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NEUE UND WENIG BEKANNTE PHASMOIDEN AUS DEM INDIAN MUSEUM, CALCUTTA.

Von KLAUS GÜNTHER, *Dresden*.

Herr Dr. B. Prashad, Director, Zoological Survey of India, Indian Museum, Calcutta hatte die Liebenswürdigkeit, mir das noch unbestimmte ziemlich umfangreiche Phasmoidenmaterial seines Museums zur Bestimmung anzuvertrauen, und ich danke ihm auch an dieser Stelle dafür. Dies Material enthält eine grosse Anzahl seltener und mir in den Sammlungen anderer Museen bisher nicht zu Gesicht gekommener Arten; mehrere darunter waren neu, und von diesen wieder die meisten werden anschliessend beschrieben. Daneben konnten in einigen Fällen die bisher unbekannten ♂♂ oder ♀♀ nur in einem Geschlecht beschriebener Arten bekannt gemacht und Beiträge zur Synonymie der Phasmoiden gebracht werden.

Auffällig, wenn auch zahlreichen Parallelen in anderen Insekten- und sonstigen Tierordnungen vergleichbar, ist der fast völlige Mangel, selbst in dem reichen mir vorgelegten Material des Indian Museum, an Phasmoidenarten aus der eigentlich indischen Subregion im Sinne Wallace's, also Vorderindiens mit Ausnahme des Südens und der Gebirge und waldigen Hügelländer im Norden. Dies trockene Steppengebiet bietet auch den orientalischen Phasmoidengattungen mit ihren dem tropischen Urwald angehörigen Arten keine ökologischen Möglichkeiten, und so finden wir denn, ebenfalls parallel zu den Verhältnissen in anderen Insektengruppen, in jenem von Steppen bedeckten vorder-indischen Raum nur einige wenige Arten der afrikanischen Phasmoidengattung *Ramulus* Sauss. (= *Gratidia* auct.) und ihrer nächsten Verwandtschaft. Einige wenige *Ramulus*-Arten aus Indien sind bereits beschrieben, und etwa die gleiche Anzahl noch unbeschriebener lagen mir aus dem Indian Museum vor; sie hier zu beschreiben und zu benennen wagte ich nicht, da heute weit über 100 zu *Ramulus* Sauss. gestellte Arten aus Afrika beschrieben sind, die mir bisher zum grössten Teil unbekannt blieben.

Im folgenden sind neu beschrieben oder sonst behandelt:

PRISOPINAE.

Ignacia lobatipes, n. sp., ♀, Ecuador.

Prisopus ariadne Hebard, ♀, Colombia.

Korinnis errans, n. sp., ♀, "Nordost Assam" (? : Borneo!).

PACHYMORPHINAE.

Rhamphophasma spinicorne (Staal), ♂ ♀, Calcutta.

PRISOMERINAE.

Acacus sarapacus (Westw.) 1859 (= *Bacteria sinkiebensis* W.-Mas. 1878), Insel Siukep.

Menexenus semiarmatus (Westw.) 1848 (= *Menexenus crisiatus* Br. 1907, = *Lonchodes contractus* Br. 1907), Assam.

Menexenus tenmalainus, n. sp., ♂ ♀, Südindien.

Prisomerus coronatum (Br.) 1907 (= *Sitheneboea esuriens* Br. 1907), Ceylon.

PHIBALOSOMINÆ.

- Pericentrus bicoronatus* (Westw.) 1848 (= *Pericentrus mōwisi* Redt. 1908)
♂, Nordostindien (♂ bisher unbekannt).
Pericentrus pinnatus Redt. 1908, ♂, Sikkim (♂ bisher unbekannt).

NECROSCIINÆ.

- Paradiacantha aeneicollis* Redt. 1908 (= *Marmessoidea flavomarginata* Redt. 1908), ♂.
Paradiacantha ? *marginata* (Br.) 1893, ♂ ♀, Nieder Birma (♀ bisher unbekannt).
Asceles glaber, n. sp., ♂ ♀, Nieder Birma.
Asceles annandalei, n. sp., ♀, Travancore.
Sipyloidea ? *nitida*, n. sp., ♀, Assam.
Sipyloidea ? *acanthonotus*, n. sp., ♀, Sulu Inseln.
Sosibia ocellata, n. sp., ♀, Insel Sinkep.
Orthonecroschia errans, n. sp., ♂ ♀, Borneo.

Ignacia lobatipes, n. sp.

1 ♀, "Ecuador"

Stumpf braun, von der Farbe vertrockneten Laubes, Costalteil der Elytren nur wenig dunkler. Kopf flach, nach hinten verjüngt, Augen kugelig heraus tretend; Antennen fehlen dem einzig vorliegenden Exemplar völlig. Pronotum länger als breit, aber kürzer als der Kopf; Mesothorax wieder ein wenig länger, oben runzelig und höckerig, mit flacher, bald verlöschender mittlerer Längsfurche vom Vorderrand aus, mit grösseren spitzen Höckern halbseitlich und am Seitenrande des nach hinten deutlich verschmälerten Tergites. Mesopleuren rauh, nach vorn spitz zulaufend verengt, da das Tergit mit seiner spitz seitlich herunter gezogenen Vorderecke an das Sternit stösst. Metapleuren ziemlich glatt, mit 1 oder 2 kleinen rundlichen Höckern. Elytren mit netzförmig unregelmässiger ziemlich dichter Aderung, mit nach oben seitlich scharfkielig erhobenem, nach vorn gewendeten und sehr spitz endenden Buckel. Alae bis zum 8. Abd.-Segment nach hinten reichend, Deckteil einfarbig, häutiger Teil leicht rauchig. Die letzten Segmente fehlen dem Tier. Unterseite bis auf das fein granulierte und gekielte Mesosternum ziemlich glatt.

Beine deutlich kantig. Schenkel unten und Schienen an den Kanten dicht ganz kurz behaart. Kanten der Schienen mit verwaschen helleren Partien, daher erscheinen sie unregelmässig gewellt. Die 4 hinteren Schenkel oben mitten zwischen ihrer Mitte und dem distalen Ende bogig aufgetrieben, und hier oben mit einem niedrigen, lang gezogenen Lappenpaar, dessen oberer Rand nicht ganz regelmässig verläuft; Unterseite dieser Schenkel mit 3 Lappenpaaren, deren proximales sehr klein und an den Hinterschenkeln nur angedeutet ist, deren beide andere aber recht gross, nach hinten stumpf gerundet ausgezogen sind. Die 4 hinteren Schienen an der Basis auf ein Fünftel ihrer Länge deutlich schwach gebogen. Tarsen lang und kräftig, Metatarsen aber kürzer als die übrigen Tarsalglieder zusammen genommen.

Körperlänge ? Länge des Mesonotums 5 mm., des Metanotums mit Segm. med. 9 mm., der Elytren 9 mm., der Alae 55 mm.; Länge der Vorderschenkel 19 mm., der Mittelschenkel 12.5 mm., der Hinterschenkel 16 mm., der Hinterschienen 17 mm. der Hintertarsen 10 mm.

Die bisher einzig bekannte Art der Gattung, *Ignacia auriculata* Bol., kenne ich nicht; die das Genuscharacteristicum darstellende Aufbuchtung der Oberseite an den 4 Hinterschenkeln scheint nach Hebard's Abbildung in *Proc. Acad. Nat. Sci. Philad.*, LXXVI, 1924, tab. v, fig. 11, dem Schenkelapex näher zu liegen als bei der hier als neu beschriebenen Art. Diese scheint sonst mit *I. auriculata* Bol. in der Gestalt der Elytren überein zu stimmen, die wenigstens für deren ♀ ähnlich beschrieben sind. Obwohl nur ein einziges, noch dazu verstümmeltes Exemplar vorlag, wagte ich die Art zu beschreiben, da sie durch ihre gelappten 4 hinteren Schenkel sowohl neben *I. auriculata* als auch neben allen bekannten Arten der Gattung *Pseudophasma* Kirby sehr gut charakterisiert ist. Ueber ihre genaue Herkunft ist nichts fest zu stellen; das Exemplar trägt neben seiner summarischen Fundortangabe nur den Vermerk: "Purchased"

Prisopus ariadne Hebard 1923.

1 ♀, Colombia, Muzo.

Unzweifelhaft zu dieser Art gehörig (*Trans. Amer. Ent. Soc.*, XLVIII, 1923, p. 352, tab. xiv, figg. 3-8).

Korinnis errans, n. sp.

1 ♀ "Sibsagar, Nordost Assam, S. E. Peal leg.": diese Angabe ist sicher falsch, das Tier stammt wahrscheinlich aus Borneo.

Sehr ähnlich *Korinnis potameis* K. Gthr. (vgl. *Zool. Anz.*, CI, 1932, p. 67, Abb. 1). Hellbraun, an Elytren und Alae gelbbraun, Mesonotum, Abdomen und Unterseite schwach glänzend. Kopf länger als breit, nach hinten verjüngt, Augen kugelig stark vorstehend, Antennen einfarbig, bis über die Mitte des Abdomens nach hinten reichend, defect; zwischen den Augen eine ganz schwach eingesenkte, ungefähr runde Stelle, ziemlich dicht mit rundlichen, grossen und glänzenden Graneln bedeckt; dahinter eine vor dem Hinterrand des Kopfes verlöschende, schwache mittlere Längsfurche, jederseits von ihr, sehr zerstreut, einige wenige, rundliche, grosse und glänzende Graneln. Pronotum mit tiefer Quersfurche vor der Mitte und mit schwächerer mittlerer Längsfurche, die auf der Metazona verlöscht und an ihren Seitenrändern, besonders auf der Metazona, einige grössere Graneln aufweist; am Vorderrande 2 ziemlich weit von einander entfernt stehende deutliche Dornen. Mesonotum durchgängig mit nicht sehr dicht stehenden grossen flachen Graneln bedeckt, sonst unbewehrt; unmittelbar hinter der Mitte ist am Seitenrande des Tergits eine schräg zur Mittellinie weisende Linie von Graneln frei; Mesopleuren ebenfalls glänzend und deutlich granuliert. Elytren fast so breit wie lang und fast rund, mit niedrigem aber deutlichem Buckel vor der Mitte, ziemlich eng netzförmig geadert. Alae reichen nach hinten bis ans 9. Abd.-Segment; ihr Deckteil einfarbig, ihr häufiger Teil milchig, fast unmerklich rosa. Abd.-Segmente nach hinten an Länge gleichmässig abnehmend, glatt; das letzte nur $\frac{1}{2}$ so lang wie das 9., hinten fast grade, mit lancettlich spitzer, sehr schmaler lamina supraanalis, die so lang wie das Analsegment ist. Cerci wenig länger als das Analsegment, kräftig, zum Ende hin abgeplattet, aber nicht

verjüngt. Operculum dünn, glänzend, am Hinterrande deutlich schmal ausgeschnitten.

Prosternum glatt, Mesosternum wie Mesotergit granuliert, Metasternum wieder glatt, mit fast unmerklicher, überaus feiner mittlerer Längsfurche und zwischen den Hinterhüften mit eingedrückter Partie, die länger als breit, nach vorn durch einen Wulst begrenzt, und an diesem mit 2 neben einander liegenden kleinen Gruben versehen ist. Sternite glatt.

Beine nicht sehr lang, Vorderschenkel an der Basis eingebogen, nirgends verbreitert, sämtliche Schenkel deutlich kantig. Schienen mit sehr deutlicher area apicalis. Metatarsen kürzer als die übrigen Tarsalglieder zusammen genommen.

Körperlänge 51 mm.; Länge des Mesonotums 6·5 mm., des Metanotums mit Segm. med. 8·5 mm.; Länge der Elytren 3 mm., der Alae 36 mm.; Länge der Vorderschenkel 11 mm., der Mittelschenkel 8 mm., der Hinterschenkel 12 mm.

Die einzige andere Art der in ihrer systematischen Stellung ungeklärten Gattung ist *Korinnis potameis* K. Gthr. 1932 (*l.c.*), von der die neue Art sich durch ihr unbedornetes Mesonotum, die Einfarbigkeit, die freilich nicht ursprünglich zu sein braucht, und den granulierten Kopf unterscheidet. Die citierte Fundortangabe findet sich im Indian Museum an zahlreichen Phasmoiden, die zum grossen Teil unmöglich von dort, sondern nur von Borneo und NeuGuinea stammen können, so dass ich sie auch in vorliegendem Falle für falsch halte.

Rhampophasma spinicorne (Staal) 1873.

1 ♂, 1 ♀, Calcutta.

Das ♀ hat eine Länge von 108 mm und stimmt mit den Beschreibungen Brunnens und Staals überein; sein Operculum ragt ein wenig über das Ende des Analsegmentes. Als ♂ nehme ich hier ein schwächtiges Tier von 80 mm. Gesamtlänge an, das keine Kopfdornen besitzt und dessen Vorderschenkel sehr schmal und nicht gesägt sind. Das Analsegment ist in schmale Loben ausgezogen, die etwas kürzer als der übrige Teil dieses Segmentes sind, aber graden oberen Rand zeigen. Die Cerci sind kürzer als die Loben, gleichmässig ziemlich kräftig, ganz wenig gekrümmt und am Ende abgeschnitten; vor ihrer Wurzel sind die Seitenränder des Segmentes unten über einander geschlagen. Die lamina subgenitalis reicht bis ans Ende des 9. Segments und ist am Hinterrand ganz wenig eingekerbt. Schenkel unten mit einem ganz niedrigen stumpfen Zahn vor dem Apex. Metatarsus an den Mittel- und Hinterbeinen (vorn fehlen sie dem Tier) so lang oder etwas länger als die übrigen Tarsalglieder zusammen.

Körperlänge 80 mm.; Länge der Vorderschenkel 35 mm., der Mittelschenkel 23·5 mm., der Hinterschenkel 29 mm., der Hinterschienen 33·5 mm., der Hintertarsen 10 mm.; Länge des Mesonotums 17 mm., des Metanotums mit Segm. med. 13 mm., des Segm med. 1·5 mm.

Bis auf die Grösse stimmt dieses ♂ mit der Beschreibung von *Baculum angustius* Br. 1907 überein, die freilich sehr kurz ist.

Acacus sarawacus (Westw.) 1859.

Bacteria sinkiebensis, Wood-Mason, *Journ. Asiatic Soc. Bengal*, XLVI, (1877), 1878, p. 343. (nov. synonym.).

1 ♀, Insel Sinkep (östl. Sumatra).

Dies Tier von der terra typica der Wood-Mason'schen Art entspricht vollkommen der Beschreibung dieses Autors, vollkommen aber auch der Beschreibung und Abbildung Westwoods für dessen *Bacteria sarawaca*, die heute Genustypus von *Acacus* Br. 1907 ist. So ist also *Bacteria sinkiebensis* Wood-Mason (die Brunner für seine Monographie übersehen hat; Kirby 1904 in seinem Catalogue führt sie bei *Staelonchodes* Kirby) unzweifelhaft synonym zu *Acacus sarawacus* Westwood. Die Art liegt mir nicht selten und aus mehreren Museen von Nordborneo vor, ist mir aber aus Sumatra bisher nicht bekannt geworden, obschon sie Kirby (Catalogue 1904) von dort angibt.

Menexenus semiarmatus (Westw.) 1848.

Acanthodera semiarmata, Westwood, *Cab. Orient. Ent.*, 1848, p. 15, tab. vii, fig. 1, ♀.

Acanthoderus semiarmatus, Westwood, *Cat. Phasm.*, 1859, p. 50, ♀.

Menexenus semiarmatus, Brunner, *D. Insektenfam. d. Phasm.*, 1907, p. 243, ♀.

Menexenus cristatus, Brunner, *l.c.*, p. 244, ♀. (nov. synonym.).

Lonchodes contractus, Brunner, *l.c.*, p. 260, ♂. (nov. synonym.).

Die Art liegt mir in beiden Geschlechtern—das ♂ ist als *Lonchodes contractus* Br. beschrieben—zahlreich aus den Museen Calcutta, Hamburg und Stockholm vor, von Nordindien (Assam, Sikkim, Sylhet). An der Zusammengehörigkeit der Geschlechter kann kein Zweifel bestehen. Die Körperlänge variiert stark, welchem Umstande auch Brunner in seinen Maassangaben Rechnung trägt; die Variabilität in der Ausprägung einfacher Dornen oder mehrspitziger kleiner Kämme an den Hinterrändern der Abd.-Segmente, wie sie besonders das Material in Calcutta gut zeigt, begreift den *Menexenus cristatus* Br. in die Westwood'sche Art ein.

Menexenus tenmalainus, n. sp.

1 ♂, 2 ♀♀, Südindien, Tenmalai, Courtallam, H. S. Rao leg., 28.x. 1926; 1 ♂, Südindien, Courtallam, 16. xi. 1921.

Im Habitus ähnlich manchen Arten der papuanischen Gattung *Neopromachus* G.-Tos., wie etwa *N. doreyanus* Bates. Körperoberfläche mit grossen Dornen bewehrt, sonst lederig, ziemlich dicht mit kleinen grauen Graneln bedeckt, braun.

Kopf länger als breit, nach hinten wenig verjüngt, mit deutlich heraus tretenden, kugeligen, aber ziemlich kleinen Augen und undeutlich ca. 40-gliederigen Antennen, deren einzelne Glieder zunächst zunehmend länger, vom 25. oder 30. an aber gleichmässig ziemlich kurz und hier beim ♂ behaart sind; sie sind $1\frac{1}{2}$ Mal so lang wie die Vordersehenkel. Kopf nicht gewölbt, Hinterkopf oben mit platter oder ganz schwach concaver grösserer Partie, die jederseits halbkreisförmig mit je 3-4 kleinen Dörnchen umstellt ist; zwischen den Augen ein deutliches Dornpaar. Pronotum mit 2 kleinen Dornen mitten am Vorderrande, mit 2 grossen, ziemlich entfernt von einander stehenden Dornen auf

der Metazona, Querfurche deutlich. Vom Mesonotum bis zum Abdominalende ziemlich scharfer Mittelkiel. Mesonotum oben mit je einem Paar weit aus einander stehender Dornen hinter dem Vorderrande, in der Mitte und am Hinterrande, die in der Mitte sind am grössten; mit je 4 Dornen, deren erster wenig vor der Mitte, deren letzter fast an den Hinterecken steht, an den Seitenrändern, und mit einem dicht neben einander auf erhöhter Struma stehenden Dornpaar oben in der Mitte. Zu Beginn des letzten Viertels der Mesonotumlänge beginnt am Seitenrand eine schräg nach innen und hinten verlaufende schwache Leiste, die jedoch den Mittelkiel nicht erreicht; in diesem letzten Teil des Mesonotums sind die Seitenränder (mit je 2 der erwähnten Seitenranddornen) wulstig erhöht, nach innen durch eine schwache Furche abgesetzt. Metanotum (*s. str.*) mit Dornpaar auf Struma vor der Mitte, jederseits davon mit einem grösseren, stark auswärts gerichteten Dorn, am Hinterrande mit 4 Dornen, deren mittlere kleinere weit auseinander und jeweils den seitlichen grösseren näher stehen, diese fast an den Hinterecken; je ein Dorn an den Seitenrändern dicht hinter der Mitte. Segm. medianum mit 2 sehr kleinen weit aus einander stehenden Dornen am Hinterrande, mitten dazwischen mit 2 undeutlichen spitzen Tuberkeln, mit je einer halbseitlichen Längsleiste, die beim ♀ undeutlich ist. Abd.-Segmente beim ♂ wenig länger als breit, beim ♀ breiter als lang, 2.-8., beim ♀ 2.-9., mit nach hinten an Grösse sehr abnehmenden je 4 Dornen am Hinterrande, deren mittlere kleinere, beim ♂ nur spitze Höcker, eng beisammen, deren seitliche grössere, aber an den letzten vier der genannten Segmente auch sehr kleine Dornen halbseitlich stehen; jederseits vom Mittelkiel mit einer gekrümmten, besonders beim ♀ aber undeutlichen und hier eigentlich nur in der hinteren Segmenthälfte wahrnehmbaren Leiste. Analsegment des ♂ länger als 9. Segment, zusammen gedrückt, am Hinterrande wenig ausgeschnitten, jederseits von diesem Einschnitt hinten breit abgerundet; beim ♀ wenig länger als 9. Segment, hinten weit deutlich ausgerandet, mit stumpf zugespitzter lamina supraanalis, die gekielt und fast so lang wie das Analsegment und länger als breit ist. Cerci beim ♂ kaum, beim ♀ garnicht heraus ragend, beim ♂ stumpf und dick endend, beim ♀ breit, flach und stumpf endend. Lamina subgenitalis des ♂ wenig bauchig, unten mitten mit stumpfem Höcker, von ihm bis zum ganz flach concaven Hinterrand längs gekielt; beim ♀ fast flach, hinter dem ersten Drittel seiner Länge scharf längs gekielt, spitz abgerundet, bis zur Mitte des Analsegmentes reichend.

Meso- und Metapleuren mit je 1 (Metapleuren beim ♀ auch 2) Dornen am Rande des Hüftloches, sonst unbewehrt; Prosternum mit beim ♂ scharf und erhöht gerandeter, beim ♀ nach vorn verjüngter Längsfurche. Mesosternum stumpf längs gekielt, Metasternum und Ventrите einfach, glatt. Hüften mit je 1 kleinen Dorn; Beine deutlich kantig, glatt bis auf kleine Genicularzähne der Schenkel oben und an den Seiten. Vorderschenkel an der Basis sehr deutlich eingebogen, dahinter ganz wenig verbreitert. Tarsen sehr kurz, besonders 2.-4. Tarsenglied, Metatarsus kürzer als die übrigen Tarsalglieder zusammen.

Körperlänge ♂ 45, ♀ 52 mm.; Länge des Mesonotums ♂ 10, ♀ 11.5 mm. des Metanotums mit Segm. med. ♂ 7.5, ♀ 8 mm., des Segm. med.

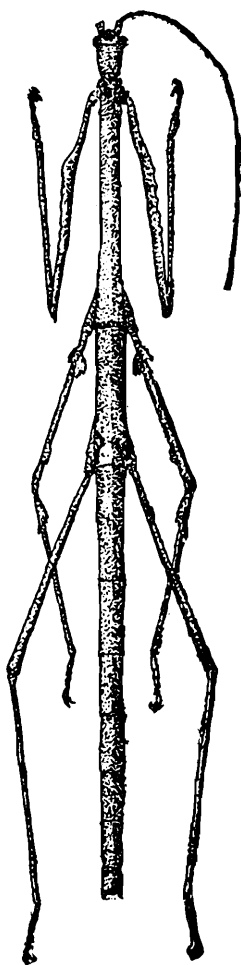
♂ 1·8, ♀ 2·2 mm.; Länge der Vorderschenkel ♂ 14, ♀ 13·5 mm., der Hinterschenkel ♂ 14, ♀ 13·5 mm., der Hinterschienen ♂ 18, ♀ 15 mm., der Hintertarsen ♂ 4, ♀ 4 mm.

Die nicht deutlich gegliederten langen Antennen verweisen die Art in die Unterfamilie der Prisomerinae, wo sie am besten bei *Menexenus* Staal steht; von den vielen dort beschriebenen Arten unterscheidet sie sich sofort durch die lange lamina supraanalis der ♀♀. Die als *Eupromachus alienigenus* Br. 1907 beschriebene Art (von Nordindien; kann nicht ins papuanische Genus *Eupromachus* Br. gestellt werden) gehört vielleicht in die Verwandtschaft der neuen Art; ich kenne sie nicht.

***Prisomera coronatum* (Br.) 1907**

Clitumnus coronatus, Brunner, *D. Insektenfam. d. Phasm.*, 1907, p. 196.
Stheneboea esuriens, Brunner, *l.c.*, p. 251. (nov. synonym.).

Die Type des *Clitumnus coronatus* Br. habe ich im Museum Berlin gesehen; die ohnehin für eine Pachymorphine sehr langen Antennen des Exemplares sind defect und würden also unversehrt noch länger



Prisomera coronatum Br., Holotypus ♀.

sein. Unzweifelhaft identisch ist diese Art mit der als *Stheneboea esuriens* Br., auch von Ceylon beschriebenen; die von Brunner als *Stheneboea* Staal geführte Gattung muss *Prisomera* Gray heissen, *Prisomera* Br. (nec Gray) ist als *Lonchodes* Gray zu führen. *Prisomera coronata* fand ich nicht im Material des Indian Museum.

Pericentrus bicoronatus (Westw.) 1848.

Acanthodera bicoronata, Westwood, *Cab. Orient. Ent.*, 1848, p. 15, tab. vii, fig. 2.

Acanthoderus bicoronatus, Westwood, *Cat. Phasm.*, 1859, p. 50.

Sthenoboea bicoronata Brunner, *D. Insektenfam. d. Phasm.*, 1907, p. 250.

Pericentrus möwisi, Redtenbacher, *D. Insektenfam. d. Phasm.*, 1908, p. 352, tab. xvi, fig. 10. (nov. synonym.).

2 ♂♂, Nordindien, Assam und Mungphu; 1 ♀ Kurseong.

Die Art ist nur nach den ♀♀ beschrieben, an der angegebenen Synonymie kann kein Zweifel bestehen; ich sah den Typus von *Pericentrus möwisi* Redt. im Museum Berlin. Hauptsächlich wegen der sehr deutlich gegliederten Antennen halte ich die Art nicht für zur Subfamilie der Prisomerinae gehörig und lasse sie also in der Gattung *Pericentrus* Redt. 1908, deren Generotypus sie bildet, bei den Phibalosominae stehen, im Anschluss an Redtenbacher.

Die oben genannten ♂♂ halte ich für die noch unbeschriebenen ♂♂ dieser Art:

♂: Schlank, ähnlich *Prisomera mimas* Westw. 1859 und besonders *Prisomera spinosissima* Redt. (beide nur als ♂♂ bekannt, von Ceylon), vielleicht auch nahe verwandt mit ihnen. Kopf nach hinten verjüngt, gewölbt, mit kugeligen Augen, deutlich 28-gliederigen Antennen, einem deutlichen Dornpaar zwischen den Augen, und mit einer Corona von 6 deutlichen Dornen auf der Hinterhauptshöhe und einigen kleineren Spitzen auf deren hinterem Abfall: 4 Dornen stehen in einer Reihe, von denen die seitlichen die grösseren sind und sehr stark seitlich divergieren, während das mittlere Paar kleiner und mehr aufrecht ist; hinter dieser Reihe steht ein Paar kleinerer Dornen auf der höchsten Erhebung des Kopfes. Alle diese Dornen haben secundäre Höcker. Sonst trägt der Kopf einige wenige undeutliche Graneln; die mit einem Dornpaar bewehrte Stelle zwischen den Augen ist von einer kreisförmigen, ganz schwach vertieften Linie umgeben und mit einer undeutlichen Mittellängsfurche versehen. Pronotum mit 4 spitzen Tuberkeln am Vorderrande, mit deutlicher Querfurche ein wenig vor der Mitte, unmittelbar vor jener Furche am Seitenrande mit je einer spitzen Tuberkel, ein grösseres Dornpaar am Hinterrand. Mesonotum mit 2 spitzen Tuberkeln zwischen Mitte und Vorderrand, mit je einem dicht stehenden Dornpaar vor und hinter der Mitte und mit einem Paar grösserer und weiter von einander entfernt stehender Dornen in der Mitte, mit je 2 sehr kleinen Dörnchen oder spitzen Tuberkeln am Seitenrande nahe der Mitte und je 2 weiteren am Seitenrande des Tergites über den Hüften; am Hinterrande ein grösseres Dornpaar. Metanotum (s. str.) mit 2 spitzen Tuberkeln vor der Mitte, je einem an den Hinterecken und einem Dornpaar mitten am Hinterrande; Segm. medianum mit 1 Dornpaar am Hinterrande mitten, und vor diesem mit noch einem enger zusammen stehenden Dornpaar. 2.-6. Abd.-Segment mit kurz spitz ausgezogenen Hinterecken und je einem kräftigen Dornpaar am Hinterrande, vor diesem zuweilen noch ein zweites viel kleineres Paar von Dornen oder spitzen Tuberkeln; 7. Abd.-Segment nur mit 2 weit von einander stehenden spitzen Höckern am Hinterrande. 8.-10. Abd.-Segment gekielt, der Kiel auf dem 9. Segment nach hinten deutlich erhöht. Analsegment nach hinten in 2 fingerförmige, von der Seite gesehen, fast gleichmässig sehr schmale, am Ende schwach

verjüngte und deutlich abwärts gekrümmte, 2 mm. lange Loben ausgezogen, die auch von oben gesehen am Ende gegen einander gekrümmt sind und also nicht zusammen liegen, und auf der Innenseite in weiten Abständen scharf gezähnt sind. Cerci 1 mm. weit hinaus ragend, gleichmässig ziemlich breit, aber besonders in ihrer distalen Hälfte sehr flach, am Ende schräg abgeschnitten. Seitenränder des Analsegmentes nach unten umgebogen und an einander stossend. Lamina subgenitalis nach unten in eine stumpfe Spitze ausgezogen, aber deutlich länger als hoch, von jener Spitze zum Hinterrand hin gekielt, hinten rund.

Meso- und Metapleuren mit mehreren spitzen Tuberkeln und je einem kleinen Dorn über den Hüften, sonst glatt; Meso- und Metasternum mit ganz wenigen Graneln, auf dem Metasternum 2 neben einander unmittelbar vor der Hüftregion. 2.-7. Abd.-Sternite mit je 2 Dörnchen oder spitzen Tuberkeln vor dem Hinterrande, sonst glatt; auf dem 8. Ventrit sind diese beiden Hinterrandhöcker kaum noch wahrnehmbar.

Hüften bedornt, Vorderschenkel an der Basis fast grade; alle Schenkel deutlich vierkantig, oben mit je 4, unten mit 4-5 Paaren von spitzen Zähnen, von denen das vorletzte und das drittletzte Paar jeweils die grössten sind, an den Knien seitliche und je 1 oberer Dorn deutlich. Schienen oben mit 3-5 Paaren, nicht neben einander, sondern jeweils ein wenig hinter einander angeordneter spitzer Zähne, die distalwärts an Grösse schnell abnehmen; unten glatt. Metatarsen kürzer als die übrigen Tarsalglieder zusammen genommen.

Körperlänge 40 und 47 mm.; Länge des Mesonotums 10.5 und 12 mm., des Metanotums mit Segm. medianum 6 und 6.5 mm., des Segm. med. 2 mm.; Länge der Vorderschenkel 14 und 16.5 mm., der Mittelschenkel 10.5 und 12 mm., der Hinterschenkel 14 und 16 mm., der Hinterschienen 18 und 20.5 mm.

Ganz sicher ist freilich die Zuordnung dieser Tiere zu *Pericentrus bicoronatus* Westw. nicht. Alle Dornen können ihrerseits mit wenigen spitzen Höckern versehen sein. Von den oben genannten und anderen als ♂♂ beschriebenen *Prisomera*-Arten, ebenso von dem anschliessend beschriebenen ♂ schon durch die Bildung des Analsegmentes verschiedenen.

***Pericentrus pinnatus* Redt. 1908.**

1 ♂, Sikkim, Gangtok, C. H. Dracott leg., 1914 (ex Coll. Lord Carmichael).

Diese ebenfalls nur nach 1 ♀ beschriebene Art (von Bhutan) kenne ich nicht, für das zu ihr gehörige ♂ halte ich ein mir vorliegendes Tier, das den vorher zu *P. bicoronatus* gestellten ♂♂ zwar sehr ähnlich, dennoch aber charakteristisch von ihnen verschieden ist.

♂: Ähnlich den vorher beschriebenen ♂♂ und auch *Prisomera mimas* Westw. und *Prisomera spinosissimum* Redt. von Ceylon, besonders den vorstehend beschriebenen ♂♂ in der Bewehrung ähnelnd, braun, ausser den Dornen glatt.

Der nach hinten verjüngte gewölbte Kopf mit stark kugelig hervorstehenden Augen, mit einem grösseren Dornpaar zwischen ihnen und einer Corona von 8 Dornen auf dem Hinterhaupt: 4, von denen die

seitlichen sehr nach aussen weisen, in der ersten Reihe, dahinter 2 mehrspitzige auf der Höhe der Wölbung, dahinter 2 kleine. Pronotum am Vorderrande mit einem kleinen, am Hinterrande mit einem grossen Dornpaar, mit je einem deutlichen Dorn am Seitenrande unmittelbar vor der schwach entwickelten Querfurche. Mesonotum mitten zwischen Mitte und Vorderrand mit 4 unregelmässig neben einander stehenden Dornen, deren mittlere sehr klein sind, ganz dicht vor und hinter der Mitte mit je einem eng stehenden Dornpaar, in der Mitte mit 4 neben einander stehenden Dornen, von denen die mittleren klein, die äusseren aber recht gross, mehrspitzig und stark nach aussen gerichtet sind. Seitenrand in und vor der Mitte mit 3 Dornen, über den Hüften mit 2 kleineren Dörnchen, Hinterrand mit einem Dornpaar. Metanotum mitten mit 2, an den Seitenrändern mit 3 spitzen Tuberkeln, deren letzter vor den Hinterecken steht, am Hinterrand mit einem Dornpaar. Segm. medianum mit einem kleinen Dornpaar am Hinterrande, davor mit 2 spitzen Tuberkeln. 2.-5. Abd.-Segment mit je 2 deutlichen hinter einander gestellten Dornpaaren am Hinterrande, 6. Abd.-Segment, mit je einem Paare spitzer Tuberkeln vor und hinter der Mitte und mit 2 kleinen weit von einander stehenden Dornen am Hinterrande, 7.-9. Abd.-Segment gekielt, der Kiel auf dem 9. nach hinten zu niedriger Crista ansteigend, die beiden letzten Segmente sehr kurz. Hinterecken des 2.-9. Segmentes spitz, am 3.-6. sehr lang, am 4.-6. zweispitzig ausgezogen. Analseg. mit unten einander genäherten Seitenrändern, längs gefurcht, am Hinterrande mit spitz und kurz ausgezogenen Hinterecken; mitten tief eingeschnitten, aber ohne ausgezogene Loben, an den eng an einander liegenden Rändern des Einschnittes ganz schwach spärlich gezähnt. Cerci wie bei der vorigen Art ziemlich breit, ganz flach comprimiert, mit verdickter Mittelleiste, am Ende zugespitzt. Operculum nach unten stumpf kegelig ausgebaucht, viel länger als hoch, mit spitz abgerundetem Hinterrande, mit einem Paar deutlicher Höcker auf dem hinteren gekielten Abfall.

Meso- und Metapleuren über den Hüften mit je 1 deutlichen kleinen Dorn und mit spitzen Tuberkeln, sonst glatt; Mesosternum mit 4, Metasternum mit 2 Paaren von spitzen Tuberkeln hinter einander, die deutlichsten jeweils unmittelbar vor der Hüftregion. 2.-7. Abd.-Sternit mit je 2 Paaren spitzer Tuberkeln in der Mitte und davor; am Hinterrande 2.-4. Sternit mit 4 kleinen, 5. und 6. Sternit mit 4 ziemlich langen Dornen neben einander, deren mittlere am 6. Sternit auf gemeinsamer Basis stehen; 7. und 8. Sternit mit 2 weit von einander entfernt fast an den Hinterecken stehenden Dornen, 7. ausserdem noch in der Mitte des Hinterrandes mit einem als die seitlichen Dornen längeren, am Distalende eingekerbten und gleichmässig schmalen Lappen, der nach hinten offen, über seine Länge halbrohrförmig zusammen gekrümmt ist. Hüften mit 2, Trochanteren mit 4 Dornen; Schenkel und Schienen deutlich kantig, Vorderschenkel an der Basis grade. Schenkel oben und unten mit 5-6 spitz nach hinten gerichteten Zahnpaaren, deren 3 proximale recht klein sind, am grössten sind das vorletzte und das drittletzte Paar; Schienen oben mit 5-6 Paaren ähnlicher, nicht jeweils genau neben einander gestellter Zähne, 3. und 4. Paar sind hier am grössten. Metatarsus an den Mittelbeinen deutlich kürzer als die übrigen Tarsalglieder zusammen, an den hinteren fast so lang.

Körperlänge 39 mm; Länge des Mesonotums 9 mm., des Metanotums mit Segm. med. 4·5 mm., des Segm. med. 1·5 mm.; Länge der Vorder-schenkel 16 mm., der Mittelschenkel 13·5 mm., der Hinterschenkel 16 mm., der Hinterschienen 16 mm.

In der Bewehrung ähnelt diese Art am meisten den vorher als die von *Pericentrus bicoronatus* Westw. beschriebenen ♂♂ und unterscheidet sich darin auch von den habituell ähnlichen aus Ceylon nur als ♂♂ beschriebenen *Prisomera* (Gray nec Br. = *Stheneboea* Br. nec Gray)-Arten. Diesen aber ähnelt sie wiederum in der Gestalt des Analsegments, in der sie sich von den vorher beschriebenen ♂♂ scharf unterscheidet. Wegen der augenscheinlichen nahen Verwandtschaft zu dem vorher beschriebenen halte ich auch das hier vorliegende ♂, obwohl ihm die Antennen fehlen, für zu *Pericentrus* Redt. gehörig, und da es jenem gegenüber mit der Beschreibung des *Pericentrus pinnatus* Redt. 1907 ♀ (Bhutan) viele Gemeinsamkeiten, besonders in der Bedornung der Abd.-Tergite und -Ventreite aufweist, nehme ich es hier als ♂ von *P. pinnatus* Redt. an.

***Paradiacantha aeneicollis* Redt. 1908.**

Paradiacantha aeneicollis, Redtenbacher, *D. Insektenfam. d. Phasm.*, 1908, p. 506.
Marmessoidea flavomarginata, Redtenbacher, *l.c.*, p. 512. (nov. synonym.).

2 ♂♂, "Moolai" (?).

Der schwach und nach hinten kantig gewölbte Hinterkopf dieser Tiere ist mit mehreren Dörnchen und spitzen Tuberkeln bestanden, von denen nur die vorderen grössten paarweise neben einander stehen.

Ich habe keinen Zweifel an der Synonymie der oben zusammen gestellten Arten; da sie nur als ♂♂ beschrieben sind, die Unterschiede zwischen *Paradiacantha* Redt. und *Diacanthoidea* Redt. aber im Operculum der ♀♀ liegen, kann die Species nicht sicher zu einer der beiden Gattungen gestellt werden. Bei ihrer auffälligen Aehnlichkeit aber mit der folgenden, sicher zu *Paradiacantha* gehörigen Art ziehe ich es vor, auch die hier in Rede stehende dort hin zu stellen. Die Maasse der hier vorliegenden Tiere sind; Körperlänge 76 mm., Länge des Mesonotums 14 mm., der Hinterschenkel 20 mm.; Mesonotumbreite mitten 1·4 mm.

Einige weitere (3: Penang; Assam, Margherita; "Timor") mir vorliegende ♂♂ sind wohl kaum grösser (Mesonotumlänge 14-16·5 mm), aber kräftiger (Mesonotunbreite mitten 1·6-1·9 mm) und stärker granuliert: auch das Pronotum trägt bei ihnen Graneln, und die des Mesonotums können besonders hinter dem Vorderrande als spitze Tuberkeln ausgebildet sein: alle diese Tiere sind verstümmelt und entbehren zumindest der letzten Abd.-Segmente. Ob sie zu der hier besprochenen, ob zu einer anderen, ob sie überhaupt zu nur einer Art gehören, kann nicht entschieden werden. *Sosibia esepus* Westw. 1859 (Malacca) wäre hier auch zu vergleichen.

***Paradiacantha* ? *marginata* (Br.) 1893.**

1 ♂, 1 ♀, Nieder Birma, Tavoy; 1 ♀, "Neu Guinea, Andai"

Das ♂ entspricht einiger Maassen der freilich ziemlich unzulänglichen Beschreibung und der Abbildung Brunner's, die nach nur 1 ♂ gemacht

sind, so dass ich das hier vorliegende Exemplar auf die genannte Art beziehen möchte. Im Gegensatz zur Abbildung Brunner's weist es jedoch nicht nur an Pro- und Mesonotum einen feinen schwarzen Mittelstreifen auf, sondern auch auf dem Kopfe, auf dem dann noch kräftige schwarze Postocularstreifen dazu kommen. Granulierung von Kopf, Pro- und Mesonotum, Gestalt und Färbung der Elytren und Alae wie in Brunner's Beschreibung; vorderer Teil der Alae graubraun und hell grau verwaschen marmoriert. Das Analsegment weicht von der Abbildung ab (Brunner erwähnt es in der Beschreibung nicht): es ist zum Ende hin verjüngt, mit, von der Seite gesehen, in der hinteren Hälfte concavem Seitenrand; am Hinterrand mitten eingekerbt, mit kleiner lamina supraanalis. Operculum fast flach, hinten spitz abgerundet, bis zur Mitte des Analsegmentes reichend. Cerci dick, grade, zum Ende hin schwach verjüngt, am Ende stumpf abgerundet. Alle Abd.-Segmente sind gekielt, das letzte nur in der distalen Hälfte.

Das ♀ war bisher unbekannt; vom ♂ unterscheidet es sich durch die Bewehrung des Kopfes und Mesonotums wesentlich: Gelbbraun bis braun, mit schwarzen Mittel- und Seitenstreifen auf Kopf und Thorax, Elytren stumpf dunkel braun, mit schmutzig gelbem Saum seitlich und hinten, Deckteile der Alae dunkel graubraun und schmutzig gelb oder hellgrau verwaschen marmoriert, Beine braun und scherbengelb marmoriert. Kopf schwach, aber deutlich gewölbt, nach hinten kaum verjüngt, mit fast körperlangen, kurz vor der Mitte beginnend 4-5 Mal hell geringelten Antennen, auf dem Hinterkopfe mit 2 deutlichen dicht stehenden Dornpaaren hinter einander und dazwischen einigen spitzen Tuberkeln; die Dornen divergieren fast nicht nach der Seite. Schwarze Mittel- und Postocularstreifen deutlich. Pronotum mit leistenförmig erhabenen Seiten- und Vorderrändern, undeutlicher Querfurche in der Mitte und zuweilen auf Pro- und Metazona unregelmässig gekrümmt verlaufenden schwarzen Linien. Mesonotum besonders längs der schwarzen Mittellinie weitläufig spitz granuliert, mit deutlich gekörneltem Kiel jederseits nahe und parallel dem Seitenrande, in der vorderen Mesonotumhälfte parallel dazu ein weiterer solcher Kiel. In der vorderen Mesonotumhälfte jederseits dicht neben der Mittellinie 3-5 senkrecht stehende Dornen; zwischen diesen Dornenreihen und den Seitenrändern je eine eingedrückte glatte Linie, oft schwarz, ungefähr bis zur Mitte nach hinten reichend. Elytren, in der Ruhelage, nach hinten fast grade abgeschnitten, mit seitlich comprimiertem, ziemlich hohen und stark gekielten Buckel. Alae reichen nach hinten bis zum Ende des 9. Segments, ihr häutiger Teil ist rauchig. 8.-10. Abd.-Segment leicht verbreitert, Analsegment nach hinten verjüngt; Cerci sehr kurz, comprimiert, zum Ende hin nur wenig verjüngt; Operculum fast flach, nach hinten verjüngt, am Ende ausgeschnitten und zweizipfelig.

Meso- und Metapleuren mit gekörnelter erhabener Leiste dicht am Unterrande und parallel zu ihm, Mesopleuren auch in der Mittelpartie mit einer weiteren, nach vorn und hinten bald verlöschenden derartigen Leiste, Pleurenfläche im übrigen zerstreut gekörnelt. Pro- und Metasternum, Ventrите glatt, Mesosternum gekörnelt. Beine deutlich vierkantig, glatt, Vorderschenkel an der Basis deutlich eingebogen,

nirgend verbreitert. Metatarsen kürzer als die übrigen Tarsalglieder zusammen genommen.

Maasse ♀: Körperlänge 77 mm.; Länge des Mesonotums 10 mm., des Metanotums mit Segm. med. 12 mm., der Elytren 7 mm., der Alae 55 mm.; Länge der Vorderschenkel 20 mm., der Mittelschenkel 12 mm., der Hinterschenkel 20 mm.

Das ♀ unterscheidet sich also vom ♂ durch die Dornen, die es auf Kopf und Mesothorax trägt, und auch durch die höheren und schärfer gekielten Elytrenbuckel; die nahe und parallel dem Unterrande verlaufenden granulierten Leisten der Meso- und Metapleuren hat aber auch das hier vorliegende ♂, ebenso, wenigstens in der vorderen Hälfte des Mesonotums, die entsprechenden Leisten auf diesem, wenn auch Brunner in seiner Beschreibung diese Details nicht erwähnt. Die Bildung der Elytren, besonders beim ♀, entspricht der der zur Gattung *Marmessoidea* Br. 1893 gestellten Arten, und in dieses Genus stellte auch Brunner seine *marginata*; wegen des zumindest beim ♀ bewehrten Kopfes ziehe ich es aber vor, die Art zu *Paradiacantha* Redt. 1908 zu stellen. Ungewiss freilich bleibt es, ob die hier zu *Paradiacantha marginata* Br. gestellten Tiere wirklich mit Brunners Typus übereinstimmen.

Ein weiteres dem oben genannten ähnliches ♂ liegt mir aus dem Indian Museum von Nieder Birma, Mergui, vor, ihm fehlt das Abdomen; es ist kleiner (Mesonotum 8 mm.) als das oben erwähnte ♂ von Tavoy, hat hell geringelte Antennen und stimmt mit jenem bis auf die kürzeren, hinten fast ganz grade abgeschnittenen Elytren überein, deren Buckel in der Mitte ihrer Länge, nicht wie beim ♂ von Tavoy vor der Mitte liegt. Ob es zu dieser, ob zu einer anderen Art gehört, ist nicht zu entscheiden.

***Asceles glaber*, n. sp.**

3 ♂♂, Nieder Birma, Tavoy; 1 ♂, "Neu Guinea, Andai"; 2 ♀♀, Nieder Birma, Tavoy; 2 ♀♀, Perak.

Grosse Art, im Habitus der *Aruanoidea aruana* Westw. ähnlich. Oberfläche nirgend deutlich gekörnelt, glatt, nur auf dem Mesosternum lederig. Farbe schmutzig grün bis hell braun, manche Stücke noch dunkler; Elytrenbuckel schwärzlich, Elytren-, oft auch Alaevorder- rand gelblich, das erste an hellfarbigen, das andere an dunkelfarbigen Stücken besonders auffällig. Beine einfarbig, aber bei einem ♀ von Tavoy mit schmal verdunkelten Knieen.

Kopf etwas länger als breit, nach hinten ganz wenig verjüngt, mit ziemlich grossen, kugelig heraus tretenden Augen deutlich vor der Mitte, ohne Ocellen, mit fast körperlangen, in weiten Abständen undeutlich breit hell geringelten Antennen, glatt, einfarbig, ganz schwach gewölbt. Pronotum deutlich schmaler als der Kopf, so lang wie dieser und länger als breit, hinter den Vorderecken verengert, mit vor der Mitte liegender, sehr schwach entwickelter Querfurche und oft heller, sehr schmaler Mittellängslinie, die bei hellfarbigen Stücken beiderseits ganz schmal schwarz gesäumt sein kann. Mesonotum dicht hinter dem Vorderrande parallel zu diesem mit einer schwachen Querleiste, mit sehr feinem, oft hellfarbigen und zuweilen in der hinteren Hälfte verlöschenden

Mittelkiel, der bei hellen Stücken jederseits sehr schmal schwarz gesäumt sein kann, ferner mit sehr feiner und oft nur undeutlich erhabener Leiste nahe und parallel dem Seitenrande; der Raum zwischen ihr und dem Seitenrande kann hell gefärbt sein. Die Fläche des gleichmässig breiten Mesonotums ist besonders in der vorderen Hälfte ganz zerstreut mit ausserordentlich flachen Graneln bedeckt, die oft mehr durch hellere Färbung, als durch wirkliche Convexität markiert sind. Elytren deutlich länger als breit, flach, mit wenig erhöhtem, aber stets deutlichen und mässig spitzen Buckel vor der Mitte. Alae reichen nach hinten bis zum Beginn oder bis zur Mitte des 7. Abd.-Segmentes, ihr häutiger Teil ist dunkel rauchig. Abd.-Segmente glatt, die letzten drei können beim ♀ stumpf gekielt sein, beim ♂ sind sie schwach verbreitert und deutlich verkürzt, zumal das letzte. Analsegment des ♂ am Ende schmal und ausgeschnitten, die Ecken dieses Ausschnittes ganz wenig spitz vorgezogen, Cerci des ♂ sehr kräftig, ganz wenig seitlich comprimiert, gegen einander gekrümmt, nicht verjüngt, stumpf endend. Operculum des ♂, wie auch 8. und hintere Hälfte des 7. Ventrites gekielt, hinten spitz abgerundet. Analsegment des ♀ mit abgeschnittenem oder ganz flach concavem Hinterrand, mit ebenfalls gekielter ganz kurzer, dreieckiger lamina supraanalis; Cerci des ♀ fast grade, rund, kaum verjüngt, dicht kurz behaart, wie beim ♂ von der Länge des Analsegmentes. Operculum des ♀ schwach glänzend, in den basalen zwei Dritteln stumpf gekielt, wenig zusammen gebogen, am Ende wie mit der Scheere einfach eingeschnitten.

Meso- und Metapleuren mit nahe und parallel dem unteren Rande verlaufenden deutlich erhabenen Leisten. Beine unbewehrt, mit graden Kanten, die gleichmässig dichte, schwache und kurze Behaarung aufweisen; Vorderschenkel an der Basis eingebogen. Metatarsus an den Vorderbeinen so lang wie die übrigen Tarsalglieder zusammen genommen, an den anderen Beinen kürzer.

Körperlänge ♂ 65 mm., ♀ 83-90 mm.; Länge des Mesonotums ♂ 12·5, ♀ 14-17 mm., des Metanotums mit segm. med. ♂ 9, ♀ 13 mm., der Elytren ♂ 3·5-4·8, ♀ 5-7·5 mm., der Alae ♂ 37, ♀ 47-52 mm.; Länge der Vorderschenkel ♂ 23, ♀ 23 mm., der Mittelschenkel ♂ 15, ♀ 14·5 mm., der Hinterschenkel ♂ 22, ♀ 21·5 mm., der Hinterschienen ♂ 22·5, ♀ 22·5 mm.; Breite des Mesonotums mitten ♂ 1·5-1·6 mm., ♀ 3-3·2 mm.; Entfernung der Elytrenbuckel von einander ♂ 3·5-4, ♀ 5-5·6 mm.

Die Art steht *Asceles certus* Redt. und mehr noch vielleicht dem mir unbekannten (nur ♂) *A. longipes* Redt., beide von Sumatra, nahe; ist aber von der erstgenannten durch die fehlenden Graneln, von der anderen durch die längeren Alae und das kürzere Analsegment, von beiden durch die Grösse geschieden.

Auffällig ist die Variabilität in der Elytrenlänge bei *Asceles glaber*, n. sp.

***Asceles annandalei*, n. sp.**

1 ♀, Travancore, W Ghats (W. side), Tenmalai, 22·xi·1908, Annandale leg., "am Licht"

Der vorher beschriebenen Art sehr ähnlich, dunkel braun und einfarbig: wahrscheinlich aber postmortal verfärbt, so dass auch hellere, vielleicht auch gezeichnete Stücke erwartet werden dürfen; fast glatt,

bis auf sehr undeutliche, sehr zerstreute, kaum convexe Graneln auf der Vorderhälfte des Mesonotums, und bis auf das rugose Mesosternum. Hinterkopf mit sehr feiner schwarzer Mittellinie und je 2 sehr feinen, eng neben einander laufenden schwarzen Postocularstreifen (Raum zwischen ihnen normaler Weise vielleicht heller als die Umgebung?); zwischen den Augen auf kreisrunder Stelle undeutlich schwärzlich punctiert, Augen ziemlich flach. Antennen fast körperlang, von der Mitte an gelbbraun, ganz undeutlich schmal dunkel geringelt. Pronotum so lang wie der Kopf, aber schmaler, mit schwach entwickelter Querfurche vor der Mitte. Mesonotum mit deutlichem Mittelkiel, nahe und parallel den Seitenrändern verlaufenden Leisten, schwache Querleiste unmittelbar hinter dem Vorderrand. Elytren flach, länger als breit, deutlicher, nicht schwarz markierter (immer?) Buckel vor der Mitte. Alae reichen nach hinten bis fast ans Ende des 7. Abd.-Segmentes, häutiger Teil rauchig, Vorderrand bei ihnen und den Elytren nicht heller. Analsegment ganz wenig länger als das 9, hinten verjüngt abgerundet; Cerci etwas kürzer, flach, gleichmässig wenig verjüngt, ganz dünn unregelmässig behaart. Operculum wenig zusammen gebogen, mitten gekielt, dahinter gefurcht, am Ende nicht tief rund und schmal ausgeschnitten. Meso- und Metapleuren mit nahe dem Unterrand und parallel zu ihm verlaufender Leiste; Sternite glatt. Beine glatt mit graden Kanten, die ganz kurz und nicht dicht behaart sind. Metatarsus nur an den Vorderbeinen so lang wie die übrigen Tarsalglieder zusammen genommen.

Körperlänge 87 mm.; Länge des Mesonotums 14 mm., des Metanotums mit Segmentum med. 13 mm., der Elytren 7·5 mm. der Alae 54·5 mm.; Länge der Vorderschenkel 26 mm. der Hinterschenkel 25 mm.; Breite des Mesosternum mitten 2·5 mm.; Abstand der Elytrenbuckel von einander 5·5 mm.

Von der vorher beschriebenen Art durch das Analsegment, die Cerci, das Operculum und die schwarzen Kopfstreifen verschieden.

Sipyloidea ? nitida, n. sp.

1 ♀, Assam, Cachar, J. Wood-Mason.

Vom Habitus der *Nescicroa*-Arten, mittelgross, kräftig; Oberfläche glänzend, ziemlich bunt.

Kopf nur ganz wenig länger als breit, kaum nach hinten verjüngt, ohne Ocellen; Hinterkopf ganz wenig gewölbt, glatt; zwischen den ziemlich flachen Augen eine kreisförmig von flacher Furche umschlossene Stelle. Antennen fast körperlang, anfangs gelbbraun, danach dunkler mit hellen Ringen. Hell braunrote oder hell violette breite Postocularstreifen und ein ebensolcher breiterer Mittelstreifen auf dem Hinterkopf; Pronotum so lang wie der Kopf, schmaler, mit Querfurche vor der Mitte, und drei hinter einander stehende Paare von Graneln auf der Metazona. Mesonotum mit ganz schwacher, im letzten Drittel verloschener Mittellinie, mit wenigen grossen, in der hinteren Hälfte seltneren und flacheren Graneln, besonders in der Nähe der Mittellinie, mit granulierter undeutlich erhabener Leiste parallel und nahe dem Seitenrande. Pro- und Mesonotum mitten breit hellbraun, an den Rändern grünlich. Elytren sehr kurz, so breit wie lang, stumpf olivgrün

bis braun, Costalteil heller, unmittelbar vor dem wenig und rundlich erhabenen Buckel mit schmalem, aber an beiden Enden verbreiterten gelben Längsstreifen, ferner mit einigen wenigen ganz kleinen schwärzlichen Flecken. Alae bis fast ans Ende des 9. Abd.-Segmentes nach hinten reichend, Deckteil grünlich mit rotbrauner Radialader und unregelmässig verstreuten schwarzen und braunen kleinen Flecken; häutiger Teil milchig, ganz zart rosa. Abd.-Segmente nach hinten allmählich an Länge abnehmend, das letzte aber etwas länger als das 9., am Hinterrande flach concav; Cerci zum Ende hin gleichmässig ganz wenig verdickt, stumpf abgerundet, grade. Operculum glänzend, rugos, mit feiner Mittelfurche in der distalen Hälfte, mit je einer halbseitlichen gekrümmten Leiste in der vorderen, verjüngt abgerundet, aber nicht spitz.

Meso- und Metapleuren mit einigen wenigen Graneln, mit granulierter, undeutlich erhabener Leiste parallel und nahe dem Unterrande; Mesosternum granulos, Metasternum und Ventrile glatt.

Beine deutlich kantig, unbewehrt; Vorderschenkel an der Basis deutlich eingebogen, Schienen ohne area apicalis; die Vorderbeine grünlich, die mittleren und hinteren braun, doch Oberseite der Hinterschenkel fast schwarz. Metatarsus kürzer als die übrigen Tarsalglieder zusammen genommen.

Körperlänge 57 mm.; Länge des Mesonotums 10 mm., des Metanotums mit Segm. med. 8 mm., der Elytren 3 mm., der Alae 35 mm.; Länge der Vorderschenkel 16 mm., der Mittelschenkel 10.5 mm., der Hinterschenkel 16 mm., der Hinterschienen 15 mm.; Breite des Mesonotums mitten 2.2 mm.

Mir ist keine ähnliche Art bekannt innerhalb des Genus *Sipyloidea* Br. 1893; es ist auch kaum zweifelhaft, dass die neue Art dort nicht gut untergebracht ist.

***Sipyloidea* ? *acanthonotus*, n. sp.**

1 ♀, Sulu Inseln, W. B. Pryer.

Mittelgrosse kräftige Art, braun, an den Flügeln auch grau. Kopf länger als breit, nach hinten kaum verjüngt, flach, mit zahlreichen feinen Graneln, flachen Augen, feinen schwarzen Postocular- und Mittelstreifen; die Postocularstreifen sind nach innen zu fein gesäumt. Antennen einfarbig, sie reichen nach hinten nur bis zur Mitte des Abdomens. Pronotum schmaler als der Kopf, ebenso lang, mit schwach entwickelter Querfurche vor der Mitte, mit undeutlichem feinen dunklen Mittelstreifen und mit ähnlicher Linie jederseits davon auf der Prozona; auf der Fläche und besonders am Seitenrände deutlich fein gekörnelt. Mesonotum auch gekörnelt, mit ähnlicher feiner, im letzten Drittel verlöschender Mittellinie, mit gekörnelter erhabener Leiste nahe und parallel dem Seitenrande, und nahe dieser Leiste, parallel zu ihr, in der vorderen Hälfte mit stärker erhabener Leiste, die je 3-4 kleine Dornen trägt. Elytren auffällig lang und parallelschön, fast ganz flach mit kaum erhabenem Buckel, am Vorder- (Aussen-) rande und mitten breit hell grau gestreift, sonst graubraun, an der distalen Schmalseite flach ausgerandet. Deckteil der Alae gelbgrau ausser am Vorderrande, mit ganz kleinen schwärzlichen unregelmässig gestalteten Flecken wie

bestäubt; häutiger Teil hyalin. Abd.-Segmente glatt, die letzten drei verkürzt, stumpf längsrunzelig, das 9. mit einem Höcker am Hinterrande; Analsegment verjüngt, am Hinterrande mitten ganz wenig eingekerbt und beiderseits davon flach rund; Cerci kurz, rund, gleichmässig zugespitzt; Operculum rauh, ganz schwach glänzend, ein wenig quer gekrümmt, sonst glatt, hinten abgerundet.

Meso- und Metapleuren, Meso- und Metasternum dicht körnelig, jene mit undeutlicher Leiste dicht parallel dem unteren Rande.

Beine vierkantig, ziemlich kräftig, unbewehrt, Vorderschenkel an der Basis eingebogen, keine area apicalis an den Schienen. Metatarsen deutlich kürzer als die übrigen Tarsalglieder zusammen genommen.

Körperlänge 68 mm.; Länge des Mesonotums 11 mm., des Metanotums mit Segm. med. 11 mm., der Elytren 7 mm., der Alae 45 mm.; Länge der Vorderschenkel 18 mm., der Mittelschenkel 14 mm., der Hinterschenkel 19 mm., der Hinterschienen 17 mm.; Breite des Mesonotums mitten 2·7 mm., einer Elytre 3·5 mm.

Mir ist keine ähnliche Art mit hinten abgerundetem Operculum bekannt; die Art kann nur provisorisch bei *Sipylodea* Br. 1893 stehen.

Sosibia ocellata, n. sp.

1 ♀, Insel Sinkep (östlich von Sumatra).

Grosse Art mit deutlichen, wohl ausgebildeten Ocellen (♀), braun wie trockene Blätter, am Deckteil der Alae heller, mit in deren distaler Hälfte noch etwas helleren verwaschenen Nebelflecken; die ersten 5 Abd.-Segmente glänzend, sonst Oberfläche matt.

Am nicht gewölbten, glatten Kopf ausser den 3 Ocellen sehr schmale helle Postocularstreifen; Pronotum mit Querfurchen vor der Mitte, mit ganz wenigen spitzen Graneln; Mesonotum mit gleichmässig über die ganze Fläche verstreuten spärlichen, sehr deutlichen spitzen Graneln, längs gekielt. Alae mit hyalinem, ganz leicht rauchigem häutigen Teil, das 5. Abd.-Segment nicht überragend. Metanotum und die ersten 5 Abd.-Segmente glänzend, ganz glatt, 7 hinten leicht verdickt. Analsegment so breit wie lang, am Hinterrande ganz leicht ausgerandet. Die kurzen Cerci rund, grade, gleichmässig dick, am Ende abgeschnitten; Operculum leicht gekielt, distal nicht verjüngt, abgerundet.

Mesopleuren, Meso- und Metasternum, das letzte nur schwach, die anderen spitzig deutlich granuliert, die Sterna mit deutlichen seitlichen Leisten. Metapleuren nur mit einer Längsreihe deutlicher weit von einander stehender Graneln am unteren Rande. Ventrile glatt, 7 aber am Hinterrande mit dicker, wulstig und breit ein wenig nach hinten vorgezogener Schuppe, deren abgerundeter Rand glänzt.

Die eingebogenen Vorderschenkel sehr kurz, kräftig verbreitert (an der breitesten Stelle 3 mm. breit), die übrigen Schenkel dünn, unbewehrt.

Körperlänge 98 mm., Länge des Mesonotums 15 mm., des Metanotums mit Segm. med. 14 mm., der Elytren 4·5 mm., der Alae 53 mm.; Länge der Vorderschenkel 10 mm., der Mittelschenkel 11 mm., der Hinterschenkel 17 mm.

Der Besitz deutlicher und nicht reduzierter Ocellen zusammen mit dem glatten und flachen Kopf und den unbewehrten Schenkeln unterscheidet die Art von den ihr am nächsten stehenden der Gattung; die deutlichen Ocellen würden nach Redtenbachers Diagnose eigentlich die Art aus der Gattung *Sosibia* ausscheiden und ins Genus *Hemisosibia* Redt. 1908 verweisen, deren einziger Unterschied zur erstgenannten nach Redtenbacher im Besitz solcher Ocellen besteht. Und in der Tat könnte nach der Beschreibung der einzigen zu *Hemisosibia* gestellten Art *H. incerta* Redt. 1908 (Südost Borneo) das hier als neue Art beschriebene Stück von Sinkep mit jener verwandt oder gar identisch sein; allein ich sah den Holotypus ♀ der *Hemisosibia incerta* im Museum Berlin: eine gracile Art mit relativ langen, nur hinter der basalen Einkrümmung sehr wenig verbreiterten Vorderschenkeln, die dem *Sosibia*-Arten vielleicht gar nicht nahe steht. Die neue Art *Sosibia ocellata* aber zeigt den gleichen Habitus wie die übrigen grossen echten *Sosibia*-Arten, und ich zog es vor, sie zu dieser Gattung zu stellen.

***Orthonecrosia errans*, n. sp.**

2 ♂♂, 2♀♀, Borneo, 6 ♂♂, 1 ♀, "California, Humboldt Bay", Indian Museum; 1 ♂, 1 ♀, Java, Naturkunde-Museum, Stettin.

Kopf glatt, gewölbt, mit 2 Ocellen, Hinterkopf längs gefurcht; meistens einfarbig hell braun, glänzend, zuweilen mit deutlichem oder verwaschenem Fleck zwischen den Augen, und manchmal auch mit zwei grösseren verwaschenen dunklen Flecken auf dem Hinterkopf neben einander. Augen gross, dunkel braun; Antennen beim ♂ länger, beim ♀ so lang wie der Körper, fast schwarz, auf den ersten $1\frac{1}{2}$ cm ihrer Länge mit 9-11 ganz schmalen, danach in sehr weiten Abständen mit 4-5 breiten und gelblichen Ringen. Pronotum glatt, mit mittlerer Querrfurche, gelbbraun bis dunkel braun, dann seitlich und auf der Metazona in der Mitte mit gelbbraunen Streifen, glänzend. Mesonotum nach vorn und hinten schwach verbreitert, matt, gelbbraun, oft in den ersten zwei Dritteln seiner Länge dunkel braun, mit ganz schmal hell markierten feinen Mittelkiel, beiderseits von ihm einige undeutliche Graneln, Seitenkanten granuliert, ganz schmal hell gesäumt. Elytren viel länger als breit, hinten schräg abgeschnitten, mit schwach, aber deutlicherhabenem Buckel; dieser ist schwarz markiert, und von ihm zieht sich ein schmaler schwarzer Streifen bis zur Elytrenbasis nach vorn. Seitlich nach aussen vor dem Buckel, nur bei den ♀♀ manchmal undeutlich, ein gelber Streifen über die ganze Elytre. Ausserand selbst aber wie die ganze übrige Elytre gelbbraun bis dunkel braun. Alae nach hinten fast bis zur Mitte des 6. Abd.-Segmentes reichend; ihr Deckteil warm dunkel braun oder dunkel violett mit gelblichen, selten grünlichen Längsadern, bei den ♂♂ stets mit gelblichem deutlichen Längsstreifen vor der Radialader, aber nicht am Vorderrande selbst, dieser Streifen fehlt den ♀♀. Häutiger Teil der Alae leicht rauchig. Abd.-Segmente, so weit von den Alae bedeckt leicht glänzend, sämtlich braun; letztes wenig länger als breit, bei den ♂♂ hinten eingekerbt mit deutlich markierten Hinterecken, bei den ♀♀ am Ende ebenfalls eingekerbt mit winziger lamina supraanalis. Cerci der ♂♂ grade, rund, so lang wie das Analsegment, zum Ende hin

schwach keulig verdickt und stumpf abgerundet, die der ♀♀ kürzer, schief kegelförmig, wobei die Kegelspitze von der Basis der Cerci, die Kegelfläche von dem stark verbreiterten, runden und schräg abgeschnittenen Ende der Cerci gebildet ist. Lamina subgenitalis der ♂♂ spitz abgerundet, das Ende des 9. Segmentes, dessen Hinterecken unten genähert sind, nicht ganz erreichend, der ♀♀ rauh, im Endteil schwach glänzend und gekielt, am Ende rundlich schmal, nicht tief ausgeschnitten und zusammen gebogen.

Meso- und Metapleuren glatt, mit deutlich erhabener Leiste nahe und parallel dem Unterrande, gelbbraun bis dunkel braun oder violett, glänzend, mit je einem grossen hellen Fleck vor den Mittelhüften und am Vorder- und Hinterrande des Metapleurons. Mesosternum besonders längs der Mitte schwach gekörnelt, Metasternum und Ventrite glatt, 7 Ventrit am Hinterrande mit schwarzem kleinen Höcker, davor kurzer undeutlicher Kiel, beiderseits von diesem je ein matt schwarzer grösserer Fleck.

Beine unbewehrt, rötlich braun mit zahlreicheren helleren, oft undeutlichen Ringen auf Schenkeln und Schienen; Vorderschenkel gerade, Metatarsen so lang wie übrigen Tarsalglieder zusammen genommen oder länger.

Körperlänge ♂ 73-76 mm., ♀ 97 mm.; Länge des Mesonotums ♂ 11.5 mm., ♀ 14.5 mm., des Metanotums mit Segm. med. ♂ 9 mm., ♀ 13 mm.; Länge der Elytren ♂ 5.2 mm., ♀ 8 mm., der Alae ♂ 40 mm., ♀ 55 mm.; Länge der Vorderschenkel ♂ 24-28 mm., ♀ 31 mm., der Mittelschenkel ♂ 18-20 mm., ♀ 23 mm., der Hinterschenkel ♂ 23-28 mm., ♀ 31 mm., der Hinterschienen ♂ 25 mm., ♀ 31 mm., der Hintertarsen ♂ 11-12 mm., ♀ 14 mm.

Die Art besitzt durchaus den üblichen Habitus der *Orthonecroscia*-Arten und ist durch ihre gleichmässig geringelten Beine und den gelben Elytren-, bei den ♂♂ auch Flügelstreifen gut charakterisiert. Welches ihre wahre Heimat sein mag, ist ungewiss; wenn auch die Angabe "California" vieler der Stücke des Indian Museum natürlich irrig ist, so fällt mir weiterhin schwer zu glauben, dass sie ausser auf Bornco, der Heimat der meisten Arten dieser Gattung, auch auf Java vorkommen sollte, von wo bis jetzt keine sichere *Orthonecroscia*-Art bekannt ist.

DESCRIPTION OF A NEW MYRMECOPHILOUS *LEPISMA*
(THYSANURA) FROM INDIA.

By FILIPPO SILVESTRI, *Portici, Italy.*

The myrmecophilous insects are very interesting for the many especial adaptations of different degree they present and are worth being known as soon as discovered, therefore I like to give here the description of a new *Lepisma* found in the nest of ants and hope that Indian Entomologists will pay more attention to this group of insects, as it is likely to be very richly represented in India.

***Lepisma subnigrina*, sp. nov.**

♀ Corpus dorso nigrescens maculis duabus transversis flavescentibus per partem anticam mesonoti et urotergitorum primi et septimi dispositis

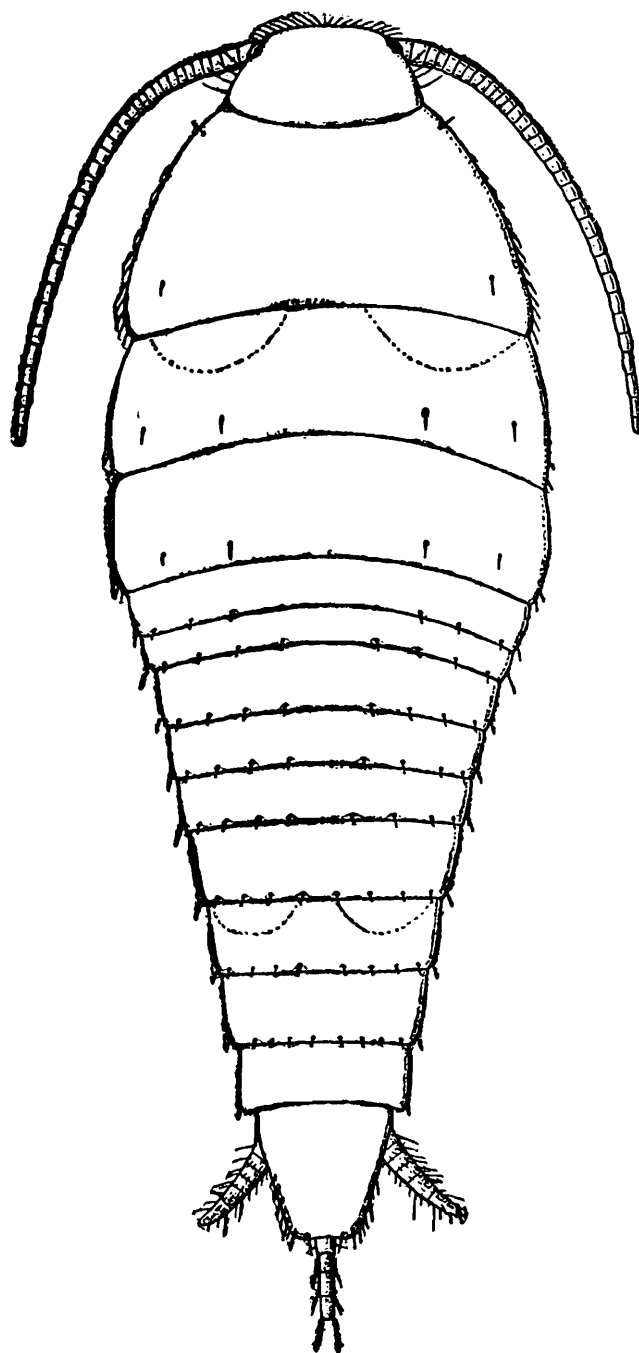


FIG. 1. *Lepisma subnigrina*, sp. nov. Animalculi circumlitio.

variegato, antennis pedibusque (a trochantero) flavescens; corporis squamae pluriradiatae, majores μ 40×65 , macrochaetae robustae integrae, apice inciso.

Caput supra bene squamosum, fronte antice et lateraliter ante oculos setis nonnullis robustis, apice inciso et setis brevibus instructa; clypeo et labro etiam setis nonnullis robustis apice inciso et setis brevibus instructo, oculis ocellis c. 15 compositis; antennis reversis metanotum haud vel vix superantibus, articulis 21 compositis, articulis a septimo in articulo basali et articulo majore distali et a decimo tertio articulo distali etiam in articulo basali et articulis sequentibus articulo proximali etiam in articulo basali breviori diviso ita ut articulus singulus in articulis duobus majoribus distalibus et articulis duobus basalibus compositus sit, setis *vide* text-fig. 2a-c; mandibulis stipitis superficie externa macrochaetis apice bifurcato instructo, parte apicali 3-dentata, mola subapicali parva; palpis maxillaribus brevibus paulum attenuatis, articulo ultimo quam penultimus parum longiore; labio lobis parvis, palpis articulo ultimo latiore quam longiore.

Thorax quam caput circa duplo latior et quam abdomen parum brevior lateribus convexiusculis, scutorum dorsualium margine postico setis nullis, pronoto trichobothriis subposticis sublateralibus 1+1, meso- et metanotum (text-fig. 2f) trichobothriis 2+2, margine laterali setis brevibus adjacentibus et setis duabus posticis parum longioribus instructis. Metasternum cordiforme c. $2/5$ ad basim latius quam longius, macrochaetarum pectinibus duobus posticis nec non setis nonnullis marginalibus apicalibus pone pectina instructum est.

Pedes breves, coxa superficie infera tota squamis vestita, macrochaetis et setis brevibus nonnullis marginalibus externis et serie submarginali proximali interna setarum brevium etiam instructa, articulis ceteris squamis destitutis setis numerosis inferis brevibus, subtilibus instructis et femore etiam setis robustis sat longis quatuor marginalibus inferis et duabus marginalibus superis, tibia seta robusta proximali externa, setis robustis distalibus internis et margine infero postico calcare longo robusto subtriangulari et seta robusta brevi et seta robusta c. duplo longiore armati, tarso articulo primo subtus menso articulos duos sequentes superante et margini postico infero setis duabus robustis instructo; praetarsis unguibus lateralibus simplicibus parum arcuatis quam medianus aliquantum longioribus.

Abdomen gradatim partem posticam versus parum angustius: tergita 1-9 seta macrochaeta marginali laterali postica et tergita 1-8 macrochaetis brevibus posticis 3-4+3-4 inter sese remotis, tergito nono macrochaetis posticis nullis; tergito decimo tam ad basim lato quam longo lateribus aliquantum convergentibus, postice parum profunde sinuato macrochaeta laterali et macrochaeta sublaterali posticis.

Urosternum 1^{um} macrochaetis nullis, urosternum 2^{um} macrochaetarum pectine mediano, urosterna 3^{um} ad 7^{um} macrochaetarum pectine mediano et pectinis duobus sublateralibus instructa, segmenti octavi subcoxis angulo interno triangulari parum producto subacuto, macrochaetarum pectine apicali parvo, stilorum tertiam partem proximalem parum superante, segmenti noni subcoxis angulo interno elongato, angustato, stilorum longitudinem c. $2/3$ superante, subacuto, macrochaetis marginalibus internis numerosis instructo et macrochaetis

tribus subapicalibus instructo; stili IX quam VIII c. $1/3$ longiores setis numerosis subtilibus et seta robustiore apicali et altera parum minore instructi.

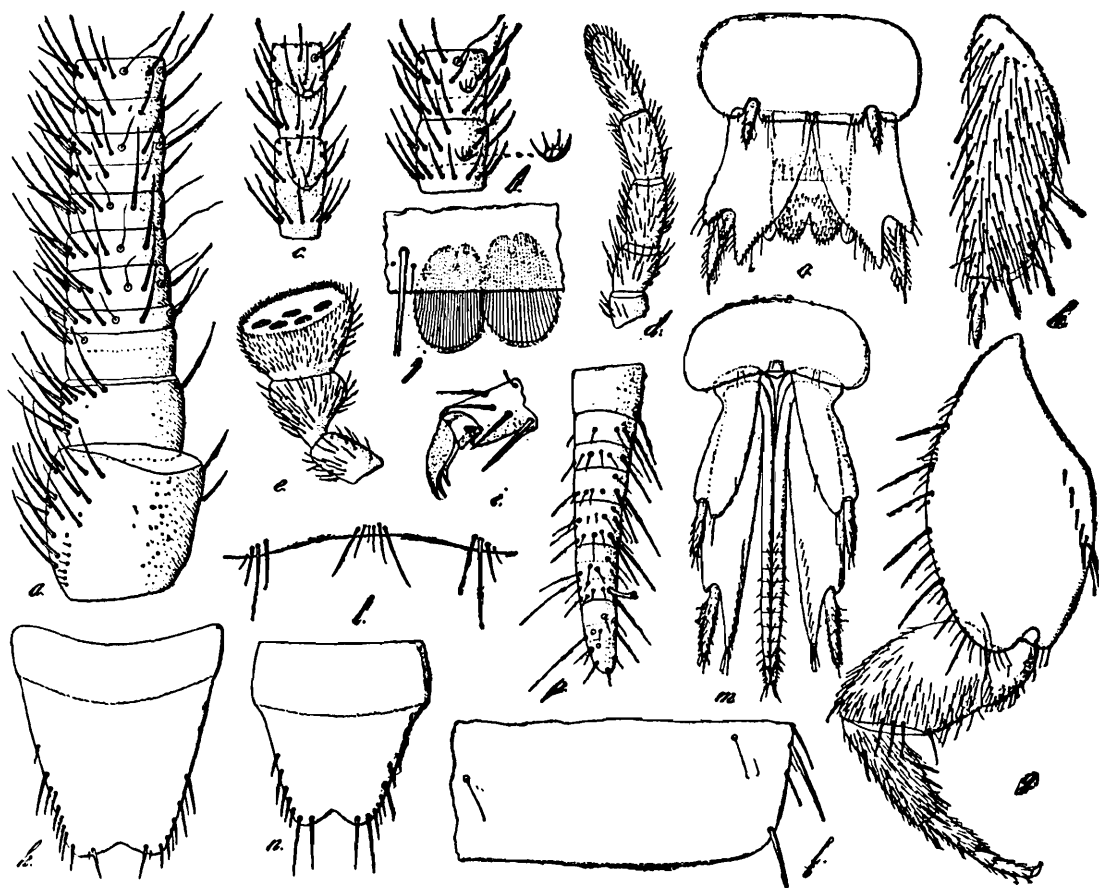


FIG. 2. *Lepisma subnigrina*, sp. nov. Femina.

a. antennae dexterarum pars proximalis prona; b. antennae eiusdem articulus decimus quartus; c. eiusdem antennae articulus vigesimus; d. palpus maxillaris; e. palpus labialis; f. metanoti dimidia pars dextera postica; g. pes tertii paris; h. eiusdem tibia magis ampliata; i. eiusdem pedis tarsi apex et pretarsus; j. urotergiti quinti particula postica; k. urotergitem decimum; l. urosteroniti quinti pars postica; m. urotergiti septimum ad nonum cum ovipositore; n. maris urotergitem decimum; o. maris urosteroniti octavum et nonum cum pene; p. maris cercus dexter pronus.

Ovipositor attenuatus stilarum IX apicem parum superans, pseudoarticulatus et setis tantum subtilibus auctus.

Cerci breves medio urotergitem decimum mm. 0,32 superante, lateralibus medium longitudine subaequalibus, setis et sensillis *vide text-fig. 2p*.

Long. corporis mm. 5; lat. thoracis 2; long. antennarum 1,90; palpi maxillaris 0,58; pedum paris tertii 2,20; stilarum IX 0,32; cercorum lateralium 0,52.

Mas: corporis statura parum minore, urotergito decimo quam idem feminae parum brevior, urosteron octavum etiam macrochaetarum pectinibus tribus (lateralibus et mediano); penis cylindraceus quam subcoxae IX aliquantum brevior; paramera distalia, brevissima.

Habitat.—Exempla nonnulla vidi in nido formicae *Cremastogaster* sp. a P. N. Krishna Ayyar ad Coimbatore (India) lecta.

Observatio.—Species haec ad *Lepisma nigrina* Silv. perproxima est, sed colore, urotergito decimo brevior, ovipositore longiore saltem distincta est.

A PRELIMINARY NOTE ON THE SPAWNING GROUNDS AND BIONOMICS OF THE SO-CALLED INDIAN SHAD, *HILSA ILISHA* (HAMILTON), IN THE RIVER GANGES.

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

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HISTORICAL.

Sir K. G. Gupta in his final report on the Fisheries of Bengal, dated the 27th January 1908, devoted a section to "The Shad in India" and after describing its distribution, ancient close season, fisheries, etc., concluded as follows :—

"Very strenuous efforts must also be made to observe the reproductive functions of the *hilsa* and ascertain their spawning grounds, so that when their anadromous character has been established hatching stations may be opened to introduce artificial propagation for replenishing our rivers."

In his general account of the species he stated that :

"As in France, the fishermen of Bengal believe that the *hilsa* does not spawn in the rivers, in proof of which it is asserted that no fry or young ones have ever been caught or seen."¹

As a result of Sir K. G. Gupta's recommendations, Dr. J. Travis Jenkins was appointed Fishery Adviser to the Government of Bengal in 1908, and though his principal work was to carry out a regular fishing survey of the Bay of Bengal, he seems to have been entrusted at the same time with investigations regarding the life-history of *Hilsa*. In 1910, Jenkins published a short note on "The Spawning of *Hilsa*", and from the well known fact that *Hilsa* are full of roe in the rains and spent from December to February concluded that they must have deposited their spawn in the rivers. The banks of the river at Sara Ghat, Rajmahal, Khulna, Bagerhat, Monghyr and Kooshtea were netted with fine meshed nets for the fry of *Hilsa*, but without any success. From

¹ According to Day (1873, p. 35) the opinion of the Madras fishermen is that ova of *Hilsa* are deposited in the river water, and whilst being carried out to sea become vivified. These observations are fully borne out by the results recently obtained both in Madras and Bengal.

the market at Monghyr, however, a single specimen of *Hilsa*, 6 cm. long, was obtained towards the end of September and from this Jenkins concluded that :

“ It would appear that the *Hilsa* spawns in the Ganges somewhere above Monghyr and careful investigation should be carried on during September and October in suitable localities above that place.”

After these somewhat disappointing results, it seems that an organised search for the spawning grounds of *Hilsa* was abandoned, and more attention directed to the artificial propagation of the species on the lines adopted in America for Shad (*vide* Southwell 1914, 1918). A hatchery station was established at Monghyr, but all attempts at artificial propagation proved futile. However, as a result of these experiments, Southwell (1914, p. 5) came to the following conclusions :

“ I think there can be no doubt that there are several breeding grounds in the Ganges, and it is quite likely that the spawning grounds change from year to year. Old *hilsa* probably spawn in the higher reaches of the river, while younger *hilsa*, more susceptible to the changes involved in the transition from the sea to fresh water, probably spawn lower down the river.”¹

In the Annual Report of the Department of Fisheries, Bengal, Bihar and Orissa, for the year ending 31st March 1919, Dr. Baini Prashad again recorded the failure of artificial fertilisation and hatching of the *Hilsa* eggs, but a distinct advance was reported in the knowledge concerning habits, distribution, etc., of the species. It was stated that :

“ Investigations regarding the distribution and habits of *hilsa* were carried on in the rivers of the Khulna district, in the Hooghly, at Madaripur, Goalundo, Dacca, Rajmahal, Bankipur, Buxar and a number of other places in the two provinces. These enquiries show that *hilsa* are available practically at all times of the year in the rivers and in the Gangetic Delta. This fact casts a very grave doubt on the generalisations of the previous observers regarding the migrations of *hilsa* during the rainy season, when, as was stated, the muddy water incited the fish to ascend into fresh-water streams for breeding. The results of our enquiries during the past year do not allow of the assumption of the *hilsa* being a true anadromous fish.”

In 1920, the Department of Fisheries, Bengal, Bihar and Orissa, was abolished and so far as I am aware no further work on the *Hilsa* problem from Bengal has been reported since. In 1933, however, Mr. Robert S. Finlow, Director of Agriculture, Bengal, in his note on the scheme for the reorganisation of a Fishery Department in Bengal, summed up the position of *Hilsa* enquiry in Bengal as follows :

“ Apart from carp, *hilsa* is much the most important fish caught in inland waters. As is well known, the *hilsa* belongs to the herring family, and its home is in the sea, but, like the salmon, the *hilsa* migrates into adjacent rivers to spawn. So far attempts to locate the spawning grounds of *hilsa* have failed, and attempts at artificial fertilization have also been unsuccessful. On the other hand, the fingerling of the *hilsa* has been identified in the *Jalka*, a small fish less than 6" long, found in the Buriganga, Lakhya and Meghna rivers in the Eastern Bengal in February-March. It is probable therefore that the main spawning grounds of the *hilsa* are in Eastern Bengal, and investigation to this end, particularly in the Lakhya, Buriganga, Torag and Meghna rivers, should form a definite item of the work of the Fishery Department.

¹ Reference may here be made to the following observation of Day (1873, p. 22). Writing about the migratory habits of *Hilsa* he says :—

“ There seem to be two classes of this fish which ascend the large rivers : those below one year of age, and which do not appear to breed, or if they do, it is at the very end of the year, or commencement of the succeeding one ; secondly, there are those which breed at the commencement of, or during the monsoon.”

These observations indicate that *Hilsa* practically breed in the rivers throughout the year, and that probably the young have to make a much longer journey upstream to attain sexual maturity.

Artificial breeding of the *hilsa* should also be persevered with. The fish appears to be peculiarly delicate and, when spawning, to die almost instantaneously on being taken from the water. At the same time, eggs have undoubtedly been fertilized both in Bengal and in Madras, and final success may prove to be largely a matter of technique. In the Bengal experiments, the development of fungoid growth seemed to be a very adverse factor. Perhaps the use of filtered water in the Macdonald jars would mitigate this disadvantage."

Mention may also be made of the observations contained in Mr. K. C. De's "Report on the Fisheries of Eastern Bengal and Assam" He stated that :

"The *hilsa* is found in the sea and in all the principal rivers, at practically all times of the year. It is also found in the *bhils* and *haors* during the flood, when they communicate with the greater rivers. The spawning takes place in October and November, and the spent fish are caught in winter. But some fishermen have assured me that individual fish with roes have been found all through the year. Nothing definite is known about the spawning. Some fishermen hold that they do not spawn in the rivers, while others believe that the young fish hatched from the ova deposited in the rivers are stunted in growth and do not bear roes. Some told me that the *hilsa* spawns in the Hakalaki *hoar* in Sylhet, but careful enquiries made there have proved this information to be incorrect. As the ova of *hilsa*, and also young fish, have been seen in the rivers, there can be no doubt that they spawn in the rivers. Like the other herrings, it is a surface-swimmer, and is not ordinarily found at a depth below 12 feet. It cannot be reared in tanks."

From the summary of the results given above, it is clear that since 1908, when Sir K. G. Gupta made a forceful recommendation regarding the urgent necessity of an investigation into the life-history of *Hilsa* with a view to establish hatcheries for the artificial propagation of the species, very little advance has been made with regard to the bionomics of the species in Bengal waters. The investigations of all these years, however, raised doubts into the true anadromous nature of the species and brought to light the probable occurrence of the young ones of *Hilsa* in the rivers of Eastern Bengal. The Madras Fisheries Department (*vide* Raj) has, however, through patient research extending over a quarter of a century, made considerable progress in locating the probable spawning grounds of *Hilsa* in Madras waters and has found indications of the probable rate of growth of the species. The results of these investigations are referred to in a comparative way in the following account.

HILSA INVESTIGATIONS AT THE CALCUTTA CORPORATION WATERWORKS AT PULTA.

In 1936, the Zoological Survey of India was requested by the Corporation of Calcutta to carry out biological investigations at the Corporation's Waterworks at Pulta. A preliminary collection of the fauna of the Waterworks was made in May 1936, but later, from September 1936 to February 1938, further collections were regularly made, almost month by month, with a view to determine the seasonal variations in the fauna of the filter-beds. From the very beginning a large number of young Clupeoids of various genera were found in the beds, but their specific determination was not undertaken till the adults were found in the settling tanks in great abundance a few months later. During the rainy season of 1937 male and female specimens of *Hilsa* with ripe gonads were collected from the Waterworks and it seemed probable, therefore, that the fish may actually be breeding in these waters, but no direct

observations on the spawning of the species were made. Day (1873, pp. 13, 36) states that *Hilsa* "never breeds in tanks or canals", but gives no reasons for his views. Attention may, however, be directed to the fact that the Killarney Shad of Great Britain spends its whole life in lakes without ever migrating to the sea (Trewavas, 1938). This occurrence lends considerable support to the assumption that *Hilsa* may also be capable of breeding in the extensive tanks of the Waterworks. The mature males and females can readily be recognised by the depth of their bodies; the females, though of a somewhat smaller size, are much deeper and bulkier.

The abundance of young *Hilsa* in an isolated settling-tank (Pucca Settling Tank No. 4), when it is emptied once a year in autumn for cleaning, shows that the various tanks of the Waterworks receive their supply of *Hilsa* directly from the river Hooghly and that the fish is capable of thriving well in confined waters and of even attaining full maturity in the two other series of connected settling tanks. The above observations, especially when coupled with the fact that fish can only enter the waterworks either as eggs or very minute larval forms, indicate that the breeding grounds of *Hilsa* could not be at a very great distance from the position of the intake pipes of the Waterworks in the river Hooghly.

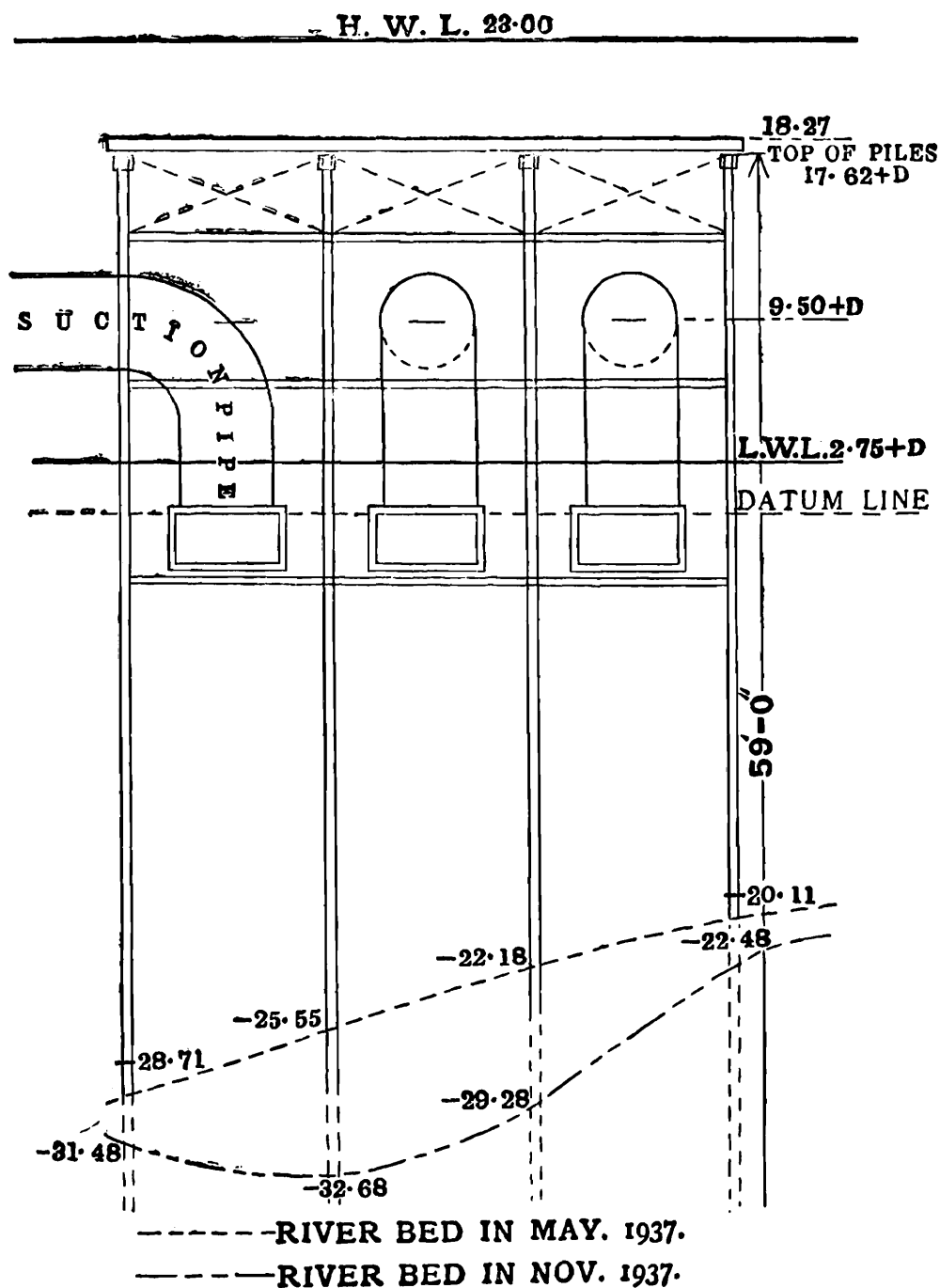
In connection with the growth of *Hilsa* in confined waters reference may also be made to the Administration Report of the Madras Fisheries Department for 1936-37 which contains observations on the bionomics of the fish similar to those made at Pulta. It is stated that :

"Young *Hilsa* not only reside in the lower reaches of rivers but frequently congregate from accident or inclination in tanks and ponds connected with the breeding reaches of such rivers.¹ In the Bahur tank watered by the Ponnaiyar river, which is one of the South Indian rivers in which *Hilsa* breed, a large collection of young *Hilsa* measuring from 16.3 cm. to 22.5 cm. was obtained in May 1936 when the tank ran dry. As the tank runs dry annually direct evidence of the growth rate of *Hilsa* in the tank is available. Since the tank received its supply for the year between 24th August 1935 and 14th September 1935 there is conclusive evidence that the *Hilsa* fry bred in the Ponnaiyar river that summer had grown in the tank to sizes ranging from 16.3 cm. to 22.5 cm."

Life history of Hilsa in the Waterworks at Pulta.—At the Pulta Waterworks about 90 million gallons of river water is pumped daily into the settling tanks through 5 pipes—one 36" pipe, one 48" pipe and three 54" pipes. All the pipes are, however, not in commission at the same time. The mouths of the pipes are directed downwards. The three larger pipes are protected by an iron grating with bars one inch apart, while the other two pipes are provided with valve-like structures which prevent any large object from entering the pipes. It is thus seen that though large objects cannot be sucked into these pipes, fishes a few inches in length and less than one inch in thickness can enter into the pipes. In the actual centrifugal pumps, however, there is only a quarter inch space between the impellers and their covers so that larger objects are invariably crushed and only eggs or very young larvae can

¹ Day (1873, p. 23) also observed that in Sind *Hilsa* are not to be found about the end of September or commencement of October. He noted, however, that they may be "taken in *dhands*, stagnant pieces of water or canals, due to some accidental cause or unnatural obstruction having obliged them to turn aside from their natural breeding-grounds."

pass through intact to the settling tanks. This was tested by making several collections of the fauna from the river water soon after it had passed through the pumps; in all samples only very minute objects were obtained. This means that *Hilsa* enters the Waterworks from the river either in the egg stage or as very young larvae. It must also be remembered that the crushing of the larger objects increases the nutrient value of the water and is thus conducive to the development of rich planktonic life in the tanks of the Waterworks.



TEXT-FIG. 1.—Section of new jetty for 54" pipes, Calcutta Corporation Waterworks. Pulta.

The form of the river bed in the region of the intake pipes undergoes considerable changes at different seasons of the year, but the depth of the river below the level of the mouth of the pipes, known as Datum Line, is generally more than 20 feet; the low water level is 2.75 feet

and the high water level 23 feet above the Datum Line. As the mouths of the pipes are directed downwards there is every likelihood of the bottom fauna being stirred up and sucked into the pipes, and correspondingly less chance of the floating organisms entering the pipes. As noted above, during experiments for the artificial propagation of *Hilsa* eggs have been fertilised both in Madras and Bengal, and it has been definitely ascertained that after fertilisation they sink deep in the water and begin to float or rest just near the bottom. The average diameter of *Hilsa* eggs was found by Jenkins to vary from 0.4 mm. to 0.63 mm. ; they would thus be very suitable objects to enter the intake pipes, pass through the centrifugal pumps and to be dispersed throughout the Waterworks. The young *Hilsa* probably feed near the bottom on planktonic organisms (*vide infra*, p. 155) and owing to their tendency to flow down with the current (*vide p.* 154) are liable to be carried to the filter-beds. Young *Hilsa* were found in the beds from April to November, though they were most abundant from August to November. On the 30th September 1937, 58 young *Hilsa* were collected from one bed ; their average length was 59 mm. and they ranged in length from 36 mm. to 70 mm. Again on the 22nd November 1937, 57 specimens of young *Hilsa* were obtained from the beds ; their average length was 50.3 mm. and they ranged from 33 mm. to 81 mm. in length. The filter-beds are dried up and cleaned at intervals of 30 to 60 days, so the young do not get very much chance to grow any bigger. The size of young *Hilsa* found in the beds varied from 30 mm. to 90 mm. in length. There would thus seem to be considerable justification for believing that *Hilsa* probably breeds during a considerable part of the year, though, from the collections made, its peak period of breeding can definitely be placed during the rainy season.

Rate of growth of Hilsa.—The isolated Pucca Settling Tank No. 4 was emptied out for cleaning on the 21st November 1937, and a very large number of young *Hilsa* were collected from it. This tank had been charged on the 19th November 1936, so the largest specimen of *Hilsa* could at the most represent approximately one year's growth. Nine hundred specimens of *Hilsa* were measured and grouped into 10 mm. difference groups, as shown in the table below.

Table of Measurements of 900 Young Hilsa Collected from the Pucca Settling Tank No. 4 on 21st November 1937, arranged in 10 mm. Difference Groups.

Number of specimens.	Measurements in millimetres.
1	57
7	80—89
72	90—99
56	100—109
52	110—119
32	120—129
97	130—139
273	140—149
220	150—159
74	160—169
14	170—179
2	180—189

It must be borne in mind that owing to fishing, for fair-sized fishes, mostly with hands, very young specimens were not collected, although a number of *Hilsa* of about 57 mm. in length were taken out and kept in an aquarium for making coloured sketches. The 900 specimens ranged in length from 80 mm. to 180 mm. More than half of the specimens were between 140 mm. and 159 mm. and would thus represent the majority size or the frequency peak; these individuals probably entered the Waterworks during the rainy season, the peak-period of breeding of the species. An analysis of the measurements further shows that specimens over 160 mm. represent the progeny of early spawners, while those below 130 mm. are probably the offspring of late spawners. From the sizes of the specimens found in the filter-beds it seems probable that during the first couple of months of its growth *Hilsa* attains a size of about 60 mm. and from the above analysis it would appear that between July-August, the peak-period of breeding, and November, when the tank was emptied, a period of 4 to 5 months, the fish had reached a size of about 160 mm. The *Hilsa* investigations of the Madras Fisheries Department have also shown that both in the Godavari and the Ponnaiyar rivers *Hilsa* attains only about 8 inches or so in the first year of its growth. In the Bahur tank connected with the latter river *Hilsa* is stated to have grown to a size of 163 mm. to 225 mm. between August-September 1935 and May 1936, a period of about 9 months. Owing to the very favourable conditions of growth in the Waterworks at Pulta, probably the rate of growth of the species is somewhat higher in these waters, as a size of 160 mm. was attained in 4 to 5 months. This is also evident from the fact that the adult *Hilsa* of the Waterworks are considerably larger than those found in the river Hooghly, though they are of a very inferior quality as food. There is, however, sufficient presumptive evidence to corroborate the findings of the Madras Fisheries Department that *Hilsa* attains full sexual maturity in about two years' time. According to Day (1873, p. 22) also *Hilsa* attains sexual maturity in its second year.

HILSA INVESTIGATIONS IN THE RIVER HOOGHLY NEAR THE PULTA WATERWORKS AND AT NAWABGUNGE.

During the rainy season of 1937, attempts were made to collect plankton at different depths near the Pulta Jettys, but the currents were so strong and the amount of suspended silt so great that the plankton nets could not function properly. Collections were then made along the bank of the river, but no *Hilsa* eggs or larvae were found. At this time of the year only large-meshed nets are used by the fishermen, so an examination of their catches was not helpful. When the waters begin to fall, very fine-meshed nets are employed to collect young fish from the river. Unfortunately I did not make any observations in October, but a visit to the Nawabgunge fish *ghat* (a landing place) on November 26, 1937, showed that baskets full of young *Hilsa* were being sold at about 6 pice per seer. The fish were about 20 mm. to 40 mm. in length and weighed 35 to a tola (about 7 drams or a little more than $\frac{2}{5}$ of an ounce). At the time of my visit there were 3 boats at the *ghat* and they had on board 10 baskets of young *Hilsa*. Each basket on

a very conservative average contained about 10 seers of fish. Thus on a rough calculation approximately 280,000 young *Hilsa* were being sold for about 9 rupees. On December 18, a lot of 53 young *Hilsa* were collected by my colleague Dr. B. N. Chopra from Nawabgunge; they weighed $6\frac{1}{2}$ tolas or 8 fish to a tola and ranged from 30 mm. to 71 mm. in length with an average length of 52.5 mm. By December 23, young *Hilsa* in the catches from the river had decreased, and only 234 specimens were collected from 3 boats. By the 11th February 1938, the young *Hilsa* had become very rare in catches and only 4 specimens—43-57 mm. in length—were obtained. The catches of young *Hilsa* and the absence of adult ones in the Hooghly near Calcutta from November to February show that after spawning the adults do not reside in this portion of the river and that the young are caught in thier migration downstream to the estuaries. The average size of the young fish at Nawabgunge from November to February, especially when compared with that of the young ones collected from the Pucca Settling Tank No. 4, also indicates that they are migrants from above and do not reside in this portion of the river. It may be mentioned that in the upper reaches of the river near Shantipore, uninterrupted *Hilsa* fishery goes on even during the post-monsoon months; these probably are the breeding grounds of the species in the river Hooghly.

The Madras Fisheries Department has already recorded the occurrence of young *Hilsa*, from 2 to 4 inches in length, in the Cauvery after the subsidence of the floods in the months of October and November. The study of the fishery in 1933-34 in the Godavari from the Dowlaishweram anicut to the sea proved the existence of *Hilsa* of varying sizes throughout the year and it was definitely established that young *Hilsa* up to $8\frac{1}{4}$ inches in length reside in the lower reaches of the river and do not go to the sea. In the case of the Ganges similar observations were made by Prashad in 1919 when he cast some doubts on the true anadromous nature of the fish.¹ The Madras Fisheries Department, through a series of observations carried over a number of years, has more or less proved :

“(1) that *Hilsa* take two years to grow to the adult size, (2) that the fish spend the first two years of their life in the lower reaches of rivers and go to the sea only in the third year, and (3) that when they leave the river they do not go far into the sea but move about in shoals in the shallow flats close to river mouths and their neighbourhood.” (Report for 1935-36, p. 38).

Observations made in the river Hooghly show that the fish run up during floods for breeding purposes and breed throughout the range of their distribution in the river and its connected waters. This is evident from the fact that Jenkins obtained a young *Hilsa* as high up in the river as Monghyr. According to Southwell (1914), old *Hilsa* going up the river for the second or the third time spawn in the higher reaches; while younger *Hilsa* making their first trip upwards, and thus being more susceptible to changes in salinity, spawn in the lower portions of the river. According to Day (1873, p. 22), however, the young immature specimens below one year stay in the river for a much longer period

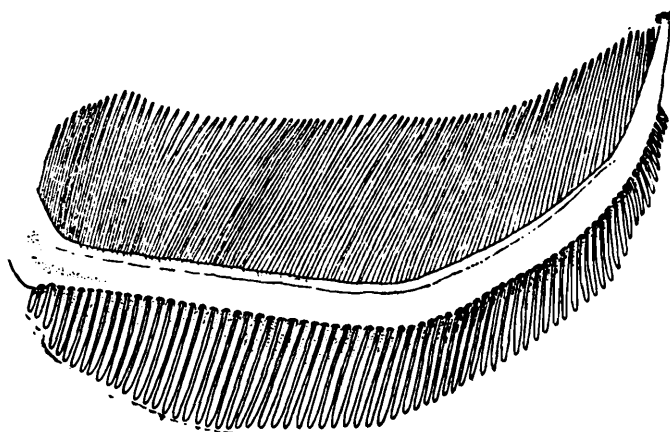
¹ In describing the colouration of the species, Day (*Fish. India*, p. 640, 1878) records to have taken young specimens of *Hilsa* in the Sunderbunds below 10 inches in length.

and only spawn towards the end of the first year of their life or in the second year. The actual breeding probably takes place in mid-water; the eggs drop to the bottom and soon after hatching the young begin to migrate downstream. Though the peak period of breeding lies in the rainy season, some fish that may have gone high up, stay in the river throughout the year and the breeding goes on for a considerable part of the year. It may here be noted that some fishermen of Eastern Bengal assured Mr. K. C. De that individual fish with roes have been found all through the year. Fish going higher up the river to breed will take a considerable time to make the return journey, and thus give rise to the post-monsoon fishery of the species in the river. Such a course of events would also explain the observations of De and Prashad that the fish resides in the river throughout the year.

The present-day migrations of *Hilsa* are thus of a very limited order; it is now primarily an estuarine fish which runs up the rivers during floods for breeding purposes. In this respect it cannot be regarded as a true anadromous species, as already pointed out by Prashad. As the rivers of the west coast of India, with the exception of the Indus, are short and without any extensive estuaries, *Hilsa* is not found along the west coast except in the Indus.

FOOD OF YOUNG *HILSA*.

As judged by the stomach contents, the young of *Hilsa* between 20 mm. and 40 mm. in length feed mostly on diatoms, and sparingly on Copepods, *Daphnia* and Ostracods. Older specimens up to 100 mm. in length were found to feed on the smaller crustaceans enumerated above and also on insects, such as Coriixid bugs, Chironomid larvae, etc., and Polyzoa. Still older specimens up to 150 mm. in length included small shrimps in their menu. Dr. Ramaswami Naidu has informed me that even adults feed mostly on diatoms with a mixture of few *Daphnia*



TEXT-FIG. 2.—Lower half of first left gill-arch of a young specimen of *Hilsa ilisha* (Ham). $\times 2\frac{1}{2}$.

Length of specimen without the caudal 120 mm. The actual number of gill-rakers on this portion of the arch was 156, but 95 could be shown in the drawing.

and Ostracods. Both in the case of the Waterworks and river specimens a few sand particles were invariably found in the stomach contents which showed that the young of the species probably feed near

the bottom. According to De, adult *Hilsa* is a surface swimmer, and is not ordinarily found at a depth below 12 feet.

The above account of the feeding habits of *Hilsa* is corroborated by the nature of its gill-rakers, which are setose, long, slender and close-set. In appearance they recall the baleen plates of the Whalebone Whales which are also used for straining minute organisms from water. On the first arch the number of gill-rakers is approximately 270 (90+180). The gill-rakers are considerably longer than the gill-filaments. In a specimen 118 mm. in length without the caudal the longest gill-raker was about 7 mm. in length.

In its feeding habits and the nature of gill-rakers *Hilsa* corresponds very closely with the Allis Shad (*Alosa alosa*) of European waters.

HATCHERIES FOR *HILSA*.

The Department of Fisheries, Bengal, Bihar and Orissa, and the Madras Fisheries Department have paid considerable attention in the past and the latter Department has still on its programme as a major item the artificial propagation of *Hilsa*. From the records available it appears that no success in this line of work has been achieved so far, in spite of repeated attempts and elaborate arrangements made both in Bengal and Madras. In view of the fact that after the floods millions of young *Hilsa* are caught from the river Hooghly, it seems that there is no need at present to augment the numbers of this fish through artificial fecundation. There would, however, seem to be an urgent necessity to preserve the natural stock by prohibiting the catching of young *Hilsa* through legislation during the months of October and November. During the monsoon months the fishermen do not catch small fish and during March to May owing to stormy weather fishing in the river is not possible on a number of days. These meteorological conditions thus provide a natural protection to the young in their migration downstream during these periods. As regards this fishery in Madras, it is not possible for me to express an opinion, but as there is a close similarity between the habits of *Hilsa* in the Hooghly and the South Indian rivers, it may also be found advantageous in that province to pay more attention to the proper conservation of the fishery rather than to the establishment of *Hilsa* hatcheries.

SUMMARY.

An historical review of the *Hilsa* investigations in Bengal is given and attention is directed to the work of the Madras Fisheries Department on the same subject. It has now been definitely established that *Hilsa* reside in the rivers, mostly in the estuaries, and rarely go out to the sea. Thus the fish, as pointed out by Prashad, is not to be regarded as a true anadromous species.

The probable course of the life-history of *Hilsa* from the egg or minute larval stage to the adult stage in the Calcutta Corporation Waterworks at Pulta is traced, and evidence is adduced to show that the supply of larval *Hilsa* is obtained from the river Hooghly year after year. The occurrence of young *Hilsa* in the filter-beds during a greater part of

the year shows that the fish probably breeds in the river over an extensive period, though its peak-period of breeding occurs during the rainy season. From the occurrence of ripe males and females in the Waterworks during the rainy season, it is presumed that the fish can probably breed in confined waters also. The probable rate of growth of the species in the Waterworks is indicated.

Failure to find eggs and very young stages of *Hilsa* in the river Hooghly with the help of plankton nets and by collecting along the banks is recorded. A regular fishery of young *Hilsa* in November is reported from an examination of catches made in the river at Nawabgunge near Calcutta. From the size of young specimens collected at Nawabgunge during November to February it is inferred that the young fish do not reside in the river but pass down to the estuaries. The probable life-history of *Hilsa* in the river is indicated and considerable support is lent to the biological observations already made by the Madras Fisheries Department. Observations on the food of young *Hilsa* and on the establishment of hatcheries for the artificial propagation of the species are made. From the destruction of young *Hilsa* on a vast scale in the river Hooghly, it is suggested that attention should be paid to the conservation of the *Hilsa* fisheries rather than to the establishment of hatcheries for the artificial breeding of this fish.

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ON THE ANATOMY AND SYSTEMATIC STATUS OF *CLEISTOGAMIA HOLOTHURIANA* FAUST, 1924.

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In a paper dealing with parasitic Trematodes belonging to the Strigeida (Holostomes), Faust (1927) described and figured under the name *Cleistogamia holothuriana* Faust, 1924, a worm from the intestine of an holothurian collected in the Andaman Sea, and deposited in the Indian Museum, Calcutta.

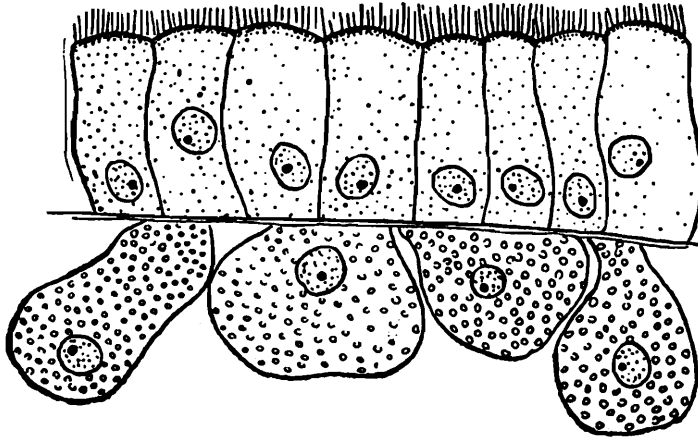
The anatomy of this worm differed so greatly from what is known of the Trematoda and particularly of the Strigeida (*vide* Dubois, 1938), that we thought it might lead to interesting results if we re-examined this parasite. Dr. Bains Prasad, Director of the Zoological Survey of India, Indian Museum, has been kind enough to loan us four specimens out of the type-material, and for this we tender him our sincerest thanks.

At first sight, the specimens agreed quite well with Faust's description. However, our study of the internal anatomy revealed such important discrepancies, that, if we were not sure of examining the original material, we would hesitate in describing this worm under the name given by Faust.

The results of our investigation lead us to an entirely different opinion as regards the systematic status of *Cleistogamia*. We redescribe and figure this worm in order to prove that the Trematode described by Faust is really a Rhabdocoelid Turbellarian. The supposed cleistogamy is inexistant since the male and female ducts open into a common genital atrium situated at the *posterior* end of the worm. It is the optical section of this atrium that Faust (1927) interpreted as the oral sucker and pharynx. Consequently, Faust's drawing of the worm, (1927, pl. xiv, fig. 1) is upside down and the organ considered by him as an hold-fast organ, is nothing else than the pharynx leading into the intestine. The original description contains many errors, and we do not find it necessary to refer to it hereafter.

Our specimens measure 2.8 mm. in length with a maximum breadth of 1.3 mm. The outline of the body is oval, tapering down towards the posterior extremity. In transverse sections, it is seen that the ventral surface is almost flat, whereas the dorsal surface is distinctly convex (text-fig. 4). The epithelial layer forming the surface of the body, is uniformly thick. It is formed by cells 18-20 μ high, whose outer surface is ciliated, the ciliation being as abundant on the dorsal as on the ventral surface. Immediately beneath the basal membrane of these cells are to be found numerous large cells containing a coarsely granular secretion (text-fig. 1). There do not appear to be any rhabdites in the epidermis, as in all other parasitic Rhabdocoelids.

The mouth is located on the mid-line, in the anterior third of the worm, and corresponds to the actual opening of the pharynx. The latter



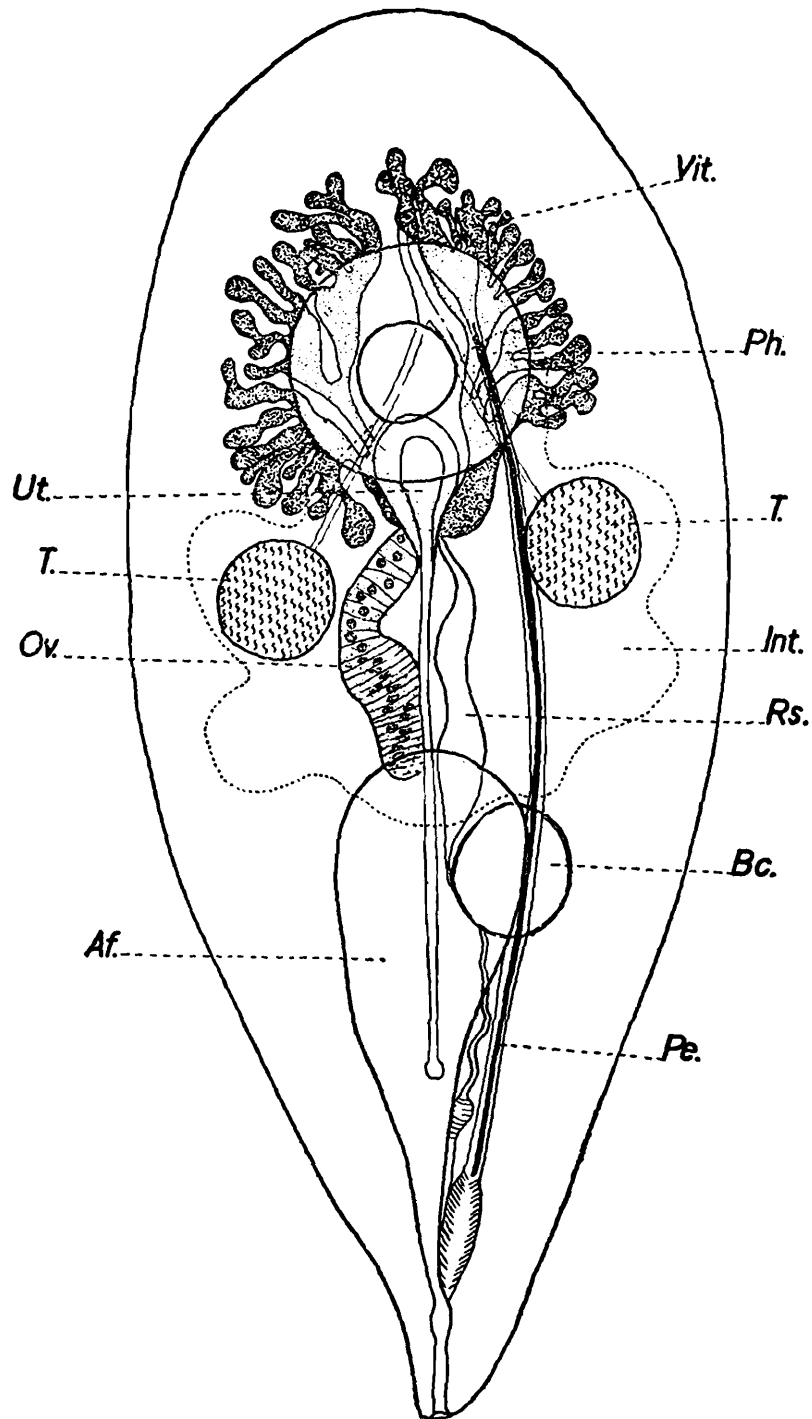
TEXT-FIG. 1.—Portion of cross-section of the skin showing the ciliated cells and the subjacent glandular cells.

is very powerfully developed and differs somewhat from the "*pharynx doliiformis*" found in most Rhabdocoelids. The pharynx is nearly three times wider than long; it measures 520-540 μ in diameter. Seen from above, it may be mistaken for a large sucker at the bottom of which arises the oesophagus (text-fig. 2). There does not appear to be a pharyngeal sac, but this may be due to the fact that in all our specimens, the pharynx is very much everted. The outer muscle layer of the oesophagus contains well developed longitudinal muscle fibers, and the inner layer is lined by a single row of epithelial cells. It is quite possible that there are glands opening into the oesophagus and into the bottom of the pharynx, but the specimens are too poorly preserved to show this distinctly. The oesophagus opens into the anterior extremity of the intestine. The latter is sac-shaped, with five or six lobes (text-fig. 2). The intestine is lined by long epithelial cells, such as one finds in other specimens of Rhabdocoelids; it is located near the dorsal surface of the worm and extends slightly beyond the middle of the body.

The brain is situated in front of the pharynx, near the ventral surface. It is well developed, occupying nearly one third of the width of the section (text-fig. 4), and from it arise several large nerves, two of which, particularly distinct, pass backwards towards the posterior end of the body and send branches to the nerve-ring, surrounding the oesophagus. No eyes are present.

The anatomy of the genital organs is very complicated, especially that of the female genitalia. The latter are located almost entirely in the fore half of the worm. There is a single, elongate, ovary, somewhat twisted about itself, and situated in the right half of the body, close to the mid-line. This position is, however, subject to variation and depends entirely on the state of contraction of the worm when preserved, so that in some cases the ovary may come to lie on the opposite side. The vitellaria are situated in two main groups of follicles on either side of the pharynx, meeting in a common duct behind the latter organ. The yolk-duct is well developed; its opening is in the immediate vicinity of the cviduct. The topographical anatomy of the female genital ducts

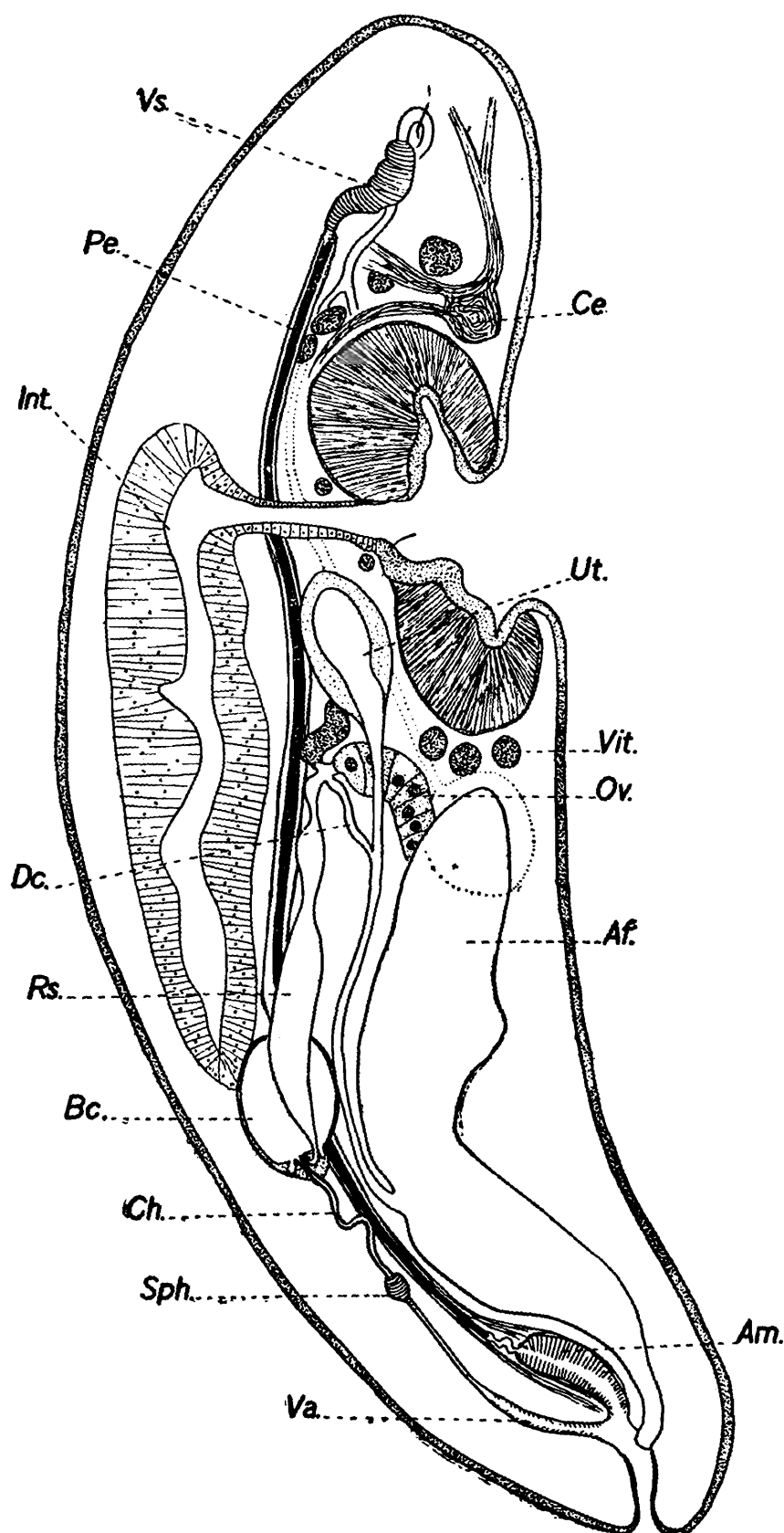
is extremely complicated, the more so as most of the authors do not seem to agree as to the names given to various parts. We will describe the ducts as we observed them and will try to homologize them with the same ducts in other genera, in a later section of this paper.



TEXT-FIG. 2.—Whole mount showing the topography of the internal organs. *Af.* Atrium femininum; *Bc.* Bursa copulatrix; *Int.* Intestine; *Ov.* Ovary; *Pe.* Penis; *Ph.* Pharynx; *Rs.* Receptaculum seminis; *T.* Testis; *Ut.* Uterus; *Vit.* Vitellaria.

The genital atrium is terminal, sometimes sub-dorsal (text-fig. 3). The vagina opens dorsally into the atrium; it is formed by a narrow canal, lined with bristles, growing gradually narrower as it recedes from the atrium. At its most narrow portion, the vagina suddenly swells into a pear-shaped portion surrounded by powerful circular muscle fibers forming a distinct sphincter, and joining the vagina to a very narrow

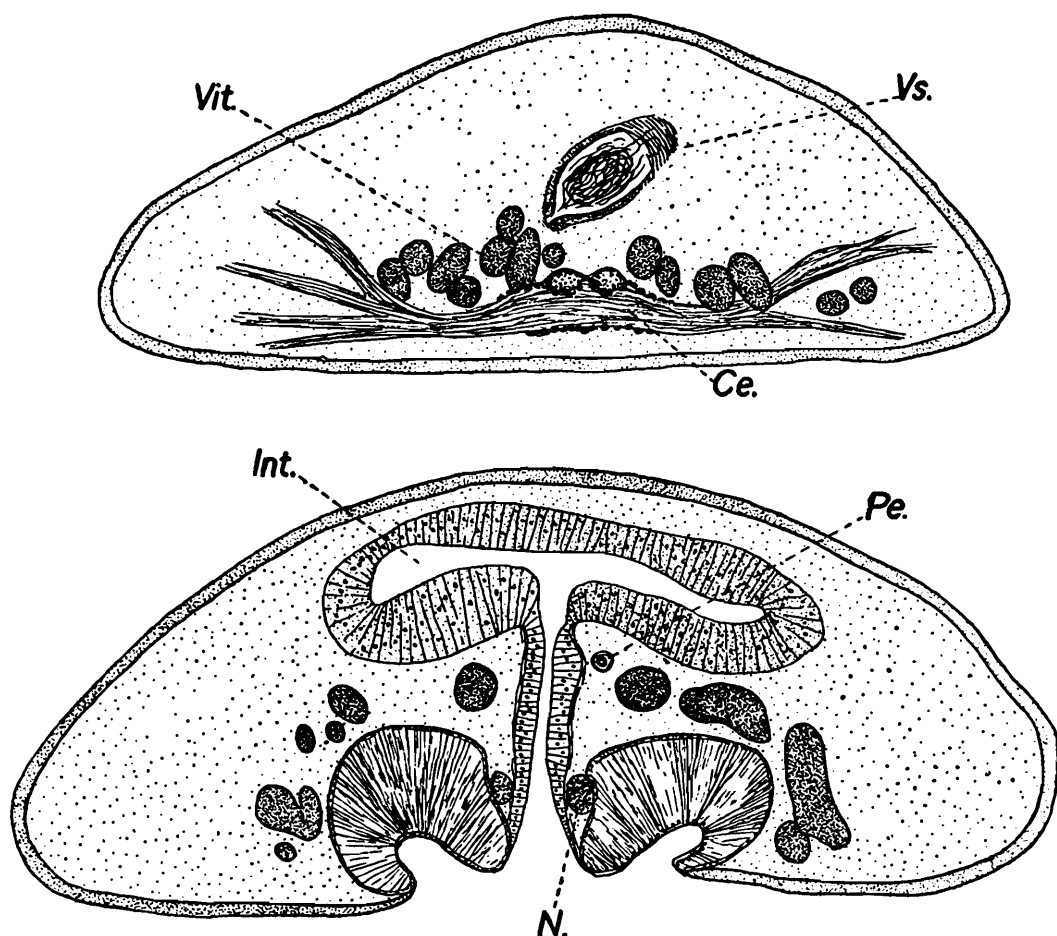
tube, somewhat bent on itself, and which is lined with a chitinous substance. This tube opens into a spherical cavity 256 μ in diameter. At



TEXT-FIG. 3.—Reconstruction of several sagittal sections showing the anatomy of the male and female organs; the shell-gland has been left out. *Af.* Atrium femininum; *Am.* Atrium masculinum; *Bc.* Bursa copulatrix; *Ce.* Brain; *Ch.* Chitinous portion of vagina; *Dc.* Ductus communis; *Int.* Intestine; *Ov.* Ovary; *Pe.* Penis; *Rs.* Receptaculum seminis; *Sph.* Vaginal sphincter; *Ut.* Uterus; *Va.* Vagina; *Vit.* Vitellaria; *Vs.* Vesicula seminalis.

the point where the chitinous tube enters the cavity, is to be found a mass of glands, indistinct in our sections, but occupying exactly the same position as those described by Westblad (1930, fig. 10) for *Anoplo-diera voluta* Westblad, 1930. In the same region, the wall of the cavity is much thicker than elsewhere, and contains a certain number of small crypts which are always filled with spermatozoa.

In the vicinity of the chitinous vaginal tube arises from the cavity a second tube, also chitinous, but much shorter than the other, which is bent on itself and opens into a thin-walled elongated vesicle. The latter is always filled with spermatozoa, and opens at a point where the oviduct, the yolk-duct and another canal generally known as the *ductus communis*, meet (text-fig. 3).



TEXT-FIG. 4.—Cross section of the brain (top) and of the oesophagus (bottom). *Ce.* Brain; *Int.* Intestine; *N.* Nerve ring; *Pe.* Penis; *Vit.* Vitellaria; *Vs.* Vesicula seminalis.

As opposed to the condition in other genera, the *ductus communis* is short. From its origin, it proceeds, posteriorly and ventrally, until it unites with a duct of the same size as its own. At the point where the two ducts unite, the *ductus communis* is surrounded by numerous glandular cells, the so-called shell gland. The duct into which opens the *ductus communis*, lies almost parallel to the longitudinal axis of the body. In the immediate vicinity of the pharynx, it becomes dilated into a thick-walled, pear-shaped structure (*Ut.*), whereas the opposite end opens into a large cavity, located ventrally (*Af.*). The latter extends from behind the pharynx to the genital atrium into which it opens through a narrow duct (text-fig. 3).

There are two testes located symmetrically on either side of the median line, in the anterior half of the body. Each testis is a spherical body, 200 μ in diameter, giving rise to a single sperm-duct. The two sperm-ducts, unite behind the pharynx, to form the *vas deferens*. The latter, after proceeding towards the anterior end of the worm, turns back and enters a thick-walled, muscular pouch, 176 μ in length and 80 μ in diameter. This muscular *vesicula seminalis* (Us.) opens into a very long and narrow chitinous tube, enclosed in a muscular sheath. This tube, the penis, extends from the pharyngeal region to the *atrium masculinum* and is nearly as long as two thirds of the total length of the worm. The *atrium masculinum* is lined with hard-set bristles and its anterior end is pierced by a small duct through which protrudes the penis. An examination of the muscles of this region shows, that the atrium can be completely everted and the penis extruded, through the contraction of its longitudinal muscular sheath. The *atrium masculinum* is 216 μ long and measures 72 μ in diameter.

We have been unable to obtain entire ova from our specimens. According to Faust (1927) the latter measure 92 μ by 77 μ and are provided with a very long polar filament.

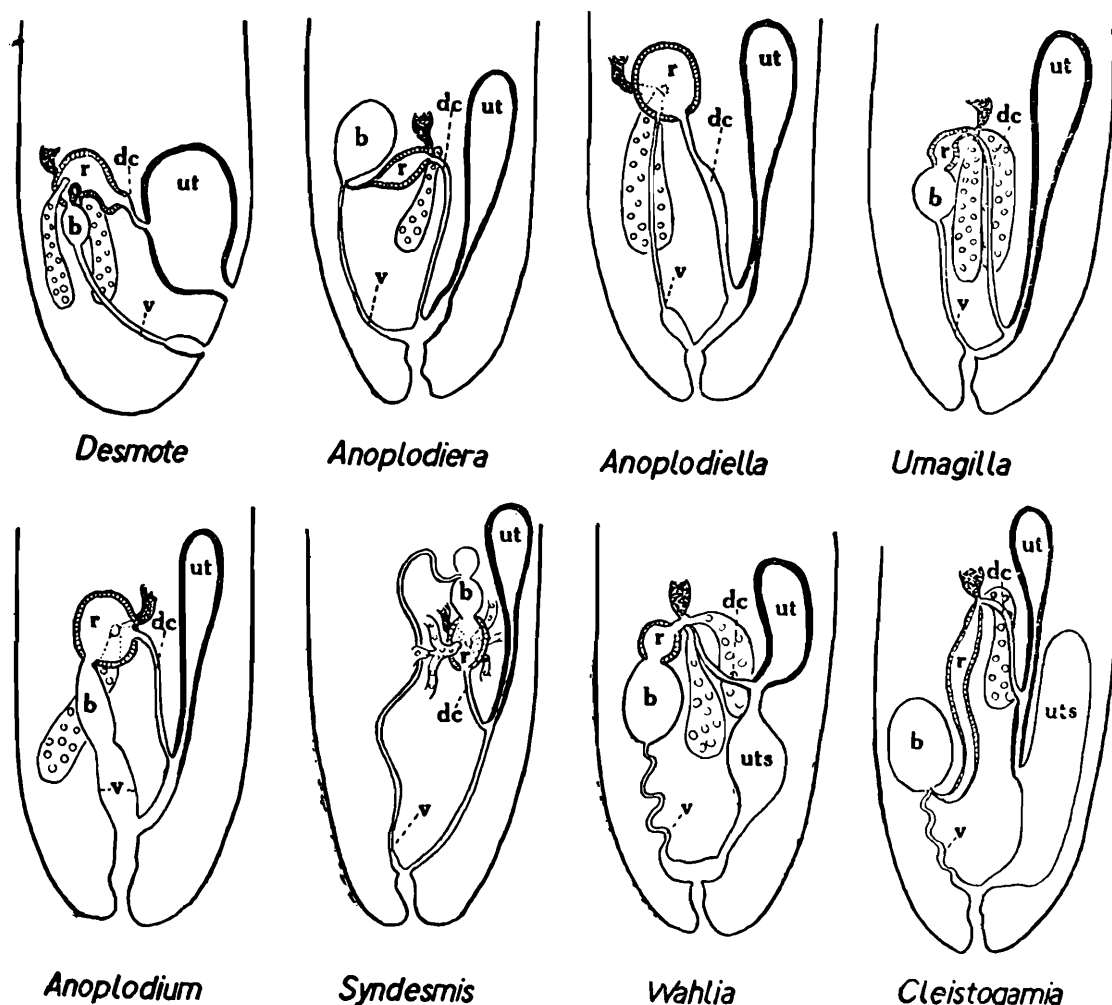
Without any doubt, the anatomy of *Cleistogamia holothuriana* as described above, is not that of a Trematode, but that of a Rhabdocoelid Turbellarian. If we refer to Bresslau's classification (1933) of this group, we find that the worm comes under the sub-order Lecithophora, and in the first section, Dalyellioida. The latter contains nearly all the parasitic Rhabdocoelids and is divided into seven families. Of these the Umagillidae is of interest in connection with the present work as its genera appear closely related to *Cleistogamia*, and all the species are parasitic either in Echinoderms or Sipunculids. The family Umagillidae Wahl, 1910 (syn. Anoplodiidae v. Graff, 1913), consists of eight genera. *Anoplodium* A. Schneider, 1858; *Anoplodiella* Bock, 1925; *Anoplodiera* Westblad, 1930; *Collastoma* Dörler, 1900; *Desmote* Beklemicheff, 1916; *Syndesmis* Silliman, 1881; *Umagilla* Wahl, 1906; *Wahlia* Westblad, 1930.

Wahl (1910) divided the Umagillidae into two sub-families, Umagillinae Wahl 1910 (syn. Anoplodiinae v. Graff, 1913) and Collastominae Wahl, 1910. The latter contains a single genus, *Collastoma* Dörler, 1900, parasitic in Sipunculids, and which is characterized in possessing a single testis, and in having the vitellaria disposed in two compact bands, parallel to the longitudinal body-axis. We maintain these two sub-families (*contra* Bresslau, *loc. cit.* p. 269), as we consider them well differentiated by their internal anatomy on the one hand, and by their different hosts on the other hand. Bresslau unites them under the name Anoplodiidae v. Graff, 1913, but on grounds of priority the latter name must be replaced by Umagillidae Wahl, 1910.

In the sub-family Umagillinae, we can at once distinguish two categories of genera according to the presence of a single or a double ovary. *Anoplodium*, *Anoplodiella* and *Anoplodiera* possess a single ovary, whereas *Desmote*, *Syndesmis*, *Umagilla* and *Wahlia* possess two ovaries. The genus *Cleistogamia*, with its single ovary, must be placed into the first of the above two categories. By the anatomy of its female genital ducts,

Cleistogamia, comes close to *Anoplodiera* Westblad, 1930. It differs, however, from the latter by the presence of a large ventral cavity in which the ova accumulate, by the peri-buccal location of the vitellaria and by the reduced size of the testes. It, therefore, ensues that the genus *Cleistogamia* must be maintained as a distinct genus of the sub-family Umagillinae, with *Cleistogamiinae* Faust, 1927 as second synonym. On the other hand, the Trematode family name *Cleistogamiidae* Bosma, 1931 lapses before *Umagillidae* Wahl, 1910.

Several authors have attempted to homologize the different parts of the female genitalia. This is however a difficult undertaking owing to the paucity of detailed descriptions concerning the origin and development of these ducts. We have tried to homologize the genital ducts of the eight genera of the Umagillinae and have grouped our results in a series of diagrammatic drawings (text-fig. 5) in which each organ or duct is always indicated in the same manner.



TEXT-FIG. 5.—Female genitalia of the eight genera actually included in the Umagillinae. The male organs have been left out and the ventral surface of the worm is always facing to the right; *b*. Bursa copulatrix; *dc*. Ductus communis; *r*. Receptaculum seminis; *ut*. Uterus; *uts*. Secondary uterus; *v*. Vagina.

Desmote can be opposed to the other genera by the absence of a genital atrium, at least according to Beklemicheff (1916). In the other genera, we find that the distance separating the genital atrium from the point where the *ductus communis* emerges, is very variable. In *Anoplodiera*, the *ductus communis* opens almost directly into the genital atrium whereas in *Anoplodium*, *Anoplodiella* and *Umagilla* its opening is

separated from the atrium by a segment, variable in length, but always shorter than the *ductus communis* itself. In *Syndesmis*, *Wahlia* and *Cleistogamia*, this segment is always longer than the *ductus communis*. In the latter two genera, it is dilated, forming a large cavity in which the eggs accumulate. In *Syndesmis*, on the other hand, the *ductus communis* is connected with the atrium by a long narrow canal which Wahl (1910) named *atrium femininum*.

If we consider the series *Anoplodiella*, *Umagilla*, *Anoplodium*, *Syndesmis*, *Wahlia*, *Cleistogamia*, we observe that the cavity in which the ova accumulate in *Cleistogamia*, and which might be interpreted as a true uterus is really an expansion of the *atrium femininum*. We are, therefore, of the opinion that the term "secondary uterus" proposed by Westblad (*loc. cit.*, p. 419) is the most appropriate to designate this organ.

The structure of the uterus is the same in all the genera—A club-shaped, thick-walled cavity in which lies a single egg or egg-capsule. *Physiologically*, the uterus of the Umagillinae is homologous with the ootype of Trematoda and Cestoda; an organ in which the ovum is formed and into which opens the shell gland. However, *anatomically*, it is not possible to derive from the Rhabdocoelidian uterus the ootype of Trematoda and Cestoda.

The *ductus communis* arises from the confluence of the yolk-duct, the oviduct and the *receptaculum seminis*. The latter appears to vary much in size, generally spherical or pear-shaped, it is very elongated in *Cleistogamia*. In *Anoplodiella*, the vagina opens directly into the *receptaculum seminis*, whereas in all the other genera are to be found, interposed between the vagina and the *receptaculum*, one, or more rarely two, accessory vesicles whose structure differs from that of the *receptaculum*. This accessory vesicle can be well developed as in *Cleistogamia*, *Wahlia* and *Anoplodiera*, and corresponds to what most authors have called the *bursa copulatrix*. According to Wahl (1910, p. 54) the *bursa copulatrix* has entered secondarily into communication with the *receptaculum*, thus serving as a fertilizing canal, and not only as a reservoir for spermatozoa. It would thus seem logical to conclude that the vagina of these species has arisen primarily from the canal connecting the *bursa* with its opening. This canal being formed by the hilus of the *bursa* which gradually grows longer as the *bursa* is displaced from near the atrium to the *receptaculum*, with which it finally connects. This hypothesis seems to be supported by the arrangement found in *Anoplodium* for instance, where the vagina and *bursa* are hardly distinct from one another. The vagina is longest in *Syndesmis* and opens into a *bursa* which, according to Wahl (1910) may sometimes be constricted so as to form two distinct bursae.

The results of our investigations show that the sub-family Umagillinae contains genera, easily distinguished from one another, yet showing a distinct relationship. *Desmote*, alone, seems to occupy a place by itself, possessing as it does, no genital atrium, the male and female openings being found separately on the ventral surface of the worm. On the other hand, it is not possible to understand clearly the disposition of the female ducts from Beklemicheff's description of the worm.

It appears necessary to examine the species anew, especially as the forked intestine is rather an unusual feature, not found before in Rhabdocoelids.

By way of conclusion, we give below a new diagnosis of the genus *Cleistogamia*, regretting, however, that the International laws of Zoological Nomenclature oblige us to maintain such an inappropriate generic name, which is also based on an erroneous interpretation.

Cleistogamia (characteribus falsis Faust, 1924) Mihi.

Umagillinae with a very large pharynx resembling a true sucker. Body covered uniformly with ciliae. Genital atrium terminal or subdorsal. Testes two. Male genital apparatus formed by a muscular seminal vesicle and a very long chitinous penis opening into an eversible *atrium masculinum*. Ovary single. Vitellaria follicular, arranged in two peribuccal groups. Well developed *bursa copulatrix* and *receptaculum seminis* present. *Ductus communis* short. Uterus opening into a very large secondary uterus, situated ventrally. The latter opens into the genital atrium. Ova with a very long polar filament.

Type species.—*Cleistogamia holothuriana* Faust, 1924.

Type host.—*Actionopyga mauritiana* (Quoy & Gaimard).

Type locality.—Andaman seas, Station No. 26.

Collection.—Zoological Survey of India, Indian Museum, Calcutta, No. W. 1499/1.

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ADDITIONAL NOTE.

The above paper had already gone to press when my attention was directed to a paper by Khalil and Azim (1937) describing under the name *Louftia louftia* a new genus and species of the Trematode family Cleistogamidae Khalil and Azim, 1937 *nec* Cleistogamiidae Bosma, 1931, from Holothurians from the Red Sea. In a further note, Khalil (1937) mentioned the discovery of living specimens and observed the ciliated covering of the body. He corrected his first statement and subsequently ascribed his genus to the Turbellarian family Anollodiidae. Khalil (*loc. cit.*) refers to a detailed description published in the *Journal of the Egyptian Medical Association*, Vol. XX, No. 9, 1937, in which the genus *Louftia* is considered to be synonymous with *Cleistogamia*. I have carefully gone through the entire volume of the above journal but have failed to find the paper referred to by Khalil. As the original description of *Louftia louftia* Khalil and Azim, 1937 is incomplete, it is not possible at present to discuss the internal anatomy. I do not, however, believe that *Louftia* is a synonym of *Cleistogamia* as the vitellaria are very differently distributed in the two genera. It will be necessary to re-examine the genus *Louftia* before assigning to it its correct systematic status.

1937. Khalil, M. & Azim, A.—On *Louftia louftia* gen. nov., a sp. of the new family Cleistogamidae, endoparasites of Holothuria from the Red Sea, Egypt. *Papers on Helminthology published in commemoration of the 30 years jubilee . . . of K. J. Skrjabin*. Moscow, pp. 289-291, 2 figs.
1937. Khalil, M.—Note on *Louftia louftia* Khalil and Azim. *ibid*, p. 796.

NOTES ON FISHES IN THE INDIAN MUSEUM.

XXXVI. ON A COLLECTION OF FISH FROM THE RAJMAHAL HILLS, SANTAL PARGANAS, BIHAR.

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INTRODUCTION.

One of the zoogeographical riddles in connection with the distribution of Indian freshwater fishes is the occurrence of similar forms, such as the Homalopteridae, *Silurus* Linn., etc., in the south-western hills of Peninsular India on the one hand, and in the Eastern Himalayas, Assam Hills, Burma and further east and south on the other. Such characteristic forms have not been found to occur along the Himalayan range beyond the Tista river water-shed, and this fact has been explained by me¹ recently by supposing that through a differential orogenic movement, which probably occurred late in the Miocene period or even later, a barrier was created between the eastern and the western Himalayan fishes. After this movement "The new stock of specialised hill-stream fishes from the east, not finding means to cross the barrier, were deflected towards south-west along the Satpura Trend which probably at this period stretched across India as a pronounced range from Gujrat to the Assam Himalayas" With a view to test this hypothesis Dr. B. Prashad, Director, Zoological Survey of India, at the author's request, very kindly sent a party of the Zoological Survey of India under Drs. H. S. Rao and H. A. Hafiz in February-March, 1938, to survey the fauna of the Rajmahal Hills. The collection dealt with in this paper was made by this party both in the northern parts of the hills and on the bank of the Ganges at Sakrigali Ghat.

The Rajmahal Hills stretch from Sahibganj on the Ganges to Nangal-banga on the Rampur Hat and "consist of a succession of hills, plateaux, valleys and ravines, the general elevation of which varies from 500 to 800 feet above sea-level, though some hills have an altitude of 1,500 feet and a few are said to rise to the height of 2,000 feet. The valley is drained by the river Morel or Moran, which, flowing from the north, has scoured out a long ravine, and by the Gumāni coming from the south-west through the Chaparbhītā pass. These rivers meet at Burhait, and the united stream, which is called the Gumāni, flows along the Ghātiāri pass, and thence through the plains to the Ganges" ². Most of the collection was made in the valleys of these rivers and their side

¹ Hora, S. L.—*Rec. Ind. Mus.*, XXXIX, p. 255 (1937).

² O'Malley, L. S. S.—*Bengal District Gazetteers*. Santal Parganas, p. 3 (Calcutta : 1910).

streams, but mention may also be made of Motijharna, a picturesque water-fall, which was also visited by the party.

At the time of the visit of the Zoological Survey party certain streams, like the one near Sundarpahari, were practically dry, while the relatively large streams, like the Gumāni river, had a shallow channel in the middle or on the sides meandering through the sand with only ankle-deep water in several parts. Streams, like the Morel, with banks had pools and puddles with a small trickle of water over a pebbly bed connecting them. The bottom of the pools, where muddy, was covered with aquatic vegetation and, where rocky, with *Spirogyra* and other algae. The muddy, rocky and pebbly portions occurred alternately according to the nature of the country over which the stream flowed. In the Gumāni the bed consisted mostly of coarse to fine sand except in bends of the river where the bottom was muddy. In the Morel, though the water mostly flowed over a muddy bed, in places the substratum consisted of pebbles and shingle.

One remarkable feature of the fish collection is the presence of a very large number of young specimens of practically all the species obtained by the party and particularly of *Barilius*, *Brachydanio*, *Barbus*, etc. From this it may safely be inferred that this is probably the breeding season of the fish found in the hills.

Of the 34 species of fish obtained by the party, 16 (*vide* list on p. 171), represent the common Gangetic forms. Six of these, were also obtained from the hill area, but all the sixteen species are widely distributed and from a zoogeographical point of view do not call for any comments. The occurrence of the very young specimens of *Gadusia chapra* in the Ganges at Sakrigali Ghat shows that the fish breeds high up in the Ganges and that the breeding season extends at least up to January-March.

Of the 18 species found only in the hills, ten, *viz.*, *Chela phulo*, *Esomus danricus*, *Catla catla*, *Aspidoparia morar*, *Nandus nandus*, *Ophicephalus gachua*, *Mastacembelus armatus*, *Lepidocephalichthys guntea*, *Barbus ticto*, *Brachydanio rerio* and *Barilius bendelisis*, are very widely distributed in Indian waters. *Barbus chagunio*, *Botia dario*, *Nemachilus zonatus*, and *Gagata cenia* are primarily north Indian forms and occur along the base of the Himalayas, but they have also been recorded from Orissa. *Amblyceps mangois* is found at the bases of hills from Siam, Burma, Assam Hills and the Himalayas as far west as the Kangra Valley and its occurrence in the Rajmahal Hills to the west of the Ganges is of special significance. Similarly *Garra gotyla* is essentially a Himalayan species. The most interesting find in the collection, however, is the presence of two specimens of *Laguvia ribieroi* Hora, a form described from the Eastern Himalayas several years ago and so far known from a single specimen.

Under the ecological conditions prevailing in the Rajmahal Hills of to-day, the presence of the typical torrential forms, which require a continuous flow of water over a rocky bed, was not to be expected, but the presence of *Laguvia*, *Amblyceps*, *Garra gotyla* and *Botia dario* has undoubtedly demonstrated the continuity of the fauna of the Rajmahal Hills with that of the hills of Assam. It has to be borne in mind

that the Rajmahal Hills of to-day are mere stumps of a once mighty range which probably had a great influence on the rainfall in India and harboured perennial torrential streams along which forms like the Homalopteridae, *Silurus*, etc., migrated at a time when the Ganges did not flow eastwards. On this last point Holdich (*vide* O'Malley, *op. cit.*, p. 6) says :—

“ There was no Gangetic basin in those days, and it was probable that Rajmahal Hills and the hills of Assam continued the land area to the Himalayas east of Sikkim. Another result of this succession of earth movements was the formation of that great Indo-Gangetic depression which forms one of the natural geographical divisions of India. The break in the connection between the Rajmahal and Assam hills, which gave an opening for the eastward flow of the Ganges, is comparatively recent.”

Wadia¹ has shown that the change in the direction of flow of the Ganges probably occurred as a result of the Potwar movement during the Pleistocene period.

LIST OF SPECIES.

Family CLUPEIDAE.

1. *Gadusia chapra* (Ham.)*

Family MASTACEMBELIDAE.

2. *Mastacembelus armatus* (Lacép.)

Family CYPRINIDAE.

3. *Chela clupeoides* (Bloch)*†
4. *Chela phulo* (Ham.)
5. *Barilius bendelisis* Ham.
6. *Brachydanio rerio* (Ham.)
7. *Rasbora daniconius* (Ham.)*†
8. *Esomus danricus* (Ham.)
9. *Aspidoparia morar* (Ham.)
10. *Amblypharyngodon mola* (Ham.)*
11. *Barbus chagunio* (Ham.)
12. *Barbus chola* (Ham.)*
13. *Barbus sophore* (Ham.)*†
14. *Barbus terio* (Ham.)*†
15. *Barbus ticto* (Ham.)
16. *Catla catla* (Ham.)
17. *Cirrhina reba* (Ham.)*
18. *Garra gotyla* (Gray)
19. *Labeo calbasu* (Ham.)
20. *Labeo gonius* (Ham.)*
21. *Rohitee cotio* (Ham.)*

Family COBITIDAE.

22. *Botia dario* (Ham.)*
23. *Lepidocephalichthys guntea* (Ham.)
24. *Nemachilus zonatus* (McClell.)

Family BAGRIDAE.

25. *Mystus cavasius* (Ham.)*

Family AMBLYCEPIDAE.

26. *Amblyceps mangois* (Ham.)

Family SISORIDAE.

27. *Laguvia ribeiroi* Hora.
28. *Gagata cenia* (Ham.)

Family OPHICEPHALIDAE.

29. *Ophicephalus gachua* Ham.

Family AMBASSIDAE.

30. *Ambassis baculis* (Ham.)*†
31. *Ambassis nama* (Ham.)*
32. *Ambassis ranga* (Ham.)*

Family NANDIDAE.

33. *Nandus nandus* (Ham.)

Family GOBIIDAE.

34. *Glossogobius giuris* (Ham.)*†

An asterisk (*) denotes that the species was collected from the Ganges at Sakrigali Ghat. An asterisk (*) and a dagger (†) denote that the species was collected in the Ganges as also in the hills. Specific names without any mark denote that the species were collected from the Rajmahal Hills only.

¹ Wadia, D. N.—*Quart. Journ. Geol. Mining and Metallurgical Soc. India*, IV, p. 96 (1932).

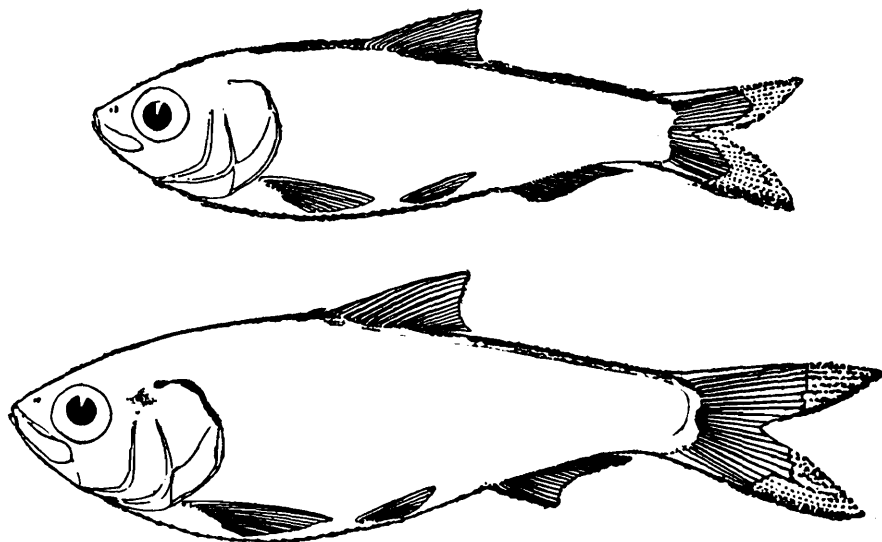
SYSTEMATIC ACCOUNT.

Gadusia chapra (Hamilton).

1917. *Gadusia chapra*, Regan, *Ann. Mag. Nat. Hist.*, (8), XIX, p. 307.

31 specimens. Sakrigali Ghat, Santal Parganas. (Purchased from market.)

The specimens of *Gadusia chapra* range in length from 23 mm. to 104 mm. in total length without the caudal. The presence of very young specimens in the collection shows that the species breeds in the river Ganges at least as high up as Sakrigali Ghat. Young specimens



TEXT-FIG. 1.—Two young stages of *Gadusia chapra* (Hamilton), 28 mm. and 34 mm. in length without the caudal respectively. $\times 2$.

of *G. chapra* along with a very large number of young ones of *Hilsa ilishia* were recently obtained from the River Hooghli at Nawabgunge near Calcutta. It seems, therefore, that both the species probably breed throughout their range in the Ganges and its tributary streams.

According to Day (*Fish. India*, p. 640), *G. chapra* occurs in "Fresh waters of rivers and tanks of Sind and throughout India as far south as the Kistna River, but absent from the Malabar coast and Madras".

Mastacembelus armatus (Lacépède).

1876. *Mastacembelus armatus*, Day, *Fish. India*, p. 340, pl. lxxiii, fig. 3.

1 specimen. Gumāni river at Durgapore, Santal Parganas.

1 specimen. Povayal river along Bario-Banji road, Santal Parganas.

Mastacembelus armatus is a widely distributed species; its range extends from China, through Burma, to India and Ceylon.

Chela clupeioides (Bloch).

1878. *Chela clupeioides*, Day, *Fish. India*, p. 602.

17 specimens. Sakrigali Ghat, Santal Parganas. (Purchased from market.)

31 specimens. Morel river at Bario, Santal Parganas. (Purchased.)

According to Day, *Chela clupeioides* is found in "Cutch, Jubbulpore, Mysore, the Deccan, Madras Presidency, and Burma" Its occurrence in the Rajmahal Hills, an intermediate area between South India and Burma, is of unusual interest.

Chela phulo (Hamilton).

1878. *Chela phulo*, Day, *Fish. India*, p. 602, pl. cliii, fig. 1.

1 specimen. Morel river near Bario, Santal Parganas. (Purchased.)

Chela phulo is distributed from Assam, through Bengal, Orissa and Central India, to the Deccan as far southwards as the Tamboodra and the Kistna rivers.

Barilius bendelisis Hamilton.

1878. *Barilius bendelisis*, Day, *Fish. India*, p. 590, pl. cxlviii, figs. 7, 8 and 9.

There is a very large number of the young of *Barilius* collected from practically all over the area visited by the party. Though the very young ones are difficult to determine specifically, certain specimens over 2 inches in total length can definitely be referred to *B. bendelisis*. The species is fairly widely distributed in Indian waters.

Brachydanio rerio (Hamilton).

1878. *Danio rerio*, Day, *Fish. India*, p. 597, pl. cli, fig. 4.

Brachydanio rerio is represented by a large number of specimens, mostly immature, collected from practically all over the area visited by the party. According to Day, the species is found in "Bengal, as low down the Coromandel coast as Masulipatam"

Rasbora daniconius (Hamilton).

1878. *Rasbora daniconius*, Day, *Fish. India*, p. 584, pl. cxlvi, fig. 2.

1 specimen. Sakrigali Ghat, Santal Parganas. (Purchased from market.)

1 specimen. Morel river at Bario, Santal Parganas. (Purchased.)

Rasbora daniconius is the most widely distributed species of the genus; it is found throughout India, Burma and Ceylon.

Esomus danricus (Hamilton).

1928. *Esomus danricus*, Hora & Mukerji, *Rec. Ind. Mus.*, XXX, p. 49.

1 specimen. Gumāni river near Dhamni, Santal Parganas.

1 specimen. Povayal river along Bario-Banji road, Santal Parganas.

3 specimens. Stream 2 miles from Kusma, Santal Parganas.

1 specimen. Gumāni river near Kusma, Santal Parganas.

Esomus danricus is common in the ponds and ditches of Assam, Bengal, Bihar, Orissa, Central Provinces, United Provinces and the Punjab. It is also found in South India.

Aspidoparia morar (Hamilton).

1878. *Aspidoparia morar*, Day, *Fish. India*, p. 585, pl. cxlvi, fig. 4.

1 specimen. Gumāni river near Kusma, Santal Parganas.

Aspidoparia morar is represented in the collection by a small specimen, about 27 mm. in length without the caudal. Day recorded the species from "Sind, Punjab, Continent of India (except the Western coast, and localities south of the Kistna river) also Assam and Burma"

Amblypharyngodon mola (Hamilton).

1878. *Amblypharyngodon mola*, Day, *Fish. India*, p. 555, pl. cxxxv, fig. 4.

1 specimen. Sakrigali Ghat, Santal Parganas. (Purchased from market.)

There is a small specimen of *Amblypharyngodon mola*, about 33 mm. in length without the caudal, in the collection under report. Most of the scales have fallen off and in other respects also the specimen is not in a good condition.

A. mola is stated by Day to occur "From Sind throughout India (except the Malabar Coast), Assam and Burma"

Barbus chagunio (Hamilton).

1936. *Barbus chagunio*, Hora & Mukerji, *Rec. Ind. Mus.*, XXXVIII, p. 139.

1 specimen. Gumāni river near Dhamni, Santal Parganas.

Barbus chagunio is represented by a young specimen, about 51 mm. in length without the caudal. The species is found throughout northern India from Assam to the Punjab; it is also known from Orissa.

Barbus chola (Hamilton).

1878. *Barbus chola*, Day, *Fish. India*, p. 571, pl. cxlii, fig. 4.

1 specimen. Pool about a mile from Sakrigali Ghat, Santal Parganas.

Barbus chola is a widely distributed species of the Indian and Burmese waters; it is represented in the collection by a single specimen about 48 mm. in total length.

Barbus sophore (Hamilton).

1878. *Barbus stigma*, Day, *Fish. India*, p. 579, pl. cxli, fig. 5.

1916. *Barbus sophore*, Chaudhuri, *Mem. Ind. Mus.*, V, p. 436.

2 specimens. Sakrigali Ghat, Santal Parganas. (Purchased from market.)

1 specimen. Stream below Boarijore Inspection Bungalow, Santal Parganas.

6 specimens. Povayal river, Bario-Banji road, Santal Parganas.

1 specimen. Gumāni river near Dhamni, Santal Parganas.

Barbus sophore is a very common Indian species; it is found in fresh and brackish waters of India and Burma.

Barbus terio (Hamilton).

1878. *Barbus terio*, Day, *Fish. India*, p. 580, pl. cxliv, fig. 3.

1 specimen. Pool near Sakrigali Ghat, Santal Parganas.

10 specimens. Povayal river, Bario-Banji road, Santal Parganas.

1 specimen. Morel river near Bario, Santal Parganas.

3 specimens. Tributary of Morel river west of Bario-Burhait road, Santal Parganas.

3 specimens. Damra river near Simlong, Santal Parganas.

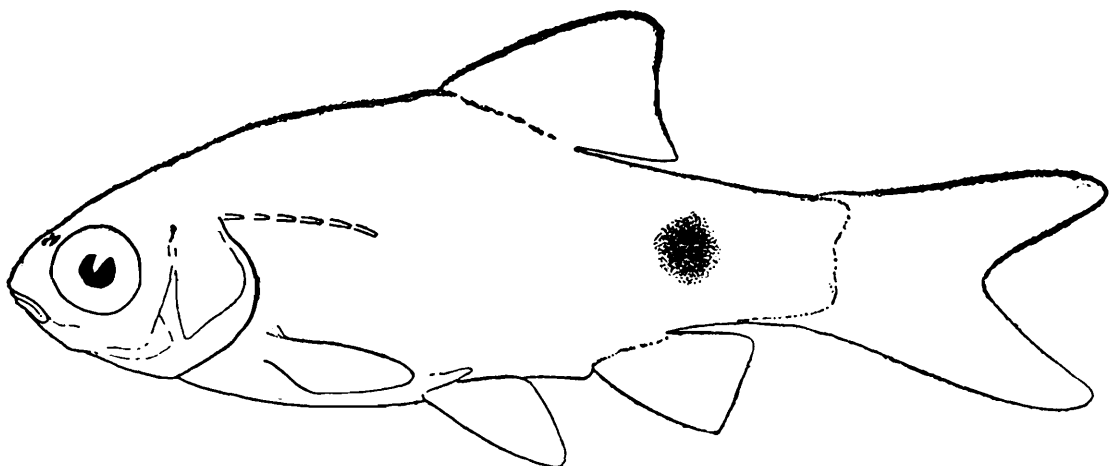
5 specimens. Gumāni river at Dhamni, Santal Parganas.

30 specimens. Gumāni river at Kusma, Santal Parganas.

9 specimens. A stream about 2 miles from Kusma, Santal Parganas.

Barbus terio is a small species which is found in northern India from Bengal to the Punjab and also in Orissa. The specimens in the

collection are very young, the largest being about 30 mm. in total length. The most characteristic feature of the species is the presence of a fairly large black blotch in the middle of the side over the anal fin. In the



TEXT-FIG. 2.—A young specimen of *Barbus terio* (Hamilton), showing the position and extent of the caudal spot. $\times 4$.

young specimens under report there are no other colour markings except that the edges of the scales are provided with a number of fine black dots.

***Barbus ticto* (Hamilton).**

1938. *Barbus ticto*, Hora & Misra, *Journ. Bombay Nat. Hist. Soc.*, XL, p. 28.

5 specimens. Gumāni river near Dhamni, Santal Parganas.

6 specimens. Povayal river, Bario-Banji road, Santal Parganas.

The specimens of *Barbus ticto* exhibit the same sexual characters with regard to colouration, etc., which were observed in the case of the Deolali examples (*vide* reference above). The species is distributed throughout India and Ceylon.

***Catla catla* (Hamilton).**

1878. *Catla Buchanani*, Day, *Fish. India*, p. 553, pl. cxxxiv, fig. 5.

1 specimen. Morel river near Bario, Santal Parganas. (Purchased.)

Catla catla is represented in the collection by one young specimen. The range of the species extends from Burma through Assam, Bengal to all parts of India above the Kistna river. It has, however, been recently introduced in the Cauvery river.

***Cirrhina reba* (Hamilton).**

1878. *Cirrhina reba*, Day, *Fish. India*, p. 549, pl. cxxx, fig. 3.

2 specimens. Sakrigali Ghat, Santal Parganas. (Purchased from market.)

Cirrhina reba is found throughout India.

Garra gotyla (Gray).

1921. *Garra gotyla*, Hora, *Rec. Ind. Mus.*, XXII, p. 653.

34 specimens. Gumāni river near Dhamni, Santal Parganas.

Only recently¹ it was pointed out by me that the young specimens of *Garra*, with a median proboscis on the snout, which I had referred to *G. lamta*, in reality belonged to *G. gotyla*; this extended the range of the latter species to the Vindhya and the Satpuras. The common occurrence of the species in the Rajmahal Hills fully confirms the view that the Satpura trend may have once served as a highway for the migration of the Himalayan forms to the Western Ghats and thence to the hills of the Peninsular India and Ceylon.

Garra gotyla is known from the Chindwin and the Irrawadi drainage systems, and from along the base of the Himalayas. It has now been recorded from several places in the Vindhyan Range.

The largest specimen in the collection is about 75 mm. in length without the caudal. The proboscis is fairly well marked in all the examples.

Labeo calbasu (Hamilton).

1878. *Labeo calbasu*, Day, *Fish. India*, p. 536, pl. cxxvi, fig. 4.

1 specimen. Sakrigali Ghat, Santal Parganas. (Purchased from market.)

Labeo calbasu is a widely distributed fish of the Indian and Burmese waters; its range does not extend to the south of the Kistna river.

Labeo gonius (Hamilton).

1878. *Labeo gonius*, Day, *Fish. India*, p. 537, pl. cxxvii, fig. 1.

5 specimens. Sakrigali Ghat, Santal Parganas. (Purchased from market.)

Labeo gonius is found in Burma and throughout northern India as low as the Kistna river.

Rohtee cotio (Hamilton).

1878. *Rohtee cotio*, Day, *Fish. India*, p. 587, pl. cli, fig. 1.

39 specimens. Sakrigali Ghat, Santal Parganas. (Purchased from market.)

The specimens of *Rohtee cotio* range in length from 31 mm. to 70 mm. without the caudal and are referable to the typical form of the species. This is the most widely distributed species of the genus; its range extends from southern China through Burma to India. According to Day, it is not found along the Malabar Coast and in the Peninsula of India south of the Kistna river.

Botia dario (Hamilton).

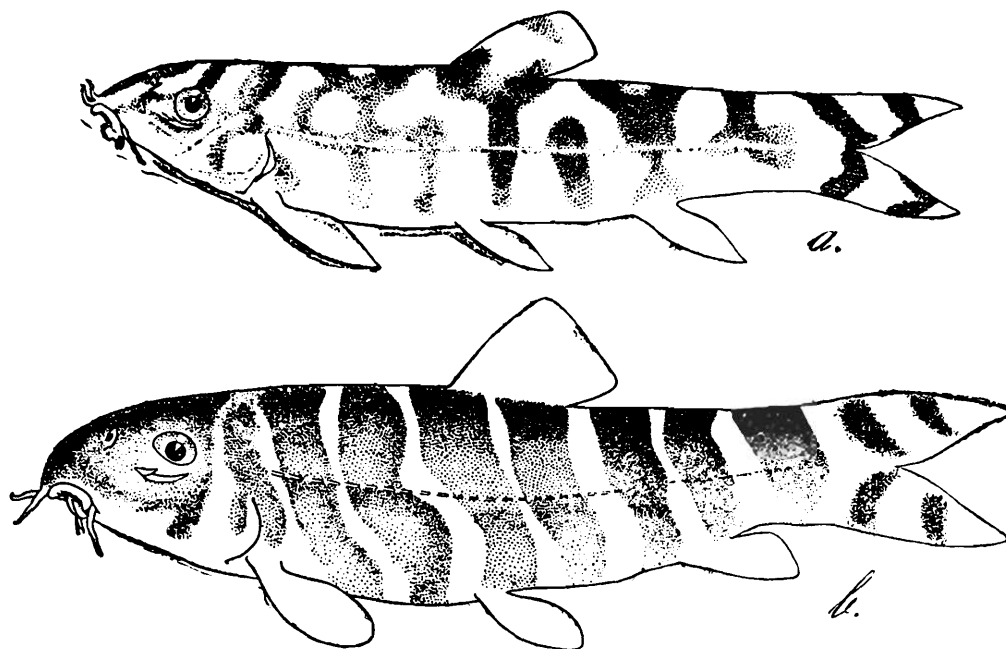
1932. *Botia dario*, Hora, *Rec. Ind. Mus.*, XXXIV, p. 573.

3 specimens. Morel river at Barhait, Santal parganas.

The three specimens of *Botia dario* are 52 mm., 74 mm. and 78 mm. in total length respectively. In the two larger specimens the colour

¹ Hora, S. L.—*Rec. Ind. Mus.*, XXXIX, pp. 347-348 (1937).

bands encircle the entire body ; some of them are split into two bands on the ventral surface. In the case of the smaller specimen the bands



TEXT-FIG. 3.—Two specimens of *Botia dario* (Hamilton), showing variation in colouration at different stages of growth. *a.* $\times 1\frac{2}{3}$; *b.* $\times 1\frac{1}{2}$.

on the back enclose small spaces of ground colour which may be saddle-shaped. Some of the markings on the dorsal surface are not continuous with those on the sides. The caudal fin is marked with two bands. The colouration of this young specimen is, therefore, different from Hamilton's *geto*, which is regarded as a juvenile form of *B. dario*.

Botia dario has hitherto been known from Assam, and from along the Himalayan foot-hills in Bengal, Bihar and the United Provinces. It is here recorded for the first time from a region to the west of the Ganges.

***Lepidocephalichthys guntea* (Hamilton).**

1878. *Lepidocephalichthys guntea*, Day, *Fish. India*, p. 609, pl. clv, fig. 4 ; pl. clvi, fig. 12.

- 7 specimens. Stream below Motijharna, Santal Parganas.
- 4 specimens. Morel river near Bario, Santal Parganas.
- 2 specimens. Stream below Boarjore Inspection Bungalow, Santal Parganas.
- 4 specimens. Povayal River, Bario-Banji road, Santal Parganas.
- 1 specimen. Dighi river, Bario-Banji road, Santal Parganas.
- 1 specimen. Bhanji river at Bhanji, Santal Parganas.
- 3 specimens. Damra river near Simlong, Santal Parganas.
- 9 specimens. Gumāni river near Dhamni, Santal Parganas.
- 3 specimens. Gumāni river near Kusma, Santal Parganas.
- 1 specimen. Kusmajharna (spring) at Kusma, Santal Parganas.

Lepidocephalichthys guntea is found throughout India, except Mysore, Malabar Coast and to the south of the Kistna river.

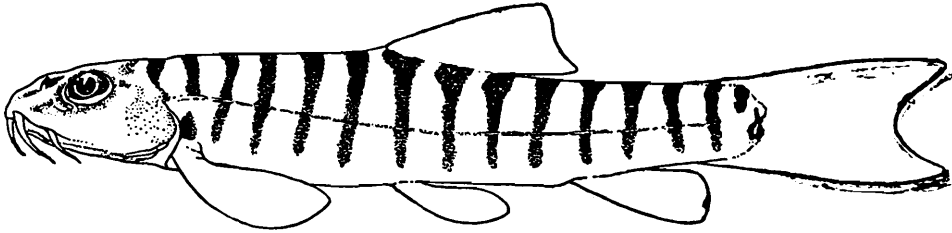
The specimens were collected from sandy or muddy places where the fish lay buried with the head protruding above the substratum.

Nemachilus zonatus (McClelland).

1878. *Nemachilus zonatus*, Day, *Fish. India*, p. 618, pl. clvi, fig. 2.

3 specimens. Gumāni river near Dhamni, Santal Parganas.

Nemachilus zonatus was described by McClelland from Upper Assam where it was found living in ponds, but Day recorded it from "Throughout the Jumna and Ganges rivers and their affluents, Bheer Bhoom, Assam and Orissa "



TEXT-FIG. 4.—Lateral view of a male specimen of *Nemachilus zonatus* (McClelland) to show the characteristic colouration of the species. $\times 2$.

The specimens from the Rajmahal Hills were collected from a sandy substratum and agree closely with Day's description of the species. On account of its very characteristic colouration, *N. zonatus* can be distinguished readily from all the other Indian species of the genus. The largest specimen in the collection is about 44 mm. in total length.

Mystus cavasius (Hamilton).

1877. *Macrones cavasius*, Day, *Fish. India*, p. 447, pl. c, fig. 1.

6 specimens. Sakrigali Ghat, Santal Parganas. (Purchased from market.)

Mystus cavasius is a very common Indian fish and is found in Burma also.

Amblyceps mangois (Hamilton).

1933. *Amblyceps mangois*, Hora, *Rec. Ind. Mus.*, XXXV, pp. 607-621.

15 specimens. Small pools at sides of Gumāni river near Dhamni Santal Parganas.

1 specimen. Morel river near Bario, Santal Parganas.

1 specimen. Damra river near Simlong, Santal Parganas.

1 specimen. Gumāni river at Kusma, Santal Parganas.

Only young specimens of *Amblyceps mangois* were collected from the Gumāni river and some of its tributary streams; the largest specimen is about 63 mm. in total length. The species, as a rule, lives at the bases of hills in shallow running streams among gravel and pebble, but in the dry season it is confined to small pools into which such streams are usually cut up.

The specimens from the Rajmahal Hills show precisely the same variations with regard to the depth of the body, the form of the caudal fin, etc., which had previously been observed by me in the examples collected in the Tista Valley.

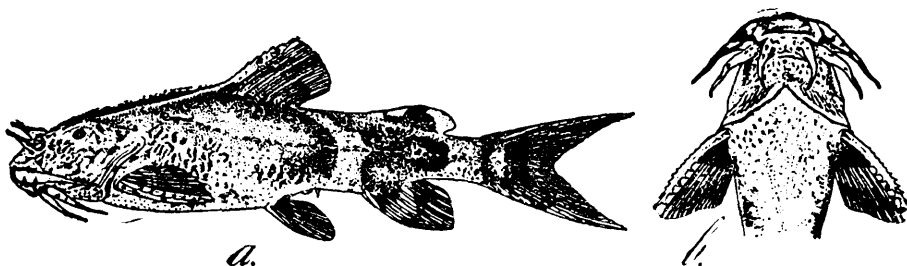
Amblyceps mangois has hitherto been known from Siam (Bua Yai, Chantabun; Pak Chong, Nakhon Rachasima; Nakhon Srithamarat and Maenam Canthaburi), North Burma (Putao Plains and Mali Hka river, Myitkyina District), Assam (Khasi, Abor and Naga Hills), Eastern

Himalayas (Siliguri, Sevoke and rivers of Terai and Duars) and Western Himalayas (Gazipore and Kangra Valley); its occurrence in the Rajmahal Hills to the west of the Ganges is of special interest as it shows that the Assam Hills and the Rajmahal Hills must have been continuous at not a very remote period of earth's history.

***Laguvia ribeiroi* Hora.**

1921. *Laguvia ribeiroi*, Hora, *Rec. Ind. Mus.*, XXII, p. 741, pl. xxix, fig. 3.
2 specimens. Morel river near Bario, Santal Parganas.

Laguvia ribeiroi was described from a single female specimen collected in the Khoila river, a tributary of the Tista river, and was distinguished from the genotype—*L. shawi* Hora, also known from the Tista river—by the position of the nostrils and the ventrals, and by the nature of the dorsal spine and of the chest region. Since then my colleagues and I have collected hundreds of specimens of *L. shawi* from the Sevoke and the Mahanadi rivers at the base of the Darjeeling Himalayas, and have found a faintly developed adhesive apparatus on the chest of all of them. The position of the nostrils with reference to the tip of the snout and the anterior margin of the eye and also of the ventrals



TEXT-FIG. 5.—*Laguvia ribeiroi* Hora.

a. Lateral view. $\times 2$; b. Ventral surface of head and anterior part of body. $\times 2$.

with reference to the tip of the snout and the base of the caudal fin have been found to be variable characters. The two species can still be distinguished readily by the nature of the dorsal spine which is strongly serrated anteriorly in *L. ribeiroi* and is smooth in *L. shawi*. In the former the eggs are very large as compared with those of the latter.

The two specimens of *L. ribeiroi* collected in the Rajmahal Hills are about 29 mm. in total length. The colour pattern is bright and dense. The head and body are thickly covered with prominent tubercles on their dorsal and lateral surfaces. The tubercles were at first associated with the sex of the specimens, but a study of a large series of specimens of *L. shawi* showed that these structures are sometimes equally well developed in both the sexes.

Laguvia was proposed for the two Tista river species referred to above. A third species *Pimelodus asperns* McClelland¹ was referred to this genus; it was described by McClelland from Chusan in China, but later recorded by Chaudhuri² from Upper Burma. The occurrence of *Laguvia* in the Rajmahal Hills is of special interest as it shows the

¹ McClelland, J.—*Calcutta, Journ. Nat. Hist.*, IV, p. 404, pl. xxiv, fig. 2 (1844).

² Chaudhuri, B. L.—*Rec. Ind. Mus.*, XVI, p. 276, pl. xii, fig. 2 (1919).

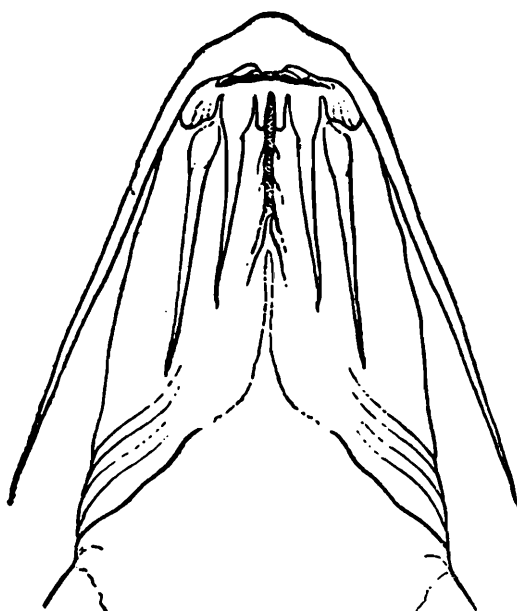
probable route of dispersal of some of the Far Eastern types of fish that are now found in the extreme south of the Peninsula.

Gagata cenia (Hamilton).

1877. *Gagata cenia*, Day, *Fish. India*, p. 492, pl. cxv, figs. 4 and 5.
2 specimens. Morel river at Barhait, Santal Parganas.

According to Day, *Gagata cenia* is distributed in the "Rivers of Bengal and Orissa, the Jumna, Ganges, and Indus, also Burma"

Two young specimens of the species were collected by the party from the Morel river at Barhait.



TEXT-FIG. 6.—Ventral surface of head of *Gagata cenia* (Hamilton) to show the positions of the 3 pairs of mandibular barbels. $\times 4$.

Besides the two mandibular pairs of barbels with stiff bases there is also a third pair. These are situated in the mid-ventral position between the bases of the inner mandibular barbels and are fleshy, and finger-like. All the three pairs of barbels lie in grooves, especially near their bases, so the median small pair is liable to be overlooked.

Ophicephalus gachua Hamilton.

1922. *Ophicephalus gachua*, Weber & de Beaufort, *Fish. Indo-Austral. Archipel.* IV, p. 321.

- 1 specimen. Tributary of Morel river west of Bario, Santal Parganas.
- 2 specimens. Gumāni river near Dhamni, Santal Parganas.
- 3 specimens. Povayal river along Bario-Banji road, Santal Parganas.

Ophicephalus gachua is one of the most widely distributed species of the Oriental Region.

Ambassis baculis (Hamilton).

1875. *Ambassis baculis*, Day, *Fish. India*, p. 51, pl. xv, fig. 1.

- 1 specimen. Pool about a mile from Sakrigali Ghat, Santal Parganas.
- 1 specimen. River Morel at Barhait, Santal Parganas.

According to Day, *Ambassis baculis* is found in Burma and northern India, from Bengal to the Punjab including Orissa.

Ambassis nama (Hamilton).

1875. *Ambassis nama*, Day, *Fish. India*, p. 50, pl. xiv, fig. 5.

9 specimens. Sakrigali Ghat, Santal Parganas.

Ambassis nama is a small species ; it is found throughout India and Burma.

Ambassis ranga (Hamilton).

1875. *Ambassis ranga*, Day, *Fish. India*, p. 51, pl. xiv, fig. 6.

2 specimens. Sakrigali Ghat, Santal Parganas. (Purchased from market.)

Ambassis ranga is distributed throughout India and Burma.

Nandus nandus (Hamilton).

1875. *Nandus marmoratus*, Day, *Fish. India*, p. 129, pl. xxxii, fig. 1.

2 specimens. Tank at Durgapore, Santal Parganas.

Nandus nandus is represented by two specimens in the collection it is found throughout India and Burma in fresh and brackish waters.

Glossogobius giuris (Hamilton).

1876. *Gobius giuris*, Day, *Fish. India*, p. 294, pl. lxv, fig. 1.

3 specimens. Sakrigali Ghat, Santal Parganas. (Purchased from market.)

1 specimen. Gumāni river at Barhait, Santal Parganas.

3 specimens. Gumāni river near Kusma, Santal Parganas.

1 specimen. Gumāni river near Dhamni, Santal Parganas.

Glossobogius giuris is a very widely distributed species and occurs in fresh and brackish waters, but according to Day, a variety of it is entirely confined to the sea and estuaries both along the coasts of India, and in the Andamans.

CHANGES IN THE INTERNAL STRUCTURES OF THE AIR-BLADDERS OF *EUTROPIICHTHYS VACHA* (HAM.), *CLUPISOMA GARUA* (HAM.) AND *AILIA COILA* (HAM.) DURING GROWTH.

By K. KRISHNAN NAIR, B.A., *Officiating Gallery Assistant, Zoological Survey of India, Calcutta.*

Presumably for lack of material, Bridge and Haddon¹, in their contributions to the anatomy of fishes, did not describe the air-bladder of *Eutropiichthys vacha* (Ham.). However they examined a dry skeleton of the fish and relying on the resemblances between the modifications of the skeletal structures usually associated with the air-bladder in this species with those found in *Clupisoma garua* (Ham.), concluded that the air-bladder of *E. vacha* may also be of the same vestigial and degenerate type as is found in *C. garua*. Dr. Hora^{2, 3}, has already shown that even externally the air-bladder of *E. vacha* though vestigial and degenerate, is not similar to that of *C. garua*; the former has a tubular and horseshoe-shaped bladder while in the latter it is a thick-walled, heart-shaped structure. The present article deals with a comparative study of the internal structures of the air-bladders of *Eutropiichthys* Bleeker, *Clupisoma* Swainson and *Ailia coila* (Ham.). Attention is specially directed to the differences between my preparations of the internal structures of the air-bladders of these fishes and the descriptions of the same by Bridge and Haddon. I have examined in each case the bladders of a series of specimens ranging from a fairly small size to full grown individuals of a large size.

I have to record my grateful thanks to Dr. Baini Prashad, Director, Zoological Survey of India, for affording me the necessary facilities for work. I am greatly indebted to Dr. S. L. Hora under whose supervision and guidance the work has been carried out, for the material, valuable suggestions and constant encouragement.

***Eutropiichthys Vacha* (Ham.).**

The air-bladder of the adult specimen of this species is a horseshoe-shaped tubular structure with its concavity directed anteriorly. It consists of a transverse portion lying across the ventral surface of the fifth vertebra, and of two lateral cornua which extend forwards into the recesses formed by the modified transverse processes. With the exception of the transverse portion, the rest of the bladder is enclosed in bone.

In the bladder of an adult specimen about 395 mm. in total length there is a very broad longitudinal septum (*ls.*) which divides the cavity

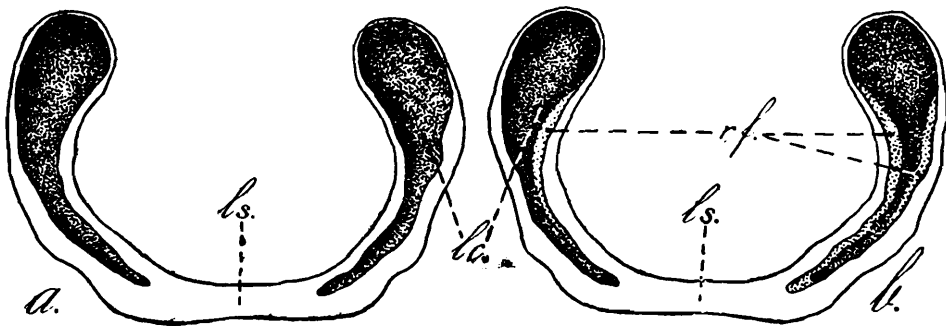
¹ Bridge, T. W. and Haddon, A. C.—*Phil. Trans. Roy. Soc. London*, (B), CLXXXIV, pp. 201-202 (1894).

² Hora, S. L.—*Journ. Bombay Nat. Hist. Soc.*, XXXIX, p. 434 (1937).

³ Hora, S. L.—*Journ. Bombay Nat. Hist. Soc.*, XXXIX, p. 663 (1937).

of the bladder into two lateral chambers (*lc.*). The cavities of these lateral chambers are very shallow owing to the walls and the root-like fibrous growths, except at the anterior ends which are more or less protected by the modified transverse processes. The walls are extremely thick and no trace of a pneumatic duct could be found.

The structure of the bladder of this fish varies during growth. In a small specimen, about 81 mm. in total length, the inside cavity is continuous, there being no transverse and longitudinal septa. There is, however, a projection from the posterior wall of the transverse portion of the bladder into the cavity, this projection does not bring about any division of the cavity into two, though the wall of the cavity between it and the anterior wall is somewhat raised. The cavity is free from any root-like fibrous growths and the walls are very thin. Even at this very early stage no pneumatic duct could be seen.



TEXT-FIG. 1.—Air-bladder of a specimen of *Eutropiichthys vacha* (Ham.) 395 mm. in total length. $\times 3$.

a. Dorsal half. b. Ventral half.

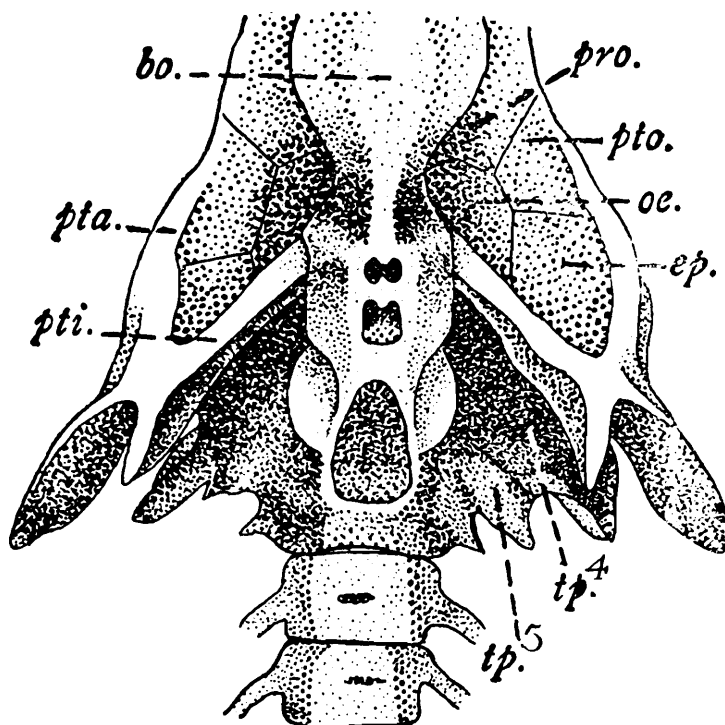
lc. lateral chambers; *ls.* longitudinal septum; *rf.* root-like fibrous growths.

With the growth of the fish the small projection from the posterior wall of the transverse portion of the bladder referred to above develops into a continuous longitudinal septum, which divides the cavity into two lateral chambers; it is very narrow to begin with, but with the growth of the fish it becomes broader and broader till it occupies almost the whole of the transverse portion of the bladder (text-fig. 1). Though, as a rule, the longitudinal septum is entire and continuous, when formed, I found in a specimen 114 mm. in total length, a narrow communication between the lateral chambers through the tissue of the septum. The presence of such a communication may be an abnormality since even in younger specimens the longitudinal septum is invariably complete.

The root-like fibrous growths appear in specimens over 105 mm. in total length; they are found along the anterior and posterior walls of the transverse portion of the bladder, and grow outwards and forwards into the cavities of the lateral chambers with the result that they are partially obliterated.

The air-bladder in the early stages of growth is quite hollow, with thin walls, but in the later stages its cavities become more and more shallow owing partly to the development of the root-like fibrous growths and partly to the thickening of the walls. The entire shape of the bladder also undergoes a slight change; Its gradual flattening shows that it is being pressed by the underlying organs.

Bridge and Haddon do not give any separate description of the skeletal modifications associated with the air-bladder of *E. vacha* but



TEXT-FIG. 2.—Skeletal structures connected with the air-bladder of a specimen of *Eutropiichthys vacha* (Ham.) 348 mm. in total length. $\times 2$.

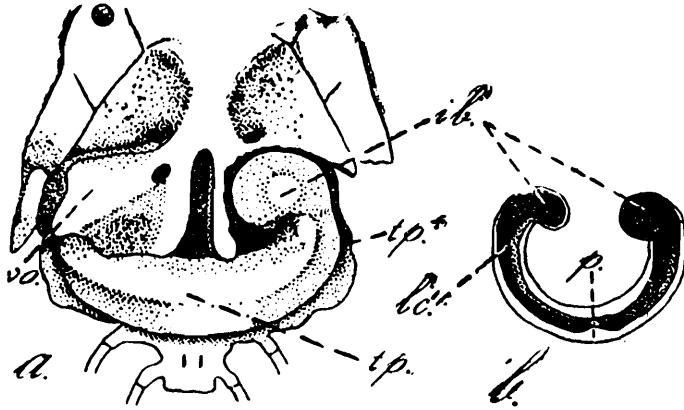
bo. basioccipital; *ep.* epiotic; *oe.* opisthotic plates of exoccipital; *pro.* pro-otic; *pta.* ascending process of the post-temporal; *pti.* inferior process or limb of post temporal; *pto.* pterotic; *tp*⁴. transverse process of the fourth vertebra; *tp*⁵. transverse process of the fifth vertebra.

remarked that the description of these structures in *Schilbichthys garua* (= *Clupisoma garua*) will probably apply to those of *E. vacha* with scarcely any alteration. It is stated in the short description of *E. vacha* that the transverse process of the fourth vertebra is broad and greatly expanded, and has its anterior and posterior margins curved directly downwards in such a way as to form a bony semicylinder. In the figure of the anterior part of the vertebral column of *E. vacha*, the transverse process of the fourth vertebra is shown as bent on itself to such an extent that it forms almost a cylinder instead of a semicylinder as described. In my preparations (text-fig. 2) the transverse process of the fourth vertebra only forms a semicylinder. Again, regarding the position of certain bones connected with the skull, there is some difference between the figure of Bridge and Haddon and my preparations. For example, I find that the pro-otic bone (*pro.*) is visible on the ventral surface, besides the other three bones, namely the epiotic (*ep.*), pterotic (*pt.*) and the opisthotic plates of the exoccipital (*oe.*).

***Ailia Coila* (Ham.).**

The air-bladder of *Ailia coila* (Ham.) (text-fig. 3, *b.*) is more or less similar to that of *Eutropiichthys vacha* (Ham.). It consists of a transverse portion (*tp.*) lying across the ventral surface of the sixth vertebra, and also of two lateral cornua (*lc.*) which extend forwards and are accommodated in the recesses formed by the modified transverse processes

(*tp*⁴.) and the ventral outgrowths (*vo.*). The bladder is tubular, horse-shoe-shaped and of a fairly uniform size. The anterior extremities of the lateral cornua (*ib.*), however, bulge inwards. The cavity of the bladder is continuous, as there are no transverse or longitudinal septa.



TEXT-FIG. 3.—*a.* Air-bladder and the connected skeletal structures of a specimen of *Ailia coila* (Ham.) 120 mm. in total length. $\times 5$. *b.* Dorsal half of the air-bladder of a specimen of *Ailia coila* (Ham.) 124 mm. in total length. $\times 3$.

ib. inwardly bulging anterior extremities of the lateral cornua; *lc*¹. lateral cornua; *p.* projection from the posterior wall of the transverse portion, jutting into the cavity of the bladder; *tp*. transverse portion; *tp*⁴. transverse process of the fourth vertebra; *vo.* ventral outgrowths.

According to Bridge and Haddon¹, however, there is no free or open communication between the anterior caecae through the transverse portion. A growth (*p.*) from the posterior wall of the transverse portion of the bladder projects into the cavity similar to that described above in the early stages of the growth of the bladder of *E. vacha*. There is a certain amount of loose tissue in the cavity of the bladder, but I could not detect any network of fibrous tissue to which Bridge and Haddon make a reference.

There is practically no difference in the internal structure of the air-bladder in specimens ranging in total length from 42 mm. to 124 mm.

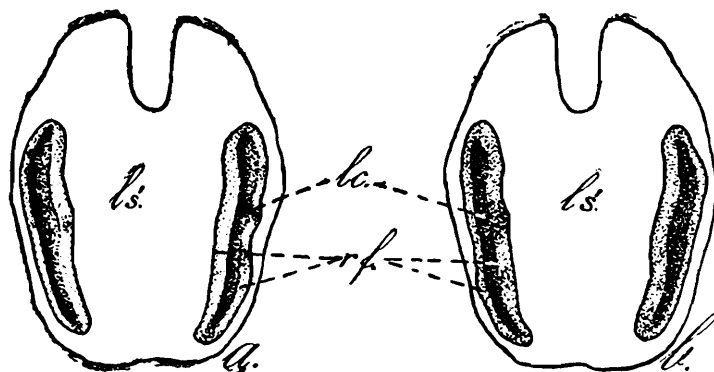
I give here a figure of the air-bladder of *Ailia coila* (Ham.) *in situ*, with the associated skeletal structures; the ventral bony outgrowth of one side is removed (text-fig. 3*a.*) to show the manner in which the anterior bulging portions of the cornua are accommodated within the bony capsules. The walls of the transverse portions are thick but those of the inwardly bulging anterior portions are extremely thin.

***Clupisoma Garua* (Ham.).**

The air-bladder of *Clupisoma garua* (Ham.) is heart-shaped with the apex pointing anteriorly. It is much flattened and is provided with greatly thickened walls even at a very early stage of its development. During growth the anterior half of the bladder apparently grows more quickly than the posterior, and in an adult specimen it assumes the shape as shown in text-fig. 4; it is very tough and smooth to the touch.

¹ Bridge, T. W. and Haddon, A. C.—*Phil. Trans. Roy. Soc. London, (B), CLXXXIV*, p. 210 (1894).

In a young specimen, about 108 mm. in total length, there is a very big transverse septum, almost filling the entire cavity, and a complete



TEXT-FIG. 4.—Air-bladder of a specimen of *Clupisoma garua* (Ham.) 377 mm. in total length. $\times 2$.

a. Dorsal half. b. Ventral half.

lc. lateral chambers; ls'. longitudinal solid structure; rf. root-like fibrous growths.

longitudinal septum which, in reality, is the constricted posterior portion of the transverse septum. These two septa divide the cavity into an anterior chamber, lying in front of the transverse septum and two lateral chambers, one on either side of both the septa. The cavities are deep in spite of the root-like fibrous growths on either side of the septa in the ventral half. The opening of the pneumatic duct is situated in front and just about the middle of the transverse septum in the ventral half. As the bladder grows, the transverse septum also grows and meets the anterior wall of the bladder, thus obliterating the anterior chamber and limiting the whole cavity into two symmetrically placed lateral chambers. For example, the air-bladder of a specimen 214 mm. in total length there are no transverse or longitudinal septa as such, but only a median, longitudinal, solid structure along the antero-posterior axis of the bladder. This solid structure along with the root-like fibrous growths gradually fill the cavities of the lateral chambers. In the air-bladder of a specimen 377 mm. in total length (text-fig. 4), there are only two narrow cavities on either side of the longitudinally placed solid structure. The opening of the pneumatic duct into the bladder disappears along with the obliteration of the anterior chamber by the transverse septum.

From their account, it appears that Bridge and Haddon¹ described the bladder of a specimen between 214 mm. and 377 mm. in total length.

¹ Bridge, T. W. and Haddon, A. C.—*Phil. Trans. Roy. Soc. London, (B)*, CLXXXIV, pp. 211-213 (1894).

NOTES ON ALEURODIDAE (RHYNCHOTA) FROM INDIA I.

By KARAM SINGH, *Department of Zoology, College of Science, Nagpur.*

Genus **Aleurotuberculatus** Takahashi (1932).

Aleurotuberculatus parvus, sp. nov.

(Plate I, figs. 1-4.)

Locality.—Royal Lakes, Rangoon.

Host.—*Bombax malabaricum*.

Pupa case.—(Pl. I, fig. 1) Colourless, without any waxy or gelatinous secretion, found singly mostly on the under side of leaves. Broadly elliptical, slightly constricted in the region of the thoracic tracheal pores. Margin almost entire with indistinct crenulations, with two pairs of minute setae, a pair anteriorly and a pair posteriorly. Dorsal disc differentiated from the submargin, which bears radial suture-like lines, a row of very fine setae about its middle and a series of crescentic markings on its inner side (Pl. I, fig. 2). Dorsal disc with reticulate markings on its peripheral region, distinctly segmented medially; both the longitudinal and transverse thoracico-abdominal sutures reaching its margin; three pairs of papillae on the cephalothorax and two pairs on the anterior two abdominal segments, the anteriormost as well as the posteriormost pair being larger than the others; in some specimens the posterior pair of papillae on the cephalothorax rather indistinct. Thoracic tracheal folds hardly indicated, terminating on the submargin in distinct circular pores, with a rim without any teeth or markings (Pl. I, fig. 3); caudal tracheal fold broad, sculptured with fine markings, narrowing posteriorly, terminating in a subcircular pore on the submargin (Pl. I, fig. 4).

Vasiform orifice small 0.018 mm. $\times$ 0.036 mm., subsemicircular, with the cephalic margin straight, a thick rim and an indistinct notch at the caudal end. Operculum similarly shaped, completely covering the orifice and obscuring the lingula. Male case smaller than a female case. Length of male case 0.64 mm.; breadth 0.55 mm.

Adults unknown.

This species resembles *Aleurotuberculatus cherasensis* Corbett (1935) but is easily distinguished by the absence of the posterior abdominal papillae, the presence of markings on the caudal tracheal fold and the form of the tracheal pores.

Collected by the author in October, 1929. Several specimens on slides and leaves in my collection. Type in the Indian Museum (No. 5765/H7).

Aleurotuberculatus burmanicus, sp. nov.

(Plate I, figs. 5-12.)

Locality.—Rangoon. Insein.

Host.—*Cassia* sp.

Pupa case.—(Pl. I, fig. 5) Black, sticking beneath leaves, with a greyish white rim of dots on the margin. Subelliptical in shape slightly

constricted in the region of the tracheal folds. Margin almost entire with three pairs of setae, one pair in front and two behind. Dorsal disc differentiated from submargin by its deeper colour and the presence of granular tubercles. Submargin (Pl. I, fig. 6) with radial rows of small semicircular markings and a thick paired wavy suture-like line on its venter about the middle. Dorsal disc with the longitudinal and transverse sutures reaching the extremity of the case, abdominal segments indicated and covered peripherally with abundant granular tubercles of various sizes, as shown in the figure. Thoracic tracheal folds indicated, terminating on the margin in slight indentations without any markings or teeth (Pl. I, fig. 7). Some specimens with indications of a pair of light eye spots. Ventrums of the case with ordinary legs and antennae as well as a pair of elevated sucker-like structures placed on the inner side of the middle pair of legs.

Vasiform orifice (Pl. I, fig. 8) subcordate, with its anterior margin straight, having a thickly chitinised rim bearing one or two papillate projections laterally, a minute pair of papillae in front and a wide notch behind. Operculum similarly shaped, occupying the orifice. Lingula not exposed. Caudal tracheal fold very broad, terminating on the caudal margin in a shallow indentation and marked with a few granular tubercles. Length of female case 0.63 mm.; breadth 0.46 mm.

Adult female.—Body dark yellow, tip of the rostrum black, about 1.5 mm. long. Eyes (Pl. I, fig. 9) divided into two halves with different sized facets, by a spinose patch. Antenna (Pl. I, fig. 10) of the usual 7 segments, their lengths and sensoria as shown in the diagram. Wings hyaline with the usual veins, forewing with four grey patches as shown in figure 11. Claws, paronychium and ovipositor normal.

Vasiform orifice (Pl. I, fig. 12) small, subcircular. Operculum subsquarish with a small lingula included within the orifice.

Adult male unknown.

This species bears a close resemblance to *Aleurotuberculatus neolitseae* Takahashi (1934), but it is differentiated by the larger number of tubercles on the dorsal disc and markings on the caudal tracheal fold.

Fairly common. Was found breeding in October, 1929 when I collected it. Types in the Indian Museum (Pupa Case No. 5766/H7; Female No. 5767/H7).

Genus **Aleuroputeus** Corbett (1935).

Aleuroputeus publicus, sp. nov.

(Plate II, figs. 1-7.)

Locality.—Nagpur.

Host.—*Tephrosia purpurea*.

Pupa case.—(Pl. II, fig. 1) Black, found in abundance on the under-side of leaves, occasionally on the petiole of a leaf; with a copious waxy fluff both on the margin as well as the dorsum arranged as follows. Three large masses of white fluff on dorsum, two on cephalothorax and one on mid abdomen respectively, about ten white spots on the submargin of the abdomen, and a broad fringe of close set filaments all round the margin (Pl. II, fig. 2). Elliptical in shape, with an indented

margin made of rounded teeth (Pl. II, fig. 3). Dorsum demarcated from the submargin by a chitinised fold. Submargin broad with paired dark markings arranged in a more or less radial fashion, also with a pair of light eye spots near the anterior end and about nine pairs of small spines disposed on the periphery. Dorsum with the longitudinal suture reaching the margin and the transverse thoracico-abdominal suture reaching the submargin. No trace of tracheal folds or pores; minute circular pores, about eight pairs on the cephalothorax, one pair each on the first two abdominal segments, three pairs on the third abdominal segment, and two pairs on the following four segments, arranged in longitudinal rows. A pair of swellings with sucker-like ends submedially on the ventrum of the cephalothorax. Antennae and legs normal; rostrum large and truncate at the tip. Abdominal segments distinctly indicated, with more or less rounded lateral extremities, terminating caudally in an elevation bearing the vasiform orifice.

Vasiform orifice subcordate with a pair of spines laterally. Operculum similarly shaped, filling the orifice and obscuring the lingula; two pairs of longer bristles on the submargin behind the orifice. Length of female case 0.88 mm.; breadth 0.55 mm.

Adult female.—Head and thorax sooty, abdomen sooty yellow with the tip greyish; eyes divided into two parts differing conspicuously regarding the size of the facets, the lower half sooty, the upper half crimson; rostrum yellow with the tip black. Length from vertex to tip of abdomen about 1.01 mm.

Antenna of 7 segments, segment II subpyriform, 0.055 mm. long, with a few spines at the distal end; segment III subcylindrical 0.111 mm. long, provided with two fringed sensoria near the distal end; segment IV 0.016 mm.; segment V 0.025 mm. with a fringed sensorium at the distal end; segment VI 0.033 mm. long, without any sensorium; segment VII 0.037 mm. long, tapering to the distal end which bears a single fringed sensorium (Pl. II, fig. 6).

Forewing (Pl. II, fig. 5) about 0.962 mm. long and 0.388 mm. broad, translucent white with grey patches as shown in the figure. Radial sector with a single flexure, cubitus seen as a distinct streak. Hindwing about 0.832 mm. $\times$ 0.333 mm. with the usual vein and a dark longitudinal streak along the middle, broken nearly half way.

Abdomen with the usual two pairs of wax glands. Hind tibia 0.31 mm. long, proximal tarsus 0.111 mm., distal tarsus 0.074 mm., claws short and slender, paronychium about the same size.

Vasiform orifice (Pl. II, fig. 7) subcircular, operculum squarish, smaller than the orifice and lying about the middle, lingula cylindrical about the length of the operculum, projecting behind the orifice, a large grey patch surrounding the orifice. Ovipositor strongly chitinised with the ordinary parts.

Adult male.—Length about 0.925 mm., coloured with regard to its body and wings like the female except that there are 3 or 4 grey bands on the abdomen and the usual 4 pairs of wax glands. Antennae and Vasiform orifice like that of the female, proportionately smaller.

Claspers (Pl. II, fig. 4) 0.111 mm. long, tapering and slightly incurved at the tip with one or two spines on the inner border; penis somewhat

swollen at the base, cylindrical distally, about three-fourth the size of the claspers.

Breeding in abundance in October. Adults very brisk at flight. Abundant material on leaves and slides. Types in the Indian Museum (Pupa Case No. 5768/H7 ; Female No. 5769/H7 ; Male No. 5770/H7).

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Takahashi, R. Aleurodidae of Formosa, Pt. I. *Rep. Dept. Agr. Govt. Res. Ins. Formosa*, No. 59 (1932).
Takahashi, R. Aleurodidae of Formosa, Pt. III. *Rep. Dept. Agr. Govt. Res. Ins. Formosa*, No. 63 (1934).

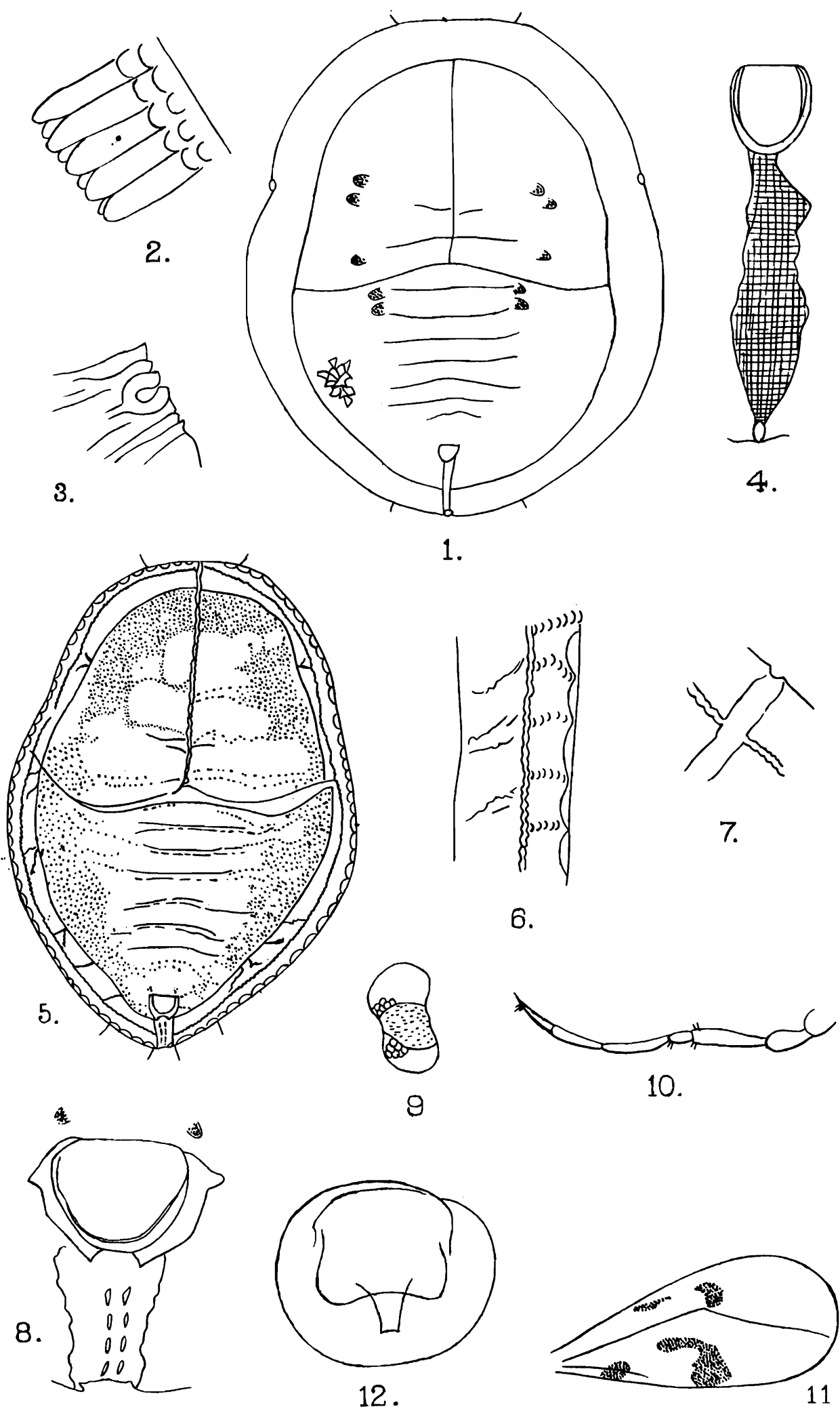
EXPLANATION OF PLATE I.

Aleurotuberculatus parvus, sp. nov.

- FIG. 1.—Pupa case. $\times 100$.
FIG. 2.—Margin of case. $\times 450$.
FIG. 3.—Thoracic tracheal pore of case. $\times 450$.
FIG. 4.—Vasiform orifice and anal tracheal fold of case. $\times 450$.

Aleurotuberculatus burmanicus, sp. nov.

- FIG. 5.—Pupa case. $\times 100$.
FIG. 6.—Margin and submargin of case. $\times 450$.
FIG. 7.—Thoracic tracheal fold of case. $\times 450$.
FIG. 8.—Vasiform orifice and anal tracheal fold of case. $\times 450$.
FIG. 9.—Eye of female. $\times 100$.
FIG. 10.—Antenna of female. $\times 100$.
FIG. 11.—Forewing of female. $\times 32$.
FIG. 12.—Vasiform orifice of female. $\times 450$.

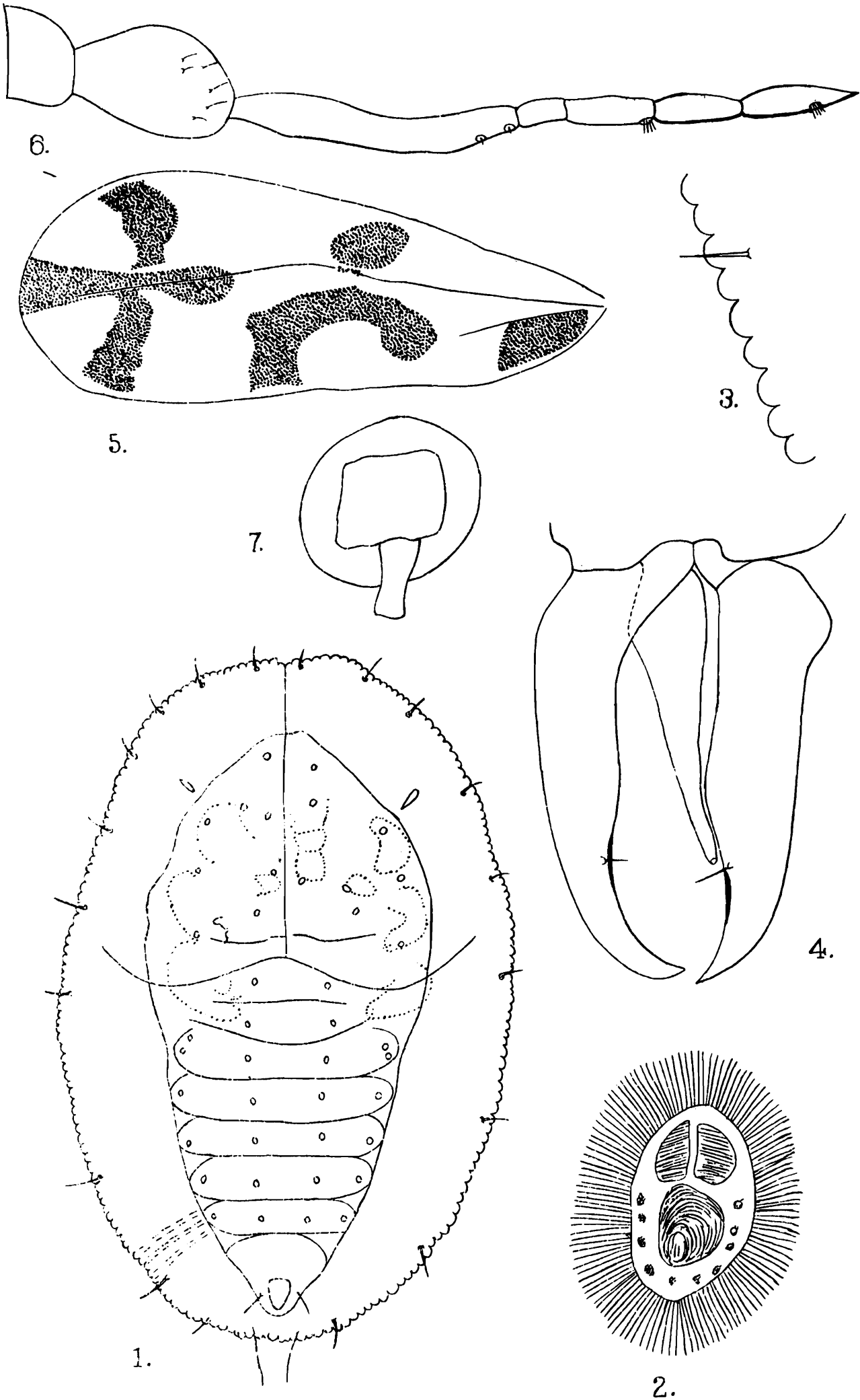


INDIAN ALEURODIDAE.

EXPLANATION OF PLATE II.

Aleuoputeus publicus, sp. nov.

- FIG. 1.—Pupa case. $\times 100$.
- FIG. 2.—Pupa case with waxy fluff on leaf.
- FIG. 3.—Margin of case. $\times 450$.
- FIG. 4.—External genitalia of male. $\times 450$.
- FIG. 5.—Forewing of female. $\times 30$.
- FIG. 6.—Antenna of female. $\times 450$.
- FIG. 7.—Vasiform orifice of female. $\times 450$.



OBSERVATIONS ON THE GROWTH AND HABITS OF THE GASTROPOD MOLLUSC, *PYRAZUS PALUSTRIS* (LINNÉ), IN THE ANDAMANS¹.

By H. SRINIVASA RAO, M.A., D.Sc., F.A.Sc., F.N.I., Assistant Superintendent, Zoological Survey of India, Calcutta.

(Plate III.)

In the course of a search for *Trochus niloticus* along the east coast of South Andaman in the vicinity of Port Blair in connection with the investigation on the *Trochus* shell fishery, the occurrence of a considerable population of *Pyrazus palustris* (Cerithiidae) on a patch of rocky sea-beach attracted my attention. The fact that Sewell² had previously published some notes on the growth of this species from data obtained in the Nicobars, and the close proximity of the Fishery Laboratory to the place of occurrence of *Pyrazus palustris* induced me to obtain additional data, if only to confirm or modify Sewell's conclusions in regard to the age and rate of growth of the species. Moreover, as the conditions under which the species lives in the locality in which Sewell collected his material and in the Andamans seemed to be different, it was thought that a comparative study of the problems of growth in the same species in two different localities would yield valuable results. The determination of the age of a group of individuals of a species and their rate of growth so far as Molluscs are concerned have been very little studied in this country, and the only papers on the subject that have been published are those by Sewell (*loc. cit.*) and by Rao³. An attempt to study this problem in Fish was made by Whitehouse⁴.

The methods usually adopted for the study of the two closely allied problems of the determination of age and of the rate of growth in Molluscs are the "annual ring" method and the "age-group" method. I am not aware that the former is applicable to Gastropod Molluscs of the tropics in which lines of growth, when present, do not have the same significance attached to them as in the Molluscs of the temperate regions⁵. But the method has been applied with success in temperate regions of the world in respect of Fish and Molluscs, taking into account the lines of growth formed on the scales and otoliths of Fish and on the shells of Molluscs⁶. The determination of age by the "age-group" method is statistical in technique and seems to depend for its success upon the breeding season of the species being limited to a short period of the year. The measurement of the dimensions (length, breadth or height) of a large number of individuals of a population consisting of animals of various sizes in a given locality, and the tabulation of the

¹ Read before the Silver Jubilee Session of the Indian Science Congress at Calcutta, January 1938.

² Sewell, R. B. S., *Rec. Ind. Mus.*, XXVI, pp. 542-544 (1924).

³ Rao, H. S., *Rec. Ind. Mus.*, XXXVIII, pp. 473-498 (1936).

⁴ Whitehouse, R., *Madras Fish. Bull.*, XVII, pp. 49-103 (1923).

⁵ Rao, H. S., *Rec. Ind. Mus.*, XXXVIII, pp. 476-477, pl. xiv, figs. 3-5 (1936).

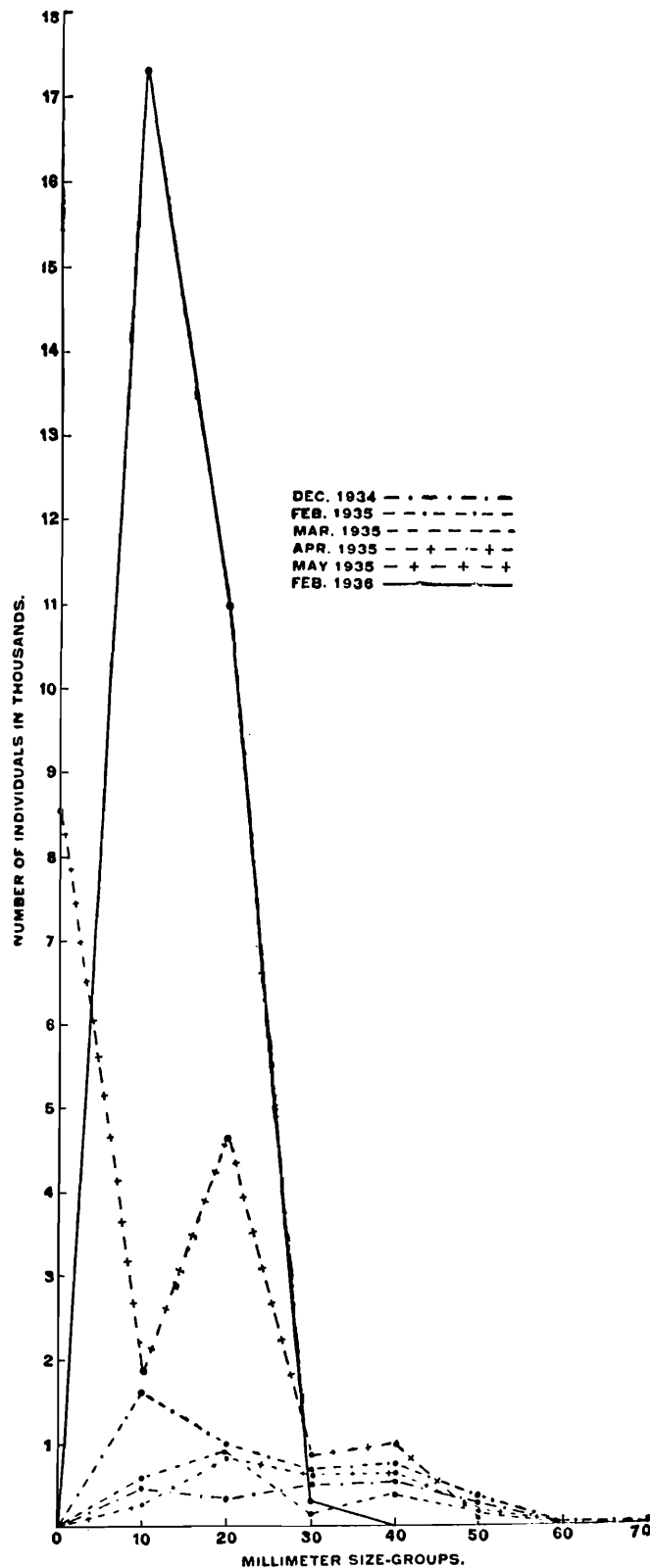
⁶ Weymouth, F. W., *State of California Fish and Game Comm.* Fish Bull. No. 7, pp. 5-101 (1923).

measurements obtained will show an approximate grouping of the animals of the same age. Thus the first year group will consist of a majority of small individuals of more or less the same size, the second year group of comparatively larger individuals which are in a majority, the third year group of still larger individuals, and so on. The difference in the majority-size of these groups will indicate the extent of growth between successive years. But as age increases the difference in size between the later year-groups becomes so small that age-determination by this method becomes difficult, if not impossible. The applicability of the "age-group" method is therefore restricted to the younger groups of a species. In regard to the older groups, however, it may be used as a rough and ready method, provided that for accurate results the conclusions are capable of being checked by more reliable methods.

A careful examination of a large number of individuals of *Pyræzus palustris* occurring in Port Blair revealed the fact that a large majority were sexually immature, and that a considerable proportion of the population of this species belonged to the young stages of the first and second year classes. It was, therefore, decided to collect as much material as possible for the determination of age by the 'age-group' or 'majority-size' method.

The occurrence of *Pyræzus palustris* in a restricted area not more than 2,400 sq. ft. in extent along the ten-mile coast line investigated was a remarkable fact. The area (Plate III, fig. 3) in question lies between tide-marks, and is well-covered by 3 feet of water in exceptionally high tide, by 6 inches to a foot of water in places in ordinary low tide, while barely moist in others. It lies about 3 furlongs south of South Point Light and immediately north of Murdakhari Bay (Plate III, fig. 2). The rocks, worn out by wind, rain and surf, lie parallel to the shore in regular lines, and in the channels between the rows of rocks the species occurs in great numbers. Similar channels between the high ridges near the South Point Light (Plate III, fig. 1) which are a continuation of the same rocks are singularly devoid of individuals of *Pyræzus palustris*, and so are the rock-pools (Plate III, fig. 4) on the coasts in the vicinity of Port Blair. The bottom of the channels where the Mollusc occurs is covered in some places with coarse sand and gravel, and in some with soft mud, while in others it is bare and consists of rock. The entire area 2,400 sq. ft. in extent was divided, for the sake of convenience, into 12 equal plots, 200 sq. ft. each, the limits of which were demarcated by arrow-marks chiselled on the rocks. As the population of shells in the area was so large that all the individuals present could not be collected on the same day, it was decided to visit the area periodically. During the period of investigation from December 1934 to May 1935, and in February 1936 the area was visited once or twice a month, and shells (both living and dead) of various sizes found in selected plot or plots, from A to L, were collected on the same day. The shells from each plot were kept separately, and the maximum height of each shell from the apex of the spire to the anterior margin of the peristome was measured by callipers in fractions of millimeters. The measured shells were removed to a sandy bay north of the South Point Light from which access to the original place of collection was difficult.

The removal of the shells to a distant place was only a safeguard against the possibility of measured individuals mixing up with the unmeasured ones, and it was also my intention to estimate the entire population of the shells of *Pyrazus palustris* found in the area. The subdivisions of the area being contiguous and without insurmountable barriers, the animals could move about freely in search of food from one subdivision to the other. It was, therefore, found that after all the shells in a plot were removed, those from adjacent plots had crawled



TEXT-FIG. 1.—Graph showing the number of shells of *Pyrazus palustris* of various size-groups collected at Port Blair during each month of the period December 1934 to May 1935, and in February 1936.

over to the depleted one. This frequent migration of individuals from one plot to another did not frustrate my object of estimating the population of shells in the whole area, and as pointed out above, the subdivision of the area into plots was only a matter of convenience for the systematic collection of shells.

The first observation in the area under discussion was made on the 29th December 1934, and the last was concluded on the 29th May 1935, exactly five months later. Collections of shells and their measurement were also undertaken during the intervening months, *i.e.*, from February to April 1935. All the shells 10 millimeters in maximum height and those above 10 mm. were removed from the area leaving only the very young ones below 10 mm. in height. The dead shells which occurred along with the living ones were, however, not measured as many of them had their spire and peristome damaged, but the number of dead shells taken in each plot was counted and recorded. The details of these data are shown in Table I. On a subsequent visit to Port Blair in February 1936, I took the opportunity of collecting more data from the same area, which had been repopulated with shells of various sizes of the same species none of which, however, exceeded 40 mm. in height. It was also observed that the number of young shells below 10 mm. in height which could be counted in thousands in May 1935 had been reduced to less than 150. Presumably, the residual population of young shells below 10 mm. in height which was left undisturbed in the area had grown up to these sizes during the interval of about 9 months from June 1935 to February 1936. The fact that very young shells of the category 2 to 9 mm. occurred in insignificant numbers (less than 0.5 per cent. of the total population) shows that no new incursion of larval forms from the open sea had taken place during this period.

Diagrammatic representation of the Plots in relation to one another.

Names of contiguous plots.		K	F	D	C	A	B
No. of shells 10 mm. and above in height.	1935	306	2,674	2,966	1,236	4,578	2,801
	1936	3,831	36	109	445	3,431	5,873
No. of shells below 10 mm. in height.	1935	..	..	..	..	8,590 ¹	2
	1936	35	..	..	..	..	27
← 200 ft. →							
No. of shells 10 mm. and above in height.	1935	1	606	1,909	2,358	464	258
	1936	1,111	2,027	4,431	5,556	832	973
No. of shells below 10 mm. in height.	1935	..	..	..	..	..	..
	1936	41	17	2	1	2	7
Names of contiguous plots.		L	J	I	H	E	G

¹ This number does not represent the entire population of young shells in this plot, as only specimens found in a small patch of mud 6' x 6', approximately one-fifth of the area of the plot, were collected. Probably, the entire population of young shells in this plot would exceed fifty thousand.

The diagram on page 196 represents the position of the 12 plots in relation to one another, the number of shells of *Pyrazus palustris* above and below the 10 mm. category taken in each plot during the years 1935, 1936. It above all shows one thing clearly, namely, the exclusive occurrence of the very young shells in Plot A during 1935 and their scanty distribution in the various plots in February 1936. The larger shells above 10 mm. in height are relatively well spread-out in the plots both in 1935 and in 1936. The exact numbers of live and dead shells found in the area in both years are shown below :

Years.	Live.	Dead.	Percentage of Dead to Total Population.
1935	28,749	4,914	14.6
1936	28,787	4,403	13.3

The plots that had a rocky bottom and were covered only with coarse sand had usually a sparse population of shells, while those in which there was abundant growth of minute algae on the bottom or a fine deposit of silt or mud had a relatively much larger population of shells, particularly of the younger forms. The very young forms below 10 mm. in height were, however, found in parts of the area where fine mud brought down from land by the rains has been deposited and left practically undisturbed during the incoming and outgoing tides. The absence of larger individuals exceeding 70 mm. in height was also remarkable, only two shells of the 70 mm. category having been found in the whole area from December 1934 to February 1936. Several of the larger examples of *Pyrazus palustris* were dissected and smears of the sexual glands examined. The visceral mass of the larger male shells is distinguished from that of the larger female shells by the presence of the yellow gonad developed round the digestive gland, which occupies a greater part of the long spiral portion of the visceral mass and is of a greenish colour with a median white streak. The visceral mass of the female is of a dull brown colour. The smears of the sexual glands of the females showed no trace of ova, while those of a few males above 50 mm. in height showed fully developed spermatozoa. Presumably, the development of the sexual products in the female takes place at a much later age than in the male. Sewell (*op. cit.*) found no sexually mature individuals at all in his collection of 212 shells of the same species in the Nankauri Harbour, Nicobars, although 44 of them were between 58 and 125 mm. in height¹.

The rocks and the mud on which *Pyrazus palustris* was found in Port Blair were carefully examined on several occasions, but no trace of the eggs or larvae of this species was detected. Some of the largest individuals obtained were kept in aquaria in the Laboratory for observations from the beginning of January 1935 to the middle of July of the same year, but as the individuals were sexually immature no eggs or larvae were observed in the aquaria. The occurrence of a large number of very young shells in the month of May 1935, which were

¹In the Indian Museum collection there are a few large specimens of this species from an unknown locality, the largest of which is 130 mm. high. von Martens (in Max Weber's *Zool. Ergebn. Nederland. Ost. Ind.*, IV, p. 176, 1897) mentions that a specimen 160 mm. high is present in the collections at Turin.

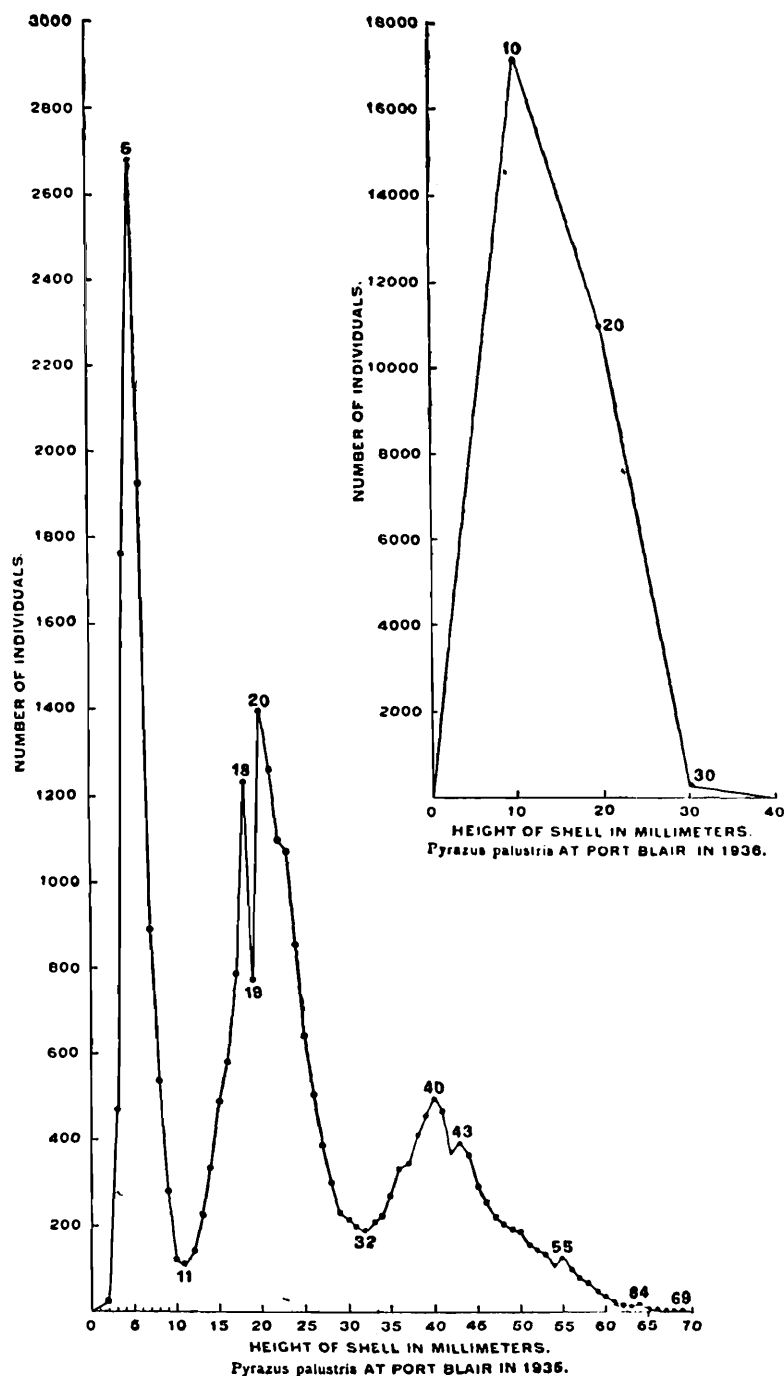
not found in the previous months from December 1934, suggests the possibility of post-larval forms from the open sea having settled down in the area. As was already pointed out, the fine silt and mud deposit in the channels between rocks being a favourable environment for the rapid growth of young forms, the post-larval population of *Pyrampus palustris* which drifted into that area must have found a foot-hold there and colonised it successfully. Examination of the plankton obtained along the coasts near Port Blair during the months December to April has revealed that a large variety of post-larval forms of Gastropods occurs in the off-shore waters of which those which resemble, in general form and sculpture, the Cerithiid shell are common. Presumably, some, at any rate, of the Cerithiid-like shells belong to *Pyrampus palustris*. Of this, however, there can be no certainty until the development of the post-larval forms is closely followed in the Laboratory¹. One thing, however, is certain, that no adult forms of *Pyrampus palustris* have ever been observed by me along the Port Blair coast between North Bay and Beadonabad, a distance of over ten miles; and the population of this species observed in the restricted area near Port Blair could only have been derived from a much larger adult population occurring in some part of the South Andaman coast where conditions for the growth of this species are more favourable than at Port Blair.

The absence at Port Blair of very young shells between 2 and 9 mm. in height during the months, December 1934 to April 1935, and their occurrence in very large numbers in May 1935 lead to the conclusion that breeding amongst the adults of the species must have taken place elsewhere in the intervening months between January and April, or even earlier. The fact that in February 1936 the young shells of 2 to 9 mm. in height were so few in number makes it probable that the breeding season is either March or April. Until the life-history of the animal is studied in further detail, the breeding-period will be a matter for conjecture.

Considering the data presented in Table I relating to the measurements of shells collected between the months of December 1934 and May 1935, and in February 1936, it will be seen that the shells fall into eight distinct size-groups the range of which lies between 2 mm. and 72 mm. The smallest size-group consists of individuals with a height of 2 to 9 mm., and the next size-group of those with a height of 10 mm. to 19 mm., and the next of 20 mm. to 29 mm. and so on. The numbers of shells belonging to each group are plotted in the graph (Text-fig. 2) which shows several peaks in the curve, the first at the 5 mm. category, the second between the 18 to 20 mm. category, and the third at the 40 mm. category. Between the 40 mm. and the 70 mm. categories there are a few relatively low peaks which are not of much significance in the application of the majority size method to the determination of age in older individuals. Thus it is shown that in a large collection of the shells which represent the entire population of the species occurring in that particular locality, the largest numbers of individuals

¹ There were no facilities in the Laboratory at Port Blair to study the development of larval forms.

belong to three distinct size-groups. Each of these groups seems to represent a year-class, the 5 mm. group to the first year, the 18-20 mm. group to the second year, and the 40 mm. group to the third year. The rate of growth of the 5 mm. class in a year seems therefore to be about 13-15 mm., and of the 18-20 mm. class 20-22 mm. in a year.



TEXT-FIG. 2.—Graph showing the number of shells in the majority-sizes of *Pyrazus palustris* occurring in Port Blair in the years 1935 and 1936.

Sewell's (*op. cit.*) estimates of the year-classes in the Nicobar shells of the same species are at variance with those presented in this paper. This is to be expected as Sewell was dealing with only a small collection of shells whereas in this paper the estimates of the year-classes are based on a collection nearly 270 times as large as his, and in statistical methods of age determination the larger the sample of population measured the more accurate are the results. The comparative statement of the two estimates which is given below reveals the extent of

this variance. The range of height in mm. in each year class is taken as the criterion for determining the limits between the majority size-groups.

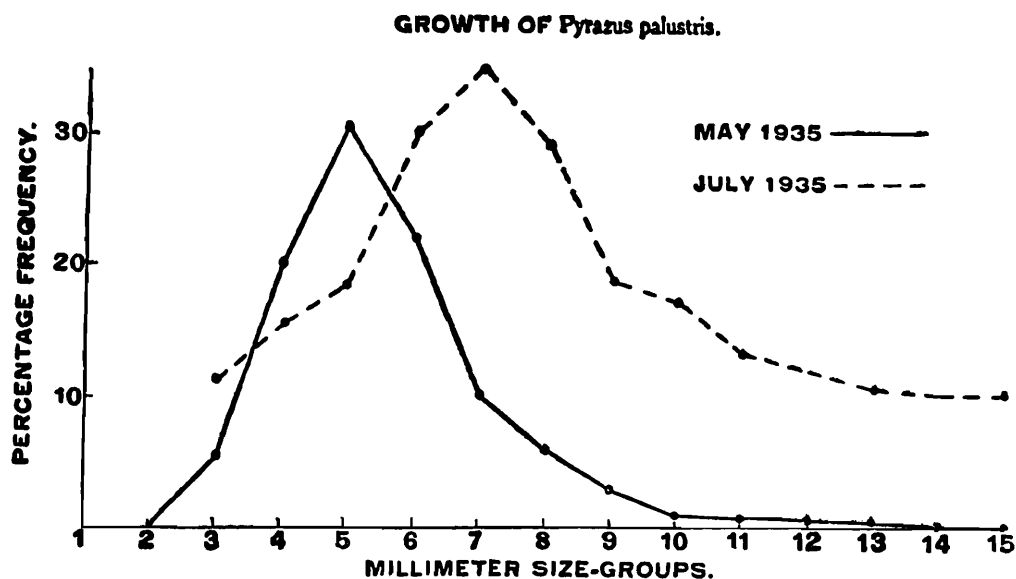
	1st year.	2nd year.	3rd year.	4th year.
Nicobar shells	9—19	24—38	58—91	109—120
Andaman shells	2—11	11—32	32—72	unknown. (probably 72—150).

The gaps in the range of size of shells from the Nicobars would probably have disappeared had a much larger collection been measured. In the Andaman shells, the difference between the lower and upper limits of the range of size of each year class exhibits a curious regularity in approximately doubling itself with each year of growth. Thus the difference in the 1st year class is 9, in the 2nd year class 21, and in the 3rd year class 40. If this phenomenon is of any significance, it should be possible to estimate the range of size of the 4th year class, which, taking the difference in the 4th year class to be about 80, would be approximately 72-150 mm.

With a view to study the rate of growth in the young individuals of *Pyrasmus palustris*, a sample of mud from the Plot A containing young forms of the species was removed to the Laboratory and kept in a large basin of sea-water. The specimens contained in the sample of mud were measured and left in the basin undisturbed. The sea-water was changed everyday. A small lot of the young shells, approximately a sixth of the number present in the basin, was measured again after six weeks. The numbers of shells present in each size-group are shown in the following table. Unfortunately, further observations on growth had to be discontinued as the *Trochus* Fishery work was abandoned and I had to return to Calcutta. The specimens under observation were, however, removed to Calcutta, but a majority of them were found dead a few days after my arrival.

28th May 1935.		13th July 1935.	
MM. Size-groups.	Number of shells.	MM. Size-groups.	Number of shells.
2.0—2.9	22	2.0—2.9	..
3.0—3.9	478	3.0—3.9	15
4.0—4.9	1,761	4.0—4.9	77
5.0—5.9	2,685	5.0—5.9	121
6.0—6.9	1,935	6.0—6.9	294
7.0—7.9	891	7.0—7.9	371
8.0—8.9	539	8.0—8.9	280
9.0—9.9	276	9.0—9.9	125
10.0—10.9	115	10.0—10.9	104
11.0—11.9	61	11.0—11.9	47
12.0—12.9	32	12.0—12.9	25
13.0—13.9	5	13.0—13.9	4
14.0—14.9	3	14.0—14.9	2
15.0—15.9	1	15.0—15.9	1

The percentage frequencies of the individuals in each size-group both in May and July of 1935 shown plotted in text-fig. 3 show clearly how the mode has moved on from the 5 mm. group to the 7 mm. group. That is to say, the majority of the individuals taken in May 1935 belonged to the size-groups, 4-6, while the majority of the same lot measured again in July 1935 belonged to the slightly higher size-groups 6-8. This indicates the growth of the shell in height from 5 mm. to 7 mm. in a period of about six weeks.



TEXT-FIG. 3.—Graph showing the growth of young *Pyrazus palustris* under Laboratory conditions determined by the majority-size method.

The movements of the individuals of the population of *Pyrazus palustris* within the boundaries of the area described in the earlier paragraphs were very considerable, but curiously, no specimen, dead or alive, was found outside the limits of the area during the period of my investigation. This is perhaps to be explained by the fact that the barriers set up by the barren rocks and sand in the surrounding regions which were practically dry when the tide had run out were sufficient to check the further colonisation of the species. Besides, heavy surf which prevails at all hours of the day along the Port Blair coast-line seems to be inimical to this species, and consequently no individuals are found on the sea-ward side of the rocky beach. Within the boundaries of the habitat of *Pyrazus palustris* at Port Blair, the rocks on the sides of the channels are covered at high tide with sea water. At this time, some examples of the species cling to the top of the rocks, but as the tide recedes they descend into the channel again or crawl into fissures and crevices on the sides of the rocks. The younger examples, particularly those below 30 mm. in height, are gregarious in their habit and congregate together in cracks and fissures at the base of the rocks or under stones. The larger examples, although slow in their movements, seem to exhibit considerable activity and are found scattered singly or in small groups of threes and fours all over the area. A great majority of the dead shells are occupied by hermit-crabs, but a few which have a worn-out spire and peristome are empty.

The features of the visceral mass in this species have already been referred to, but there are a few other points in the gross anatomy of the animal which are worthy of mention. In all the examples that

I have examined considerable reserves of food material in the form of refringent granules were found accumulated in and around the digestive gland. The long cylindrical crystalline style¹ which is lodged in a caecum, the numerous chitinous folds in the thickened walls of the stomach and the long cord-like intestine are other interesting features of the anatomy².

The presence of large accumulations of refringent granules around the digestive gland suggested an experiment with these animals to test their capacity to survive adverse conditions of life. Two examples, 5.58 cms. and 5.40 cms. in maximum height respectively collected on the 4th January 1935 were weighed in a chemical balance after wiping away the water adhering to the shells, and left in a large enamel basin of sea-water just enough to keep them immersed in it. The sea-water was changed everyday, and the shells (with the animal inside) were weighed (after wiping away the water) every week at first, and every month later, until they were found dead on the 4th June 1935. In the absence of mud, sand, or algal growth in the basin, the animals were completely starved. The loss of weight at the end of the first week and a month before their death was quite appreciable, but in the intervening period it was comparatively low or even negligible. The total loss of weight over a period of four months was, in the case of the larger specimen, 21.3 per cent. of its original weight, and in that of the smaller 28.8 per cent. of the original weight. The details of weighment on each occasion and other information in regard to this experiment are given below. The results having been obtained from inadequate data may not prove to be of much value in drawing conclusions from this experiment. There seems to be no doubt, however, that *Pyrarus palustris* is a species capable of tiding over adverse periods when food is not available, subsisting, presumably, on the reserves of food in the form of refringent granules accumulated in the digestive gland.

Table showing the weights of two individuals of Pyrazus palustris starved during a period of 4 months.

Dates on which shells were weighed.	Shell—5.58 cms. high.		Shell—5.40 cms. high.		
	Weight of shell in grams.	Loss of weight in grams.	Weight of shell in grams.	Loss of weight of grams.	No. of days.
4. i. 35	15.23	..	14.46	..	..
11. i. 35	14.76	0.47	13.63	0.83	7
18. i. 35	14.75	0.01	13.55	0.08	7
25. i. 35	14.59	0.16	13.50	0.05	7
8. ii. 35	14.54	0.05	13.50	..	14
1. iii. 35	14.54	..	13.40	0.10	21
2. iv. 35	14.52	0.02	13.39	0.01	32
4. v. 35	14.04	0.48	12.90	0.49	32
Total loss of weight in four months.	..	1.19	..	1.56	120

¹ Yonge, C. M., *Sci. Rep. Great Barrier Reef Exped.*, 1928-29, I, pp. 274-279 (1932) ; Seshaiya, R. V., *Rec. Ind. Mus.*, XXXIV, pp. 171-175 (1932).

² The anatomical features of an allied species, *Telescopium telescopium* (Brug.), are described by Berkeley, M. J. and Hoffman, G. H., in the *Zool. Journ.* V, pp. 431-436, 2 pls. (1831).

SUMMARY.

1. From a large population of *Pyrazus palustris* occurring in a restricted area near Port Blair, the ages of the various sizes of shells have been determined by the 'majority-size' or 'age-group' method. From a study of the entire populations occurring in the area in two consecutive years it has been shown that shells 5 mm. high are in their first year of growth, shells 18-20 mm. high in the second year of growth, and shells 40 mm. high in the third year of growth.

2. The large population of young shells of the 2-9 mm. size-group of the 1935 year class reached in about nine months the next size-group 10-19 mm.

3. Growth is rapid in the very young shells under Laboratory conditions closely approximating to those in nature. 5 mm. shells grow up to the 7 mm. size in a period of about 6 weeks.

4. The habits of *Pyrazus palustris* have been studied in some detail. In early life the Mollusc seems to prefer a muddy habitat to a rocky or sandy one. The distribution of this species in Port Blair is restricted to a very small area. From the fact that no sexually mature individuals occur in Port Blair, it is surmised that the area has been colonised by post-larval stages of the species occurring in the off-shore plankton.

5. The breeding period is believed to be March or April. This is deduced from the fact that no young shells of the 2-9 mm. class occur in Port Blair between December and April.

6. The species is capable of living without food for a considerable period. The loss of weight in individuals due to want of food is demonstrated. It is presumed that during periods of starvation they live on reserves of food present in the digestive gland in the form of refringent granules.

TABLE I.

Table showing the number of living shells of each size-group and the number of dead shells collected on various dates in each of the twelve plots of the area in Port Blair.

Names of Plots.	Dates of collection.	Millimeter Size-groups.										
		70	60	50	40	30	20	10	2—9	No. of Shells.		Total No. of shells.
										Living.	Dead.	
A	29. xii. 34	..	34	313	584	513	336	478	3	2,261	370	2,631
	2. ii. 35	..	30	226	387	189	74	92	..	998	246	1,244
	22. iii. 35	..	22	151	282	105	30	5	..	595	245	840
	19. iv. 35	..	15	109	206	59	28	11	..	428	73	501
	2. v. 35	..	1	7	23	10	4	3	..	48	70	118
	28. v. 35	..	..	2	23	3	6	217	8,587	8,838	..	8,838
	7. ii. 36	..	..	..	..	7	1,490	1,934	..	3,431	725	4,156
Total No. in Plot A		..	102	808	1,505	886	1,968	2,740	8,590	16,599	1,729	18,328

TABLE I—*contd.*

Names of Plots.	Dates of collection.	Millimeter Size-groups.										Total No. of shells.
		70	60	50	40	30	20	10	2—9	No. of shells.		
										Living.	Dead.	
B {	12. ii. 35	..	5	25	37	317	561	1,404	2	2,351	325	2,676
	19. iv. 35	..	12	50	99	33	143	115	..	452	185	637
	15. ii. 36	..	..	..	..	..	1,414	4,459	27	5,900	168	6,068
Total No. in Plot B		..	17	75	136	350	2,118	5,978	29	8,703	678	9,381
C {	12. ii. 35	2	16	111	354	195	381	141	..	1,200	430	1,630
	29. v. 35	..	1	3	20	8	4	..	..	36	70	106
	18. ii. 36	..	..	..	..	11	291	143	..	445	281	726
Total No. in Plot C		2	17	114	374	214	676	284	..	1,681	781	2,462
D {	22. iii. 35	..	4	28	105	84	897	572	..	1,690	710	2,400
	22. iv. 35	..	3	29	255	339	557	93	..	1,276	600	1,876
	18. ii. 36	..	..	..	2	28	67	12	..	109	113	222
Total No. in Plot D		..	7	57	362	451	1,521	677	..	3,075	1,423	4,498
E {	19. iv. 35	..	3	13	80	207	113	48	..	464	100	564
	18. ii. 36	..	..	..	..	3	97	732	2	834	630	1,464
Total No. in Plot E		..	3	13	80	210	210	780	2	1,298	730	2,028
F {	16. v. 35	..	4	58	396	386	1,228	602	..	2,674	440	3,114
	18. ii. 36	..	..	..	1	5	24	6	..	36	280	316
Total No. in Plot F		..	4	58	397	391	1,252	608	..	2,710	720	3,430
G {	2. v. 35	..	1	25	45	65	109	13	..	258	23	281
	18. ii. 36	..	..	..	..	..	50	923	7	980	170	1,150
Total No. in Plot G		..	1	25	45	65	159	936	7	1,238	193	1,431
H {	2. v. 35	..	2	12	63	129	1,923	229	..	2,358	195	2,553
	19. ii. 36	..	..	..	2	38	3,333	2,183	1	5,557	328	5,885
Total No. in Plot H		..	2	12	65	167	5,256	2,412	1	7,915	523	8,438
I {	16. v. 35	..	1	13	135	142	1,087	531	..	1,909	250	2,159
	18. ii. 36	..	..	..	1	207	2,025	1,208	2	4,433	137	4,570
Total No. in Plot I		..	1	13	136	349	4,012	1,829	2	6,342	387	6,729

TABLE I—*contd.*

Names of plots.	Dates of collection.	Millimeter Size-groups.										
		70	60	59	40	30	20	10	2—6	No. of shells.		Total No. of shells
										Living.	Dhad.	
J {	28. v. 35	..	2	14	113	80	220	177	..	606	135	741
	18. ii. 36	..	..	..	3	36	725	1,263	17	2,044	504	2,548
Total No in Plot J		..	2	14	116	116	945	1,440	17	2,650	639	3,289
K {	28. v. 35	..	..	13	78	57	80	78	..	306	435	741
	19. ii. 36	..	..	..	..	8	541	3,282	35	3,866	1,026	4,892
Total No in Plot K		..	..	13	78	65	621	3,360	35	4,172	1,461	5,633
L {	28. v. 35	..	..	1	..	..	..	..	..	1	12	13
	19. ii. 36	..	..	..	..	..	32	1,079	41	1,152	41	1,193
Total No in Plot L		..	..	1	..	..	32	1,079	41	1,153	53	1,206
Total No. in Plots A to L.		2	156	1,203	3,294	3,264	18,770	22,123	8,724	57,536	9,317	66,853

TABLE II.

Table showing the number of living shells of each size-group and the total number of dead shells collected during each month of the period of investigation.

	Millimeter Size-groups.										
Months.	70	60	50	40	30	20	10	2—9	Living shells.	Dead shells.	Total No. of shells.
December 1934	..	34	313	584	513	336	478	3	2,261	370	2,631
February 1935	2	51	362	778	701	1,016	1,637	2	4,549	1,001	5,550
March 1935	..	26	179	387	189	927	577	..	2,285	955	3,240
April 1935	..	33	201	640	638	841	267	..	2,620	958	3,578
May 1935	..	12	148	896	880	4,661	1,850	8,587	17,034	1,630	18,664
February 1936	..	..	..	9	343	10,989	17,314	132	28,787	4,403	33,190
Total No. of shells collected during the period of investigation.	2	156	1,203	3,294	3,264	18,770	22,123	8,724	57,536	9,317	66,853

TABLE III.

Table showing the total number of living shells collected in the years 1935 and 1936.

Millimeter Size-groups.								
Year.	70	60	50	40	30	20	10	2—9
1935	2	156	1,203	3,285	2,921	7,781	4,809	8,592
1936	..	..	..	9	343	10,989	17,314	132

EXPLANATION OF PLATE III.

- FIG. 1.—Inter-tidal region near South Point Light, Port Blair, showing rows of faulted rocks with pools of water standing between them. *Pyrazus palustris* does not occur here.
- FIG. 2.—View across the Murdakhari Bay, Port Blair, at low tide a few yards south of the area shown in Fig. 3. No specimens of *Pyrazus palustris* were found here.
- FIG. 3.—The habitat of *Pyrazus palustris* north of the Murdakhari Bay. The four persons standing indicate the limits of occurrence of the species.
- FIG. 4.—Inter-tidal region east of Ross I., Port Blair, where conditions are more or less similar to those occurring in the area shown in Fig. 3, and in which not a single specimen of *Pyrazus palustris* was found.



Habitat of *Pyrarus palustris*.

ON A COLLECTION OF AQUATIC RHYNCHOTA FROM THE RAJMAHAL HILLS, SANTAL PARGANAS, BIHAR.

By H. A. HAFIZ, *Ph.D. (London), D.I.C., Assistant Superintendent* and
G. MATHAI, *Gallery Assistant, Zoological Survey of India, Calcutta.*

In connection with the investigation of the fauna of the Rajmahal Hills in Santal Parganas, Bihar, Dr. H. S. Rao and the senior author recently collected a number of aquatic insects from rivers, streams, ponds and pools. The present paper deals with only the adult members of the Order Rhynchota, nymphal forms in the absence of their corresponding imagines being omitted. In the case of the Naucorid bug *Heleocoris vicinus* Montand., we have, however, dealt with a number of nymphs which were collected in association with the adults.

We are very grateful to Dr. Baini Prashad, Director, Zoological Survey of India, for helping us in preparing this paper for the press.

SYSTEMATIC ACCOUNT.

Family HYDROMETRIDAE.

Subfamily Vellinae.

Rhagovelia nigricans Burm.

1910. *Rhagovelia nigricans*, Distant, *Faun. Brit. Ind., Rhyn.* V (Appendix), p. 137.

Several specimens—Pools of water in the course of the Hill-stream of the Motijharna Waterfalls, near Maharajpur Railway Station, Santal Parganas.

Recorded by Distant from Travancore ; Ceylon ; Syria ; Egypt ; Abyssinia ; West Africa ; Mascarene Islands ; and Seychelles.

Represented in the collection of the Zoological Survey of India from the Simla Hills, Punjab ; Assam ; Satara, Bombay Presidency ; Ceylon ; and Palestine.

Subfamily Gerrinae.

Gerris spinolae Leth. & Serv.

1904. *Gerris spinolae*, Distant, *Faun. Brit. Ind., Rhyn.* II, p. 180.

One specimen—Morel River, near Bario, Santal Parganas.

One specimen—Gumani River, near Kusma, Santal Parganas.

Recorded from North India ; Calcutta ; Toungoo, Burma ; Ceylon ; and China.

The specimens in the Zoological Survey of India are from the Kumaon Hills and Lucknow in United Provinces ; Bihar ; Assam ; Calcutta ; Chilka Lake, Ganjam district, Orissa ; Travancore ; and Burma.

Metrocoris nigrofasciatus Dist.

1910. *Metrocoris nigrofasciatus*, Distant, *Faun. Brit. Ind., Rhyn.* V (Appendix), p. 159.

Four specimens—Gumani River, near Kusma, Santal Parganas.

Recorded from Naini Tal, United Provinces ; Dawna Hills, Lower Burma ; Malay Peninsula ; and Pahang.

Represented in the collection of the Zoological Survey of India from Western Himalayas ; Nepal Terai ; United Provinces ; Assam ; and Malay Peninsula.

Family NEPIDAE.

Laccotrephes griseus Guér.

1910. *Laccotrephes griseus*, Distant, *Faun. Brit. Ind., Rhyn.* V (Appendix), p. 314.

One specimen—Round about a pool of water, near the Dak Bungalow at Taljahari, Santal Parganas.

One specimen—Morel River, near Bario, Santal Parganas.

Recorded from Bengal ; Pondicherry, Madras Presidency ; Ceylon ; Burma ; Malacca ; and Mahé, Seychelles.

Represented in the collection of the Zoological Survey of India from Punjab ; Nepal Terai ; Kumaon Hills and Lucknow in United Provinces ; Rajshahi, Siliguri, Khulna and Calcutta in Bengal ; Ganjam, Orissa ; Satara, Bombay Presidency ; Cochin State ; Ceylon ; and Siam.

Laccotrephes ruber Linn.

1906. *Laccotrephes ruber*, Distant, *Faun. Brit. Ind., Rhyn.* III, pp. 18-19.

Two specimens—Gumani River at Barhait, Santal Parganas.

Five specimens—Gumani River, near Kusma, Santal Parganas.

One specimen—Gumani River, near Dhamni, Santal Parganas.

One specimen—A pool of water, near the Dak Bungalow at Taljahari, Santal Parganas.

One specimen—Amongst weeds in sluggish stream, below Boarijore Inspection Bungalow, Santal Parganas.

Six specimens—Small pools in sand between stones in the course of the dried-up Sunderpahari River, half a mile from the Sunderpahari Inspection Bungalow, Santal Parganas.

Recorded from Kashmir ; Punjab ; Naga Hills and North Khasi Hills in Assam ; Calcutta ; Sind ; Ceylon ; Bhamo, Burma ; China ; Japan ; and Formosa.

Represented in the collection of the Zoological Survey of India from Nepal ; Sikkim ; Darjiling district and Calcutta in Bengal Presidency ; Santal Parganas and Purnea district in Bihar ; Siam ; and Japan.

Ranatra elongata Fabr.

1906. *Ranatra elongata*, Distant, *Faun. Brit. Ind., Rhyn.* III, pp. 20-21.

Two specimens—Tributary of Morel River, near Barhait, Santal Parganas.

Two specimens—Gumani River, near Kusma, Santal Parganas.

One specimen—Bhanji River, close to Bhanji, Santal Parganas.

Recorded from Kashmir ; Calcutta ; Bombay ; and Nilgiri Hills, Madras Presidency.

Represented in the collection of the Zoological Survey of India from Nepal ; United Provinces ; Calcutta, Bengal ; Puri, Orissa ; Madras Presidency ; and Australia.

Ranatra filiformis Fabr.

1906. *Ranatra filiformis*, Distant, *Faun. Brit. Ind., Rhyn.* III, pp. 21,22.

One specimen—Amongst weeds in sluggish stream, below Boarijore Inspection Bungalow, Santal Parganas.

One specimen—Morel River, near Bario, Santal Parganas.

One specimen—Gumani River, near Dhamni, Santal Parganas.

Recorded from Quetta ; Karachi ; Bombay ; Assam ; Tranquebar, Madras Presidency ; Johore ; and Philippines.

Represented in the collection of the Zoological Survey of India from Chota Nagpur ; South India ; and Siam.

Family NAUCORIDAE.

Subfamily *Iaccocorinae*.

Heleocoris elongatus Montand.

1906. *Heleocoris elongatus*, Distant, *Faun. Brit. Ind., Rhyn.* III, p. 31.

One specimen—Pools of water in the course of the Hill-stream of the Motijharna Waterfalls, near Maharajpur Railway Station, Santal Parganas.

Recorded from “Indes orientales”

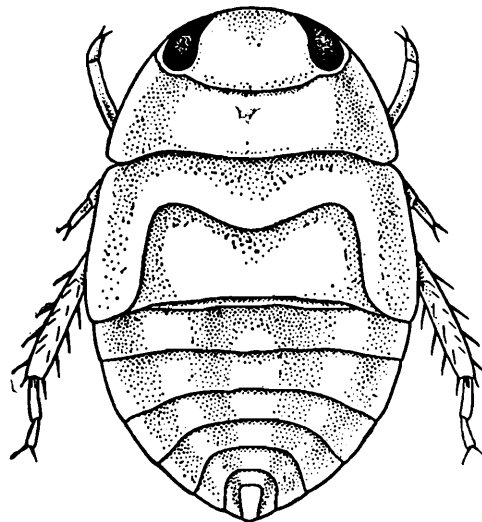
Represented in the collection of the Zoological Survey of India from Paresnath, Western Bengal ; Poona, Satara and Ratnagiri districts in Bombay Presidency.

Heleocoris vicinus Montand.

1910. *Heleocoris vicinus*, Distant, *Faun. Brit. Ind., Rhyn.* V (Appendix), pp. 322-323.

Seven imagines and four nymphs—Gumani River, near Kusma, Santal Parganas.

The nymphs are much lighter in colour than the imagines and only show rudiments of the wings (text-fig.).



TEXT-FIG.—Dorsal view of the nymph of *Heleocoris vicinus* Montand. $\times 7$.

Recorded from Western Bengal and Tenmalai, Western Ghats.

Represented in the collection of the Zoological Survey of India from the Kumaon Hills, United Provinces ; Assam-Bhutan Frontier ; Western Bengal ; and Tenmalai, Western Ghats.

Family BELOSTOMATIDAE.

Sphaerodema annulatum Fabr.

1906. *Sphaerodema annulatum*, Distant, *Faun. Brit. Ind., Rhyn.* III, pp. 35,36.

One specimen—Red mud on the road side, between Taljahari and the River Ganges, Santal Parganas.

Recorded from Sylhet, Assam ; and Calcutta.

Represented in the collection of the Zoological Survey of India from Mangaldai district, Assam ; Saran in Bihar ; Asansol, Khulna, Rajshahi, Calcutta and Berhampur Court in Bengal Presidency ; Puri, Orissa ; and Chota Nagpur.

Family NOTONECTIDAE.

Enithares abbreviata (Kirby).

1906. *Enithares indica*, Distant, *Faun. Brit. Ind., Rhyn.* III, pp. 42-43.

One specimen—Pools in the course of the Hill-stream of the Motijharna Waterfalls, near Maharajpur Railway Station, Santal Parganas.

Recorded from Santal Parganas, Bihar ; Bombay ; Tranquebar, South India ; Travancore ; Ceylon ; Andaman Island ; Java ; and Sumatra.

Represented in the collection of the Zoological Survey of India from Lucknow in United Provinces ; Satara, Nasik and Belgaum districts in Bombay Presidency ; Travancore ; and Ceylon.

Anisops sardea Herr.-Schaff.

1906. *Anisops sardea*, Distant, *Faun. Brit. Ind., Rhyn.* III, p. 45.

Three specimens—A pool on the side of the River Ganges, about a mile from Sakrigali Ghat Railway Station, Santal Parganas.

Distributed over British India, Ceylon and Celebes.

Represented in the collection of the Zoological Survey of India from the Simla Hills, Punjab ; Siliguri, Damukdia Ghat and Port Canning in Bengal ; Ganjam district, Orissa ; Nilgiri Hills, Madras Presidency ; and Yawnghwe, Burma.

Family CORIXIDAE.

Corixa promontoria Dist.

1910. *Corixa promontoria*, Distant, *Faun. Brit. Ind., Rhyn.* V (Appendix), p. 341.

One specimen—Dighi River, Bario-Bhanji Road, Santal Parganas.

One specimen—Gumani River at Barhait, Santal Parganas.

Five specimens—Morel River, near Bario, Santal Parganas.

Recorded from Lucknow and Naini Tal in United Provinces.

The Zoological Survey of India collection contains specimens from Lucknow and Naini Tal in United Provinces ; Berhampur Court and Calcutta in Bengal.