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RESULTS OF THE AUSTRIAN-CEYLONESE HYDROBIOLOGICAL MISSION 1970 OF THE 1ST ZOOLOGICAL INSTITUTE OF THE UNIVERSITY OF VIENNA (AUSTRIA) AND THE DEPARTMENT OF ZOOLOGY OF THE VIDYALANKARA CAMPUS OF THE UNIVERSITY OF CEYLON.

Part XI: Larvae and Pupae of Water Beetles collected from the Island of Ceylon

by

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The material collected in Ceylon by the Austrian-Ceylonese Hydrobiological Mission 1970 included several specimens of larvae and pupae of Water Beetles representing a few families. The author wishes to express his thanks to Dr. F. Starmühlner of the First Zoological Institute, Vienna, and Prof. M. Costa of the Vidyalankara University of Ceylon, Kelaniya for providing him with the material. Similar material collected by Dr. F. Starmühlner in Madagascar and New Caledonia were studied by the author in 1972 and 1968 respectively.

Larvae and pupae were collected exclusively from lotic biotopes in localities of the southern part of Ceylon, which is occupied partly by uplands and mountains rising to 2.538 m. (Pidurutalagala Peak) and 2.262 m. (Adam's Peak) and partly by hills and lowlands (from 0 m to 150 m). A few of the stations are situated at an elevation between 50m and 100m (lowland) ; but most of them are between 700m and 1.000m (upland) or even between 1.800m and 2.000m (highland).

Water courses examined were in the basins of several rivers reaching the western coast : Kelani Ganga, Kalu Ganga, Gin Ganga, the southern coast : Nilwala Ganga and the eastern coast : Walawe Ganga, Kirindi Ganga, Menik Ganga.

Generally the stations are located on tributaries or subtributaries of these rivers and it must be pointed out that many of them are flowing in deep, shaded valleys and through cultivated land such as tea plantations, some through evergreen forests.

The chief information about the Water Beetles of Ceylon, is to be found in a publication from the Fisheries Research Station : " A Guide to the freshwater fauna of Ceylon " —Mendis and Fernando (1962). Which includes an important list of species of Water Beetles belonging to a few families : *Dytiscidae*, *Gyrinidae*, *Haliplidae*, *Hydrophilidae s. lat.* (including, besides *Hydrophilidae s. str. Sphaeridiidae*, *Hydrochidae*, *Hydraenidae*, two other families : *Helodidae* and *Dryopidae*, s.lat. mentioned in Junk's Catalogue, pars 58 (Pic. 1914) and pars 17 (saitzev, 1910). In pars 58, we cannot find the genus *Eubrianax Kiesenw.* (*Dascillidae*, *Eubriinae*) actually classified as *Psephenidae*, *Eubrianacinae* by Hinton and many authors or *Dascillidae*, *Eubrianacinae* by ourselves (Bertrand 1972) ; however *Eubrianax* exists in Ceylon and also aquatic *Lampyridae*.

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In the " Guide to the freshwater fauna of Ceylon " there are some short comments on aquatic insect larvae and also a synopsis for the families, including the larvae of water beetles but restricted only to the families listed above. All valuable and original information about Ceylon larvae or pupae of water beetles from Ceylon seem to be lacking up to this day.

Practically the best method for identifying larvae consists in breeding them ; unfortunately this method was used only for a few families and that by European authors, and only very recently by some entomologists of U.S.A. and Australia.

Nevertheless, now a great number of larvae of water beetles from several parts of the world have been correctly identified to the generic level or even to the specific one. These data were incorporated in a book, on the life history of the water beetles of the world (Bertrand, 1972).

It was easy to identify up to the genus a part of the material collected from Ceylon by Dr. F. Starmühlner and Prof. M. Costa. Many of them (*Dryopidae*) were worked on by M. Delève of Brussels, who described new genera and species. Unfortunately there is no information about the insects at the imaginal stage belonging to the families *Dascillidae* (*Eubrianacinae*) and *Lampyridae*.

Listed below is the material collected in Ceylon, with information needed for their identification and descriptions of the new forms (genera). A few biological and ecological comments are also included.

MATERIAL

Dytiscidae

Genus *Neptosternus* Sharp

N. sp.

Kalu Ganga basin (Ratnapura region).

F 12—Kalu Ganga, near Ratnapura, 50m. valley with woods and plantations, 20 November, 1970 : 1 specimen.

FC 13—Upper arm of Kalu Ganga, near Malwala, 100m. through plantations, 21 November, 1970 ; 3 specimens (with a pupa).

Gin Ganga basin—(Deniyaya region).

FC 5—Campden Hill Dola, with cascades, 700m. through tea plantations, 11 November, 1970 : 1 specimen.

Gyrinidae

Genus *Aulonogyrus* Regimbart

A. obliquus Walker

Kalu Ganga basin (Ratnapura region).

FC 11—Rajanawa, with cascades, near a waterfall, in dense primary forest, 700m. 19 November, 1970 : 1 specimen.

Walawe Ganga basin (Belihul Oya region).

FC 26—Veli Oya, with cascades, 700m. 8 December, 1970 : 1 specimen.

Genus *Orectochilus* Lacordaire

O. (*Patrus*) sp.

Kalu Ganga basin (Ratnapura region).

FC 13—Upper arm ofKalu Ganga, near Malwala, 1,000m, through plantations, 21 November, 1970 : 1 specimen.

O. (*Patrus*) sp.

Walawe Ganga basin (Belihul Oya region).

FC 26—Veli Oya, with cascades, 700m. 8 December, 1970 : 1 specimen.

Hydrophilidae

Berosini genus 2 (Bertrand, 1935, 1965, 1972)

B.g. sp. 2.*

Nilwala Ganga basin (Deniyaya region).

FC 7—Thanipita, with cascades, 600m. through forest and plantations, 12 December, 1970 : 1 specimen.

Helodidae

Genus *Hydrocyphon* Redtenbacher

H. atratus Motschulsky ?

Kelani Ganga basin (Kitulgala region).

FC 36—Rambukpotha near Pitawala, 650m. 27 December, 1970 : 1 specimen.

FC 37—Kelani Ganga, near Kitulgala resthouse, 28 December, 1970 : 1 specimen.

Kelani Ganga basin (Maskeliya region).

FC 19—River mouth near manager's bungalow, Gartmore estate, 1,800m, through tea plantations and gardens, 30 November, 1970 : 1 specimen.

Kalu Ganga basin (Ratnapura region).

FC 10—Katugas Ela, with cascades and water fall in a deep pass, 18 November, 1970 : 3 specimens.

FC 11—Rajanawa Dola, with cascades and water fall in very dense primary forest, 19 November, 1970 : 1 specimen.

Gin Ganga basin (Deniyaya region).

FC 6—Kiriwela Dola, near factory dam, stream through cultivated land and tea plantation, 11 November, 1970 : 1 specimen.

Nilwala Ganga basin (Deniyaya region).

FC 8—Nagahaketa Dola, through forest and plantations, 500m. 13 November, 1970 : 1 specimen.

Walawe Ganga basin (Belihul Oya region).

FC 24—Belihul Oya near resthouse, 650m. 7 December, 1970 : 1 specimen.

FC 25—Kirikatu Oya below Horton plains, 700m. 8 December, 1970 : 1 specimen.

FC 26—Veli Oya, with cascades, 700m. 1 specimen.

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* Possibly it belongs to *Berosus* (*Enoplurus*) *indicus* Motsch, a species which inhabits both Sunda Isles, Southern Asia and Ceylon (Unisch, 7924).

Dascillidae (Eubrianacinae)

Genre *Eubrianax* Kiesenweter

Eubrianax sp. sp. (+)

Kelani Ganga basin (Kitulgala region).

FC 34—Bibili Oya behind Kitulgala, shaded, 26 December, 1970 : 12 specimens.

FC 35—Hal Oya near Ginigathena, 700m. 27 December, 1970 : 11 specimens.

FC 37—Kelani ganga near Kitulgala resthouse, 28 December 1970 : 14 specimens.

Kelani Ganga basin (Maskeliya region).

FC 16—Mocha Dola, outflow of Maskeliya dam, near Adam's Peak estate, 1,800m through tea plantations, 28 November, 1970 : 2 specimens.

FC 18—Gartmore Dola, under water falls, near Mocha Dola (FC. 17), 1,800m. tea plantations, 30 November, 1970 : 2 specimens.

FC 21—Hakgala Dola, with cascades, through Hakgala gardens, near Nuwara Eliya very shady 2,000m. 2 December, 1970 : 3 specimens.

Kalu Ganga basin (Ratnapura region).

FC 9—Bodathpitiya Ela, water fall about 50m. height, 17 November, 1960 : 12 specimens.

FC 10—Katugas Ela, with casscades and water falls in a pass, 500m,18 November, 1970 : 2 specimens.

FC 11—Rajanawa Dola, with cascades near a water fall through dense primary forest, 19 November, 1970 : 15 specimens.

FC 12—Kalu Ganga, near Ratnapura, 50m. : 7 specimens.

FC 13—Kalu Ganga upper arm, upper course near Malwala, 100m. through plantations, 22 November, 1970 : 15 specimens.

FC 14—Upper course of Kalu Ganga from the foot of Adam's Peak near Carney estate, 1,800m. in a pass in very dense primary forest, 22 November, 1970 : 24 specimens (larvae) and 2 pupae.

FC 15—Ira Handha Pana-Dola, Kalu Ganga right affluent, 100m. 23 November, 1970 : 13 specimens and 2 exuviae.

Gin Ganga basin (Deniyaya region).

FC 1—Meda Dola, near Sinharaja Range, 1.000m, dense primary forest, 9 November, 1970 : 2 specimens.

FC 3—Hola Dola, torrent arising from primary forest through tea plantations, 700m. 10 November, 1970 : 10 specimens and 2 exuviae.

FC 5—Kiriwella Dola; valley streams near factory dam through tea plantations, 11 November, 1970 : 6 specimens.

FC 6—Campden Hill Dola, with cascades, through tea plantations, 700m, 11 November, 1970: 5 specimens.

Nilwala Ganga basin (Deniyaya region).

FC 7—Thanipita Dola, with cascades, 600m. through forest and plantations, 12 December 1970 : 11 specimens.

FC 8—Nagahaketa Dola, through forest and plantations, 500m, 13 November, 1970 : 15 specimens.

Walawe Ganga basin (Belihul Oya region).

FC 24—Belihul Oya, behind the resthouse, 650m. 7 December 1970 : 1 specimen.

FC 25—Kirikatu Oya, below Horton Plains, 700m. 8 December 1970 : 3 specimens.

Kirindi Ganga basin (Belihul Oya region).

FC 28—Wetakei Ela, through primary forest, near Welawaya, 100m. 9 December 1970 : 8 specimens.

Menik Ganga bsin (Belihul Oya region).

FC 27—Kuda Oya, near Buttala on south-western upland, very shady in primary forest, 9 December 1970 : 28 specimens.

Dryopidae

Genus *Potamophilinus* Grouvelle

P. costatus Hinton

Menik Ganga besin (Belihul Oya region).

FC 27—Kuda Oya, near Buttala, on the south-western upland, vary shady in the primary forest, 9 December 1970 : 1 specimen (with *P. costatus* Htn.)

P. impressicollis Deléve

Kalu Ganga basin (Ratnapura region)

FC 13—Kalu Ganga upper arm, high course, near Malwala, 100m. through plantations, 22 November 1970 : 1 specimen.

Genus *Ilamelmis* Deléve

I. sp. (*I. foveicollis* Grouvelle, *I. brunnescens* Deleve)

Kelani Ganga basin (Kitulgala region).

FC 36—Rambukpoth Oya, near Pitawala, 650m. 27 December 1970 : 1 specimen (with *I. brunnescens* Del.).

FC 38—Kelani Ganga upper course, near Hanwella, 28 December 1970 : 2 specimens.

FC 18—Gartmore Dola under water falls, near Mocha Dola (FC. 17), 1,800m. tea plantations, 30 November 1970 : 1 specimen (with *I. foveicollis* Gr.).

Kalu Ganga basin (Ratnapura region).

FC 13—Kalu Ganga upper arm, upper course, near Malwala, 100m. through tea plantations, 22 November 1970 : I specimen (with *I. foveicollis* Gr.).

Nilwala Ganga basin (Denivava region).

FC 7—Thanipita Dola, with cascades, 600m. through forest and plantations, 12 December 1970 : 1 specimen.

Menik Ganga basin (Belihul Oya region).

FC 25—Kirikatu Oya, below Horton Plains, 700m. 8 December 1970 : 1 specimen.

Genus *Taporbanelmis* Deleve ?

T. carinata Delève ?

Kalu Ganga basin (Ratnapura region).

FC 12—Kalu Ganga, near Ratnapura, 50m. in a valley with woods and cultivated land, 20 November 1970 : 1 specimen.

Genus *Podelmis* Hinton

P. sp. (*P. quadriplagiata* Motschulsky)

Kelani Ganga basin (Maskeliya region).

FC 18—Gartmore Dola, above the water falls, near Mocha Dola (FC. 17), 1,800m. through tea plantations, 30 November 1970 : 1 specimen with (*P. quadriplagiata* Motsch).

FC 19—Affluent of Gartmore-Dola (FC 18), near the manager's bungalow, Gartmore estate, 1,800m. through tea plantations and gardens, 30 November 1970 : 6 specimens (with numerous *P. quadriplagiata* Motsch).

FC 20—Maskeliya Dola at the foot of Adam's Peak, 1 km. from the mouth of Maskeliya dam, 1,800m. 1 December 1970 : 1 specimen (with *P. quadriplagiata* Motsch).

Kalu Ganga basin (Ratnapura region).

FC 9—Bodathpitiya Ela, Water fall about 50m. high, 17 November 1970 : 1 specimen (very small. Gin Ganga basin (Deniyaya region).

FC 3—Hola Dola, arising from primary forest, through tea plantations, 700m. 16 November, 1970 : 1 specimen (with *P. quadriplagiata* Motsch).

Walawe Ganga basin (Belihul Oya region).

FC 24—Belihul Oya near the resthouse, 650m. 7 December 1970 : 2 specimens.

FC 25—Kirikatu Oya, below Horton Plains, 700m. 8 December 1970 : 1 specimen.

FR 26—Veli Oya, with cascades, 700m. 8 December 1970 : 1 specimen.

Lampyridae

L. g. sp.

Kelani Ganga basin (Kitulgala region).

FC 35—Hal Oya, near Ginigathena, 700m. 27 December 1970 : 1 specimen.

Kelani Ganga basin (Maskeliya region).

FC 16—Outflow of Maskeliya lake near Adam's Peak estate, 1,800m. through tea plantations 28 November 1970 : 2 specimens.

FC 18—Gartmore Dola, below the water falls, near Mocha Dola (FC 17), 1,800m. through tea plantations and gardens, 30 November 1970 : 4 specimens.

FC 19—Affluent of Gartmore Dola (FC 18), near manager's bungalow, 1,800m. through tea plantations and gardens, 30 November 1970 : 4 specimens.

FC 23—Dick Oya, road from Maskeliya to Hatton, 1,800m. 3 December 1970 : 4 specimens.

Kalu Ganga basin (Ratnapura region).

FC 9—Bodathpitiya Ela, water fall about 50m. high, 17 December 1970 : 1 specimen.

FC 12—Kalu Ganga near Ratnapura, 50m. 20 December 1970 : 1 specimen.

FC 13—Kalu Ganga upper course near Malwala, 100m. through plantations, 22 November 1970 : 1 specimen.

FC 15—Ira Handha Pana-Ela, Kalu Ganga right affluent, 100m. 23 November 1970: 1 specimen.

Gin Ganga basin (Deniyaya region).

FC 1 Meda Dola near Sinharaja Range, 1,00m. very dense primary forest, 9 November 1970 : 1 specimen.

FC 5—Campden Hill Dola, with cascades, 700m. through tea plantations, 11 November, 1970 : 2 specimens.

FC 6—Kiriwel-Dola near the factory dam, valley with cultivated land and tea plantations, 11 November 1970 : 3 specimens.

FC 7—Thanipita Dola, with cascades, 600m. through forest and plantations, 12 November 1970 : 2 specimens.

FC 8—Nagahaketa Dola, through forest and plantations, 500m. 13 November 1970: 1 specimen.

Kirindi Ganga basin (Beluhil Oya region).

FC 28—Wetakei Ela, through primary forest near Wellawaya, 100m. 9 December 1970 : 1 specimen.

Menik Ganga basin (Belihul Oya region).

FC 27—Kuda Oya, near Buttala on south-western upland, 9 December 1970 : 1 specimen.

SYSTEMATIC STUDY

Genus *Neptosternus Dytiscidae* Sharp

Neptosternus is an Afro-asiatic genus, the range of which reaches the Australian region. We classified to this genus larvae found in various parts of the Ethiopian region before we completed our trip through Africa ; we confirmed, this determination by the capture on the eastern coast of Madagascar, in Andasibe forest, near Moroansetra, of a few larvae which were living in association with *Neptosternus oberthuri* Guign. (Bertrand, 1963, 1969, 1972).

A larvae, collected by Dr. J. Illies in New Guinea, probably belongs to the same genus (Bertrand, 1968, 1972) ; it differs from the typical larvae by the chetotaxy of the cerci.

Two species are found in Ceylon : *N. taprobanicus* Sharp and a new species *N. Starmuhlneri* Wewalka. In a few localities Dr. F. Starmuhlner found larvae and also a pupa ; larvae are sometimes associated with *Neptosternus.*

Gyrinidae

All the larvae belong to genera *Aulonogyrus* Motsch. and *Orectochilus* Lacord.

Genus *Aulonogyrus* Motschulsky

Dr. Per Brinck, who visited Ceylon, informs us that there is a single species in the island : *A. obliquus* Walker. The cuticular ornamentation of the larvae is quite similar to that of an Ethiopian larva captured by Basilewsky in Ruanda Urundi, and is different from *A.* (*A*.s.str.) *striatus* 01. (Bertrand, 1955, 1972).

Genus *Orectochilus* Lacordaire

There are several species in Ceylon.

Hydrophilidae

Berosini genus 2 (Bertrand, 1935, 1972)

It is quite strange that hydrophilid larvae are designated as " *Berosini* genus " (Bertrand, 1972) because their labroclypeus and mandibles are similars to those of the *Berosus* larvae which are better known, but the number and the position of the abdominal gills are atypical. These larvae have been captured successively from Java, Sumatra, Southern Africa and New Caledonia (Bertrand, 1972). All belong probably to genus *Berosus* (*s. lat*)

Berosini genus 2 was found for the first time in Java (Bertrand, 1935).

Genus *Hydrocyphon* Redtenbacher

We know the larvae of two European species (Bertrand, 1955), but larvae not very different to these were found in the Ethiopian region : Helodidae *genus* 15, in Java and Sumatra, Helodidae genus E (Bertrand, 1964, 1966, 1972).

Possibly, Ceylon larvae belong to *Hydrocyphon atratus* Motsch. (Cat. Junk, Pic, 1914).

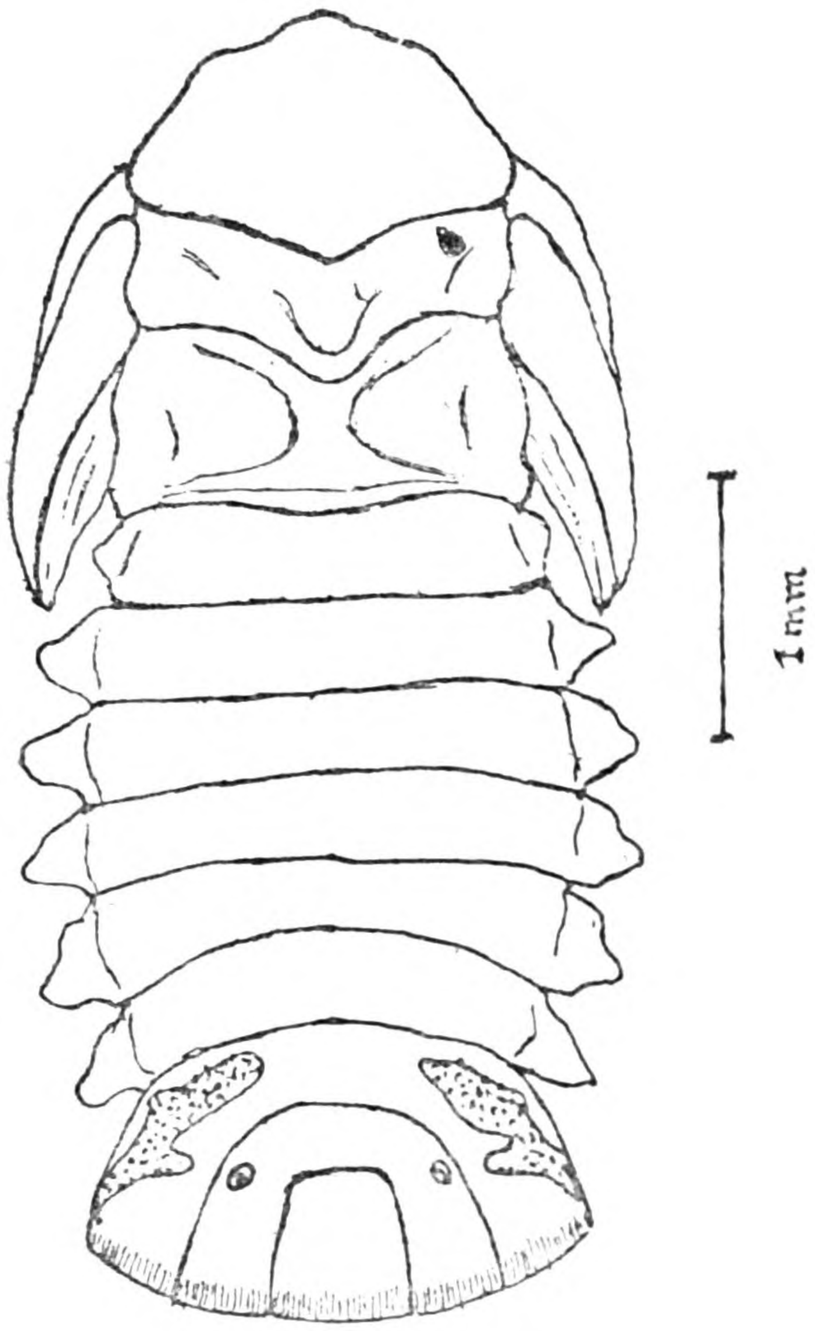
Dascillidae (Eubrianacinae)

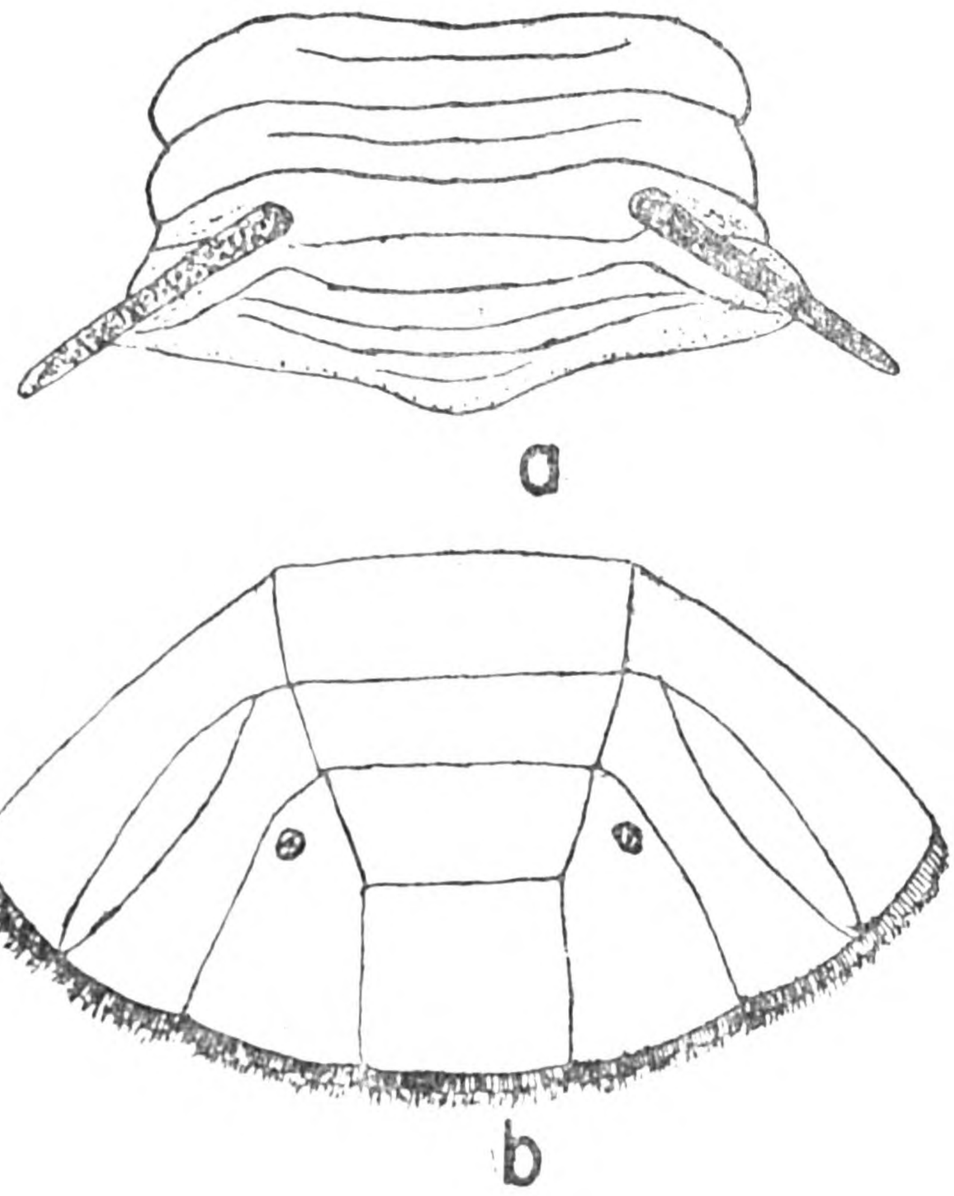
Genus *Eubrianax* Kiesenweter

This genus, which inhabits United States, Japan, ethipoian and oriental regions was formerly classified as : *Dascillidae*, *Eubriinae* (Cat. Junk, Pic, 1914) is now described as *Psephenidae, Eubrianacinae* by Hinton and many authors, also as *Dascillidae, Eubrianacinae* (Bertrand, 1972).

The larva and the pupa of *E. edwardsi* Lec., an American species, were described by Blackwelder (1930).

We dont have a good definition of the specific characters of the larvae, but it was possible to give a synopsis of the pupae for almost all the ethiopian species (Bertrand, 1961, 1965, Bertrand et Villiers, 1970) based on the pattern of the last sclerotized segments.





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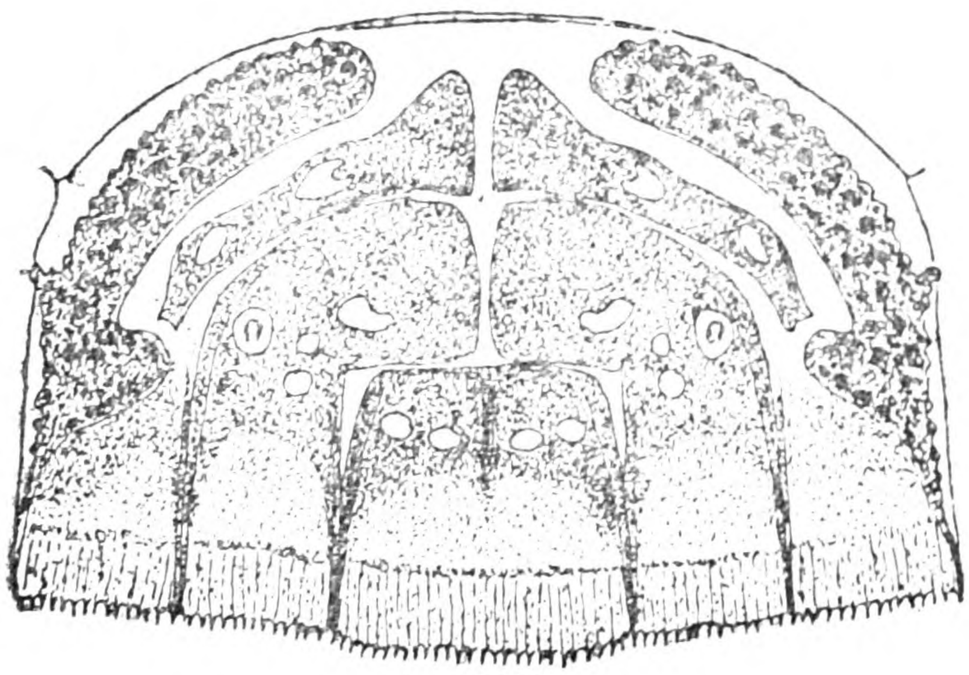

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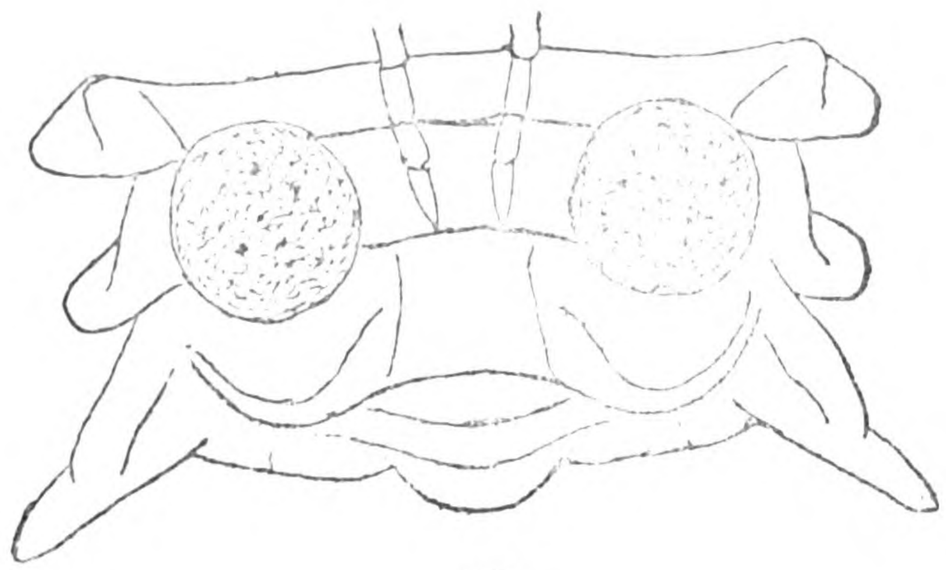

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Fig. 1. *Eubrianax*, pupae : a, *E invittatus*, dorsal view ; (*b*) *E vittaticollis*, last segments (after Bertrand).
Fig. 2. *Eubrianax sp.* (Ceylon), a ; pupa, last segments ; b ; larval exuvia, last segments (after Bertrand).
Fig. 3. *Eubrianax sp.* (Ceylon), pupa, last segments. ventral view.

Dr. F. Starmuhlner captured numerous *Eubrianax* larvae and also a few pupae ; it seems that there are several species in Ceylon, but information about imagoes are unfortunately lacking, and the last segments are membranous and not sclerotized, except bands baaring the spiracles.

Dryopidae

Several genera and species of this family inhabit Ceylon (Cat. Junk, Zaitzev, 1910) but the best information was given by M. J. Delève, from the Institut Royal des Sciences naturelle de Belgique, in Brussels and this provided the opportunity for us to identify the larvae ; they belong to the genus *Potamophilinus* Grouvelle and three genera of Helminthinae.

Genus *Potamophilinus* Grouvelle

Larvae collected in Sumatra were formerly named : Helmiinae genus I (Bertrand, 1935) but Delève (1967) described *P. sumatrensis* nov. sp. sometimes associated to them (Bertrand, 1972).

Larvae found in Ceylon are different from the typical larva of *P. sumatrensis* Del. A larva from Kuda Oya (Menik Ganga basin) was identified as *P. costulatus* Htn., ; the other one belong probably to *P. impressicollis* Del.

Synopsis of *Potamophilinus* larvae

1 (2) Ninth abdominal segment wide in front, with two posterior processes short but nevertheless distinct and straight .. .. *P. sumatrensis* Delève (Sumatra).

2 (1) Ninth adbominal segment not so wide, with two posterior processes very small or even toothlike (Ceylon).

3 (4) Posterior processes wide, very short .. *P. costatus* Hinton (Menik Ganga basin, eastern coast).

4 (3) Posterior processes tooth like .. *P. impressicollis* Delève (Kalu Ganga basin, western coast).

Several genera of *Helmiini* (*Helmiinae auct.*) inhabit Ceylon : larvae of two genera are known : *Stenelmis* Dufour and *Ordobrevia* Sanderson, *Stenelmis* being a widely spread genus and *Ordobrevia* living in America, Japan and the oriental region ; but we did not find larvae of the two genera in the Indopacific expedition material.

But with M. Delève's information, it was possible to identify larvae of *Podelmis* Hinton, *Illamelmis*, Delève and *Taprobanelmis* Delève.

We can classify these larvae as follows :

1 (2) Tergites, except the last one, with median region flat, somewhat depressed between two carinae ; lateral blades quadrate ; ninth abdominal segment carinate ; body elongate, in front slightly enlarged ; superficial appearance of *Microdinodes* larvae (ethiopian region) .. *Ilamelmis* Delève.

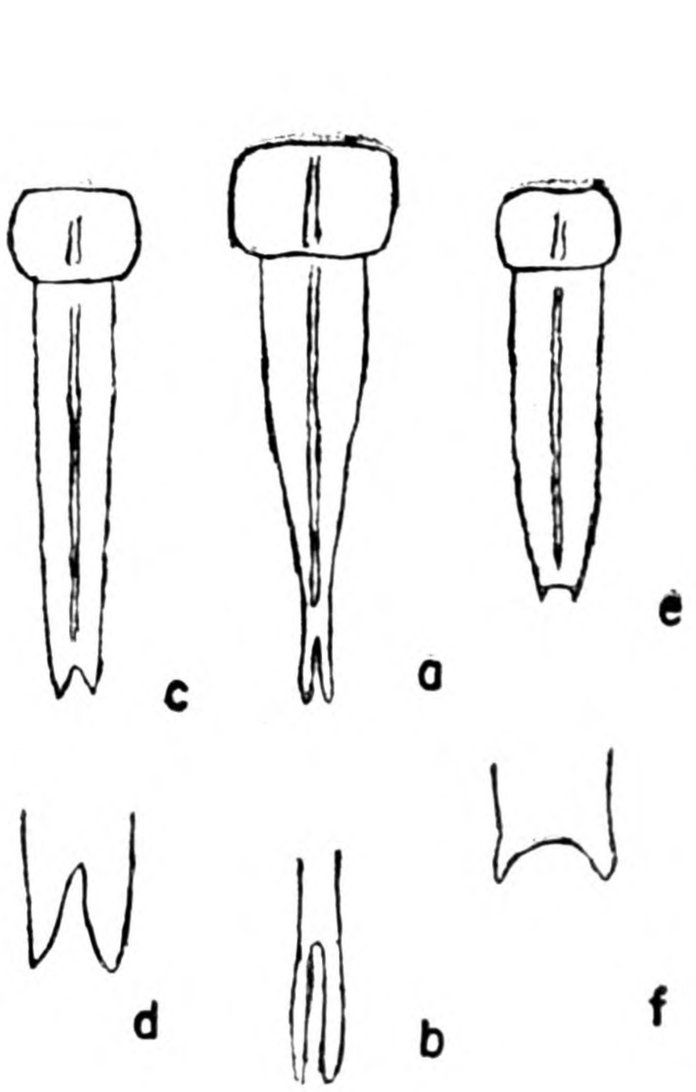
2 (1) Tergites carinate or tectiform ; body stout or elongate.

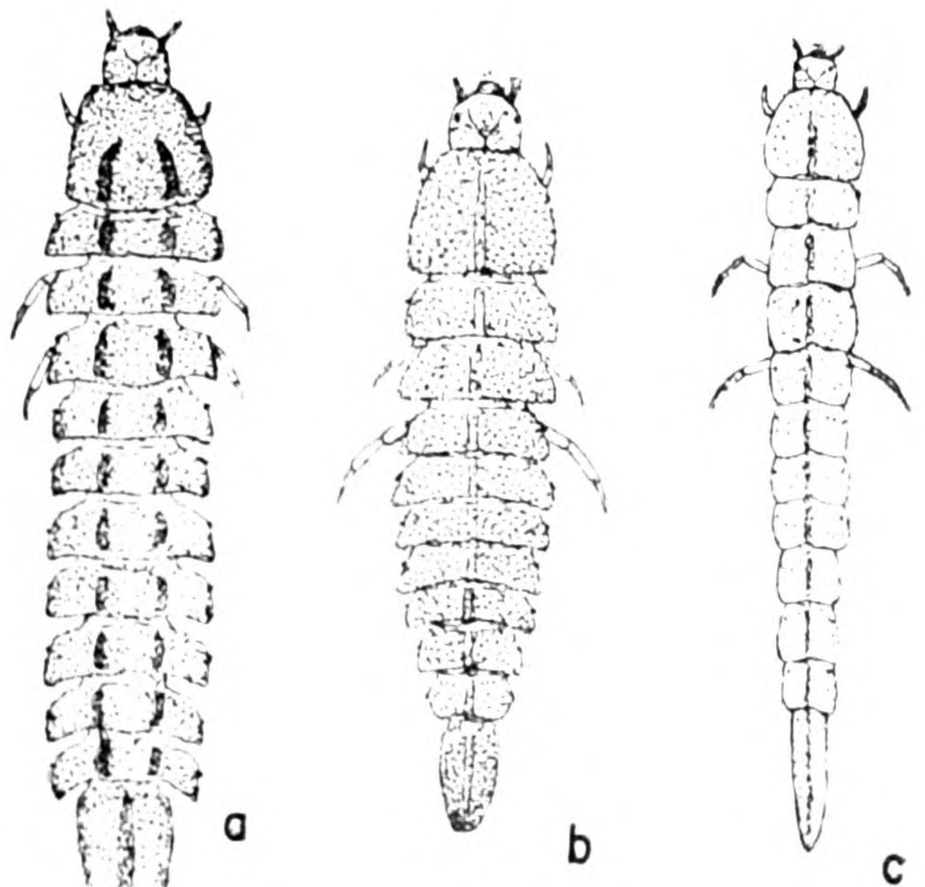
3 (4) Body stout ; tergites carinate, carina sometimes overlapping posteriorly ; lateral plades with rounded margin .. ? *Taprobanelmis* Delève (*T. carinata* Delève).

4 (3) Body slender ; tergites tectiform ; lateral blades absent ; small larvae .. *Podelmis* Hinton.

Genus *Ilamelmis* Delève

Third instar larvae larger than these of the two following genera, well characterised by lateral blades quadrate with straight external margin and thus looking like *Microdinodes* larvae. Found in various parts of Ceylon : west (Kelani Ganga basin), south (Nilwala Ganga basin), east (Menik Ganga basin).





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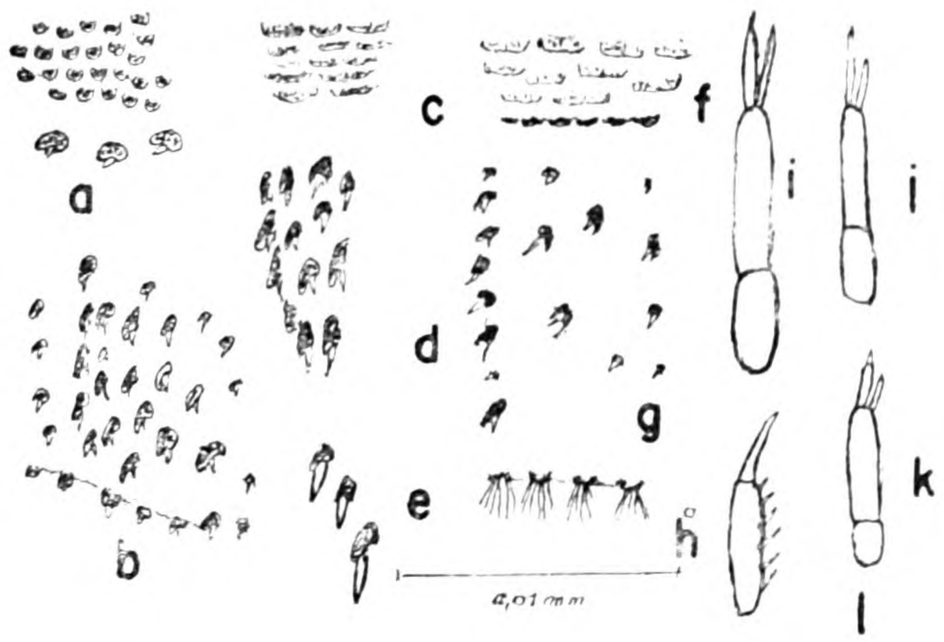

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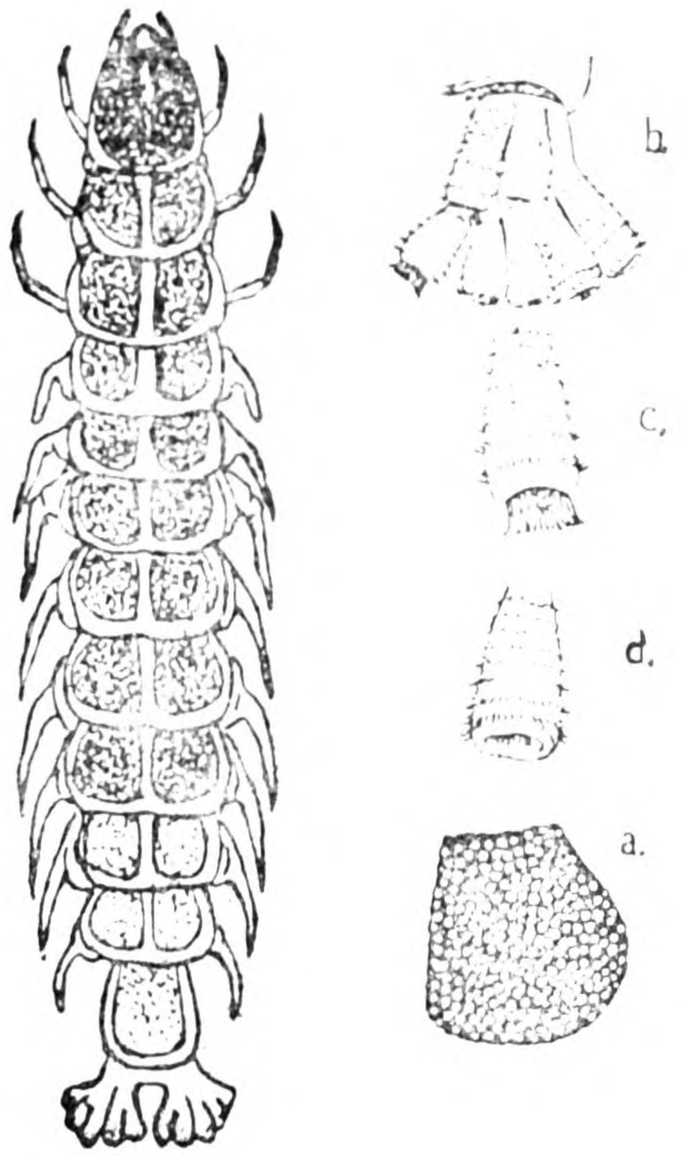

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Fig. 4. Potamophilinus larvae, last segments, a & b : *P. sumatrensir*, c & d : *P. costatus*, e & f : *P. foveicollis*.
Fig. 5. Helminthinae larvae, a. *Ilamelmis*, b. *Taprobanelmis*, *c*: *Podelmis*.
Fig. 6. Helminthinae larvae, tergite dorsal aspects, a & b. *Ilamelmis*, c, d & e: *Taprobanelmis*, *f*, *g* & h. *Podelmis* Antennae, i : *Ilamelmis*, j : *Taprobanelmis*, k: *Podelmis*, lj: tarsus of fore legs : *Ilamelmis*.
Fig. 7. Larva of Pyrophanes, dorsal view a : dorsal plate, b : c : & d : Terminal grasping organ (After Blair).

Head with three-jointed antennae : first joint the shorter, second large, third joint setiform, subequal to seta (or lateral joint).

Prothorax large, equal to mesothorax and metathorax ; mesothorax and metathorax transverse, almost similar to abdominal segments, except the last one, with lateral blades quadrate, external margin stright ; median part of tergites flat ; lateral ribs present from mesothorax to eight segment, prolonged on posterior half of prothorax.

Ninth abdominal segment carinate but without lateral ribs ; posterior teeth absent Procoxal cavities closed ; mesothorax and metathorax with two pleurites.

Ventral side of abdomen with distinct pleurae to the seventh segment ; operculum trapezoidal ; claws normal, incurvated.

Legs long, median and posterior ones slender ; anterior tibiotarsi with a range of spines.

Dorsal side of the head with large, flat tubercles ; cuticular scales blackish on vertex and epistome posterior corner. Tubercles with short hair, slightly bicuspid, more prominent on pronotum, ventral margin of lateral blades, intermediate ribs and carina of ninth abdominal segment ; smaller and scattered in other places ; a range of strong tubercles on posterior margin of sclerites, a few also behind pretergal and prosternal sclerites, these sclerites with blackish scales as on vertex and epicrane posterior corners.

Coloration olive green, sclerotized parts brown, cuticular scales blackish. Two species : *I. foveicollis* Gr. and *I. brunnescens* Del.

Genus *Taprobanelmis* Delève

A single larve, unfortunately not associated with the imago, that we designate as : *Taprobanelmis* Del. a new endemic Ceylon genus.

Body stout, thoracic segments widest ; all segments, except the ninth abdominal one, provided with rounded lateral blades.

Head with three jointed antennae : first joint short, second large, third small, slender lateral stick subequal.

Prothorax equal to the two following segments, mesothorax and metathorax transverse ; thoracic and abdominal segments, except the last one, with lateral blades not quadrate, external margin rounded. Thoracic and abdominal segments carinate, carina sometimes overlapping posteriorly ; ninth segment without posterior teeth.

Procoxal cavities closed ; mesothorax and metathorax with two pleurites. Ventral side of abdomen with distinct pleure only to the fourth segment ; operculum trapezoidal ; claws normal, incurvated.

Legs short and stout.

Dorsal side of the head clothed with tubercles. Tubercles large ; with short hair, slightly bicuspid, dense and more prominent on sagittal carina and dorsal side, smaller on ventral side, a range on posterior margin of sclerites. Anterior part of segments clothed with cuticular scales large, some of the same kind on prothoracic prosternal sclerites.

Coloration olive green.

Genus *Podelmis* Hinton

Larvae not exceeding 3 mm, captured from numerous localities from West to East ; Kelani Ganga basin, Maskeliya region ; Gin Ganga basin : Walawe Ganga basin.

Body elongate with dinstinct lateral edges, but lateral blades not conspicuous, quite different from *Ilamelmis*, and *Taprobanelmis*.

Head with three jointed antennae ; first joint short ; second large, third setiform exceeding slightly lateral stick.

Prothorax large, equal to mesothorax and metathorax ; mesothorax transverse, metathorax, longer. Thoracic and abdominal segments without carina but tectiform.

Procoxal cavities closed ; mesothorax and metathorax with two pleurites.

Ventral side of abdomen with distinct pleasure to seventh segment ; operculum trapezoidal, elongate ; anal claws normal, incurvated.

Legs long, slender.

Tegument with small and scattered tubercles, bicuspid ; double row on sagittal dorsal line, a posterior range on sclerites, a few tubercles behind prescutal regions, clothed with large and short cuticular scales.

Coloration bistre.

Several species are to be found in Ceylon, but if we take into consideration imagoes associated with them, the larvae belong mostly to *P. quadriplagiata* Gr.

Lampyridae

A few lampyrid larvae are aquatic, but always pupation takes place out of the water.

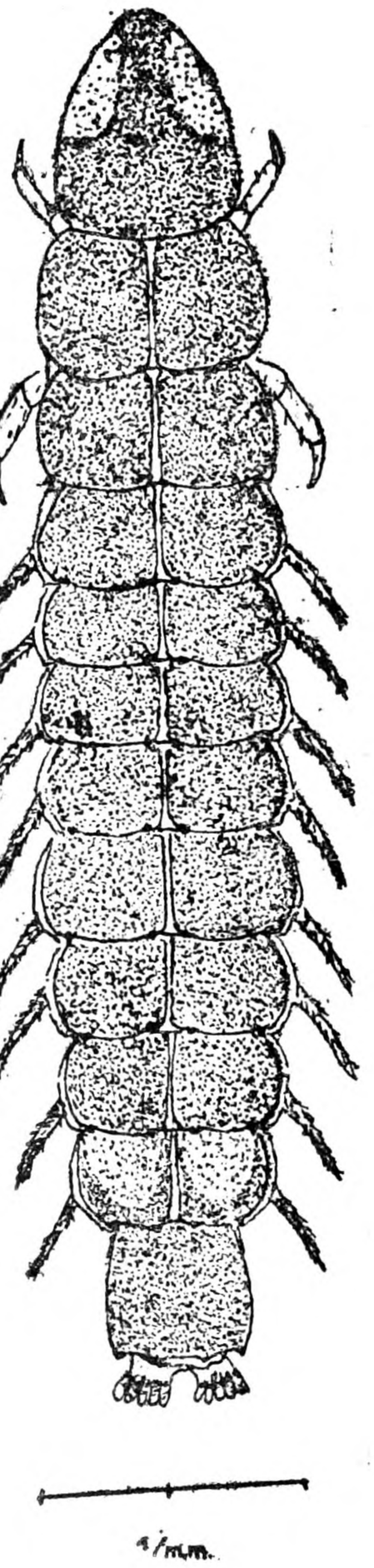
Some larvae look quite like the terrestrial ones and are found in various parts of the ethiopian region (Bertrand, 1965): Undetermined Madagascar larvae, larvae af southern African, larvae found by Lamotte and Roin French Guinea, and larvae collected by Bruneau de Mirè in Tibesti belong to the genus *Luciola*.

Imms (1933) reported that a Lampyrid larva, probably *Luciola*, was collected in a hot spring, near river Turwell, in East Africa.

In Asia, aquatic Lampyrid have been captured in Malaysia (Annamdale, 1900) and in India, near Calcutta (Annamdale, 1906) ; these larvae, like the African ones are without gills. But a few asiatic larvae from Japan and Celebes possess gills. The aquatic larvae of two Japanese *Luciola* : *L cruciata* Motsch, and *L. lateralis* Motsch, have lateral abdominal gills divided into two branches (Okada, 1928) but Blair (1927) decribes a S. Celebes larvae probably : *Pyrophanes similis* Oliv/with undivided gills.

Lampyridae genus

A great number of aquatic Lampyrid larvae were captured in rivers and streams by the Austrian-Ceylonese Hydrobiological Mission 1970. The Ceylon Lampyrid larvae are almost similar to the *Pyrophanes* larvae ; they are provided with unbranched gills, the structure of the terminal grasping organ looks the same : digitiform processes with transverse rows of hooks, the extremity of



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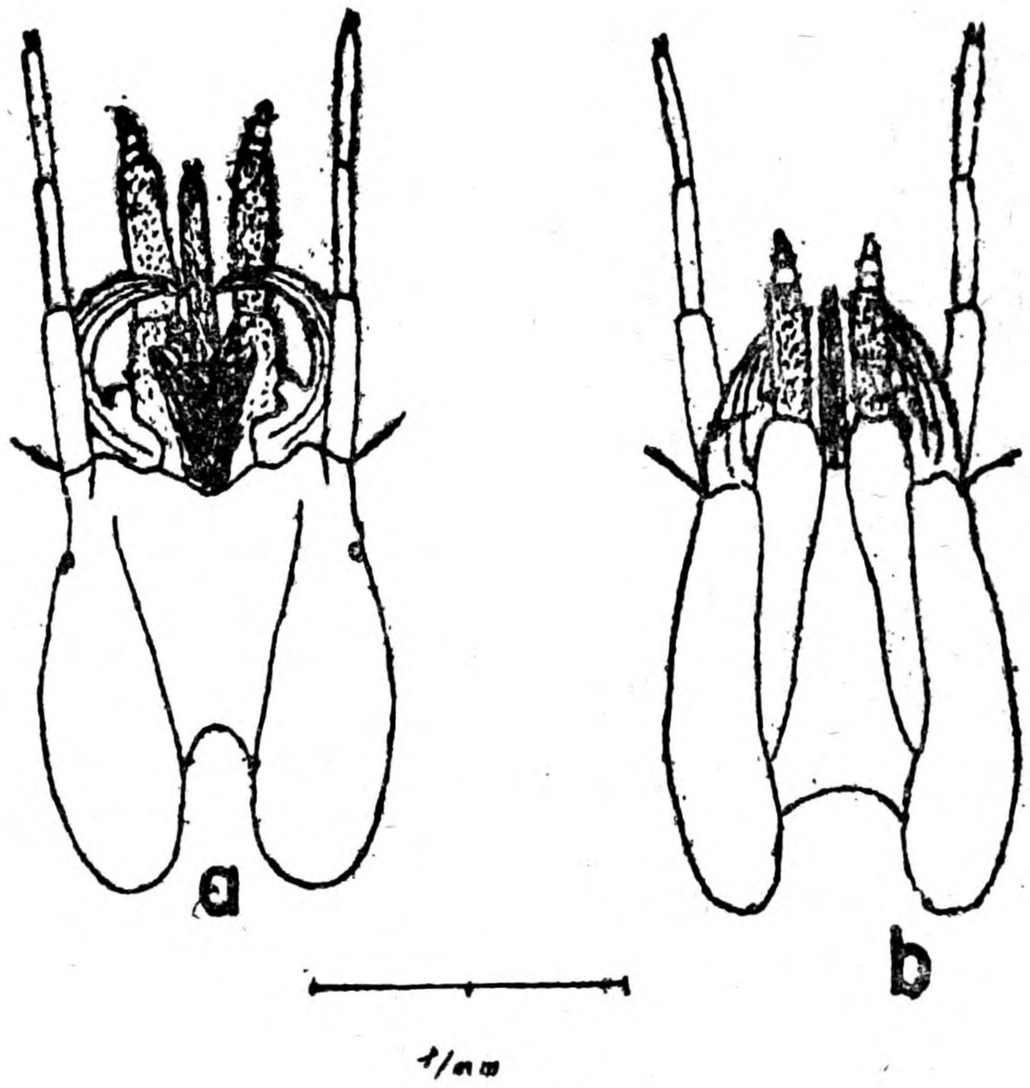

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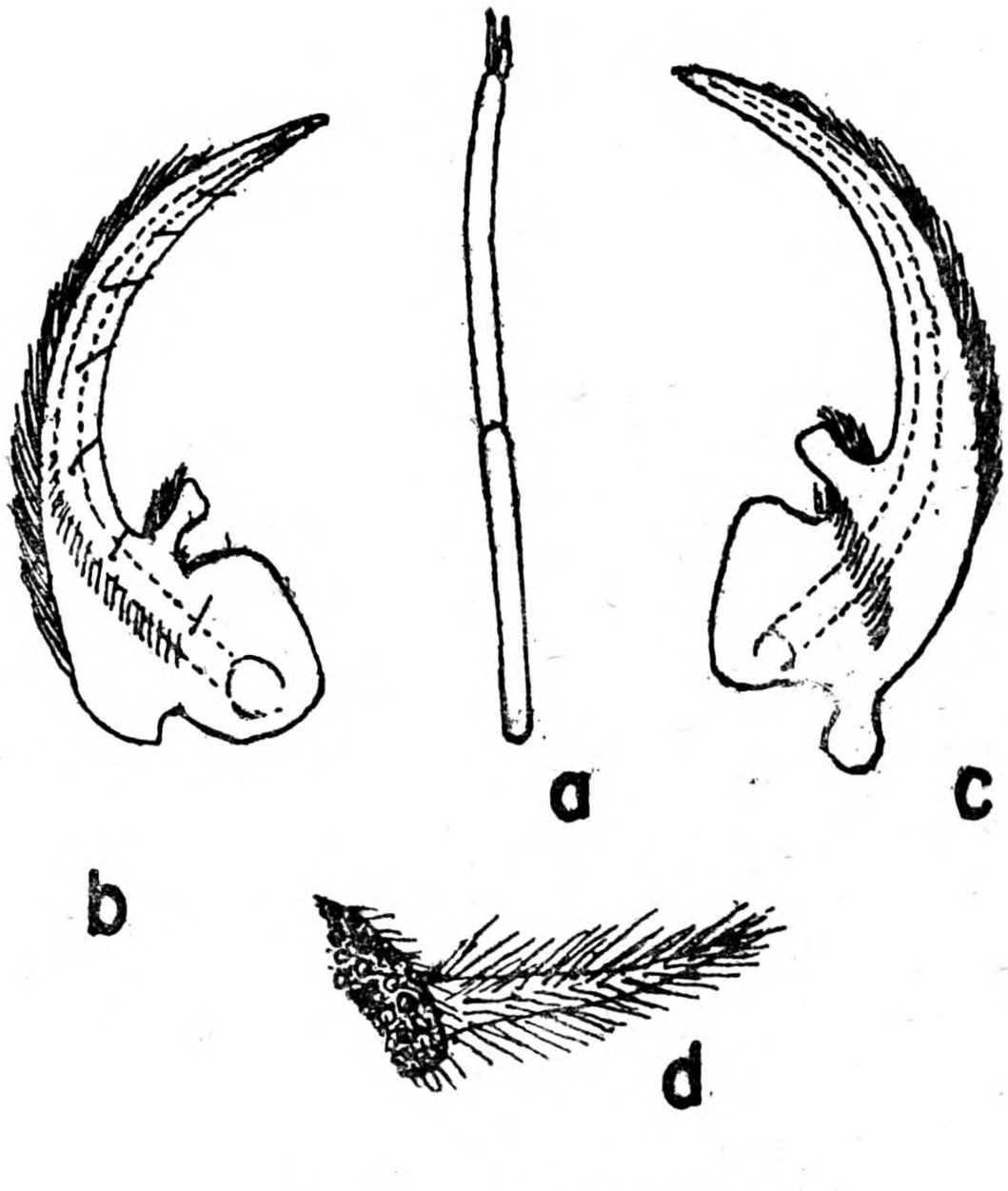

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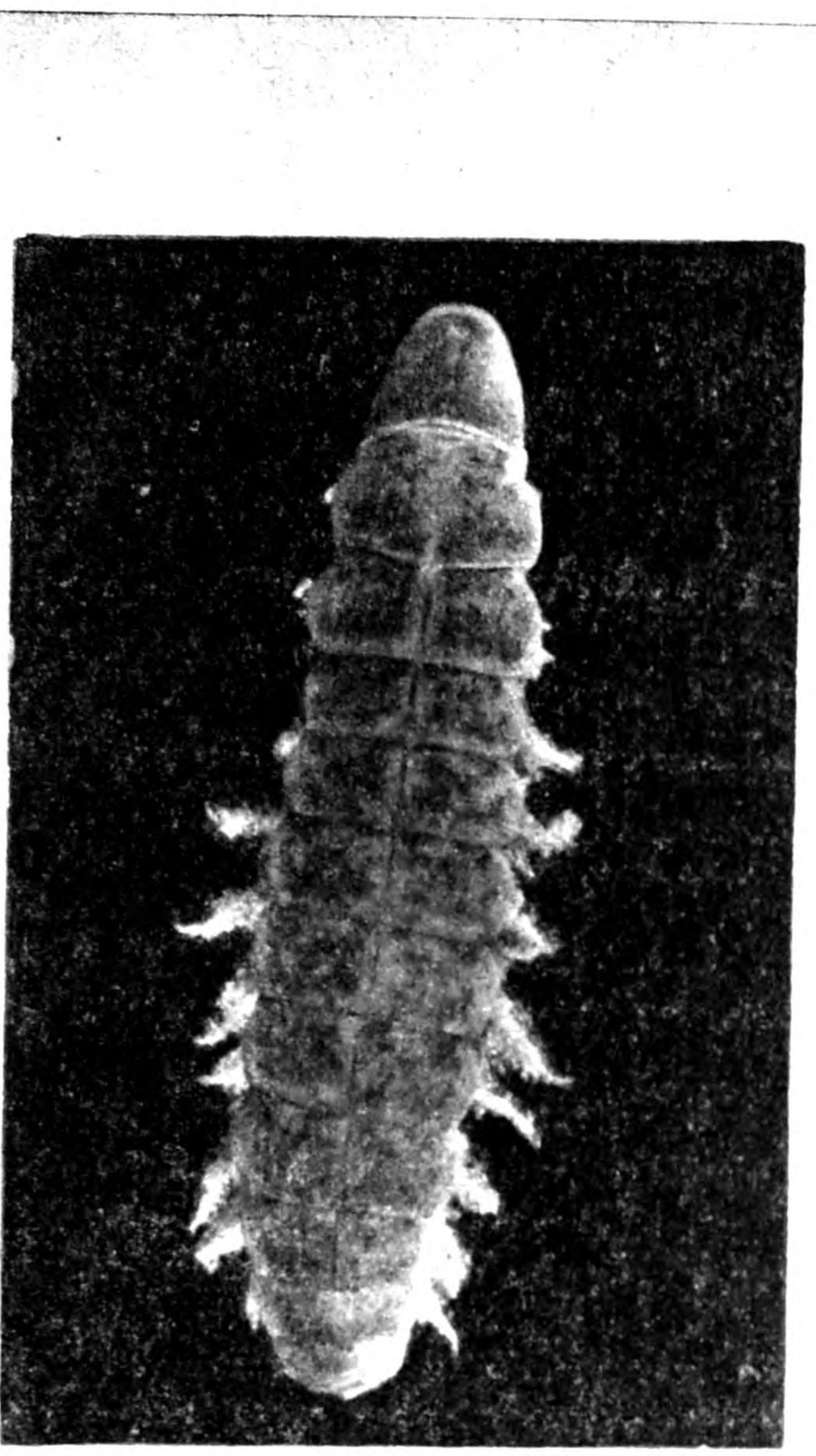
Fig. 8. Aquatic larva of Lampyrid, dorsal view (one pair of legs omitted).
Fig. 9. Aquatic larva of Lampyrid, head, *a*. dorsal view, *b*. ventral view.
Fig. 10. Aquatic larva of Lampyrid, *a*. antenna, *b*, *c*. Mandible dorsal and ventral view, *d*. a gill, tegument with " clear pores " and hairs.



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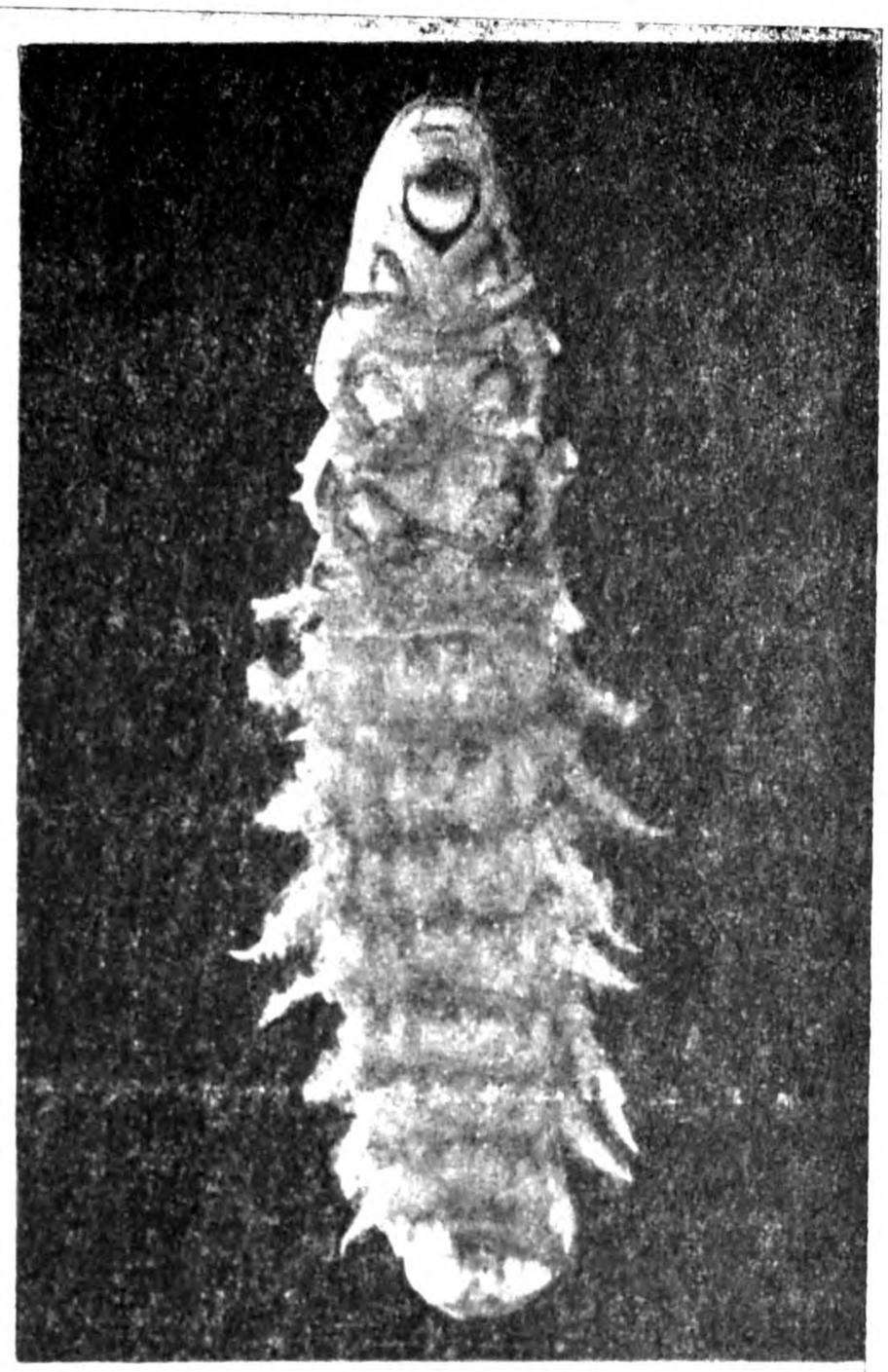

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Fig. 11. Aquatic Lrva of a Lampyrid (animal curved by fixation).
Fig. 13. Lateral view of same larva.

Fig. 12. Ventral view, same larva.
Fig. 14. *Eubrianax sp.* pupa, ventral view.

them with larger hooks. Blair gives us also a figure (I a) of a dorsal plate " densely cribriform, with clear white pores or thin places " ; the plates of our larvae are quite similar to these and we can see the insertion of a short hair in the center of each white pore.

We can describe the Ceylon larvae as follows :—

Body elongate, stout, the larger specimens reaching in length approximatively 12mm., General appearance the same as many of lampyrid larvae *Lampyris* larva, for example—with prothorax large, elongate, narrowed in front, the head completely retracted within the prothorax, tip of antennae and maxillae only prominent.

Mesothorax and metathorax and abdominal segments, except the ninth, transverse, about twice as wide as long. Ninth adbominal segment smaller, oval, protruding at its apex, two bundles of digitiform processes : a dorsal series of five, the ventral one of two ; number and structure of these processes are the same as for *Pyrophanes* larvae (See figures.)

All dorsal plates or terga, except the last one are mediately divided as for the *Pyrophanes* larva, but with a difierence as we can judge from the Blair's figure—these plates bear on the posterior margin, two pairs of small projections, vestigial on anterior segments, but well developed on the posterior ones : two median ones, and two other lateral near the posterior angles.

Three pairs of legs are visible dorsally (a pair omitted in our figure).

Thoracic spiracles on the mesothorax as usual.

Abdomen with eight pairs of spiracles in front of gills ; eight pairs of lateral gills, simple and hairy.

On ventral side of the body there are two prosternal sclerites on prothorax and sternal plates on abdominal segments, trapezoidal mediately divided, except the last one.

The head is completely retracted within prothorax, provided with single ocelli behind antennae. Antennae almost entirely retracted inside long membranous sheath, but the first two joints are long, the second one a little longer than the first, the third very small with a stick or lateral joint.

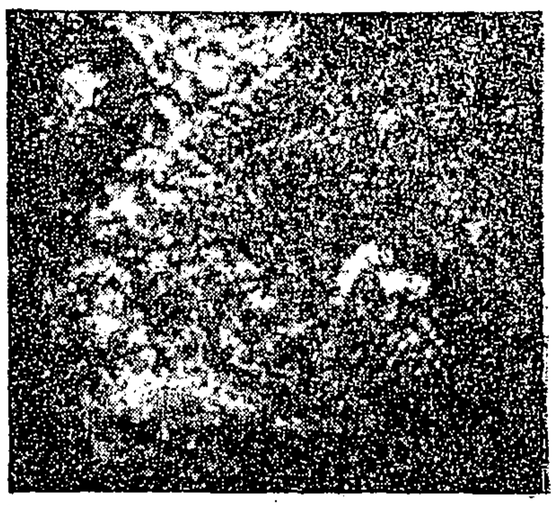

Fig. 15. Larva of *Eubrianax sp.* and larva of *Euphaa splendens* (*Odonata, zygoptera*) on a stone, station FC 14, 22–11–1970 : upper reaches of Kalu Ganga, near Carney Estate (Adam's Peak).

Labroclypeus with median depression, without teeth. On the ventral side is a maxillolabial complex large, with labial part narrow ; maxillary palps three jointed. Mandibles symmetrical canaliculated, canal reaching base of appendix, with a small anterior orifice retinaculum great ; long hairs on external edge and also on ventral and dorsal sides. Membranous parts of body white ; chitinous ones testaceous or black.

BIOLOGY

All the larvae collected in Ceylon by the Austrian-Ceylonese Hydrobiological Mission 1970 are assigned to lotic habitats and remarks about their biology only confirm observations made on other tropical regions, especially in the ethiopian region visited by ourselves during several years (1957–1960).

Dytiscidae

Genus *Neptosternus* Sharp

Throughout the whole ethiopian region, we found *Neptosternus* larvae in running waters or associated biotopes, sometimes in rock pools in the marginal zone of large rivers, in springs ; the typical larvae of *Neptosternus oberthuri* Guign. were collected in Madagascar, from a spring in the primary evergreen forest.

Gyrinidae

Genus *Aulonogyrus* Regimbart and *Orectochilus* Lacordaire

The larvae of these two genera live in running waters ; they are active predators of the larvae of blackflies and m dges.

Hydrophilidae

Berosini genus 2

All the larvae designated as " *Berosini* genus " from different parts of tropical regions (australian oriental, ethiopian regions) were collected in lotic biotopes.

Helodidae

Genus *Hydrocyphon* Redtenbacher

In Europe and northern Africa, the larvae of this genus live in running waters. In tropical countries also it is in running waters, sometimes in mountain lakes that are found related larvae : *Helodidae genus 75*, *Helodidae genus* E, also larvae of several undertermined genera of southern Africa. Pupation takes place in water, the pupae fixed to the stones. *Helodidae genus* 15, in the mountains of Africa are found at an altitude of more than 4.000 metres (4.185m.) in Green lake in Ruwenzori range (Bertrand, 1964).

Dascillidae (Eubrianacinae)

Genus *Eubrianax* Kiesenweter

Eubrianax larvae live in running waters, sometimes in the marginal zone of large mountain lakes ; very often near the cascades and waterfalls.

But always they pupate on land, under the stones.

Dryopidae

Larvae of *Dryopidae Potamophilini* and *Helmiini* live in running waters. Sometimes in lakes. Larvae of several *Potamophilini* are woodfeeders.

Lampyridae

The aquatic larvae are to be found either in running waters, or in stagnant waters ; they are predators of aquatic snails.

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