itself end near acetabulum. The turning back of anterior main duct on itself at anterior end suggests the stenostomate protonephridial system of Echinostomata. Genital pore near anterior end. Cirrus sac absent. Adults parasitic in kidneys, ureters or urinogenital organs of birds, infected when terrestrial snails infected with metacercariae are swallowed.

XVII. Family EUCOTYLIDAE Skrjabin, 1924

Eucotyloidea n. supf : Body medium sized with or without collar-like thickening at neck. Oral sucker subterminal or terminal. Pharynx present; oesophagus short or almost absent. Caeca terminating blindly or united together near posterior extremity. Rudimentary acetabulum occasionally present. Genital pore median, some distance posterior to intestinal bifurcation. Testes symmetrical, diagonal or tandem, equatorial or preequatorial. Cirrus sac absent. Ovary submedian pretesticular. Vitellaria follicular, lateral. Uterus much coiled between intestinal bifurcation and posterior extremity. Eggs numerous, embryonated without filaments. Excretory vesicle tubular, bifurcating at level of acetabulum,

Parasitic in kidneys and urinogenital organs, occasionally in intestine of birds.

Type genus : *Eucotyle* Cohn, 1904.

Subfamilies Eucotyliinae Freitas, 1951 syn. Eucotylinae Yamaguti, 1958 and Taisiinae Freitas, 1951 syn. Tanaisiinae Yamaguti, 1958 are dropped.

Genus 84. **Tanaisia** Skrjabin, 1924

Syn. *Proshystera* Korkhaus, 1930

Eucotylidae : Body elongate, linguiform, anterior extremity without collar-like thickening. Oral sucker and pharynx well developed. Oesophagus short or absent; caeca simple, united posteriorly near or some distance short of posterior extremity. Small acetabulum occasionally present. Testes entire or lobed, symmetrical, oblique or tandem, intercaecal rarely extracaecal, usually preequatorial or in middle third of body. Cirrus sac absent. Seminal vesicle median, anterior to testes or anteromedial to ovary. Genital pore median, some distance posterior to intestinal bifurcation. Ovary pretesticular, entire or lobed, intercaecal, submedian usually dextral or median. Receptaculum seminis present. Vitellaria extracaecal, extending from in front of ovary or testes to varying distance from posterior end. Uterus entirely or mostly intercaecal, sometimes extending forwards and outwards beyond caeca, usually reaching posterior extremity. Parasitic in kidneys and urinary organs of birds.

Type-species : *T. fedtschenkoi* Skrjabin, 1924

169. **Tanaisia (Tamerlania) indica** K. S. Singh, 1962

(Fig. 112)

Specific diagnosis.—Body elongated, slightly tapering anteriorly with rounded ends, spined all over, 3.756 long, 0.64 in maximum breadth almost in midbody. Oral sucker terminal, 0.303 in diameter. Acetabulum absent. Pharynx 0.139 in diameter. Oesophagus absent. Caeca fairly wide, running laterally near body margin and united with each other near posterior end. Testes intercaecal, symmetrical, oval, almost equal, preequatorial; left 0.22×0.165; right 0.238×0.154. Vas deferens median, Cirrus sac absent

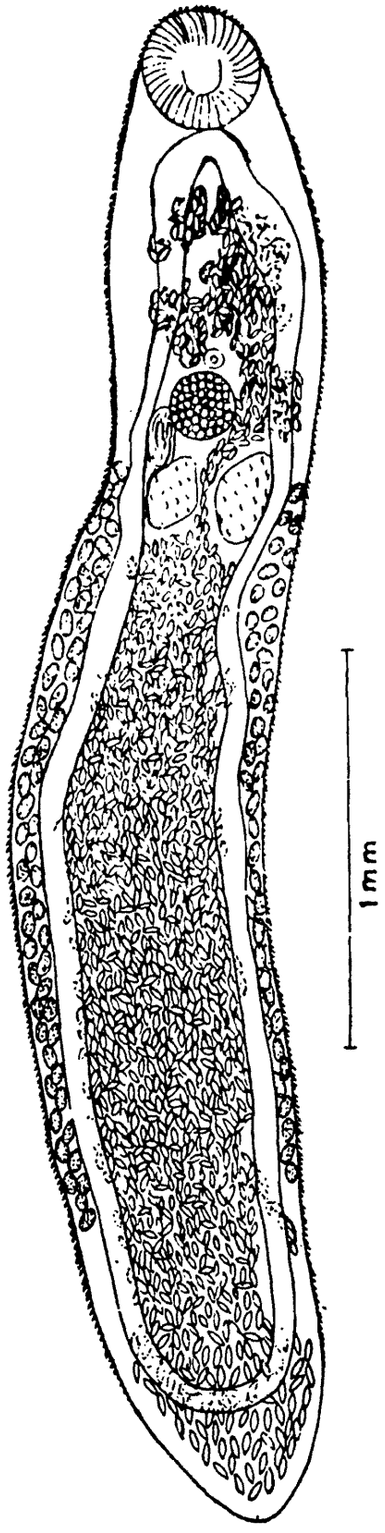


FIG. 112. *Tanaisia (Tamerlania) indica* K. S. Singh, 1962.

Ovary rounded, a little anterior to right testis, 0.21 in diameter. Receptaculum seminis large, a little posterior and

lateral to ovary. Vitellaria of numerous small follicles extracaecal, extending from testicular region to one fourth of body from posterior end. Eggs small, 0.0286–0.033×0.044–0.046. Genital pore median, much behind intestinal bifurcation, approximately at one fourth body length from anterior end.

Host.—Black-throated Jay, *Garrulus lanceolatus* Vigors, 1831 (Corvidae).

Location.—Kidney.

Locality.—Mukteswar, Kumaon (Ht. 7500 ft.).

V Suborder OPISTHORCHIATA La Rue, 1957

Fasciolatoidea : Distomate, pharyngeate. Genital pore preacatabular. Cirrus sac absent. Hermaphroditic duct present; sometimes cutaneous copulatory organs gonotyl or genital sucker developed. Cercariae pleurophocercous or opisthorchoid with eye spots, with two or three short transverse rows of oral spines, acetabulum rudimentary or absent. Carcariae developing in simple rediae with short intestine and without ambulatory appendages. Excretory vesicle V-shaped or Y-shaped; protonephridia stenostomate or mesostomate. Caudal excretory tubes in developing cercaria short with pores on lateral margins of tail near body-tail furrow. Encystment of cercariae in lower vertebrates usually fishes, sometimes amphibians. Three host life cycle.

H. Superfamily *OPISTHORCHIOIDEA* (Faust, 1929) Vogel, 1934

Opisthorchiata : Body usually with poorly developed musculature. Eyes present or absent. Excretory vesicle V-shaped or Y-shaped. Cirrus sac and cirrus absent. Receptaculum seminis usually well developed. Hermaphroditic duct present. Eggs small, embryonated.

Key to families of OPISTHORCHIOIDEA

1. Uterus not extending behind testes; genital atrium small; gonotyl absent. 2

   Uterus extending between testes or to posterior extremity; genital atrium containing one or more gonotyls, sometimes in close relation with acetabulum or enclosing it. ... 3

2. Excretory vesicle with short arms not reaching anterior extremity; eye spots absent.	OPISTHORCHIIDAE	Braun, 1901
Excretory vesicle Y-shaped with arms very long reaching anterior extremity; eye spots usually present.	ACANTHOSTOMIDAE	Poche 1925
3. Excretory vesicle V-shaped or Y-shaped, limbs spacious extending to pharynx; eyes frequently present; genotyls sometimes present; parasitic in maring and fresh water fishes, exceptionally reptiles	CRYPTOGONIMIDAE	Ciurea, 1933
Excretory vesicle Y-shaped or sometimes saccular or triangular, limbs not extending anterior to ovarian level; genital atrium variously modified sometimes in close relation with acetabulum or enclosing it or gonotyl present; parasitic in birds or mammals	HETEROPHYIDAE	Odhner, 1914

XVII. Family OPISTHORCHIIDAE Braun, 1901

Opisthorchioidea : Body small to medium sized, sometimes very long, generally transparent sometimes much thickened. Suckers rather weakly developed near each other except in *Microtrema* Kobayashi. Pharynx present; oesophagus short or very short; caeca usually reaching near posterior ends Genital pore just preacetabular. Gonotyl or sucker-like structures associated with genital atrium absent. Tester diagonal, tandem or almost symmetrical (*Pachytrema*) near posterior extremity or a little in front. Vesicula seminalis tubular, sinuous, rarely saccular, free in parenchyma. Cirrus sac absent, sometimes rudimentary in *Pachytrema*. Ovary submedian, pretesticular, sometimes intertesticular or posttesticular. Receptaculum seminis well developed, exceptionally absent (*Pachytrema*). Laurer's canal present. Vitellaria follicular, continuous or in grape-like bunches, lateral, varying in length. Uterus large, much coiled, mostly preovarian, sometimes posttesticular, intercaecal, sometimes ovarlapping caeca laterally. Eggs numerous, embryonated. Excretory vesicle Y-shaped with long stem and short cornua. Parasitic in bile ducts, gall bladder and liver of mammals, birds, reptiles and fishes, rarely in intestine of these vertebrates.

Type genus : *Opisthorchis* Blanchard, 1895

Key to Indian subfamilies of **Opisthorchiidae**

1. Uterus surrounding acetabulum.	METORCHIINAE Lühe, 1909	
Eterus not extending anterior to acetabulum	2	
2. Testes diagonal or tandem; ovary pretesticular. . .	OPISTHORCHIINAE	Looss, 1899
Testes almost symmetrical, ovary intertesticular, sometimes posterior to level of testes. . .	PACHYTREMINAE	Railliet, 1919

XLVII. Subfamily *OPISTHORCHIINAE* Looss, 1899

Opisthorchiiae : Body elongated, sometimes very long and narrow, spined or unspined. Acetabulum as a rule small, wide apart from anterior extremity. Oral sucker and pharynx well developed. Oesophagus short, very short or moderately long. Testes diagonal near posterior extremity. Seminal vesicle tubular, sinuous, rarely convoluted, posterior to acetabulum. Ovary pretsticular, median or submedian. Vitellaria band-like, continuous or composed of follicle groups, extending from near acetabulum to ovary, posterior testis or even further behind. Uterine coils intercaecal, sometimes overlapping caeca, between ovary and acetabulum. Excretory vesicle Y-shaped with long sigmoid or straight stem dorsal to testes or passing between testes ans short arms.

Type genus : *Opisthorchis* Blanchard, 1895

Key to genera of **Opisthorchiinae**

Vitellaria from acetabular zone or behind it to ovary or posterior testis or even further behind; uterus usually not overlapping caeca.	*Opisthorchis* Blanchard, 1895
Vitellaria of restricted extent, postequatorial, anterior to testes; uterus extending laterally beyond caeca.	*Cyclorchis* Lühe, 1909

84. Genus **Opisthorchis** Blanchard, 1895

Syn. *Amphimerus* Barker, 1911
Paropisthorchis Stephens, 1912
Clonorchis Looss, 1907
Notaulus Skrjabin, 1913
Gomtia Thapar, 1930
Thaparotrema Gupta, 1953
Nigerina Baugh, 1958

Opisthorchiinae : Body elongated, flattened, exceptionally pear-shaped or with reffled margins forming conical lateral projections having stratified character in postacetabular region (subgenus *Nigerina* Baugh, 1958), spined or unspined. Acetabulum usually small, in anterior third of body. Oral sucker well developed. Prepharynx usually absent or small exceptionally long; pharynx present; caeca terminating behind testes near posterior end. Genital pore immediately preacetabular. Testes in posterior part of body, oblique or tandem, usually more or less lobed or banched, exceptionally entire. Ovary pretesticular, lobed or entire. Recptaculum seminis usually prominent. Laurer's canal present. Uterine coils between ovary and acetabulum, usually not overlapping caeca. Vitellaria composed of follicles arranged in bunches or continuous extending from acetabulum or a little in front but behind intestinal bifurcation to ovary, posterior testis or further behind. Excretory vesicle Y-shaped with long sigmoid or straight stem dorsal to testes or passing between testes. Parasitic in gall bladder, bile ducts of mammals, birds, reptiles and fishes, exceptionally intestine of fishes.

Type species : *O. tenuicollis* (Rud., 1809) Stiles and Hassall, 1896.

Key to subgenera of **Opisthorchis**

1. Body consisting of narrow cylindrical anterior part and long broad flattened posterior part with margins behind acetabulum ruffled forming lateral conical projections.	Subgenus *Nigerina* Baugh, 1958
Body elongate, postacetabular region having not ruffled margins forming conical projections.	2
2. Vitellaria extending to ovary or anterior testis.	Subgenus *Opisthorchis* Erhardt, 1935*
Vitellaria extending to posterior testis or further behind.	Subgenus *Amphimerus* Erhardt, 1935

Key to Indian species of **Opisthorchis (Opisthorchis)**

1. Parasitic in mammals	2
Paratistic in birds	3
Parasitic in fishes	9

*The author of nominal subgenus should be Blanchard, 1895 according to rules. —*Ed.*

2.	Testes tendem, strongly branched overlapping caeca	*O. sinensis* (Cobbold, 1875)
	Testes, diagonal, not branched, anterior testis rounded or oval; retractile peduncle present . .	*O.* (*O.*) *noverca* Braun, 1903
3.	Testes oblique. .	4
	Testestandem. . .	6
4.	Body pear-shaped; oesophagus peculiarly thick walled.	*O.* (*O.*) *giddhis* Lal, 1939
	Body not pear-shaped; oesophagus not thick walled.	5
5.	Oesophagus moderately long 0.3–0.6 long; receptaculum seminis longitudinal, slightly constricted in middle.	*O.* (*O.*) *tenuicollis geminus* (Looss, 1896)
	Oesophagus short, bulb-shaped, 0.16 long; receptaculum seminis transverse .	*O.* (*O.*) *allahabadi* Mehra, 1941
6.	Body very long, 8–15 or 16 long.	7
	Body not very long, 3–7 long.	8
7.	Testes strongly branched.	*O.* (*O.*) *longissimus dendriticus* (Morgan, 1927) Erhardt, 1935
	Testes slightly lobed, massive.	*O.* (*O.*) *anhingi* Mehra, 1941
8.	Testes dendritic; receptaculum seminis small	*O.* (*O.*) *obsequens* Nicoll, 1911
	Testes lobed, massive; receptaculum seminis large, elongate S-shaped.	*O.* (*O.*) *pelicani* Mehra, 1941
9.	Vitellaria commencing a little in front of acetabulum.	*O.* (*O.*) *vitellani* (Gupta, 1955)
	Vitellaria commencing behind actatubum.	10
10.	Testes tandem, entire; excretory vesicle stem straight, dorsal to testes.	*O.* (*O.*) *gomtii* (Thapar, 1930) Mehra, 1941
	Testes tandem, faintly lobed; excretory vesicle stem sigmoid, running between testes; oesophagus very short	*O.* (*O.*) *mehrai* Agarwal, 1961
	Testes oblique tandem; excretory vesicle stem sigmoid running between testes; oesophagus prominent. . .	*O.* (*O.*) *pedicellata* Verma, 1927

174. **Opisthorchis (Opisthorchis) noverca** Brawn, 1903

(Figs. 113 & 114)

Syn. *Opisthorchis caninus* (Lewis and Cunningham, 1872)
Distomum conjunctum Cobbold, 1875
Paropisthorch s indicus Stephens, 1912

Specific diagnosis.—Body 2.1–12.7 long, 1.4–2.5 broad, spined. Protrusible pedicel without spines bearing acetabulum and genital pore on the tip present. Oral sucker larger than acetabulum 0.23–0.27 in diameter. Acetabulum 0.164–0.176 in diameter, at 1/6 to 1/8 body length from anterior end sometimes on retractile pedical. Prepharynx absent or very small. Pharynx 0.184–0.26. Oesophagus 0.04 long. Ovary irregularly lobed or with three lobes with one or more subdivision, 0.32×0.24. Vitellaria extending from ovarian region to level of vesicula seminalis, consisting of eight follicle groups. Testes in posterior body third, round or lobater; anterior testis round or egg-shaped, 0.3–0.49; posterior testis partly rounded, partly lobed, 0.42–0.52 in diameter. Receptaculum seminis pear-shaped, 0.28 long.

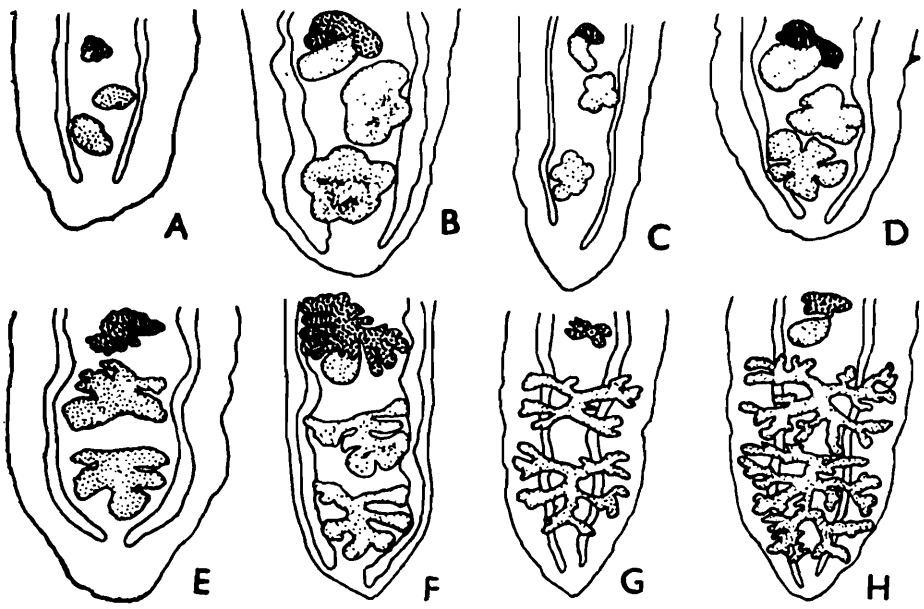


Fig. 113. Variation of testes of *Opisthorchis*; *After* Morgan, 1927
A—*O. noverca*; B—*O. gemius*; C—*O. felineus*; D-*O. viverrin* ; E—*O. obsequens*; F—*O. dentriticus*; G—*O. sinensis* (young stage); H—*O. sinensis* (adult).

Shell gland between ovary, receptaculum seminis and first uterine convelutions. Uterus strongly coiled. Eggs 0.02–0.027×0.011. Genital pore median, at anterior margin of

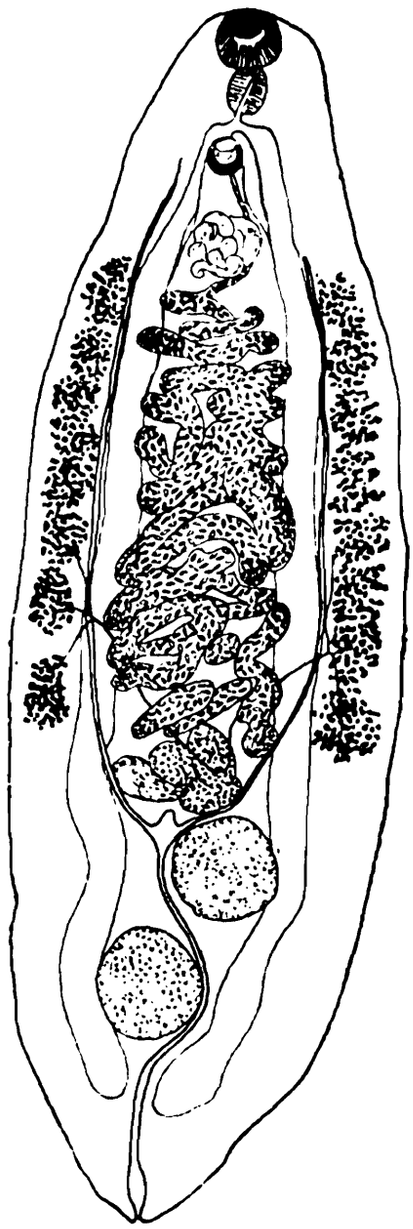


Fig. 114. *Opisthorchis* (*O.*) *noverca* Braun, 1903.

acetabulum on pedicel with acetabulum. Excretory vesicle Y-shaped, stem beginning behind ovary, passing between testes.

Host.—Man, dog, swine.

Location.—Liver.

Locality.—Kasauli, Muktewsar, Bengal.

Rai and Pande (1965) described the metacercaria of the species from musculature of *Channa punctatus* and *Cirrhinus mrigala*.

175. **Opisthorchis (O.) sinensis** (Cobbold, 1875) Blanchard, 1895

Syn. *Distomais nensis* Cobbold, 1875
Clonorchis sinensis (Cobbold, 1875) Looss, 1907
Distomum spathulatum Leuckart, 1876

Specific diagnosis.—Body aspinose 6–19 long, 1.3–4 broad; body parenchyma provided with numerous yellowish or brownish granules. Oral sucker 0.43–0.62 in diameter. Acetabulum 0.37–0.47 in diameter. Pharynx half as large as oral sucker. Oesophagus slightly longer than pharynx. Caeca reach either both or only one of them the body end. Testes strongly branched, overlapping caeca; anterior testis with four branches, posterior with five branches. Ovary lobed, with three large lobes. Receptaculum seminis retort-shaped or pear-shaped. Mehlis' gland and Laurer's canal present. Vitellaria extend from level of acetabulum to region of ovary. Uterus strongly coiled, usually between caeca. Genital pore preacetabular. Eggs 0.026–0.03× 0.013–0.017 Excretory vesicle stem S-shaped, dorsally over testes.

Host.—*Homo sapiens* L., *Canis familiaris* L., *Felis ocreata domestica* Briss., *Sus scrofa* L., *Lutrula scivaricus* Kobayashi.

Location.—Liver.

Locality.—Southern India, Japan, China, Indochina.

176. **Opisthorchis (O.) tenuicolis gemius** (Looss, 1896) Erhardt, 1935

(Fig. 115)

Syn. *Opisthorchis cheelis* Lal, 1939
Opisthorchis milvusensis Murhar, 1959

Specific diagnosis.—Body 6–11.5 long, 1.6–2.355 in maximum breadth at middle of body length. Oral sucker 0.18×0.24–0.285. Acetabulum 0.2×0.15. Pharynx 0.12–0.165×0.15–0.21. Oesophagus thin walled, 0.3–0.6 long. Caeca undulating, terminating wth their ends bent inwards closely to one another. Testes oblique, slightly or deeply lobed, in posterior one sixth part of body; anterior testis usually smaller, 0.33–0.48×0.59–0.7; posterior testis 0.405–0.525×0.525–0.78; testes equal in larger specimens, 0.78×0.96; anterior testis four-lobed, posterior five-lobed. Ovary trilobed with equal lobes, 0.78–0.84×0.21–0.24, median or slightly

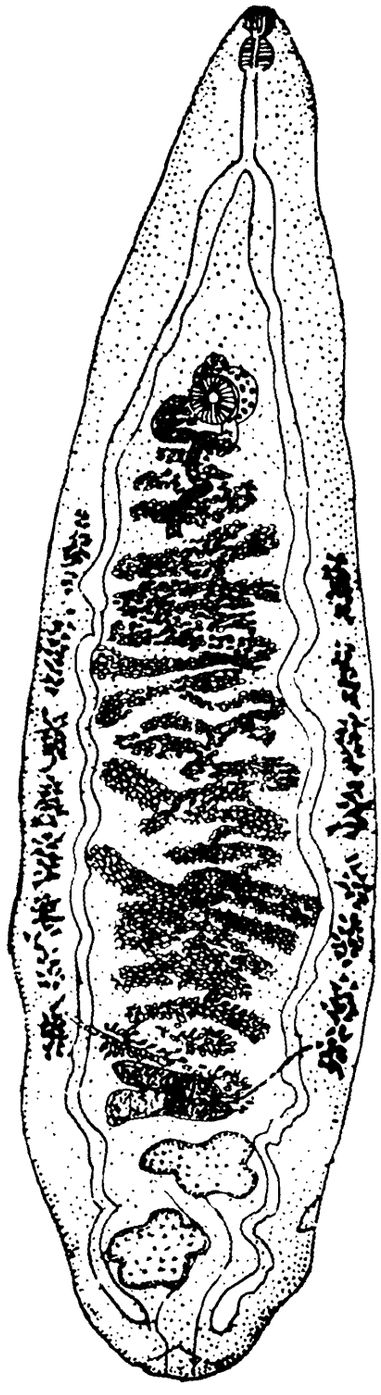


Fig. 115. *Opisthorchis* (*O.*) *tennicollis* geminus (Looss, 1896) Erhardt, 1935. Ventral view.

dextral. Shell gland mass large, occupying entire intercaecal space, just in front of ovary. Receptaculum seminis longitudinal, slightly constricted in middle, 0.3×0.1. Uterus

transversely coiled, intercaecal. Eggs 0.025–0.264×0.0132. Vitellaria extracaecal, composed of eight follicle groups, separate or contiguous to one another, commencing at some distance behind acetabulum. Excretory vesicle Y-shaped with S-shaped stem dividing just behind receptaculum seminis into cornua.

Host.—Kite, *Milvus migrans govinda;* scavenger vulture, *Sacro-gypes clavus.*

Location.—Gall bladder and liver.

Locality.—Allahabad, Lucknow, U.P.; Nagpur.

177 **Opisthorchis (O.) longissimus dendriticus** (Morgan, 1927) Erhardt, 1935

(Fig. 116)

Specific diagnosis.—Body 8.2–15.5 long, 0.65–1.3 broad, unspined. Oral sucker 0.12 in diameter. Acetabulum 0.13, at one fifth anterior body length. Prepharynx absent; pharynx of same size as oral sucker. Oesophagus 0.36–0.6 long; caeca reaching hinder end. Gonads in last seventh part of body. Ovary much lobed, taking up entire intercaecal space. Receptaculum seminis large, pear-shaped, obliquely behind ovary. Testes tandem, directly behind one another, strongly branched, reaching caeca, branching of different shapes in individuals. Uterus intercaecal. Genital pore immediately preacetabular. Vitelaria of small follicles from ovarian region to not more than half the distance from the latter to acetabulum. Shell gland preovarian. Stem of excretory vesicle S-shaped, lying dorsally to testes, touching testes branches ventrally. This species is closely related to *Notaulus asiaticus* Skrjabin, 1913 (Morgan, 1927).

Host.—Saurus crane, *Antigone antigone.*

Location.—Liver.

Locality.—Unknown. Host died at the Zoological Gardens, London.

178. **Opisthorchis (O.) giddhis** Lal, 1939

Specific diagnosis.—Body pear-shaped, unspined, 3.9×1.5. Oral sucker 0.15×0.2. Acetabulum 0.175×0.22, at 1.27 from



Fig. 116. *Opisthorchis* (*O.*) *longissimus dentriticus* (Morgan, 1927) Erhardt, 1935.

anterior end. Prepharynx short, 0.05 long; pharynx elliptical, 0.19×0.11; oesophagus peculiarly thick walled, 0.3 long; caeca slightly sinuous extending to posterior end. Testes oblique, ovoid, feebly lobed or with notched margins; anterior testis sinistral, 0.4×0.15; posterior testis 0.0475×0.16. Ovary transversely placed, 0.42×0.1. Receptaculum seminis behind

ovary, 0.2×0.15. Vitellaria extracaecal, of small follicles, contiguous or of follicle groups. Uterus transversely coiled. Eggs 0.0225×0.01.

Host.—*Sarcogyps calvues.*

Location.—Liver.

Locality.—Lucknow, U.P.

This species may be synonmous to *Opisthorchis tenuicollis geminus* (Looss, 1896) Erhardt, 1935. The specimens were probably contracted and are thus different in shape and in condition of oesophagus.

179. **Opisthorchis (O.) allahabadii** Mehra, 1941

Specific diagnosis.—Body muscular, greyish coloured in anterior, posterior and lateral regions, dark yellow in middle region, 5.5–6.6 long, 2.01 in maximum breacdth in region of ovary, unspined. Oral sucker 0.132–0.18×0.19–0.191. Prepharynx absent; pharynx 0.122 in diameter, slightly larger than half the size of oral sucker; oesophagus bulb-shaped, 0.16 long; caeca slightly undulating, ending near posterior extremity. Acetabulum transversely elongated, 0.264–0.29×0.201; thinner than oral sucker, at about 1/6 anterior body length. Gonads in posterior third part of body. Testes large, deeply lobed, oblique; anterior testis smaller, four-lobed, 0.5–0.75×0.6–0.9; posterior testis four or five lobed, 0.5–0.75×0.7–1.05. Ovary 0.15–0.34×0.615–0.87, characteristically trifoliate, each lobe subdivided into two lobes, slightly dextral. Shell gland mass large, median closely in front of ovary. Receptaculum seminis 0.67–0.8 long, 0.22–0.2 broad, transversely directed with proximal one third part overlapped by ovary. Uterine coils transversely and obliquely arranged, sometimes extending outside caeca. Eggs 0.0231×0.013. Vitellaria band-like ,extracaecal, commencing 0.37–0.52 behind acetabulum and terminating in ovarian region or just behind. This species is closely related to *O. tenuicollis geminis* (Looss, 1896 or even it may be synonymous to it.

Hest.—Scavenger vulture, *Sarcogypes calvus.*

Location.—Gall bladder.

Locality.—Allahabad, U.P.

180. **Opisthorchis (O.) anhingi** Mehra, 1941

Specific diagnosis.—Body very long, flattened, 8.7–16.5 long, 0.42–0.95 in maximum breadth, unspined, anterior part in acetabular region or slightly in front marked off by a constriction, tapering towards anterior pointed end. Oral sucker 0.132–0.165 in diameter. Acetabulum nearly equal to oral sucker, 0.14–0.18 in diameter, just behind anterior sixth body length. Prepharynx absent; pharynx 0.145–0.166× 0.11–0.135. Oesophagus 0.22–0.37 long, longer than the combined lengths of oral sucker and pharynx; caeca unequal, the right ending in front of the left one. Testes and ovary in posterior fourth of body. Testes massive, slightly lobed, unequal, tandemn close to one another, slightly shifted to right with lobes varyng n number; anterior smaller, 0.56–0.9×0.36–0.52; posterior 0.57–0.98×0.36–0.57. Ovary tripartite, each part deeply multilobed, giving the ovary a follicular appearance, median, 0.13–0.21 in front of anterior testis, 0.31–0.67×0.25–0.6. Shell gland mass large, irregular in shape, fills intercaecal space closely in front of ovary, sometimes overlapping caeca. Receptaculum seminis large, elongated somewhat pear-shaped, pressed between ovary and anterior testis close inside left caecum, 0.28–0.6×0.16–0.33. Uterine convolutions irregular upto commencement of vitellaria, spiral in front, last soil straight to left side dorsally to acetabulum. Eggs 0.0231–0.0264×0.0125–0.0132. Vitellaria composed of irregular groups of irregular follicles from commencement of ovary to about half the distance between it and acetabulum.

Host.—Common Indian darter, *Anhinga melanogaster.*

Location.—Biliary ducts.

Locality.—Allahabad, U.P.

181. **Opisthorchis (O.) obsequens** Nicoll, 1911

Syn. *Opisthorchis indicus* Mehra, 1941

Specific diagnosis.—Body elongated, slender, delicate with a slight constriction just behind acetabular zone, 7 long, 1.215 in maxmum breadth, unspined. Acetabulum 0.27 in dameter or 0.21–0.28, at end of anterior fourth of body. Prepharynx absent. Pharynx larger than half of oral sucker, 0.15–0.16×0.11. Oral sucker 0.24–0.255×0.21, oval, transversely elongated. Oesophagus 0.2–0.42 long; caeca slightly

undulating posteriorly behind ovary, bending inwards near their ends near hinder end. Testes tendem in posterior third of body, not massive, dendritic or deeply lobed; anterior testis 0.42 in front of posterior testis, four lobed; posterior five lobed, at 0.6–0.75 in front of posteriof extremity. Ovary tripartite, each part further subdivided first into two and then into four or more parts, 0.24–0.3 in front of anterior testis. Receptaculum seminis small, 0.16×0.1, to right side of ovary, connected by small duct with oviduct. Shell gland mass indistinct. Uterus thin walled in obliquely arranged coils lying far apart from each other, intercaecal, sometimes overlapping caeca. Eggs 0.0264×0.0132. Vitellaria band-like outside caeca, left commencing and ending a little in front of the right one which ends at posterior end of ovary.

Host.—Goshawk, *Austur gentilis gentilis.*

Location.—Gall bladder.

Locality.—Allahabad, U.P.

182. **Opisthorchis (O.) pelicani** Mehra, 1941

(Fig. 117)

Specific diagnosis.—Body 5–6.5 long, 0.7–0.8 in maximum breadth at about middle, pink in colour in living condition, spined throughout body length. Oral sucker 0. 132–0.135× 0.1–0.105. Acetabulum 0.18–0.19 in diameter, just behind anterior third. Prepharynx absent; pharynx 0.086–0.09 in diameter. Oesophagus 0.23–0.29 long; caeca terminate a little in front of hinder end coming close near one another. Gonads in posterior fourth of body. Testes tandem, lobed, massive, five-lobed, intercaecal and slightly overlapping caeca; anterior 0.39–0.46×0.22–0.25, 0.08–0.1 in front of posteiror testis which measures 0.39–0.46×0.24–0.255, situated 0.33 in front of hinder end. Ovary trilobed, slightly shifted to left side, 0.18–0.4 in front of anterior testis, 0.37–0.4×0.12–0.24; two of its three lobes bifid. Shell gland mass diffused, median, just preovarian. Receptaculum seminis large, elongated S-shaped, 0.35×0.24, just behind ovary near left caecum. Uterus intercaecal opisthorchoid coils, confined between ovary and commencement of vesicula seminalis. Eggs 0.023–0.0264 ×0.0165. Vitellaria of eight follicle groups, band-shaped,

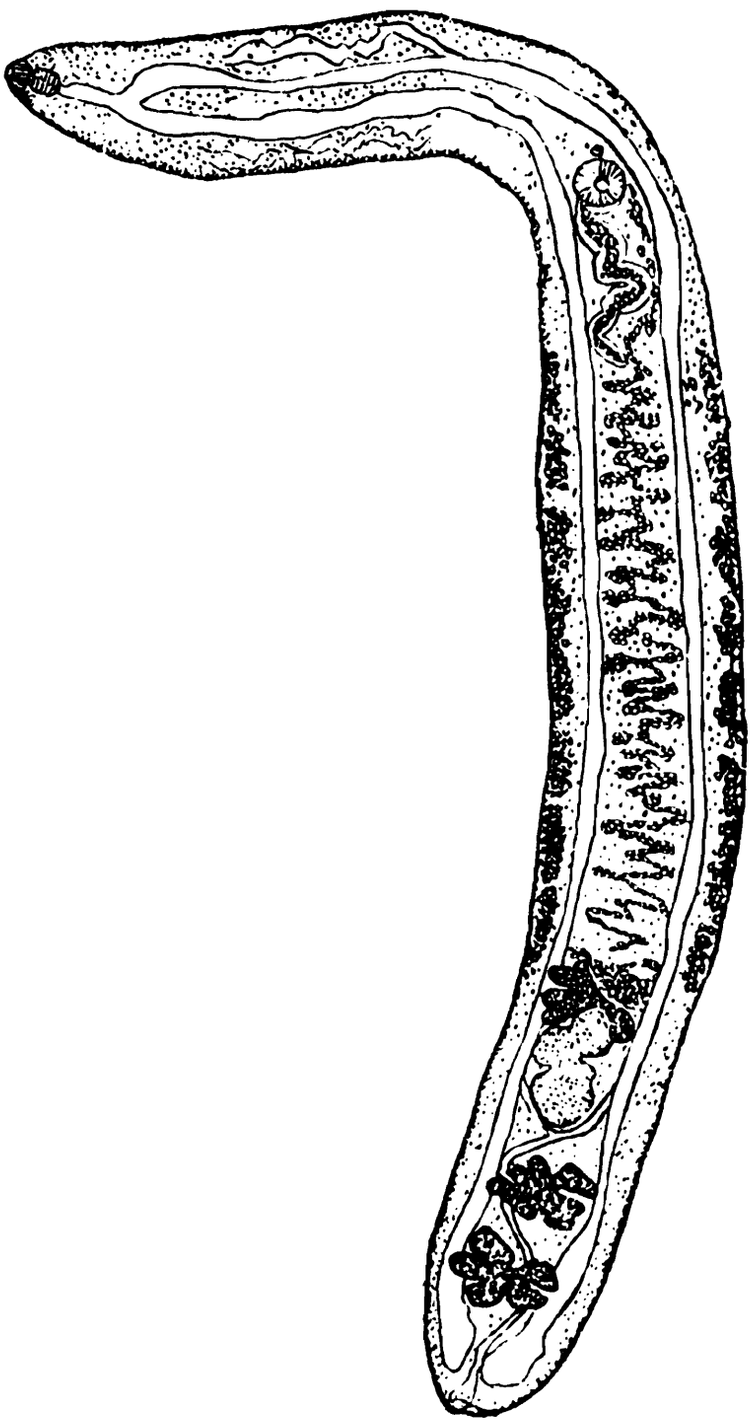


Fig. 117. *Opisthorchis* (*O.*) *pelicani* R. K. Mehra, 1941. Dorsal view, from anterior margin of ovary to commencement of vesicula seminalis.

Host.—Rosy pelican, *Pelicanus onocrocotaulus onocrocotaulus.*

Location.—Gall bladder.

Localy.—Alahabad, U.P.

183. **Opisthorchis (C.) pedicellata** Verma, 1927

Syn. *Opisthorch s thaparaes* Agarwal, 1962

Specific diagnosis.—Body 6.3–12.7 long, 0.23–1.6 broad, spined. Acetabulum larger than oral sucker, 0.28–0.39 or 0.195×0.206. Oral sucker 0.204–0.308. Genital pore median, preacetabulur. Prepharynx present; pharynx 0.13–0.19 in diameter. Oesophagus prominent, one and half to three times longer than pharynx; caeca extend to hinder end, left caecum slightly shorter than rght caecum. Gonad in last fifth of body. Testes oblique tandem, close to each other; posterior 0.4–0.56×0.19–0.35, divided into 3–5 lobes; anterior roughly triangular, 3–5 lobed usually displaced to left, separated from posterior testis by excretory vesicle stem, overlapping caeca. Ovary rounded or pear-shaped to right side, at one fifth body length from hinder end. Receptaculum seminis prominent, oval, obliquely between ovary and anterior testis. Uterus from ovary to acetabulum, touching caeca, sometimes overlapping them consisting of 18–24 convolutions. Eggs oval, 0.03×0.016. Vitellaria from a little behind acetabulum to ovarian region, consisting of eight follicle groups. Stem of excretory vesicle S-shaped, running between two testes, bifurcating behind receptaculum seminis in longer left and shorter right cornua.

Host.—Fish, *Rita rita* (*Rita buchanani* Day), *Bagarius yarallii* Sykes (*Bagarius bagarius* Ham. Buch.).

Location.—Gall bladder.

Locality.—Allahabad, U.P.

184. **Opisthorchis (O.) psdicellata** var. **minuta** Mehra, 1941

Specific diagnosis.—Length 2.4–5, maximum breadth 0.56–0.84 in ovarian region, spined. Oral sucker 0.106–0.181 in diameter. Acetabulum 0.119–0.181 in diameter, 0.97–1.95 behind anterior end *i.e.*, often at about end of anterior one third body length. Two suckers equal in size in contrast to the type species. Prepharynx very small; pharynx 0.073–0.119×0.056–0.083; oesophagus twice the length of pharynx; caeca crenated up to acetabulum, terminate at same level near hinder end. Testes with irregular margin, but not lobed; anterior testis smaller, 0.16–0.39×0.24–0.375, nearly triangular, occupying the same position as described

in the type; Posterior rounded, 0.2–0.4×0.21–0.39. Ovary pear-shaped, 0.15–0.3×0.105–0.24, lies transversely to right side. Receptaculum seminis large, pear-shaped, 0.15–0.3× 0.075–0.18, nearly equal in size to ovary or even larger, immediately behind the latter to right side. Uterine coils opisthorchoid, filling intercaecal space. Eggs 0.0297×0.l0132. Vitellaria band-shaped, from just behind acetabulum to posterior margin of ovary.

Host.—*Mystus seenghala* Sykes and *Wallago attu* Bleckeri called in vernacular *Tengra* and *Parona* respectively.

Location.—wall bladder.

Locality.—Allahabad, U.P.

185. **Opisthorchis (O.) gomtii** Thapar, 1930 Mehra, 1941

Syn. ***Gomtia piscicola* Thapar, 1930**
***Gomtia lucknowensis* Dayal, 1949**
***Gomtia gagatea* Dayal, 1949**

Spscific diagnosis.—Length 1.5–4.2, manimum breadth 0.4–0.03 a little behind acetabulumi body spined. Oral sucker larger, smaller or enual to acetabuıum, 0.08–0.14 in diameter. Acetabulum 0.12–0.14, at 0.40–0.65 from anterior end. Prepharynx long, 0.099–0.10 long. Pharynx 0.066–0.11 in diameter. Oesophagus short of same length as prepharynx; caeca extend to hinder margin of anterior testis. Gonads in posterior third of body. Testes large, entire, tandem at posterior end; anterior larger, contiguous to sometimes overlapping posterior testis, spherical or oval, usually 0.033–0.4 in diameter; posterior testis spherical, oval or somewhat triangular, 0.24–0.33. Vesicula seminalis long, winding, sometimes broad behind. Ovary entire, oval or subspherical, slightly dextral, 0.14–0.22 0.15–0.10. Receptaculum seminis pear-shaped, between ovary and anterior testis, 0.12–0.1 0.0 –0.2. Uterine coils transversely arranged, intercaecal, sometimes overlapping caeca. Eggs 0.025–0.02 × 0.013–0.015. Vitellaria lateral from just behind or posterior end of seminal vesicle to posterior end of ovary or front end of anterior testis. Excretory vesicle Y-shaped with straight stem lying dorsal to testes, extending to ovary; pore posteroterminal.

Host.—Siluroid fishes, *Bagarius varralli* Sykes, *Gagata cenia.*

Location.—Intestine.

Locality.—River Gomti near Lucknow; rivers Ganga and Jamuna at Allahabad, U.P.

186. **Opisthorchis (O.) mehrai** Agarwal, 1962

Specific diagnosis.—Body 6.8 long, 1.68 in maximum breadth, spined all over. Oral sucker 0.247×0.221 Acetabuum 0.247 in diameter, at anterior third of body. Prepharynx small; pharynx 0.117×0.13; oesophagus very short, 0.026 long; caeca reaching posterior end. Testes tandem, faintly lobed; anterior testis 0.468×0.428; posterior testis 0.621×0.426, much longer than anterior testis. Ovary ovoid, nonlobate, 0.351×0.338. Receptaculum seminis conspicuous. Uterine coils similar to those of *O. pedicellata.* Eggs 0.0216× 0.0216, smaller than those of *O. pedicellata.* Vitellaria from just behind posterior border of acetabulum to level of anterior border of ovary. Excretory vesicle stem sigmoid, running between testes.

Host.—*Rita pavimentata.*

Location.—Gall bladder.

Locality.—Ranital tank in Jabalpur, M.P.

187. **Opisthorchis (O.) mehrai** (Gupta, 1955)

Syn. *Thaparotrema vitallani* Gupta, 1955

Specific diagnosis.—Body elongated, 2.38–4.06 long, maximum breadth 0.48–0.77 in ovarian region. Oral sucker oval, 0.22×0.18. Acetabulum smaller, 0.15×0.17, at anterior one third body length. Prepharynx short; pharynx 0.11×0.12. Oesophagus 0.24 long; caeca with slightly crenate margins reach hinder end. Testes oblique in posterior fourth of body, close to each other or some distance apart, with irregular margins; anterior testis dextral, just behind or in level with ovary, 0.19×0.31; posterior testis 0.27×0.22. Vesicula seminalis extending from anterior end of acetabulum to about 0.12 behind the latter, broader in posterior region, narrow tubular anteriorly. Ovary sinistral, a little in front of anterior testis, oval or spherical, 0.14×0.15. Receptaculum seminis flask-shaped, to right posterior side of ovary, 0.07×0.24. Vitellaria of small follicle, lateral to caeca partly covering them, from a little in front of acetabulum or behind intestinal bifurcation to hinder end of anterior testis, extending a little towards median line in the acetabular region and region of vesicula seminalis. Uterine coils transverse, intercaecal between ovary and acetabulum. Eggs oval, 0.08–0.1×0.05–

0.06. Excretory vesicle Y-shaped with long sigmoid stem and swollen short cornua at its anterior end.

Host.—*Rita rita* (Ham.).

Location.—Gall bladder.

Locality.—River Brahamputa, Gauhati, Assam.

6. Subgenus. **Nigerina** (Baugh, 1958)

187 Opisthorchis. Body elongated consisting of narrow cylindrical anterior and long broad flattened posterior parts with margins of postacetabular latter region ruffled much forming conical lateral projections; cuticle unspined. Suckers large, strikingly muscular. Acetabulum at end of anterior part of body. Pharynx well developed; oesophagus short; caeca terminating at posterior end. Genital pore median, immediately preacetabular. Testes oblique, globular, near posterior end. Vesicula seminalis convoluted near posterior border of acetabulum. Ovary pretesticular. Receptaculum seminis small. Laurer's canal present. Vitellaria weakly developed, of very small follicles, lateral in posterior half of body to level of posterior testis. Uterine coils preovarian. Excretory vesicle sigmoid, passing between testes to ovary. Parasitic in gall bladder of birds.

188. **Opisthorchis (Nigerina) hardoiensis** (Baugh, 1958)

(Fig. 118)

Syn. *Nigerina hardoiensis* **Baugh, 1958**

Specific diagnosis.—Body long, cricket bat-shaped consisting of short narrow cylindrical anterior part and long broad flattened posterior part, unspined, 5.65–12.6 long, 0.85–1.03 in maximum breadth in posterior region. Margins of postacetabular region ruffled forming conical lateral projections. Acetabulum at end of anterior part at 1.19–1.8 from anterior end, 0.328–0.459×0.41–0.459. Oral sucker terminal, 0.196–0.246×0.41–0.574. Pharynx 0.164–0.246×0.18–0.278. Oesophagus short, bulbous, 0.082–0.148 long; caeca extend to posterior extremity. Gonads in posterior end of body. Testes globular, oblique; anterior testis 0.164–0.295×0.16–0.246; posterior 0.164–0.278×0.164–0.246. Vesicula seminalis convoluted, just posterior to acetabulum. Genital pore preacetabular. Ovary round or oval, 0.082–0.18×0.115–0.180. Receptaculum seminis and Laurer's canal present. Shell gland mass compact, close to ovary. Vitelline follicles

extremely small, sparsely distributed in lateral region of posterior half of body up to level of posterior testis; two transverse vitelline ducts on each side, one from preovarian and one from postovarian follicles on each side meet to form small vitelline reservoir immediatey behind ovary. Eggs intercaecal in front of ovary, extremely small, 0.0247–0.060 × 0.0130–0.0150. Excretory pore terminal; excretory vesicle sigmoid, passing between testes to ovary.

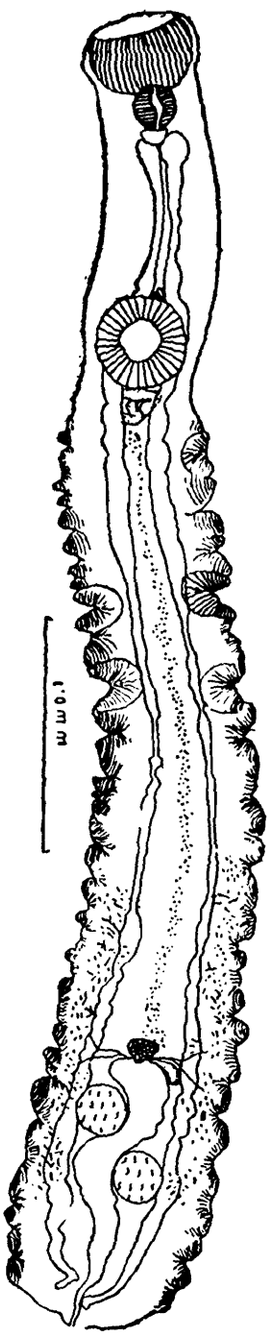


Fig. 118. *Opisthorchis* (*Nigerina*) *hardoiensis* Baugh, 1958.

Host.—Little cormorant, *Phalacrocorax niger* (Vieillot).

Location.—Gall bladder and liver.

Locality.—Vicinity of Hardoi, U.P.

Genus 85. **Cyclorchis** Luhe, 1909

Opisthorchiinaa : Body elongated, almost fusiform, unspinulate or spinulate. Acetabulum relatively small in anterior half of body. Oral sucker almost as large as acetabulum. Oesophagus short or moderately long; caeca terminating near posterior end. Genital pore median, immediately preacetabular. Testes diagnonal or symmetrical, entire, near posterior end. Ovary submedian or median, a little in front of anterior testis. Receptaculum seminis well developed. Uterus strongly winding from side to side between testes and acetabulum, extending laterally beyond caeca. Vitellaria short, postequatorial, reaching anterior margin of anterior testis. Excretory vesicle sigmoid, running between testes, bifurcating in front of anterior testis. Parastic in biliary ducts or intestine of reptiles and mammals.

Type species : *C. amphileucus* (Looss, 1896) Lühe, 1909

189. **Cyclorchis campula** (Cobbold, 1876)

(Fig. 119)

Syn. *Campula oblonga* Cobbold, 1876
Distoma campula Cobbold, 1876

Specific diagnosis.—Body almost fusiform, spined. Measurements, of body not given. Suckers almost equal. Acetabulum at about one sixth to one eleventh from anterior end. Pharynx well developed. Oesophagus short. Caeca zigzag or spirally twisted behind acetabulum, straight behind ovary terminating near posterior end. Genital pore median, immediately preacetabular. Testes oval, diagomal close behind one another near posterior extremity. Ovary submedian, dextral a little in front of anterior testis. Receptaculum seminis present. Uterus very long, strongly winding from side to side, forming secondary coils between acetabulum anterior testis, extending laterally beyond caeca. Vitellaria short, postequatorial, reaching anterior margin of anterior

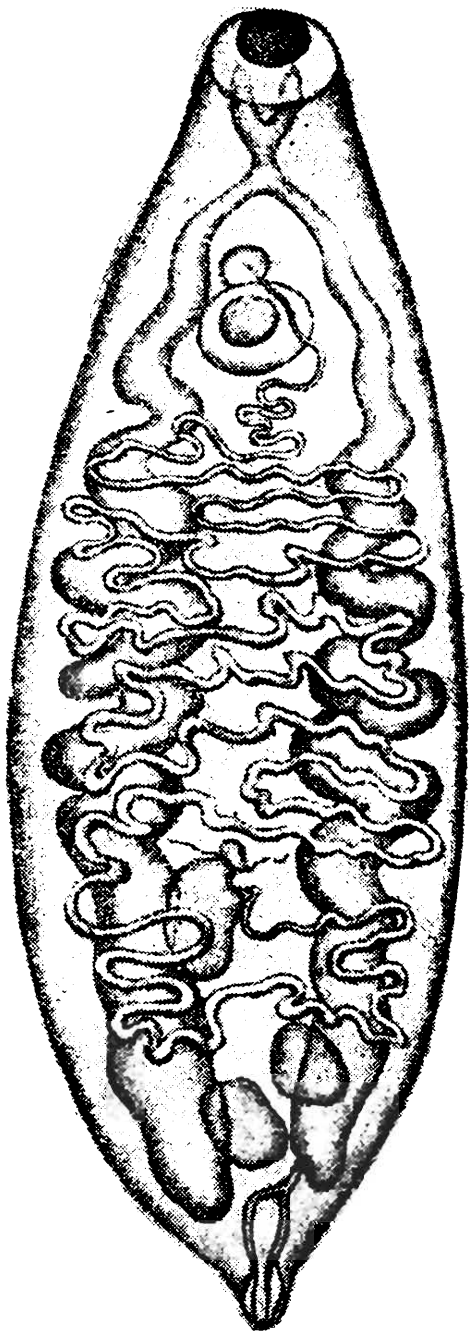


Fig. 119. *Cyclorchis camoula* (Cobbold, 1876) Luhe, 1909.

testis. Eggs 1/1000 of inch long ×1/2100 inch broad. Excretory pore terminal.

Host.—*Platanista gangetica* and *Orcella brevirostris*.

Location.—Bile ducts.

Locality.—The Ganga, India,

XLVIII. Subfamily *METORCHIINAE* Luhe, 1909

Opisthorchiidae : Body elliptical, broadened posteriorly, spined or unspined. Acetabulum small, wide apart from oral sucker. Pharynx usually small; oesophagus short; caeca reaching hinder end terminating in front of testes. Testes tandem, diagonal or somewhat symmetrical near posterior extremity. Seminal vesicle winding beside or behind acetabulum. Ovary median or submedian, pretesticular. Vitellaria lateral, largely or entirely in anterior half of mid-region of body. Uterine coils intercaecal or overreaching caeca laterally, surrounding acetabulum. Excretory vesicle bifurcating between or dorsal to testes. Parasitic in gall bladder or billary ducts of birds and mammals.

Type genus : *Metorchis* Looss, 1899

Genus 86. **Metrochis** Looss, 1899

Metorchiinae : Body small to median sized, forebody tapering, hindbody plump, spined or unspined. Ora lsucker well developed. Acetabulum equal or subequal to oral sucker, nearer equator than anterior end. Pharynx usually small; oesophagus very short; caeca terminating at posterior extremity. Genital pore immediately preacetabular. Ovary median or slightly submedian, pretesticular. Receptaculum seminis and Laurer's canal present. Uterus winding forward from ovary beyond zacetabulum, overlapping caeca laterally. Vitellaria lateral from ovarian zone to beyond acetabulum. Excretory vesicle bifurcating between testes or dorsal to anterior testis; pore ventral to posterior testis. Parasitic in gall gladder of mammals and birds.

Type species : *M albidus* (Braun, 1893) Looss, 1899

190. **Metorchis xanthosomus** (Crept., 1886) Braun, 1902

(Fig. 120)

Syn. *Metrochisinettioni* Baugh, 1958

Specific diagnosis.—Body pear-shaped, broad rounded posteriorly, with bluntly pointed anterior end, spinose, 2.37

long, 1.06 in maximum breadth. Oral sucker 0.132×0.198. Acetabulum 0.195 in diameter, slightly larger than oral sucker, at 0.67 from anterior end. Pharynx 0.065×0.075; oesophagus short, 0.065 long; caeca terminating at posterior extremity, masked greatly in middle region of body by dense uterine coils. Testes oblique, lobate at posterior end; anterior dextral, 0.606×0.393; posterior sinistral, 0.557×0.508. Vesicula seminalis sinuous on left side of acetabulum. Genital pore median, immediately preacetabular. Ovary transversely

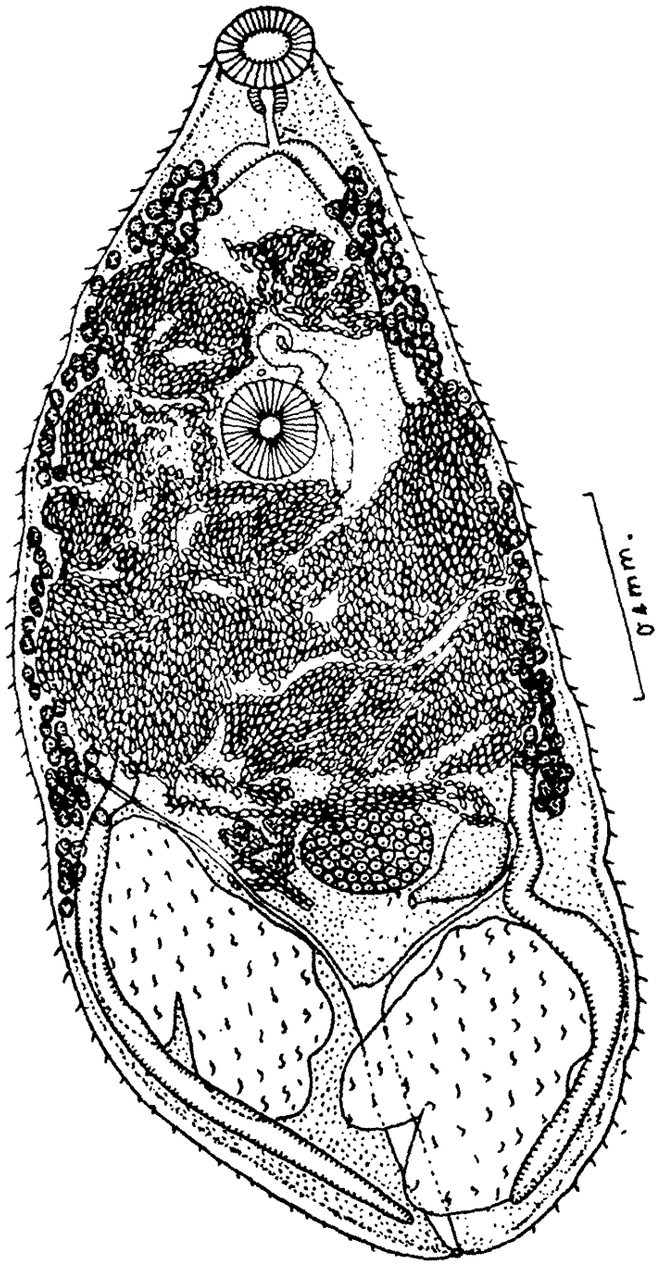


Fig. 120. *Metrochis zanthosomus* (Creplin, 1846) Braun, 1902.

oval, median, 0.247×0.165. Receptaculum seminis large, pear-shaped, to left of ovary, just in front of posterior testis, 0.165×0.123. Vitellaria of small follicles, extending from intestinal bifurcation to level of ovary. Uterine coils extensive, densely packed, occupying almost entire space between intestinal bifurcation and ovary, extending laterally into extraceacal fields. Eggs operculated, 0.026–0.028×0.013–0.015. In this species the acetabulum is slightly smaller than oral sucker, but in the Indian form it is slightly larger as reported.

Host.—Common teal, *Nettion crecca* Linnaeus.

Location.—Gall bladder.

Locality.—Lucknow, U.P.

XLIX. Subfamily *PACHYTREMATINAE* Ejsmont, 1931

Syn. *Pachytreminae* Railliet, 1919
Multivitellar nae Phadke and Gulati, 1929

Opisthorcoiioas : Bodk thick flattened oval to elliptical, concave dorsally, convex ventrally, unspined. Suckers small, close to one another. Pharynx small; oesophagus very short; caeca wide, reaching near posterior entremity. Testes almost symmetrical, in posterior quarter of body near posterior extremity. Ejaculatory duct muscular, lined with cuticle; rudimentary cirrus sac sometimes present. Ovary median, posttesticular or intertesticular. Receptaculum seminis absent. Laurer's canal present. Uterus transversely coiled, preovarian, intercaecal sometimes overlapping caeca. Vitellaria entracaecal, forming grape-lide bunches along entire length of caeca from acetabular zone. Excretory vesicle Y-shaped, stem bifurcating behind ovary. Parastic in gall bladder of birds.

Type genus : *Pachytrema* Looss, 1907

Genus 87. **Pachytrema** Looss, 1907

Syn. *Minutorchis* Linton, 1928
Multivitellar a Phadke and Gulati, 1929

Pachytrematinae ; Body flattened, thick fleshy, oval or elliptical, concave dorsally, convex ventrally. Suckers small near each other. Oesophagus very short. Caeca wide, terminating on each side of excretory stem near posterior

end. Testes lateral, almost symmetrical, rounded or ovoid, medioventral or ventral to caeca near posterior end. Seminal vesicle well developed, free in parenchyma. Ejaculatory duct muscular, lined with thick cuticle. Cirrus sac absent or rudimentary. Genital pore immediately preacetabular, slightly to left, sucker-like in *P. hewletti* (Phadke and Gulati). Ovary small, median, intertesticular or posttesticular. Laurer's canal present. Receptaculum seminis absent or small. Uterus transversely coiled sometimes forming double loops first to right and then to left, occupying most of intercaecal region anterior to ovary, overreaching caeca or not, sometimes overlapping them laterally. Vitellaria extracaecal forming grape-like bunches along caeca from acetabular zone to caecal ends. Excretory vesicle Y-shaped, stem bifurcating behind ovary. Excretory pore terminal. Parasitic in gall bladder of birds.

Type species : *P. calculus* Looss, 1907

191. **Pachytrema hewletti** (Phadke and Gulati, 1930)

(Fig. 121)

Syn. *Multivitellaria hewletti* Phadke and Gulati, 1930

Specific diagnosis.—Body elliptical, plump, thick, unspined, liver-like in colour when alive, dorsal surface flattened, wrinkled, posterior end notched in middle, 11–16.6 long (flattened), 6–7.8 long when unflattened; breadth 6.7–10 in flattened, 4.0–6.4 in unflattened specimens. Oral sucker smaller, less prominent than acetobulum. Pharynx muscular; oesophagus 0.5 long; caeca straight or slightly curved, zigzag, 10–13 long, 0.5 broad. Gonads in posterior half. Testes lateral, ovoid, ventral and medial to caeca. Ovary median, posttesticular above excretory stem bifurcation, adjacent to shell gland, receptaculum seminis and Laurer's canal. Vitellaria extracaeca, consisting of tubuar follices in 24 grape-like bunches from acetabular zone to caecal ends. Uterus large, coiled in definite manner, making a loop first to one side and then to the other, some loops forming subloops, occupying intercaecal region between ovary and acetabulum. Eggs 78–88$\mu \times$ 34–53μ. Genital pore behind gut fork, immediately preacetabular, sucker-like.

Host.—House crow, *Corvus splendens.*

Location.—Gall bladder.

Locaiity.—Bombay.

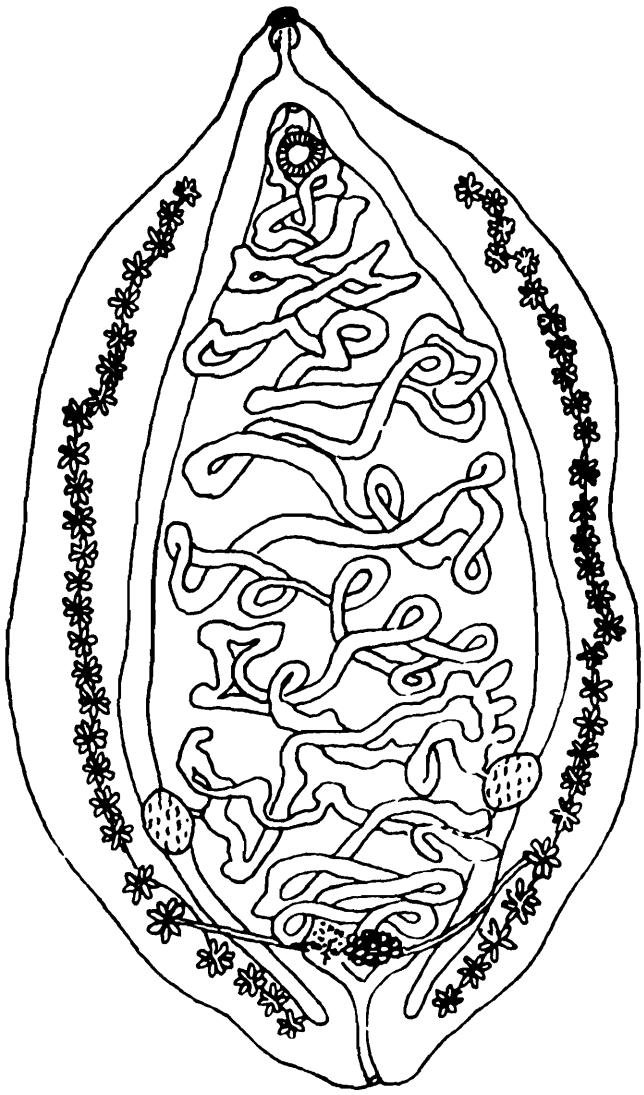


Fig. 121. *Pachytrema hewletti* (Phadke and Gulati, 1930).

XXIX. Family ACANTHOSTOMIDAE Poche, 1925

Opisthorchloidea : Body elongate, usually slender. Eye spots usually present. Circumoral coronet of spines present or absent. Oral sucker well developed. Acetabulum usually small. Prepharynx present, usually long, sometimes short or absent. Pharynx present; caeca long, exceptionally short. Genital pore immediately preacetabular. Testes two, intercaecal or extracaecal, exceptionally postcaecal in hindbody or at posterior extremity. Cirrus sac absent. Vesicula seminalis tubular. Gonotyle sometimes present. Ovary pretesticular. Receptaculum seminis present. Vitellaria follicular, lateral. Uterus not extending into posttesticular region. Eggs small. Excretory vesicle Y-shaped with long cornua

extending to anterior region. Parasitic in intestine of reptiles and fishes.

Type genus : *Acanthostomum* Looss, 1899

L. Subfamily *ACANTHOSTOMINAE* Nicoll, 1914

Acanthostomidae : Body subcylindrical, long. Circumoral crown of spines present. Prepharynx very long; oesophagus short or very short; caeca ending blindly or opening outside near posterior extremity. Testes tandem or diagonal at posterior extremity. Ovary median or submedian, pretesticular. Vitellaria lateral anterior to ovary and testes. Uterine coils intercaecal between ovary and acetabulum. Excretory vesicle Y-shaped, bifurcating behind acetabulum.

Genus 88. **Acanthostomum Looss,** 1899

Syn. *Acanthochasmus* Looss, 1900
Atrophecaecum Bhalerao, 1940
Proctocaecum Baugh, 1956

Acanthostominae : Body medium sized, long, slender, subcylindrical, spinulate. Oral sucker terminal, finger bowl-shaped or funnel-shaped, with a crown of speines. Acetabulum small, preequatorial. Prepharynx long; pharynx half way between two suckers; oesophagus short or very short, bifurcating in front of acetabulum. Caeca usually opening outside near posterior extremity. Testes tandem or somewhat diagonal, intercaecal at posterior extremity. Vesicula seminalis tubular, winding behind acetabulum. Ovary submedian or median, pretesticular. Receptaculum seminis between ovary and anterior testis. Vitellaria from behind seminal vesicle to preovarian level or ovariotesticular zone. Eggs small, very numerous. Excretory vesicle Y-shaped bifurcating behind acetabulum, cornua reaching near oral sucker. Parasitic in intestine of reptiles and fishes.

Type species : *A. spiniceps* (Looss, 1896) Looss, 1899

192. **Acanthostomum indicum** Sinha, 1942

Specific diagnosis.—Body spined, 6.2–7.33×0.36–0.45 in maximum breadth in acetabular region. Oral sucker 0.35× 0.32 with a single row of large spines of 0.051–0.0533×0.0132–0.0144 size. Acetabulum 0.2 in diameter, at the 1/4th anterior

body length; ratio of suckers 5 : 3. Prepharynx 0.86 long; pharynx 0.18 in diameter; oesophagus very short; caeca terminate blindly near posterior end. Testes tandem at posterior end, oval; anterior slightly smaller, 0.28×0.25; posterior 0.85×0.25.' Vesicula seminalis extending to 0.95 behind acetabulum, consisting of basal sac-like and anterior narrow coiled parts; saccular basal part 0.3×0.13; ductus ejaculatorius commences at middle of acetabulum. Ovary ovoid, 0.22×0.17, dextral, anterior to testes. Receptaculum seminis large, oval, 0.127×0.062. Vitellaria of small follicles, extending from 3.7 behind anterior end to anterior end of ovary, restricted to caeca. Uterus transversely coiled between ovary and basal part of vesicula seminalis. Eggs 0.032–0.034×0.0145–0.016.

*Host*l—Crocodile.

Location.—Intestine.

Locality.—River Tehri at Gonda, U.P.

193. **Acanthostomum burminis** (Bhalerao, 1926)

(Figs. 122, 123)

Syn. ***Atrophecaecum burminis*** **Bhalerao, 1940**
Atrophecaecum indicum **Simha, 1958**
Atrophecaecum h industanensis **Baugh, 1956**

Specific diagnosis.—Body spined, 2.0–4.0 long, 0.18–0.37 in maximum breadth at acetabular level. Oral sucker 0.032–0.138×0.07–0.181 or 0.16×0.13, with a single row of 24–28 spines arranged in circle around mouth, 0.028–0.04× 0.012–0.024. Acetabulum 0.069–0.082, at one fifth to one sixth anterior body length. Ratio of suckers 2 : 1. Prepharynx 0.08–0.18 long; pharynx 0.06–0.08 in diameter; oesophagus short, 0.032–0.094 long; caeca open by ani, at 0.12–0.18 from posterior end; anal opening funnel-shaped; caecum of right side much atrophied, only one fifth thickness of left caecum. Testes tandem, oval, pear-shaped or roughly spherical, 0.08–0.23×0.07–0.192 or anterior 0.092–0.17, posterior 0.094–0.18 in diameter. Vesicula seminalis 0.23 behind acetabulum; its large basal sac 0.124–0.13×0.055–0.13. Ovary oval or round, median, 0.083–0.12×0.069–0.14 or 0.115–0.132×0.082–0.115. Receptaculum seminis 0.069–0.09 ×0.06–0.117 or 0.115–0.231. Eggs 0.027–0.042×0.011–0 0182,

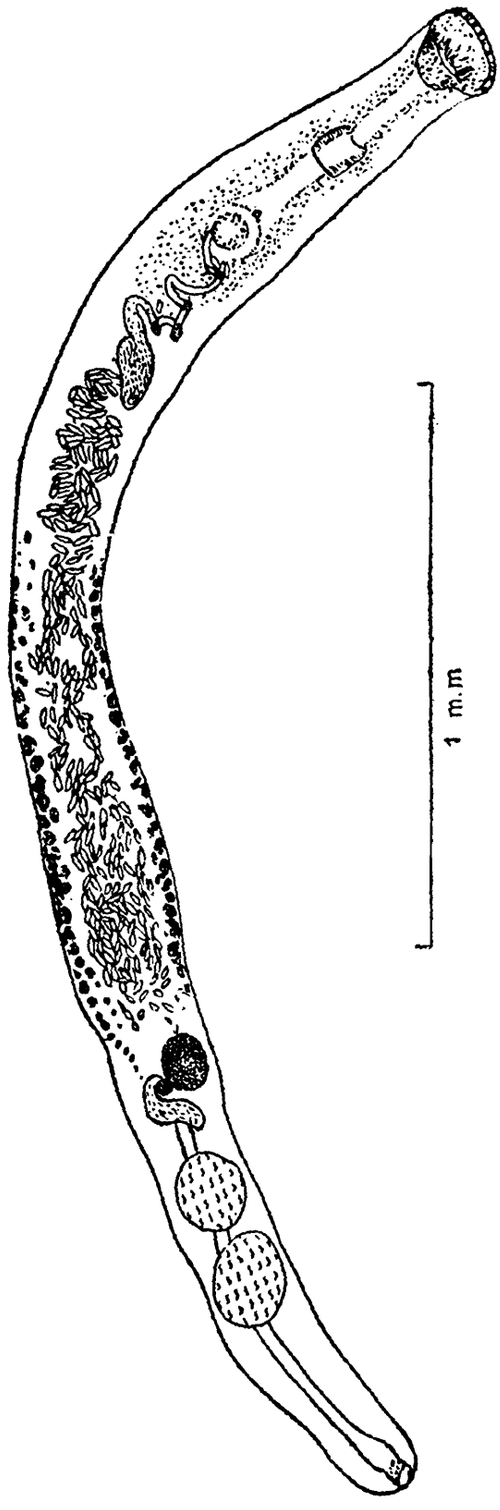


Fig. 122. *Acanthostomum burminis* (Bhalerao, 1926) from specimen collected at Allahabad.

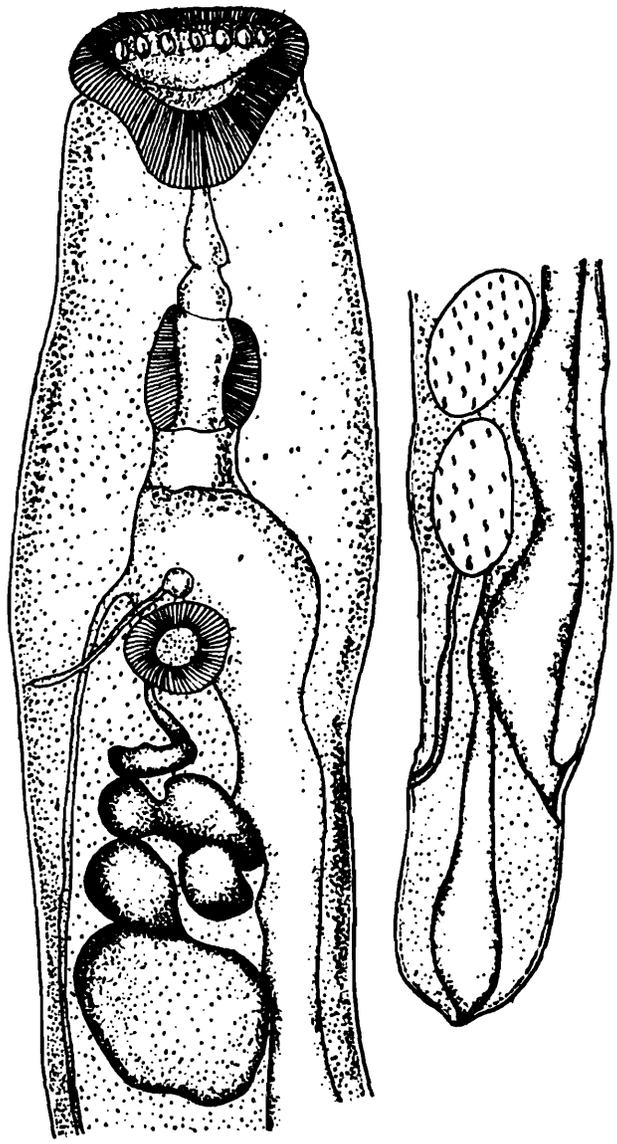


Fig. 123. *Acanthostomum burminis* (Bhalerao, 1936) syn. *Atrophecaecum burminis* Bhalerao, 1940.

Host.—Natrix piscator; (Tropidonotus piscator)

Locaqion.—Intestine.

Locality.—Rangoon, Burma; India Nagpur, Maharastra Lucknow, Allahabad, Banaras, U.P.; Hyderabad Deccan, South India.

Key to Indian species of **Acanthostomum**

Caeca ending blindly and normal; oral spines 22; parasitic in crocodile.	*A. indicum* Sinha, 1942
Caeca with ani; right caecum atropied; oral spines 24–27; parasitic in *Natrix piscator*	*A. burminis* (Bhaleroa, 1926)

XXX. Family HETEROPHYIDAE Odher, 1914

Syn. *Haplorchidae* Travassos, 1924
St ctodor dae Toche, 1925

Opisthorchioidea : Body small to very small, oval or pyriform, spined. Caeca long or short, occasionally opening outside or into excretory vesicle. Acetabulum well developed or atrophied, rarely absent, median or submedian, sometimes contained in genital atrium. Testes diagomal, tandem or symmetrical, occasionally single on posterior half of body. Vesicula seminalis well developed. Genital atrium variously modified containing a gonotyl (s) (genital sucker), sometimes acetabulum as well. Gonotyl present or absent. Ovary pretesticular, submedian. Receptaculum seminis and Laurer's canal present. Vitellaria usually inter- and extracaecal, diffuse or forming group or groups of follicles. Uterus coiled between genital pore and testes or posterior extremity. Eggs small, embryonated. Excretory vesicle Y-shaped, sometimes almost triangular, exceptionally saccular, limbs not extending anterior to ovarianlevel. Parasitic in intestine of birds or mammals.

Type genus : *Heterophyes* Cobbold, 1886

Key to Indian subfamilies of **Heterophyidae**

1. Oral sucker posteriorly funnel-shaped, with circumoral crown of spines.	ASCOTOTYLINAE	Yamaguti, 1958
Oral sucker ordinary; circumoral spines absent. ..	2	
2. Testis single near posterior extremity.	HAPLORCHIINAE	Looss, 1899
Testes double, symmetrical or tandem near posterior extremity.	HETEROPHYINAE	Ciurea, 1924

LI. Subfamily *HETEROPHYINAE* Ciurea, 1924

Heterophyidae : Body small or very small, elongate to oval. Oral sucker small. Prepharynx long; oesophagus moderately long or short; caeca long terminating at posterior extremity. Acetabulum well developed, median, close to genital pore or separated from it, equatorial or preequatorial. Testes symmetrical or tandem at or near posterior extremity. Seminal vesicle bipartite or tripartite. Male and female

pores united and then opening in centre of sucker-like pad. Common genitalia pore postero-lateral to acetabulum. Ovary pretesticular, median or submedian. Receptaculum seminis and Laurer's canal present. Uterus extending to posterior extremity or not. Vitellaria limited in extent, forming paired pretesticular bunches of follicles. Excretory vesicle Y-shaped. Parastic in intestine of mammals and birds.

Genus 89. **Heterophyes** Cobbold, 1886

Heterophyinae : Small to very small, covered with scale-like spines. Prepharynx distinct; pharynx small; oesophagus moderately long; caeca terminating at posterior extremity. Acetabulum in middle third of body or slightly more ansterior. Testes juxtaposed or somewhat obliaue, at caecal ends. Genital pore sucker-like, with a crown of spines, opening postero-terminal to acetabulum. Ovary median, pretesticular. Vitellaria on each side of hindbody, anterior and anterolateral to testes. Uterus coiled between testes and acetabulum. Excretory vesicle Y-shaped, stem passing between testes and bifurcating between ovary and testes. Metacercariae in fishes. Parasitic in gut of birds and mammals.

Type species : *H. heterophyes* (Siebold, 1853) Stiles and Hassall, 1900

194. **Heterophyes indica** Rao and Ayyar, 1931

Specific diagnosis.—Body flat covered with scales directed backwards; sides taper anteriorly; posterior end slightly flattened and notched for excretory pore. Length of mature worm 1.4–2.1, breadth 0.65–0.95 in middle, greatest breadth slightly anterior to testicular region. Oral sucker 0.07–0.09 in diameter. Acetabulum large, 0.3–0.47 in diameter, at about middle. Genital sucker behind acetabulum, a little to left; plane of its surface at an angle sloping towards that of acetabulum, more or less circular, with diameter 0.16–0.26. Crown of rodlets interrupted on anterior sdide of genital sucker adjoining acetabulum; rodlets tend to get shorter as they approach the interrupted side. Each rodlet has 2–4 barbs, which lessen in number as the former gets shorter. The barb at fixed end (away from the centre) is double like the letter 'V', the angle of it joined to the rodlet. This character is not described in genus *Heterophyes*. Other barbs simpler

and perpendicular to surface plane of genital sucker. Pharynx oval, 1.0 behind oral sucder, 0.12 in widthi oesophagus having average length of 0.19. Distance from oral sucder to intestinal bifurcation 0.41. Caeca reach almost posterior end curving round testes, left caecum having its end perceptibly dilated. Testes elliptical, ie side by side at posterior end of body, left one a little in front of the other: their long diameters form an acute angle posteriorly. Vas defences between testes or nearer the left one continues forward and swells into globular seminal vesicle, which lies median in level with genital sucker and to its right side. Ovary median in posterior third of body anterior to testes; shell gland globular behind ovary. Vitelline follicles on lateral margines 14–15 on each side from level anterior to ovary to anterior borders of testes or a little behind, meeting mesially on dorsal side. Uterine coils occupy most of space between acetabulum and testes. Eggs operculated, may show a tiny knob at the end opposite to the operculated one, 25μ in length with thick shell.

This species is allied to *H. persicus* (Braun, 1901) Looss, 1902, which it resembles in vitellaria extending forwards nearly to posterior border of ovary, in 62–70 rodlets in genital sucker and position of genital organs in general.

Host.—Stray dog.

Locatien.—Small intestine.

Locality.—Madras.

LII. Subfamily *ASCOCOTYLINAE* Yamaguti, 1958

Heterophyidae. : Body small, pyriform, attenuated anteriorly, broadened posteriorly. Oral sucker drawn out posteriorly in form of a funnel with single or double row of spines. Prepharynx very long; pharynx well developed; oesophagus short, occasionally moderately long; caeca varying in length. Acetabulum just postequatorial associated with genital sinus. Testes symmetrical at or near posterior extremity. Seminal vesicle sigmoid, undivided or bipartite. Acetabulogenital apparatus simple or complex, Genital pore immediately preacetabular. Ovary pretesticular, postacetabular, submedian. Receptaculum seminis large. Laurer's canal present. Uterus coiled between testes and ventrogenital sinus or extending further forward up to intestinal arch. Vitellaria lateral in ovario-testicular zone or further

forward beyond acetabulum, sometimes to pharynx. Excretory vesicle Y- or T-shaped. Paratitic in birds and mammals.

Type genus : *Ascocotyle* Looss, 1899

Genus 90. **Ascocotyle** Looss, 1899

Ascocotylinae.—Body small, spinose, pyriform. Oral sucker with a crown of single or double row of straight cylindrical spines. Oral sucker continued posteriorly into a distinct appendage. Acetabulum median, just postequatorial, associated with genital atrium in a depression of ventral body surface. Genital atrium may contain gonotyl. Genital pore immediately preacetabular. Prepharynx long; pharynx well developed; oesophagus present or absent; caeca long or short. Testes one on each side at hinder and of body. Vesicula seminal is large, undivided or bipartite; ejaculatory duct present. Cirrus sac absent. Ovary median or slightly to one side, pretesticular, postacetabular. Receptaculum seminis large, medial to ovary or behind it. Vitellaria lateral, postacetabular, sometimes extending as far forward as pharynx and meeting mesially near intestinal bifurcation. Uterus usually postacetabular, rarely extending forwards as far as pharynx. Excretory vesicle Y or T-shaped. Parasitic in birds and mammals.

Type species : *A. coleostoma* (Looss 1896) Looss, 1899

Key to subgenera of **Ascocotyle**

Vitellaria extending in front of acetabulum; uterus winding in front of ventro-genital sinus; oesophagus almost absent	*Ascocotyle* (*Ascocotyle*)
Vitellaria postacetabular except in *A. intermedius* Srivastava; oesophagus well developed; uterus confined behind ventro-genital sinus..... ...	*Ascocotyle* (*Phagicola*)

195. **Ascocotyle** (**Phagicola**) **intermedius** Srivastava, 1935

(Fig. 124)

Specific diagnosis.—Body pyriform or flask-shaped, spined, 0.6–0.9 long, 0.2–0.38 in maximum breadth across anterior

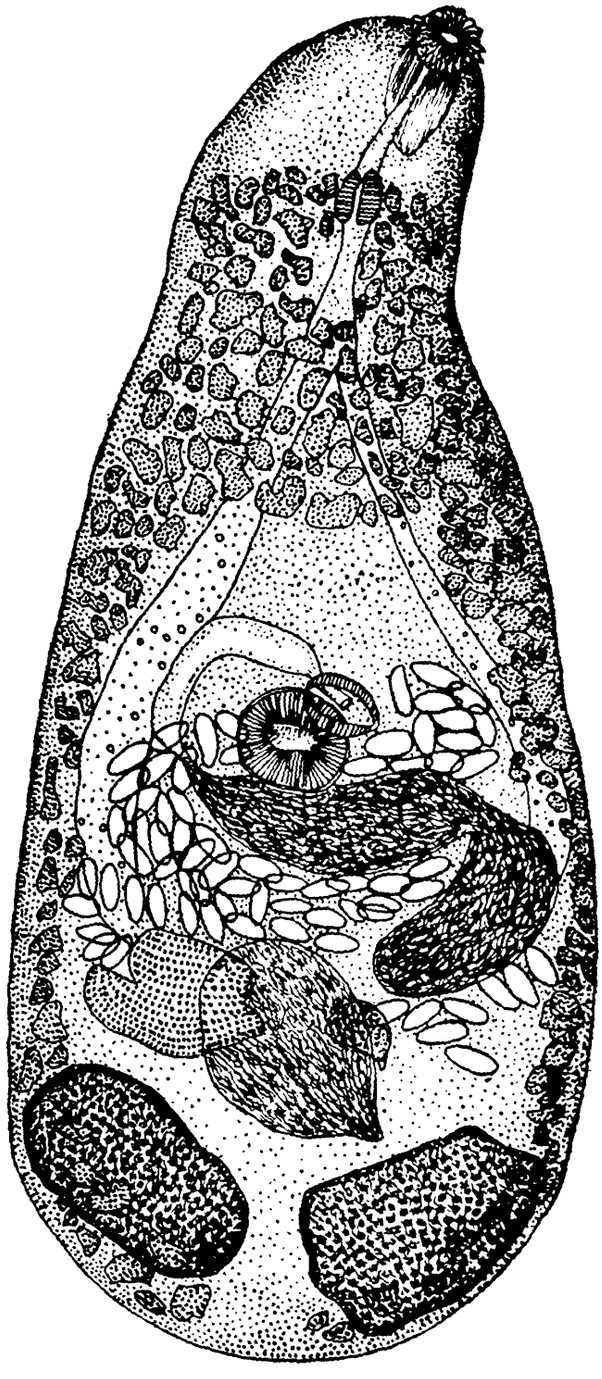


Fig. 124. *Ascocotyl* (*Phagicola*) *intermedius* Srivastava, 1935

margin of ovary. Oral sucker terminal, 0.04–0.06 in diameter, surrounded by two rows of alternatng spines, 28–30 in number; spines of anterior row 0.01–0.013×0.009; hinder row spines 0.009–0.01×0.003. Acetabulum feebly muscular, 0.066–0.077 in diameter, equatorial. Ratio of suckers 2 : 3.

Acetabulum and genital pore lie in a shallow depression- the ventro-genital sinus on ventral surface. Ductus hermaphroditicus opens in this depression just in front of acetabulum. Genital opening guarded on anterior and posteriors sides by two transversely elongated pads, lenticular in shape,—the gonotyls, 0.04–0.05×0.013 in size. Oral sucker has posterior cone or hollow appendage of 0.04–0.05×0.03 size, lying dorsally to prepharynx. Prepharynx long, 0.06–0.09 long; pharynx 0.03–0.04×0.02–0.03; oesophagus 0.03–0.05 long; caeca wide moderately long, terminating in level with anterior margin of ovary. Testes symmetrical with long axis directed obliquely, one on each side, with irregular margins, 0.12–0.17× 0.07–0.12. Vesicula seminalis enormous, sigmoid almost bipartite; ejaculatory duct long, 0.1–0.12×0.03. Ovary slightly dextral in middle of postacetabular region, irregular in outline, 0.08–0.1×0.11–0.14. Receptaculum seminis median, in level with and partially overlapping ovary and yolk reservoir, 0.0 18–0.13×0.1–0.13. Laurer's canal short but fairly wide. Vitellaria of small irregular follicle, extensive from anterior level of pharynx to posterior ends of testis, meeting mesially in anterior region from pharynx to a little behind intestinal bifurcation. Uterus of wide S-shaped ascending coil between testes and ventro-genital sinus. Eggs 0.03–0.035×0.015–0.017.

This species is assigned to subgenus (*Phagicola*) Travassos on account of moderately long oesophagus, length of caeca extending beyond acetabulum and the extent of uterus. The species resembles subgenus (*Ascocotyle*) Travassos in the arrangement of oral spines and in the uterus confined to region behind ventro-genital sinus. It differs from all the species of subgenus *Phagicola* in the enormous development and extent of vitellaria and in having double crown and number of oral spines.

Host.—Fishing-eagle, *Haliaeatus leucoryphus.*

Location.—Intestine.

Locality.—Allahabad, U.P.

LIII. Subfamily *HAPLORCHIINAE* Looss, 1899

Heterophyidae : Body very small, oval or elliptical. Oral sucker and pharynx present. Oesophagus long or short; caeca long, occasionally very short. Ventrogenital sac present, median or submedian, postbifurcal; contains acetabulum, common genital pore or separate male and female

pores, opening dorsally or on left, and either or both gonotyl or dorsal pocket. Acetabulum armed (most genera) or unarmed; modified or not; imbedded in posterior-dorsal wall of ventrogenital sac on right side, with axis inclined slightly to longitudinal axis of body. Gonotyl present or absent; if present, usually unarmed, surrounding or adjacent to genital pore. Genital pore (s) (opening of genital sinus) or separate male and female pores, on dorsal or lateral wall of ventrogenital sac, typically lateral to acetabulum on the left side. Seminal vesicle usually bipartite, occasionally tripartite, rarely undivided; distinct part may be modified into an expulsor. Pars prostatica variable; a prostatic bulb, a long region of ejaculatory duct, or a poorly differentiated region. Testes one or two. Ovary pretesticular or opposite anterior testis. Seminal receptacle and Laurer's canal present. Uterus coils through most of body behind ventrogenital sac; with one or three primary loops; reaches posterior end. Vitellaria follicular, postacetabular, inter- and/or extracaecal. Excretory vesicle saccate or broadly V-shaped, tubular or Y-shaped with short arms, extends to between posterior border of ovary and behind posterior border of testis (or testes). Cercariae pleurolophocercous with or without lateral finfolds; oculate; gpigmented; acetabulum present, but rudomentary; seven pairs of penetration glands, with ducts in 3-4-4-3 arrangement. Excretory vesicle saccate.

Type genus : *Haplorchis* Looss, 1899. Other Indian genus : *Haplorchoides* Chen, 1949

Key to Indian genera of **Haplorchiinae**

Prepharynx very long; oesophagus short: parasitic in fishes. . .	*Haplorchoides* Chen, 1949
Prepharynx short; oesophagus longer than prepharynx; parasitic in birds and mammals	*Haplorchis* Looss, 1899

Pearson (1964) did not accept the validity of the genus *Tubanguia* Srivastava, 1933, which Yamaguti considered valid, because it was found in a fish. Yamaguti (1958) transferred this genus to family Crytogonimidae and erected subfamily Tubanguiinae to accommodate it. Pearson (1964) writes "As it will be pointed out below for *Haplorchoides*, occurrence in a fish does not preclude the possibility of a species being a heterophyid *sensu strictu* and further Tubangui's statement that the acetabulum absent and that the genital

pore is '.....surrounded by a small genital sucker.....guarded by the chitinous spines' suggests heterophyid rather than Cryptogonimid affinities, but until the species is redescribed, it is not possible to place it or decide the validity of the genus *Tubanguia'*. In view of Pearson's opinion, and the inclusion of *Haplorchoides* in the subfamily Haplorchiinae Looss by him the subfamily Tubanguiinae is dropped.

Genus 91. **Haplorchis** Looss, 1899

Syn. *Monorchotrema* Nishigori, 1934

Haplorchiinae : *Haplorchis* group of Pearson. Oesophagus longer than prepharynx. Caeca extend to between middle of ovary and beyond posterior border of testis. Ventro-genital sac median, postbifurcal, comprising larger ventral chamber and smaller dorsal out-pocketing, armed or not. Ventral sucker modified; cavity reduced with groove mid-dorsally or notch on left side opposite genital pore, divisible (except in *Vanissimus*) into nucleated base, with parenchymatous medulla, embedded in body, and armed, usually solid muscular apex projecting into ventro-genital sac. Gonotyl absent. Testis single with one or two vasa efferentia. Seminal vesicle thin walled, bi- or tri-partite; ejaculatory duct without prostatic bulb; prostatic glands free. Ovary sub-median, to left, closer to ventral surface than is testis. Seminal receptacle postero-dorsal to ovary to right side, overlapping ovary and testis. Laurer's canal opens dorsally to left of midline. Uterus with three descending loops. Vitelline follicles in a single group, primarily dorsal to gonads, with some follicles among coils of uterus post-testicularly, and ventrally. Ejaculatory duct and uterus unite to form short genital sinus. Excretory vesicle sac-like or broadly V-shaped, extends to posterior border of testis; excretory system mesostomate; flame cell formula $2(n+n+n)+(n+n+n)$ or $2[(n+n)+(n+n)]$.

Type species : *Haplorchis pumilio* (Looss, 1896) Looss, 1899. According to Pearson (1964). Species inquirendum *Haplorchis pearsoni* Fernando, 1933.

Nemen nuda : *H. butei* Chatterji, 1948
H. tagoreai Chatterji, 1948

196. **Haplorchis taichni** Nishigori, 1924

Syn. *Monorchotrema taichui* Nishigori, 1924
Monorchotrema microrchis Matsuda, 1932
Haplorchis taichui (Nishigori) Witenberg, 1930
Bhalerao, 1936 (cat; India)
Haplorchis tachookui (sic.) Nishigori, Abdel-Azim, 1938 (dog, Egypt)

Haplorchis rayii Saksena, 1954 from *Milvus migrans* from Mukteswar. *Haplorchis taichui* (Nishigori) Pearson, 1964 (from a cat, from a kite from Egypt and 28 whole mounts from a cat from the type locality, Taiwan.

Bhalerao (1938) obtained specimens from cats in Calcutta and Mukteswar. He writes that "Coincidently on both the occasions the flukes were mixed with *Echinochasmus perfoliatus*"

Pearson described it from specimens, 10 whole mounts and 4 sectioned serially from a kite from Egypt, and 28 whole mounts from a cat from Taiwan.

Measurements given by Bhalerao are as follows :

Calcutta specimens	Mukteswar specimens
Length 0.085–1.3	0.62–0.67
Breadth 0.32–0.42	0.2–0.27
Spines on gonotyl 14–15 arranged in a fan-shaped manner, measuring 0.075–0.40 × 0.012–0.026	14–15 arranged in a fan-shaped manner, measuring 0.006–0.033
Eggs 0.019–0.0275 × 0.012–0.026.	0.024–0.028 × 0.013–0.014.

Description according to Pearson (1964)

(Fig. 125)

Caeca thick walled, usually inflated; extend to between mid-level of testis and just behind posterior border of testis, most commonly to level of posterior border of testis; typically with right caecum slightly longer than left (based on Taiwan specimens). Vitelline follicles large, primarily dorsal; extend on dorsal face from between anterior and posterior borders of ovary beyond testis almost to posterior end, form roughly triangular, with apex over ovary, extend to lateral margins of body over testis and into lateral and ventrolateral fields behind testis; occasionally in front of single rosette, with centre dorsal to testis. Uterus apparently with three primary loops; uterine eggs (20), 27(24–28)μ × 13(12–15)μ (based on

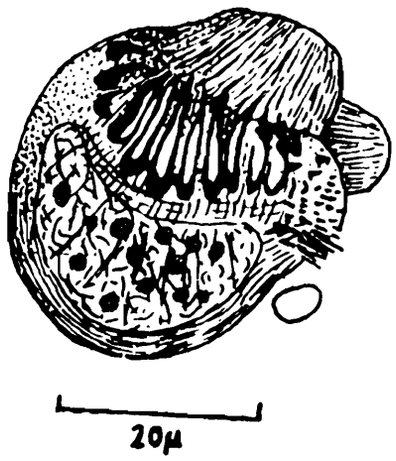


Fig. 125. Ventral aspect of ventral sucker of *Haplocchis taichui* (Nishigori).

Taiwan spedimens). Ventrogenital sac median, postbifurcal; wall muscular, lined by a thick, spineless cuticle; comprises large ventral chamber, and small dorsal pocket, with ventral chamber almost filled by apex of acetabulum; mouth of ventrogenital sac median; genital pore enters ventral chamber dorsally on left. Acetabulum highly modified with long axis so inclined that apex is directed anteroventrally toward the left side, comprises two parts, not separated by a constriction, a solid basal part embedded in the body and a solidly muscular apical part (= modified rim of sucker) projecting into ventrogenital sac. Basal part subspherical, with distinct external muscular capsule enclosing parenchymatous medulla with few scattered nuclei and traversed radially by well separated muscle fibres running from apex to base. Apical part anucleate; with cavity greatly reduced to a semi-lunar pocket between relatively unmodified ventral lip and greatly enlarged dorsal lip, with notch on medial (left) side between dorsal and ventral lips opposite (and ventral to) genital pore; ventral lip with fusiform group about 25μ wide of anteriorly directed spines on external face; spines hollow, shaped-like canoes, with thick bottom and thin sides, arranged bottom outwards on ventral face embedded for most of length in cuticle, with free end presumably flexible tips which can be recurved over edge of lip into cavity of sucker; fusiform group of anteriorly directed spines with 12–16 spines of maximum length 25–30μ (for eight specimens); on medial (left) side anteriorly directed hollow spines replaced by patch of small, solid, outwardly directed spines the longest of which may reach 4μ in length, borne on a slight prominence, with a few spines on inner edge of ventral lip; dorsal lip unarmed,

enlarged, swollen, hemispherical, typically subdivided by an internal longitudinal groove into a large lateral and a small medial lobe, at margin of medial notch. Gland cells are not seen in acetabulum. Dorsal pocket with thickened muscular wall lined by unarmed cuticle; opens into ventral chamber dorsal to dorsal lip of acetabulum by transverse, elongate-oval opening. Gonotyl absent. Short genital sinus opens into ventrogenital sac dorso-medially, opposite notch between ventral lip and medial lobe of dorsal lip of acetabulum. Parts so arranged that sperms from genital sinus pass through notch into cavity of acetabulum and from thence along internal groove in the dorsal lip to the ventrogenital sac.

Host.—Kite, *Milvus migrans* (Boddaert); domestic cat.

Location.—Small intestine.

Locality.—Faiyum Province, Egypt; Taiwan; India, Calcutta, Mukteswar, U.P.

Haplorchis rayii Saksena, 1954 from intestine of *Milvus milvus migrans* from Mukteswar according to Pearson (1964) at the end of his addendum is a synonym of *Haplorchis taichui* (Nishigori). Pearson (1964) at the end of his addendum page 676 writes, "This species, based on 10 specimens from a kite, *Milvus migrans* (Boddaert), taken in Mukteswar, India, is clearly a synonym of *Haplorchis taichui* although I have not examined the specimens, as the 'gonotyl' (ventral sucker) is described as having 15 keel-shaped spines 6–13μ long, in a semicircular crown."

197 **Haplorchis yokogawai** (Katsuta, 1932)

(Fig. 126)

Syn. *Monorchotrema yokogawai* Katsuta, 1932
Haplorchi pumilio Gohar (1934 (not Looss, 1899)
Monorchotrema taihokwii Nishigori, 1924
Haplorchis yokogawa (Katsuta), Chen, 1936
Haplorchis vagabund Baugh, 1963 (from the common tree pie, *Dendroc tta vagabunda* (Latham), type specimen and four other specimens examined by Pearson (1964) as mentioned in his addendum on page 676).

Description by Pearson (1964).

Specific diagnosis.—Body specially forebody relatively wide; 296(226–338)μ long, 231(195–276)μ wide; organs in hindbody

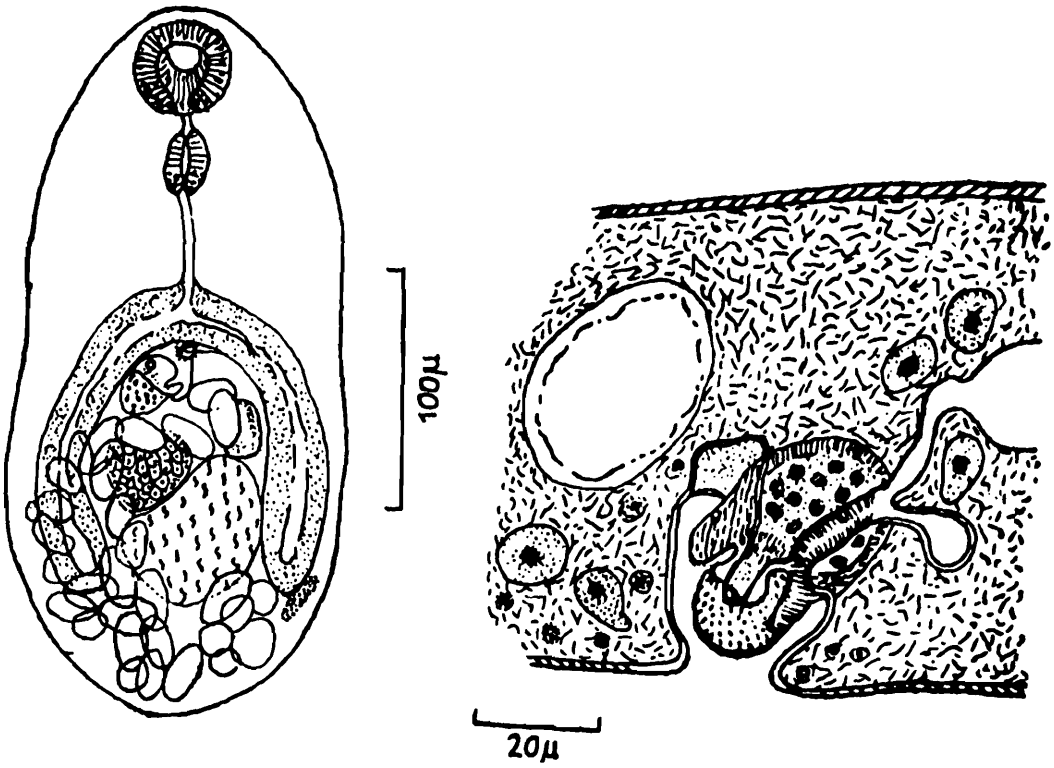


Fig. 126. *Left*: *Haplorchis yokogawai* (Katsuta) Chen, 1936 *Right*: Reconstruction from sagittal section of ventrogenital complex of *Haplorchis yokogawai* (Katsuta).

crowded together with ovary flattened against testis antero-laterally on right side and contiguous with base of acetabulum. Oral sucker 42(28–47)μ long and 49(40–54)μ wide; pre-pharynx present, but not measurable; pharynx 31(25–35)μ 21(17–24)μ wide; oesophagus 32(21–51)μ long; caeca extend to between middle and posterior border of testis.

Ovary triangular slightly to right side, 48(41–66)μ long, 53(47–66)μ wide; seminal receptacle subspherical, latero-dorsal to testis on right side, 59 (37–94)μ long and 52 (28–75)μ wide; eggs 20 uterine, 29 (28–30)μ long and 15 (13–17)μ wide. Uterus with three primary loops first arises from ootype and loops backwards anterior to testis on left side; second loop descends directly on right side, coils loosely behind testis, ascends ventrally, turns antero-medially and runs ventrally to ovary and seminal vesicle, crosses midline and runs ventral to distal part of seminal vesicle, then runs dorsad, turns medially towards ventrogenital, and terminates in a short metraterm that unites with ejaculatory duct to form short, vestigial genital atrium. Vitelline folicles large, more or less uniformly distributed dorsally from anterior boarder of ovary to half way between posterior border of testis and

posterior end, with a few follicles ventrally, posterior to testis. Testis 108 (89–131)μ long and 117 (94–140)μ wide; seminal vesicle bipartite, proximal part a little smaller. Ventrogenital sac mouth 125 (109–146)μ from anterior end; area immediately about mouth spineless, lined by thick unarmed cuticle; with opening of hermaphroditic duct (genital pore) dorsally on medial (left) side; almost filled by free, apical portion of acetabulum; divided into a large ventral chamber containing apical portion of acetabulum and a smaller, dorsal chamber lateral to opening of the genital pore and guarded by dorsal lobe of the apex of acetabulum. Acetabulum highly modified, with long axis so inclined that mouth of sucker opens antero-ventrally; of two parts, base and apex, rarely separated by a slight constriction. Base sunk in mesenchyme; subglobular; with thick muscular capsule surrounding numerous nuclei in a nonmuscular (parenchymatous) matrix 19 (17–22)μ long and 22 (16–26)μ wide. Apex (modified rim of acetabulum) projects into ventral part of ventrogenital sac; solidly muscular, with fibres arranged radially at base, anucleate; with eversible cavity reduced to a pocket between and medial lobes and narrow slit between ventral lobe and dorsal and latero-dorsal lobes, rim produced into four lobes. Lobes comprise a large, semispherical ventral lobe 22 (20–25)μ long and 21 (16–25)μ wide, with swollen tip and slightly constricted base, with shallow cavity (depression) on medial side of internal (dorsal) face, and apparently containing duct of at least one gland cell a finger-like medial lobe; and two blunt, poorly differentiated lobes, one median dorsal and one latero-dorsal. Median dorsal lobe bipartite; comprises main part with internal spines and an outwardly (dorsally) directed stout, conical, broad based, aspinose part, which projects toward or into the dorsal pocket of ventrogenital sac; with large notch between medial and dorsal lobes. Ventral lobe with characteristic cuticular plate latero-ventrally in form of horse shoe or of top separated plates with smooth or toothed margins and of variable cuticularization (fig. 7); with minute (1μ) spines over most of the internal face most numerous proximally, specially medially opposite medial lobe and as a narrow band of smaller spines proximally on external (ventral) face. Medial lobe with minute spines on inner side; continuous with those on ventral lobe, and with a small group of larger spines on tip. Dorsal and dorso-lateral lobes with minute spines on tip, margin next to ventral lobe and a part of the internal faces; continuous with spines on ventral lobe. Gonotyl

absent. Genital sinus short, thick walled, muscular; arises on right of base of acetabulum and crosses the latter dorsally to open on left side of ventrogenital sac dorsal to medial lobe of acetabulum. The characteristic cuticular plates on ventral lobe of acetabulum do not lie flat on the surface, but project ventrally at right angles to the surface as a pair of tooth-like structures.

Host.—Domestic cat, water rat, *Hydromys chrysogaster* Geoffr.; whistling eagle, *Hallustur sphenurus* (Vieillot) in Australia. The common tree pie, *Dendrocitta vagabunda* (Latham) from U.P., North India. Crow phaesant, *Centropus sinensis* from Lucknow and Mathura, U.P., North India.

Location.—Small intestine; caeca of birds.

Baugh (1963) described in *Z. parasitnk.* 22 : 303–315 *Haplorchisvagabundi.* Pearson (1964) on examination of the type specimen and four others sent to him by Baugh writes "The material was aparently dead when collected and has been flattened and distorted in mounting. All the specimens clearly belong to *H. yokogawai* as in all it can be seen that the ventral suker is bipartite, and that the large ventral lobe on the apex has a collar of spines widest internally (dorsally) and the highly characteristic though variable cuticular plate. In some of the specimens though not in the type, the other apical lobes can be made out. The 'gonotyl' (Fig. 2) as circular (or spherical) by Baugh, and described as having a peripheral row of radially arranged rodlets is, it seems an optical section of the ventral lobe. The lateral to anterolateral position of the ovary as seen in these 5 specimens, is not as Baugh considered characteristic of his specimens, but is found in *H. yokogawai* as redescribed above. From this it follows that *Haplorchis vagabundi* Baugh, 1963 is a synonym of *Haplorchis yokogawai* (Katsuta)."

Genus 92. **Haplorchoides** Chen, 1949

Syn. *Pseudohaplorchis* **Dayal, 1949**
Pseudohaplorchis **Yamaguti, 1954**

Haplorchiinae : Body small, spindle-shaped, elliptical, ovoid or spherical, spinulate with more or less attenuated mobile forebody. Oral sucker subterminal. Prepharynx very long; pharynx small; oesophagus usually short sometimes moderately long; caeca extending to testis or a little behind, terminating short of posterior extremity. Acetabulum reduced, enclosed in ventrogenital sac, wrongly called by several authors as

gonotyl. Testis single, postequatorial, intercaecal, usually spherical. Vesicula seminalis bilobed. Genital pore to one side of median line immediately behind intestinal bifurcation, at or just outside caecum. It communicates with ventrogenital sinus, containing embedded armed acetabulum carrying a circlet of weakly chitinised fret saw-shaped rodlets in a single row, 36–40 or 42–48 in number. Ovary pretesticular, median or to one side, rounded with smooth margin. Receptaculum seminis large, nearly rounded, lateroposterior to ovary. Uterus of descending and ascending coils occupies all available space between ovary and posterior extremity. Preovarian uterine coils continue into metraterm which terminally opens along with ejaculatory duct into posterior border of ventrogenital sinus. Vitellaria of large oval or elongated follicles postovarian mostly lateral from near shell gland to a little distance behind caeca or in front of posterior extremity, a few follicles in pre- and post-testicular areas passing almost to meet mesially. Excretory vesicle sac-shaped, receives behind anterior margin two common collecting ducts. Parasitic in intestine of fresh water fishes.

Type species : *H. cahirinus* (Looss, 1896) Chen, 1949

Rai and Pande (1966) from their study of species of *Haplorchoides* Chen, 1949 from the siluroid fishes in Indian region hold that only two species are valid. Following Pearson (1964) who dealt with the species of *Haplorchis* Looss, 1899 from birds and mammals according to the concept of the ventrogenital complex they show that the ventrogenital sinus contains the armed acetabulum carrying a circlet of weakly chitinised fret saw-shaped rodlets, "42–48" in number in *H. attenuatum* (Srivastava, 1935). The characters stressed by the authors of the various species show an extreme degree of variability.

Key to Indian species of **Haplorchoides**

Body elongated or spindle-shaped with somewhat attenuated anterior region; ventrogenital sinus enclosed acetabulum armed with a single circle of weakly chitinised fret saw-shaped 40–48 rodlets	*H. attenuatum* (Srivastava, 1935) Yamaguti, 1958
Body ovoid, elliptical or spherical; ventrogenital sinus enclosed acetabulum armed with a circle of weakly chitinised fret saw-shaped 36–40 rodlets.	*H. piscicola* (Srivastava, 1935) Yamaguti, 1958

198. **Haplorchoides attenuatum** (Srivastava, 1935) Yamaguti, 1958

(Fig. 127)

Syn. *H. siluudii* (Srivastava, 1935) Yamaguti, 1958
H. taakree (Dayal, 1935) Yamaguti, 1958
Monorchotrema taakree Dayal, 1935
H. seenghali Gupta, 1955

Specific diagnosis.—Body elongated or spindle-shaped, spined, 0.80–1.15 long, 0.2–0.4 in maximum breadth in testicular region. Oral sucker subterminal, 0.038–0.064 in diameter. Prepharynx 0.17–0.25 long; pharynx at about the middle of prebifurcal region, 0.04–0.06×0.3–0.04; total length of prepharynx and oesophagus varies much in younger specimens and those fixed with forebody fully extended; oesophagus about ½ of the length of prepharynx; caeca extend behind middle of body, terminating a little behind testis. Genital pore immediately behind intestinal bifurcation somewhat laterally displaced ventrally to the caecum, overlapping it or just outside it. It communicates with ventrogenital sinus containing the embedded acetabulum carrying a circlet of 40–48 fret saw-shaped weakly chitinised rodlets in a single row. Testis single in posterior half of body, intercaecal, nearly spherical with smooth margin, 0.25–0.36×0.21–0.3. Seminal vesicle, bilobed oblique and anterolateral to ovary; anterior and posterior lobes, 0.06–0.15 ×0.061–0.15 and 0.032–0.15×0.03–0.09 respectively; the size of lobes depending on the amount of sperm mass. Seminal vesicle opens through small ejaculatory duct jointly with metraterm into ventrogenital complex. Ovary pretesticular, rounded with smooth margin, median between intestinal bifurcation and anterior margin of testis, 0.1–0.15 in diameter. Receptaculum seminis nearly rounded, 0.1–0.15×0.1–0.15, lateroposterior to ovary. Shell gland mass between the latter and ovary. Uterus in descending and ascending coils occupies the available space between shell gland mass and posterior extremity. Preovarian uterine coils end into a metraterm, which along with ejaculatory duct opens into posterior border of genital sinus. Vitelline follicles post-ovarian from shell gland mass to a little distance in front of posterior extremity, a few follicles in pre- and post-testicular regions passing inwards to meet mesially. Eggs fully embryonated, 0.024–0.03×0.015–0.016.

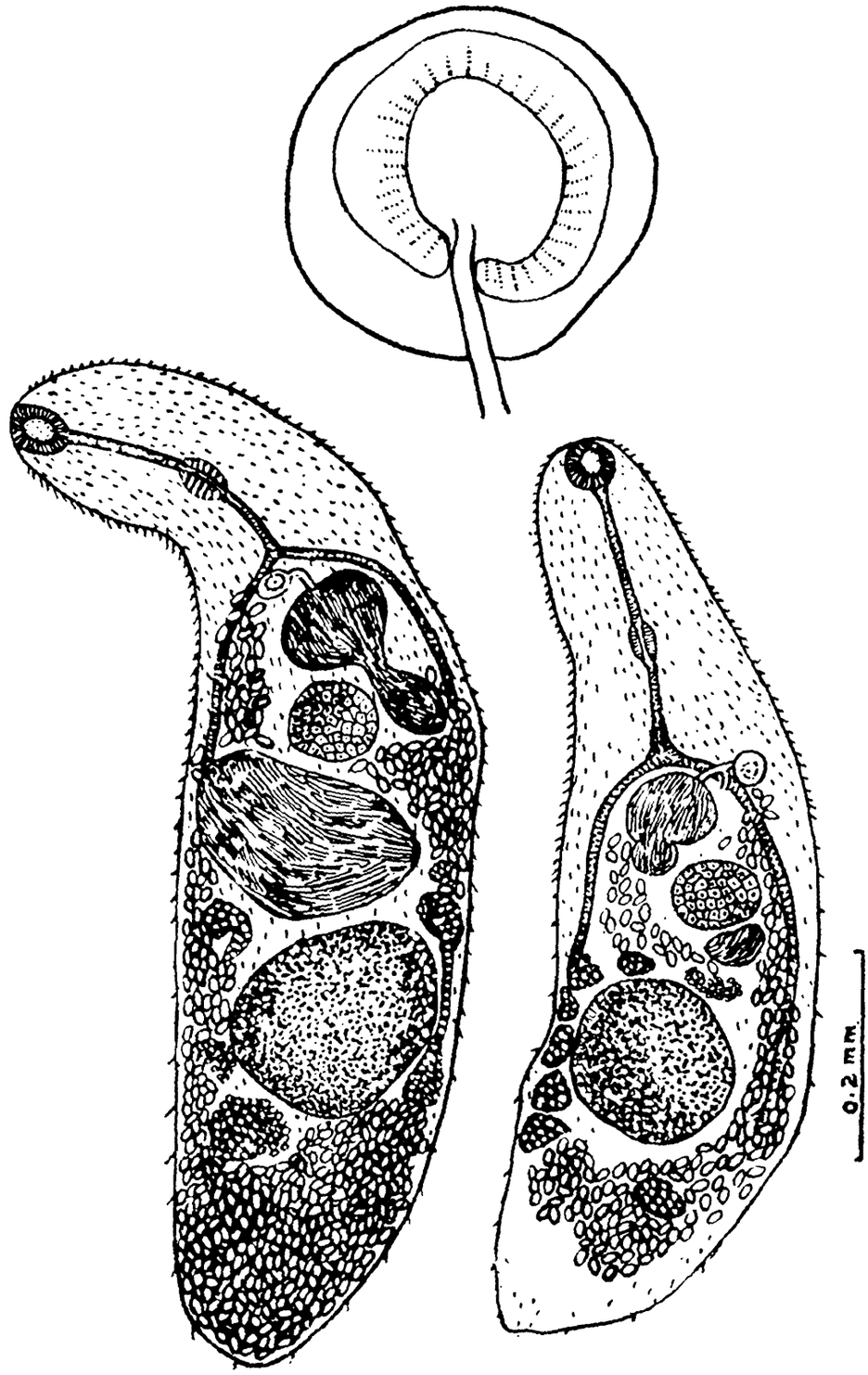


Fig. 127. *Top* : Ventro-genital complex of *Haplorchoidesattenuatum* (Srivastava, 1935) with 42 rodlets.
Bottom : *Haplorchoides attenuatum* (Srivastava, 1935) Yamaguti, 1958.

Host.—*Macrones seenghala*, *Silundia gangetica*, *Wallago attu*.

Location.—Intestine.

Locality.—Allahabad, Lucknow, Gorakhpur, U.P.

199. **Haplorchoides piscicola** (Srivastava, 1935) Yamaguti, 1958

(Fig. 128)

Syn. *H. gangeticus* (Srivastava, 1935) Yamaguti, 1958
H. macrones (Dayal, 1949) Yamaguti, 1958
Pseudohaplorchis macrones Dayal, 1949
H. parii (Chatterji, 1956)
Haplorchis parii Chatterji, 1956
H. gomtiensis Gupta, 1955
H. brahamputraensis Gupta, 1955

Specific diagnosis.—Body ovoid, elliptical or spherical, spined, 0.8–2.3 in length, 0.30–0.58 in maximum breadth near middle of body. Oral sucker subterminal, 0.06–0.1 in diameter. Prepharynx 0.16–0.22 long; pharynx 0.04–0.06 × 0.03–0.04; oesophagus of 0.05–0.07 length showing variations from fixation; caeca extend up to testis. Genital pore in region of intestinal bifurcation, median or lateral behind the bifurcation or in level with it. Acetabulum embedded inside ventro-genital sinus carrying a circlet of weakly chitinised 36–40 fret saw-shaped rodlets. Testis median, nearly spherical, 0.1–0.2 × 0.1–0.19. Vesicula seminalis characteristically bilobed; anterior lobe 0.06–0.09; posterior lobe 0.02–0.03 × 0.016–0.02. Ejaculatory duct opens jointly with metraterm inside ventrogenital sinus. Ovary pretesticular, rounded, median, 0.08–0.15 × 0.07–0.14. Shell gland mass between ovary and receptaculum seminis, 0.08–0.1 × 0.07–0.09, significantly reduced or even absent in some specimens. Uterus in its descending and ascending coils occupies the available space between shell gland and posterior end of body; in some specimens some area in posterior body region appears free from eggs. Ascending uterine limb passes into metraterm. Vitelline follicles lateral to gonads, extending from shell gland area to a little distance behind caeca; a few follicles in posttesticular space pass inwards. Eggs 0.02–0.04 × 0.012–0.017, embryonated.

Host.—*Eutropichthys vacha*, *Pseudeutropius ethrenoides*, *Macrones seenghala*, *Rita rita*, *Wallago attu*, *M. vittatus* and *C. garua*.

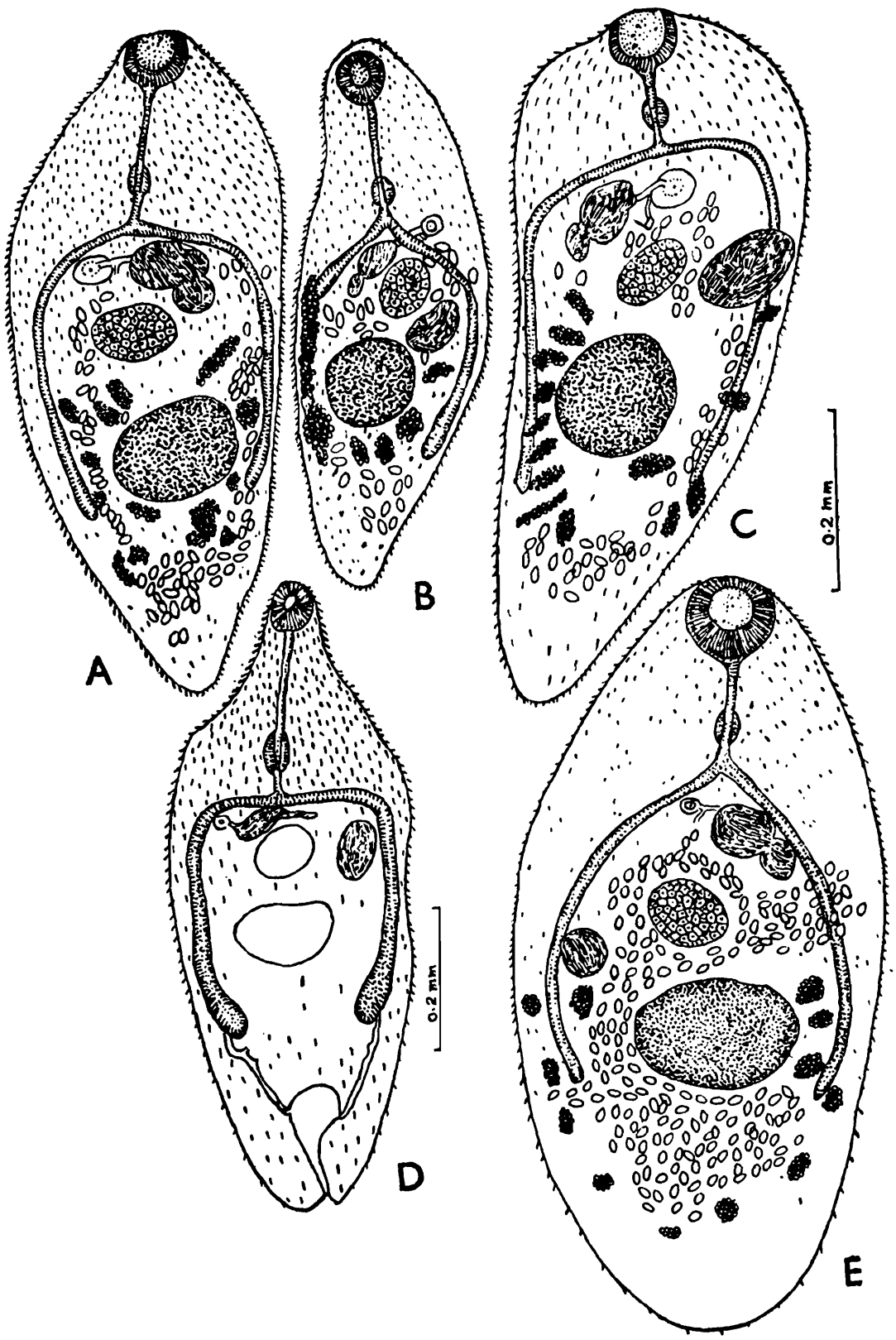


Fig. 128. (A-E) *Haplorchoides piscicola* (Srivastava, 1935) Yamaguti, 1958.

Location.—Intestine.

Locality.—Allahabad, Lucknow, Gorakhpur, U.P.; River Brahmaputra at Gauhati (Assam).

XXXI. Family CRYPTOGONIMIDAE Ciurea, 1933

Opisthorchioidea : Body small, oval to elongate. Eye spots present or absent. Oral sucker terminal or subterminal. Pharynx present. Oesophagus short. Caeca usually long, sometimes short. Acetabulum usually small, located in parenchyma or enclosed in genital atrium, occasionally reduced or absent. Testes usually two, sometimes single or numerous, intercaecal or extraceacal, postequatorial. Vesicula seminalis well deveoped. Gonotyls sometimes present. Genital pore preacetabular. Ovary pretesticular, occasionally intertesticular. Receptaculum seminis present. Vitellaria follicular, grouped in bunches, occasionally compact, motstly lateral, postequatorial, occasionally in forebody. Uterus extending into posttesticular region of body. Eggs with or without polar filament. Excretory vesicle V-shaped or Y-shaped, arms spacious and very long, reaching near pharynx. Parasitic in intestine of marine and fresh water fishes, exceptionally reptiles.

Type genus : *Cryptogonimus* Osborn, 1903

Key to Indian subfamilies of **Cryptogonimidae**

1. Testes divided into follicles in two groups, occupying most of posttesticular half of body or into numerous follicles massed together in posterior half of body. ...	POLYORCHITREMATINAE, Srivastava, 1939	
Testes single or double, rarely divided into a longitudinal series of lobes.	2	
2. Acetabulum present; testes diagonal or symmetrical rarely divided into a longitudinal series of lobes. ...	CRYPTOGONIMINAE	Ward, 1917

LIV Subfamily *CRYPTOGONIMINAE* Ward, 1917

Gryptogonimi : *dae.* Caeca short or long. Acetabulum medium, simple or bipartite. Testes diagonal or symmetrical, sometimes divided into a longitudmal series of lobules Ovary compact or multilobate. Vitellaria largely in acetabulo-ovarian zone.

Genus 93. **Mehracola** Srivastava, 1939

Syn. *Mehrailla* Srivastava, 1939

Cryptogoniminae : Body muscular, elongate, spinulate. Oral sucker subterminal, larger than acetabulum. Acetabulum small in genito-acetabular depression at about junction of anterior and middle thirds of body. Prepharynx and pharynx well developed; oesophagus short; caeca simple, broad, reaching near posterior extremity. Testes two, lobed, reniform, almost symmetrical, overlapping caeca. Vesicula seminalis long, constricted and twisted; pars prostatica ill defined; ductus ejaculatorius well developed. Genital pore just preacetabular in genito-acetabular depression. Ovary pretesticular, median, multilobulate. Receptaculum seminis and Laurer's canal present. Vitellaria lateral from behind intestinal bifurcation to testes. Uterus large, transversely coiled from behind acetabulum to posterior end, a little in front of caecal ends, filling most of intertesticular and post-testicular region. Eggs small, roughly triangular with a polar filament. Excretory vesicle Y-shaped. Parasitic in intestine of marine fishes.

Type-species : *M. ovocaudatum* Srivastava, 1939

200. **Mehracola ovocaudatum** Srivastava, 1939

(Fig. 129)

Specific diagnosis.—Body elongate, muscular, spined with broadly round anterior and somewhat truncate posterior extremity, 4–9.4 long, 1.36 in breadth in acetabular region. Oral sucker 0.3 in diameter. Ratio in size of suckers 3 : 2. Prepharynx long, 0.18×0.16; pharynx 0·22×0.28; oesophagus 0.08 longi caeca terminate a little in front of hinder end. Testes reniform with trilobed outer and entire inner regular margin, almost symmetrical in front of posterior third of body, overlapping caeca; right testis 0.7×0.3, slightly larger; left 0.58×0.36. Vesicula seminalis long with three or four constrictions and twisted to right side of acetabulum, extending from a little behind acetabulum to about one third distance between acetabulum and intestinal bifurcation; pars prostatica ill defined; ductus ejaculatorius wide; hermaphroditic duct small. Genital pore median preacetabular liying in a small depression of ventral bodywall along with acetabulum. Ovary

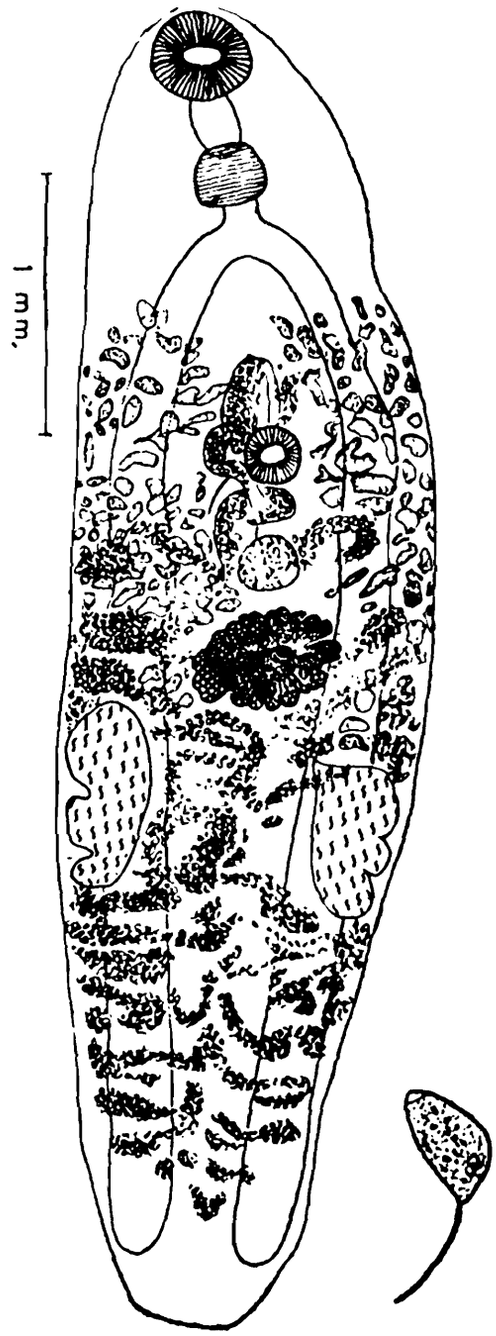


Fig. 129. Ventral view of *Mehracola Ovocaudatum* Srivastava, 1939

0.5×0.58, multilobate, consisting of a large number of pear-shaped follicles, median, a little anterior to testes. Receptaculum seminis spherical, 0.22 in diameter, a little in front of ovary. Laurer's canal arises from duct of receptaculum seminis. Vitellaria of irregular follicles from a little behind intestinal bifurcation to anterior margin of testes. Uterus transversely coiled from genito-acetabular drepression to a little in front of caecal ends, extending laterally to bodywell

behind testes. Eggs rough y triangu ar, opercu ate, 0.016–0.023×0.0076–0.01, with ong po ar fi ament at opercu ate end. Excretory vesic e Y-shaped.

Host.—*Stromateus cinereus* B och.

Location.—Intestine.

Locality.—Karachi, Arabian Sea.

LV Subfamily *POLYORCHITREMATINAE* Srivastava, 1939

Cryptogoni : Bodymidae p ump, muscular, smooth. Caeca long. Acetabulum feebly muscular, small or large, enclosed in genital atrium. Testes divided into two lateral groups occupying most of posterior half of body. Vitellaria iateral, consisting of follicies arranged in bunches from postrior extremity to near acetabular or beyond it.

Type genus: *Polyorchitrema* Srivastava, 1939

Genus 94. **Polyorchitrema** Srivastava, 1939

Cryptogonimidae, Polyorchitrematinae : Body medium sized, smooth, pyriform or subspherical. Oral sucker subterminal. Pharynx large; oesophagus very small or absent; caeca wide, straight, terminating near hinder end. Acetabulum feebly muscular, enclosed in genital atrium, in first third of body. Genital pore triangular, postbifurcal. Testes numerous, 35–50 massed together, mostly intercaecal in posterior third of bodypartly over lapping caeca laterally. Vesicula seminalis tubular, sinuous; pars prostatica and ductus ejaculatorius well deve oped. Ductus hermaphroditicus short, opening into genita atrium just in front of acetabulum. Genital atrium containing acetabulum and chilinous triangu ar gonoty Ovary median, immediately pretstticular, postequatorial, entire, triangular or oval, rarely slightly lobed. Receptaculum seminis large or small. Laurerls canal present. Vitellaria lateral, composed of grape- ike bunches of follicies from little behind acetabu um to hinder end. Uterus coi ed, main y postacetabu ar, over apping caeca atera y extending to sides of testicu ar zone. Eggs sma . Excretory vesic e Y-shaped with cornua extending to eve of pharynx. Parasitic in intestine of fresh water fishes.

Type species: *P. piscicola* Srivastava, 1939

201. **Polyorchitrema piscicola** Srivastava, 1939

(Fig. 130)

Specific diagnosis.—Body 4.5–7.8 in length, 2.0–2.8 in maximum breadth across basal part of acetabulum, inspined, highly muscular; prominent glands present in preacetabular region. Oral sucker 0.48–0.62 × 0.48–0.56. Acetabulum 0.84–1.18 in diameter, feebly muscular, imbedded in ventral surface of large ventro-genital sinus, just behind first quarter of body length; acetabulum and triangular chitinous gonotyl highly mobile. Ventro-genital sinus opens through small itriangular opening with gonotyl projected out sometimes. Well developed retractor muscules present in connection with gonotyl and acetabulum. Prepharynx very small; pharynx 0.36–0.48 × 0.42–0·54; oesophagus absent; broad caeca terminate in front of hinder end. Excretory pore terminal; excretory vesicle Y-shaped with cornua reaching pharynx. Testes numerous, 35–50, small spherical or oval, mostly intercaecal, overlapping one another and caeca in front of caecal ends. Vesicula seminalis sinuous, 0.07–0.95 long with a few constrictions, extending posteriorly to a short distance behind first half of body. Pars prostatica small, 0.42–0.7 long, surrounded by poorly developed prostate cells. Ejaculatory duct of about same length as pars prostatica joins terminal part of feebly muscular metraterm. Ovary median, just pretesticular, 0.43–0.54 × 0.3–0.4, roughly triangular or oval, roughly slightly lobed and triangular in shape. Receptaculum seminis obliquely behind ovary on left side, 0.44–0.68 × 0.34–0·5 Vitellaria composed of 7–9 grape-like bunches, extending from a little behind pharynx to hinder end. Uterus coiled, intercaecal between testis mass and level of anterior end of vitellaria, overlapping caeca laterally; metraterm narrow, feebly muscular to right side of pars prostatica; small ductus hermaphroditicus opens into ventro-genital sinus just in front of acetabulum. Eggs 0.03–0.038 × 0.013–0.015.

Host.—*Eutropichthys vacha* Day.

Location.—Intestine.

Locality.—Allahabad, River Ganges and Jumuna.

202. **Polyorchitrema eutropicthis** Chatterji, 1956

Specific diagnosis.—Body cylindrical twice as long as broad, 2.47–3.9 long, 1.02–1.2 in maximum breadth in region between

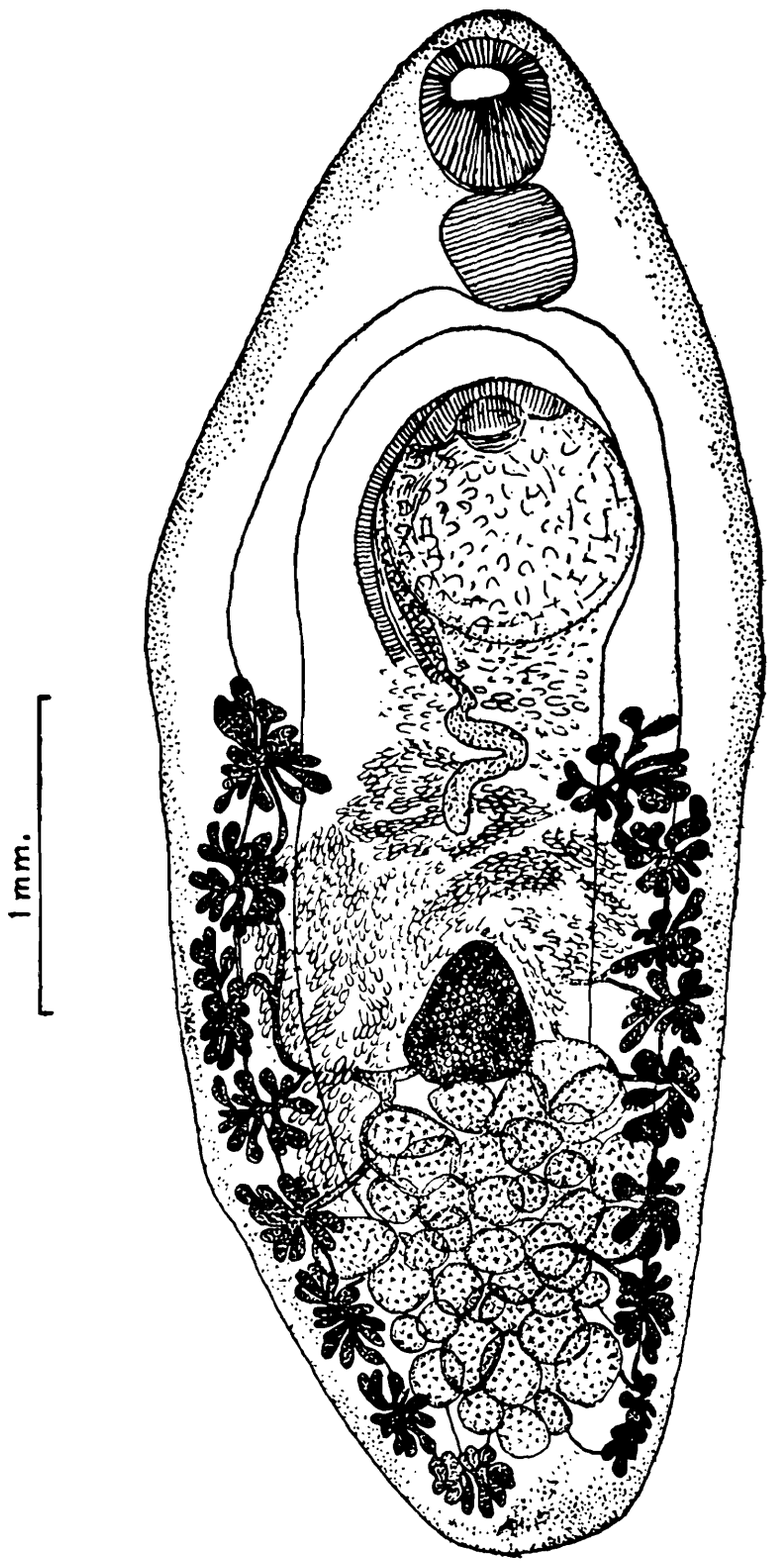


Fig. 130. *Polyorchitrema piscicola* Srivastava, 1939.

ovary and acetabulum, unspined. Oral sucker terminal, 0.27–0.36 × 0.31–0.37. Acetabulum 0.49–0.61 × 0.58–0.61. Small gonotyl pressed against right side of acetabulum with a few minute spines but not clearly seen in mounted specimen.

Prepharynx 0.135 long, 0.285 broad; pharynx 0.24–0.31 × 0.27–0.31; oesophagus very small; caeca extend to a little in front of hinder end. Testes follicles at posterior end, about 35 overlapping one another and a few overlapping caeca. Vesicula seminalis tubular, preovarian. Ovary trilobed, slightly dextral 0.19–0.38 × 0.31. Receptaculum seminis small, just behind ovary. Eggs spindle-shaped, non-operculate, 0.026–0.033 × 0.007–0.0132. Vitellaria of small foliicles in grape-like bunches from about middle of body to hinder end.

Host.—*Eutropichthys vacha* Day.

Location.—Small intestine.

Locality.—Allahabad, River Ganges, U.P.

Key to species of **Polyorchitrema**

Prepharynx very small; receptaculum seminis large; gonotyl well developed, triangular.	*P. piscicola* Srivastava, 1939
Prepharynx well developed; receptaculum seminis very small; gonotyl small, with a few spines.....	*P. cutropicthis* Chatterji, 1956

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ALPHABETICAL INDEX

Names in italics are synonyms

Acanthochasmus, 370
Acanthostomum, **370**, 373
— burminis, **371**, 372, 373
— indicum, **370**, 373
— spiniceps, 370
Acanthostomidae, 11, 344, **369**
Acanthostominae, **370**
Allechinostomum, 125, 133
— *orocodilli*, 133
Amphistomum collinsi, 233
Amphistomum hominis, 229
Amphistomum watsoni, 235
Amphimerus, 345, 346
Antorchiinae, 304, **312**
Antorchis;, 312
Apopharynginae, 164
Artyfechinostomum, 3, 9, 79, **79**
— indicum, 80, **81**
— *malayanum*, 80
— *paradoxyuri*, 80
— sufrartyfex, **80**
Ascocotyle, **377**
— coleostoma, 377
— (Ascocotyle), 377, 379
— (Phagicola), 377, 379
— intermedius, **377**, 378
Ascocotylinae, 374, **376**
Atrophecaecum, 370
— *burminis*, 371
— *hindustanensis*, 371
— indicum, 371
Azygiatoidea **52**, 53

Balfouria, 107, 108
Barisomum, 282
Brachycladiidae, 175
Brijicola, 138
— *caballeroi*, 139
Buckleytrema, 3, 319, **321**
— indica, 321, **322**

Calicophoron, 195, **200**
— calicophorum, **200**
— cauliorchis, 200, **201**
— crassum, 200, **201**, 202
— ijami, 203
papillosum, 200, **202**
Campula oblonga, 363
Carmyerius, 220, **224**
— gregarius, **225**
— spatiosus, **225**
— wenyoni, 225
Catatropis, 264, **270**
— indicus, 270, **271**
— orientalis, **270**
— verrucosa, 270
Cathaemasia, **171**, 172
— hians, 172
— indicus, 172, **173**, 174
— mehrai, 172, **175**, 176
— orientalis, **172**, 173
Cathaemasiidae, 56, **171**
Cathaemasiinae, **171**
Cetiosaccinae, 279
Ceylonocotyle, 195, **208**, 209
— *dawesi*, 209
— dicrocoelium, 209, **211**
— näsmarki, **212**
— orthocoelium, 209, **211**
— scoliocoelium, **209**, 210
— streptocoelium, 209, **211**
Charaxicephalinae, 279, **289**
Charaxicephalus, 289, **290**
— loossi, **290**, 291
— robustus, 290
Chaunocephalinae, 57, **106**
Chaunocephalus, 56, 106, **108**, 109
— elongatus, 109, **115**, 117
— ferox, **109**
— kirati, 109, **115**, 116
— leucocephalus, 109, **110**, 111
— odhneri, 109, **113**, 114
— *similiferox*, 109
— travassosi, 109, **110**, 112
Chiorchis burti, 248
Choanophorinae, 279
Cladocoelium, 177
— *elephantis*, 179
— *giganteum*, 178
— *hepaticum*, 177
Cladorchiinae, 193, **236**
Cladorchis watsoni, 235
Cleptodisciinae, 194, **257**
Cleptodiscus, **257**
— poonensis, **258**
— reticulatus, 257

Cloacitrema, 156
Cloacitrematinae, 157
Clonorchis, 345
— *sinensis*, 350
Corpopyrum kossacki, 334
Cotylophoron, 11, 195, **203**
— cotylophorum, 203, **204**, 205, 206
— elongatum, 204, **208**
— indicum, 204, **205**
— *madrasensis*, 205
— orientalis, 204, **206**
— ovatum, 204, **206**, 207
— *skriabini*, 204
Crassotrematinae, 189
Cryptogonimidae, 11, 13, 344, **393**
Cryptogoniminae, **393**
Cryptogonimus, 393
Cyclocoelata, 3, 54, **323**
Cyclocoelidae, **324**
Cyclocoelinae, 324, 325, **326**
Cyclocoeloidea, **323**
Cyclocoelum, 4, 324, 325, **326**
— *allahabadi*, 327
— *bivesiculatum*, 335, 337
— *capellum*, 327, 330
— *cuneatum*, 327
— *dumetellae*, 335
— *erythropis*, 317
— *exile*, 327
— *indicum*, 327
— *leidyi*, 327
— *lobatum*, 327
— *macrorchis*, 327
— *mackii*, 327
— *mehrii*, 327
— *mutabile*, 327
— *nebularium*, 334
— *obliquum*, 327
— *orientale*, 327, 328
— — var. *eurhinus*, 327
— *problematicum*, 327
— *sharadi*, 335, 337
— — sp, 330
— *straightum*, 328
— *titiri*, 332
— *toratsogami*, 327
— *turusigi*, 328
Cyclocoelum (Cyclocoelum), 325
— — mutabile, **326**, 327
— — obscurum, **327**, 328, 330, 332
— — odeningi, **330**, 331
— — ovipunctatum, **328**, 329
— (Haematotrephus), 325, **331**
— — kossacki, **334**
— — vanelli, **331**, 333
— (Hyptiasmus) elongatum, **335**, 336
— (*Pseudhyptiasmus*) *sinhaladvipa*, 335, 337
— (—) *dollfusi*, 335
— (Uvitellina) *dollfusi*, 332
Cyclorchis, 345, **363**
— amphileucus, 363
— campula, **363**, 364
Cymbiforma, 276
— *indica*, 277

Dadytrema, 250
Dadaytrematinae, 194, **249**, 250
Desmogoniinae, 289
Diaschistorchinae, 289
Diaschistorchis, 289, **292**
— gastricus, **292**, 293
— pandus, 292
Diplodiscus, **244**
— amphichrus, **244**, 245
— var. *magnus*, 244
— mehrai, 244, **245**, 246
— subclavatus, 244
Diplodiscinae, 193, **243**
Discogasteroides, 307
— *caranxi*, 307, 309
— *indicus*, 307, 308
Discogasteroidinae, 305
Dissurus, 125, **139**
— farrukhabadi, **141**
Distoma, 177
— campula, 363
— *cucumarinum*, 338
— *echinatum*, 60
— *giganteum*, 178
— *hepaticum*, 177
— *sinense*, 350
— *sinensis*, 350
Distomum, 181
— *buski*, 181
— *conjunctum*, 348
— *crassum*, 181
— *hepaticum*, 177
— *pachysoma*, 185
— *rathouisi*, 181
— *spathulatum*, 350

Echinochasmus, **125**, 133, 137, 138
— antigonus, **126**
— bugulai, 126, **127**, 128
— *bursicola*, 134
— canai, 136
— *caninum*, 136
— crocodili, 133
— coaxatus, 126
— corvus, 136
— *famelicum*, 132
— famelicus, 126, **132**

— megavitellus, 126, **130**
— narayani, 126, **130**, 131
— perfoliatus, 126, **131**, 382
— var. *japonicus*, 131
— var. *shieldai*, 131
— reniovarus, 136
ruficapensis, 126, **128**, 129
Echinochasminae, 58, **124**
Echinoparyphium, 59, **64**, 65, 71
— *bagulai*, 70
— clerci, 66
— dollfusi, 66, **67**
— gizzardai, 66, **67**
— indicum, 66, **69**
— *longicirrus*, **66**
— recurvatum, 65, **66**
— *splendens*, 60
Echinostoma, 58, **59**
— *armigerum*, 60
— bhattacharyai, **62**
— chasma, **64**, 65
— *coalitum*, 60
— *crecci*, 62
— *famelicum*, 132
— govindum, 60, **62**, 63
— *longicirrus*, 66
— *microspina*, 36
— minimum, 60
— *novum*, 60
— revolutum, 59, **60**
— *thapari*, 118
Echinostomata, 1, 3, **55**
Echinostomatidae, 3, **56**, 57, 151
Echinostominae, **58**
Echinostomatinae, **58**, 59
Echinostomatoidea, **55**
Echinostephilla, 156
Echinostephillinae, 157
Echinostomum, 134
— *bursicola*, 134
— govindum, 60, **62**
Episthmium, 125, **134**, 137, 138, 139
— africanum, 134
— bursicola, **134**, 135
— *chauhani*, 134
— corvus, 134, **136**, 137
— *reniovarus*, 136
Episthochasmus, 134, 138
— *caninum* 136
Eucotyle, 341
Eucotylidae, **340**
Eucotylinae, 341
Eucotyloidea, 323, **340**
Euparyphium, 59, **71**
— capitaneum, 71
— longitestis, **71**
Explanatum, 196
Fasciola, 175, **177**
— gigantica, 177, **178**, 179
— hepatica, **177**
— *indica*, 178
— jacksoni, 177, **179**, 180
— *revolutum*, 60
Fasciolatoidea, 1, **52**, 53, 54
Fasciolidae, 56, **175**
Fasciolinae, **176**
Fasciolopsidae, 175
Fasciolopsinae, 176, **181**
Fasciolopsis, **181**
— buski, **181**, 182
Fastula, **312**
— brevichrus, **313**, 314
— *chauhani*, 313
— clupii, 313, **315**
— ilishii, 313, **315**
— gangeticus, 313, **315**
— keksooni, 313
Fellodistomata, 1, 3, 54, **303**
Fellodistomidae, **304**
Fellodistominae, 304, **305**
Fellodistomoidea, 3, **304**
Fellodistomatoidea, 289
Fellodistomum, 304, **305**
— *fellis*, 291
— incisum, 305
— lethrini, **306**
Fischoederius, 220, **222**
— *ceylonensis*, 222
— cobboldi, 222, **224**
— elongatus, **222**, 223
— *fischoederi*, 222
— *siamensis*, 222
Fistucaria cervi, 196

Gastrodiscinae, 193, **226**
Gastrodiscus, **226**
— aegyptiacus, **227**
— *hominis*, 229
— secundus, **227**
Gastrodiscoides, 11, 226, **228**
— hominis, **229**, 230
Gastrothylacinae, 193, **219**
Gastrothylax, 11, 219, **220**, 224
— *bubalis*, 225
— *compressus*, 220
— crumenifer, **220**, 221
Gastrothylax (Gastrothylax) crumenifer, 220
— (Fischoederius) elongatus, 222
— *mancupatus*, 225
— *minutus*, 225
— *synethes*, 225
Glyphicephalus, 282
Gomtia, 345

— *gagatea*, 359
— *lucknowensis*, 359
— *piscicola*, 359
Gigantocotyle, 195, 198
— *explanatum*, 198
Gorgoderida, 1, **53**

Haematotrephus adelphus, 331, 332
— *fasciatus*, 328
— *lanceolatum*, 334
— *similis*, 331
Haematotrephus (*Haematotrephus*) *lobivanelli*, 332
— *uvitellina Vanelli*, 332
— (*Uvitellina*) *kaniharensis*, 332
Haplocladinae, 316
Haplocladus, 316
Haplocladus orientalis, 317
Haplorchis, 380, **381**
— *pumilio*, 381, 384
— butei, 381
— *parini*, 391
— *pearsoni*, 381
— *r[illegible]ii*, 382, 384
— *tachnookui*, 382
— tagorai, 381
— *taichui*, **382**, 383
— *vagabundi*, 384, 387
— yokogawai, **384**, 385, 387
Haplorchoides, 380, **387**, 388
— attenuatum, 388, **389**, 390
— *brahamputraensis*, 391
— cahirinus, 388
— *gangeticus*, 391
— *gomtiensis*, 391
— *macrones*, 391
— *parini*, 391
— piscicola, 388, **391**, 392
— *seenghali*, 389
— *silundii*, 389
— *taakree*, 389
Haploporidae, 55, 183, **188**
Haploporoidea, 55, **183**
Haploporus, 189
Haplorchidae, 374
Haplorchiinae, 374, **379**
Haplosplanchnidae, 55, **183**
Haplosplanchninae, 183
Haplosplanchnoides, 184
Haplosplanchnus, 183, **184**
subg. Haplosplanchnus, 186
(H.) caudata, 185, **187**
(H.) pachysomus, 184, **185**, 186
(*H.*) *purii*, 185
Hawkesius, 234
Helostomatinae, 194, **255**
Helostomatis, **255**
— helostomatis, 255
— sakrei, **256**
Hemiuratoidea, 1, 3, **52**, 53
Heteroechinostomum, 125
Heterophyes, 11, **375**
— heterophyes, 375
— indica, **375**
— persicus, 376
Heterophyidae, 4, 11, 13, 344, **374**
Heterphyinae, **374**
Hindia, 264
(Hindia), 264, **265**
— gibbus, 265, **268**, 269
— *lucknowensis*, 267
— *pacifera*, 268
Himasomum, 282
Himasthala, 139
Hindolana, 264
Homalogaster, 226, **230**
— paloniae, **231**
— *philippinensis*, 231
Hypoderaeinae, 57, **84**
Hypoderaeum, **84**
— conoideum, **85**
— magnocirrussa, 85, **86**
— *mainpuria*, 85
— microspina, 85, **86**, 87
Hyptiasmus, 325, **335**

Ignviinae, 124
Ignavia, 125, **148**
— breviovarica, **148**, 149
— venusta, 148
Indosolenorchis, 259, **260**
— herudinaceus, **260**

Kossackia, 264, 265

Lankatrema, **301**
— mannarensis, **302**, 303
Lankatrematinae, **301**
Laruea, 184
— *caudata*, 187

Maccallumia, 251
— *burmanica*, 252
Macravestibulinae, 279
Medioporus, 282
Megasolenidae, 188
Mehlisia, 164
— acuminata, 169
— gatesi, **169**, 170
Mehracola, **394**, 395
— ovocaudatum, **394**
Mehrailla, 394
Mehrastominae, 58, **152**

Mehrastomum, 3, **153**
— minutum, **154**, 155
Mehratrema, 3, **319**
— dollfusi, **319**, 320
— *polynemusinis*, 319
Mehratrematinae, **318**
Mesorchis, 142
— *pennanti*, 142
Metacetabulinae, 279
Metorchiinae, 345, **365**
Metorchis, **365**
— *albidus*, 365
— *nettioni*, 365
— xanthosomus, **365**
Minutorchis, 367
Microparyphinae, 57, **120**
Microparyphium, **120**
— facetum, 120
— montei, **120**
Microtrema, 344
Monascinae, 304, **316**
Monascus, **316**
— filiformis, 317
— orientalis, **317**
Monodhelminthidae, **317**
Monodhelmins, 318
Monilifer, 141
Monorchotrema, 381
— *microrchis*, 382
— pumilio, 384
— *taakri*, 389
— *taichui*, 382
— *taihokwii*, 384
— *yokogawai*, 384
Monostomum, 338
— *asperum*, 338
— *flavum*, 338
— *lanceolatum*, 331
— *obscurum*, 327
— *sarcodiornicola*, 338
— *vanelli*, 331
— *vicarium*, 328
Morishitium straightum, 328
Multispinotrema
Multivitellaria, 367
— *hewletti*, 368
Multivitellarinae, 366

Naviformia, 264
Navicularia, 104
Nephrostominae, 58
Neoartyfechinostomum, 79
— *shubhrai*, 80
Neocladorchis, 257, 258
Neocladorchis poonensis 258
Neoechinostoma, 89
— *spinosa*, 89
Neoparamonostomum, 272
Neopronocephalinae, 279, **294**
Neopronocephalus, **294**
— gangeticus, **296**, 298
— mehri, **296**, 297
— triangularis, **295**, 298
Nephroechinostoma 148
Nephrostominae, **96**, 97
Nephrostomum, 6, **97**
— *bicolanum*, 97
— ramosum, **97**
Nicollodiscinae, 194, **254**
Nicollodiscus, **254**
— gangeticus, **254**
Nigerina, 345, 346, **361**
— *hardoiensis*, 361
(Nigerina) 346, **361**
— hardoiensis **361**
Notaulus, 345
Notocotylidae, **263**
Notocotylinae, 264
Notocotyloidea, 192, **262**
Notocotylus, 6, 263, **264**
(Notocotylus), 264, **265**
— *anatis*, 267
— attenuatus, **265**, 266
— babai, 265, **267**
— *gibbus* 265
— imbricatus, 265, **267**
— *indicum*, 267
— *lucknowensis*, 267
— *pacifera*, 268
— *solitaria*, 267
— triserialis, 265
— parviovatus, 265, **268**
— (Hindia) gibbus, **268**, 269

Ogmocotyle, **276**
— indica, **277**
— pygargi, 276
Ogmocotylinae, 263, **276**
Olveria, 3, **236**
— bosi, 237, **238**
— indica, **237**, 238
Ommatobrephidae, 56, 151, **161**
Ommatobrephus, **161**
— *folium*, 162
— lobatum, **162**, 163
— megacetabulus, **162**
— *nicolli*, 162
— singulare, 161
Ophthalmophagus, 325
Opisthometra metatestis, 139
Ophthalmotrema, 156
Opisthorchiata, 3, **343**
Opisthorchiidae, 11, **344**, 345

Opisthorchiinae, **345**
Opisthorchioidea, **343**
Opisthorchis, 344, **345**, 346
— *canicus*, 348
— *cheelis*, 350
— *indicus*, 355
— *milvusensis*, 350
— *obsequens* **355**
— tenuicollis 350
— thaparae, 358
Opisthorchis (Nigerina) hardoiensis, **361**, 362
Opisthorchis (Opisthorchis) allahabadii, 347, **354**
— (—) anhingi, 347, **355**
— (—) gidhis, 347, **352**
— (—) gomtii, 347, **359**
— (—) longissimus dendriticus, 347, 352, 353
— (—) mehrai, 347, **360**
— (—) noverca, 347, **348**, 349
— (—) obsequens, 347, **355**
— (—) pelecani, 347, **356**, 357
— (—) pedicellata, 347, **358**
— (—) var. minuta, **358**
— (—) sinensis, 347, **350**
— (—) tenuicollis geminus, 347, **350**, 351
— (—) vitellani, 347, **360**
Opisthotrema, 301
Opisthotrematidae, 263, **301**
Orientodiscus, **250**
— jumnai, 250, **251**
— lobatum, **250**
Orientophorus, 312

Pachytrema, 344, 366, **367**
— calculus, 368
— hewletti, **368**, 369
Pachytrematinae, **366**
Pachytreminae, 345, 366
Parallelotestis, 94, **95**
— horridus, 95
— tarai, **95**, 96
Parallelotestisiinae, 58, **94**
Paramonostomum, 264, **272**
— alveatum, 272
— *casarcus*, 274
— fulicai, 272, **274**
— *hardwoodi*, 274
— microstomum, 272, **273**
— *nettioni*, 274
— querquedulum, 272, **274**, 275
Paramphistomacotyle, 195, **217**
— spinicephalus, **217**, 218
Paramphistomata, 3, **191**, 192
Paramphistomidae, **192**, 193
Paramphistominae, 193, **194**
Paramphistomum, 11, 193, **195**, 196
— *birmiense*, 198
— cervi, 195, **196**, 197
— *cotylophorum*, 204
— *crassum*, 198
— explanatum, 195, 198
— gotoi, 196, **199**
— *indicum*, 196
— *spinicephalus* 217
— *dicrocoelium*, 211
— maplestonei 213
— *orthocoelium*, 209
— (*Orthocoelium*) *dicrocoelium*, 211
— (*Paramphistoma*) *orthocoelium*, 211
— *scoliocoelium*, 209
— *shipleyi*, 209
— *streptocoelium*, 211
Paramphistomoidea, **192**
Paramphistomoides, 3, 195, **212**
— maplestonei, **213**, 214
Paropisthorchis, 345
— *indicus*, 348
Parorchiinae, 57, **150**, 151, 157
Parorchis, 150, **151**
— acanthus, 151
— snipis, **151**, 152
Paryphostominae, 58
Paryphostomum, 9, 59, **72**
— *novum*, 60
— *bubulcusi* 77
— dollfusi, 73, **77**
— giganticum, 73, **78**
— horai, 73, **75**, 76
— pentalobum, 73, **75**
— radiatum, 72, **73**
— testitrifolium, 72, **74**
Paryphostomum, 79
— *indicum*, 81
Patagifer, 96, 97, **99**
— bilobus, 99
— *chandrapuri*, 99
— *sarai*, 100
— simerai, 99, **100**
— *srivastavai*, 99
— wesleyi, **99**
Pagosomatinae, 101
Pegosominae, 57, **101**
Pegosomum, 56, **101**
— egretti, **102**, 103
— saginatum, 102
Pelmatostomum, 56
Petasiger, **104**
— antigonus, 104, **106**, 107
— exaretus, 104
— nicolli, **104**
— variospinosum, 104

— *yamagutii* 104
Petasigerinae, 58, **102**
Pfenderius, 236, **239**
— birmanicus, 239, **240**
— *heterocerca*, 240
— papillatus, 239, **240**
Philophthalmidae, 41, 56, 151, **156**
Philophthalminae, **157**
Philophthalmus, 156, **157**
— *aequillai*, 158, 160
— gralli, **158**, 160
— *halcyonis*, 158
— *indicus*, 158, 160
— *lucknowensis*, 158
— *mirzai*, 158
— *nocturnus*, 160
— (*Myxophthalmus*) *chrysommae* 158
— palpebrarum, 158
Pleurogonius, 280, **282**
— *chelonii*, 285
— karachii, **283**, 284
— keamarii, 283, **285**
— longiusculus, 282
— mehrai, 282, **285**, 286
— sindhii, **283**
Podocotyle pachysomus, 185
Polyorchitrema, 12, **396**
— piscicola, 396, **397**, 398, 399
— eutropicthis, **397**, 399
Polyorchitrematinae, 393, **396**
Proctobium, 151
Proctocaecum, 370
Proechinocephalus, 95
— *egreti*, 95
— *tarai*, 95
Pronocephalidae, 263, **278**, 279
Pronocephalinae, **279**
Pronocephalus, **280**
— obliquus, **280**, 281
— *trigonocephalus*, 280
Proshystera, 341
Protocladorchis, 250, **251**
— burmanica, **252**, 253
— *burmanicus*, 252
— pangasii, 252
Profotasciolinae, 176
Pseudoartyfechinostomum, 79
— *laruiformis*, 81
Pseudodiscogasteroides, 305, **307**
— caranxi, 307, **309**
— indicus, 307, **308**
Pseudochiorchiinae, 194, **247**
Pseudochiorchis, **247**
— burti, **248**, 249
Pseudodiscinae, 193, **232**
Pseudodiscus, **232**
— (*watsonius*), 234
— (*pseudodiscus*) *collinsi*, **232**, **233**, 234
— *hawkesi*, 235
— *stanleyi* 233
— (*Watsonius*) *watsoni*, 235
Pseudechinochasmus, 59, **83**
— satjivani, **83**
Pseudeschinostominae, 57, **91**
Pseudechinostomatinae, 91
Pseudechinostomum, 56, **92**
— incoronatum, 92
— indicus, **92**, 93
Pseudohaplorchis, 387
— *macroenes*, 391
(*Pseudhyptiasmus*), **335**
Pseudoparamphistoma, 195, **215**
— cuonum, **215**, 216
Psilocollaris, 164, **166**
— indicus, **166**, 168
Psilorchiinae, 57, **88**
Psilorchis, 3, **89**
— *ajgainis*, 89
— indicus, **89**, 90
— *halcyoni*, 89
— *ketupi*, 89
— *mehrai*, 89
— *spinosa*, 89
— *thapari*, 89
Psilochasmus, 164, **165**
— *agilis*, 165
— *alii*, 165
— *indica*, 165, 166
— *japonicus*, 165
— *longicirratus*, 165
— *megacetabulus*, 165
— oxyurus, **165**, 166, 167
— *skrjabini*, 165
Psilocollaris, 3, **166**
— indicus **166**
Psilostomidae, 56, **164**
Psilostominae **164**
Psilostomum, 164
Pygorchis 156

Renigonius, 280, **287**
— orientalis, **287**, 288
Reptiliotrema, 79
— *indicum*, 81
— *tandani*, 81
Rhabdiopoeus, 298
Rhabdiopoeidiae, 263, **298**

Saakotrema, 125, **138**, 139
— metatestis, 138, **139**, 140
Schikhobalotrema, 184
Schikhobalotrematinae, 183

Singhiatrema, 3, **122**
— hyderabadensis, 122, **124**
— longifurca, **122**
— singhia, **122**, 123
Singhiatrematinae, 58, **121**, 151
Singhia, 3, **118**
— thapari, **118**
Singhiinae, 58, **118**
Sharmaia, 169, 170
— *gatesi*, 169
Skrjabinophora, 84
Skrjabinovermiinae, 157
Skriabinovermis, 159
Sobolevistoma, 141
Solenorchiinae, 193, **259**
Solenorchis, 259
Sphaeridiotreminae, 164
Stephanoprora, 10, 125, 138, **141**
— fusca, 142, **143**
— gigantica, 142, **145**, 146
— nigerica, 142, **145**, 147
— ornata, 142
— pennanti, **142**
— reynoldi, 142, **143**, 144
Steringophoridae, 304
Steringophorus, 305
— *lethrini*, 306
Stictoderidae, 374
Stunkardia, **241**
— dilymphosa, **242**, 243
Strigeatoidea, 1, **52**, 53
Synechorchis, 292

Tagumaea, 239
— *heterocerca*, 240
— (Tamerlania) indica, 341
Taisiinae, 341
Taprobanella, 298, **299**
— bicaudata, **299**, 300
Taprobanellinae, **298**
Tanaisia, **341**
— fedtschenkoi, 341
— (Tamerlania) indica, **341**, 342
Tanaisiinae, 341
Teloporiinae, 279
Testifrondosa, 79
Testifrondosa cristata, 80
Testisacculus, 79
— *indicum*, 81
Thaparotrema, 345
— *vittelani*, 360
Tracheophilus, 338
Tubanguia, 380, 381
Typhlocoelinae, 324, **337**
Typhlophilus, 338
Typhlocoelum, 337, **338**
— *americanum*, 338
— *asperum*, 338
— cucumerinum, 337, **338**, **339**
— *obovale*, 338
— *reticulare*, 338
— *shoevllus*, 338, **339**
— sinowi, 338

Uvitellina, 332
— *adelpha*, 332
— *indica*, 332
— *keri*, 332
— *macroisophaga*, 332
— *magniembria*, 332
— *pseudocotylea*, 332
— *tageri*, 332
— *vanelli*, 332

Waretrema, **189**
— piscicola, **190**, 191

Velamenophorus, 125
Vermatrema, 71

Waretrematidae, 188
Waretrematinae, **189**
Watsonius, **234**
— watsoni, **235**
Wellmanius, 224
— wellmani, 225
Wildesia, 292

Yamagutia, **310**
— lateroporus, **310**, 311

Zeugorchis, 151
Zygocotyle, 241
Zygocotylinae, 193, **241**