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A REVISION OF THE ORDER EPHEMEROPTERA FROM EGYPT

Samir A. Hassan and Abdel Fattah M. Amer
Entomology Department, Faculty of Science, Cairo University

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ABSTRACT

A general survey including a wide collecting procedure was continued for about six years (1997-2002), covered different ecological habitats in Egypt, has lead to valuable information and resulted in a considerable number of new species and new records. Twelve species belonging to five genera in four families were collected during this work. One new species was recorded and three species as new records from Egypt Also a new genus and new family were recorded for the first time from Egypt. These results may be summarized as follows:

Family: Baetidae: Two genera (*Cloeon* and *Baetis*) with six species were recorded. Belonging to the genus *Cloeon* Leach five species were recorded during this work [*Cloeon dipterum* (L.); *Cl. cognatum* Stephens; *Cl. simile* Eaton; *Cl. Kaherniesis* Abdel Fattah and *Cl. Moursii* Abdel Fattah], meanwhile belonging to the genus *Baetis* Leach: one species only was recorded (*B. cleopatrae* Soldan). Family: Caenidae is represented by one genus (*Caenis* Stephens) including four species (*Caenis haywardi* Navas; *C. horaria*; *C. robusta* and *Caenis mabroukii* n.sp. *C. mabroukii* was recorded as a new species; while both *C. horaria* and *C. robusta* were recorded for the 1st time from Egypt (new record). Family Polymitarcidae is represented in Egypt by one sp. only, *Ephoron savignii* Pict. The last family was Oligoneuridae was recorded for the 1st time from Egypt and represented by one genus (*Homoeoneuria*) "newly recorded genus" and one species. Preliminary identification along with material were sent to the British Museum for confirmation. Also, Dr. Ernst Baurnfeind of the Nat. Mus. Wien, gave opinions that added new evidences supporting the present work.

INTRODUCTION

Before this study was started Ephemeroptera had practically received almost no attention by taxonomists in Egypt. The main Egyptian reference insect collections and the available literature showed records of three species only belonging to three

genera and three families of this order.

Ephemeroptera are very soft-bodied insects with two or three long thread-like caudal filaments in the nymphal and adult stages. Nymphs are found in a variety of aquatic habitats. They can usually be recognized by the leaf-like gills along the sides of the abdomen and the three long caudal filaments. Subimago is usually dull in appearance, more or less pubescent and with translucent wings usually margined by prominent fringes of hairs, it moults once more, usually on the next day to become adult. Adult is usually smooth and shining, and has longer caudal filaments and legs than the subimago. It has vestigial mouth parts and does not feed, seldom lives more than a day or two.

Many authors studied the classification and survey of the order Ephemeroptera; In Egypt, Navas. 1926; Abdel Fattah M. Amer, 1996; Madlen, 1998; Abdel Fattah *et. al.*, 2007 and many others from different regions of the world. Some investigators have tried to use the egg morphology as a taxonomic character (Koss, 1968; Kopelke; Manual & Willian, 1980 and Muler-Liehenau, 1982 ; Malzacher, 1982 and Boris, 1984). The studies offered by Needham & Hsu (1935) and Elliott & Humpesch (1983) on mayfly insects are hero being regarded as basic key work on ephemeropterous species, although these studies do not include descriptions or classification of the species. Elliott *et al.* (1983 & 1988) studied the key of families and species of this order with some notes on their ecology.

Information on the order Ephemeroptera indicates that this group of insects has practically received no attention in Egypt. Accordingly, the present study was planned to classify this order and identify all its taxa including families, genera and species under investigation.

A general survey on Ephemeroptera revealed that it is represented in Egypt by 11 species belonging to five genera under four families. Preliminary identification along with material were sent to the British Museum for confirmation. Dr. Ernst Baumfeind of the Nat. Mus. Wien, gave opinions that added new evidences supporting the present work.

The present study resulted in one new species and new records of three species; one genus and one family was recorded as new family for the first time from Egypt.

MATERIALS AND METHODS

Survey and collection of mayflies from different localities of the Egyptian Governorates continued for about six years. Twelve species belonging to six genera in four families were collected during this work. The collected species were examined and identified All identifications were confirmed by Dr. Ernst Bauernfeind, Nat. Museum Wien, Austria, Some specimens were sent

to the British Museum for identification.

Collecting Nymphs:

Securing a diversity of mayfly nymphs requires a wide variety of aquatic habitats and using different collecting devices. We use different types of nets such as drift nets and riffle nets or hand screen. The hand screen is generally used in running waters. The screen is held across the current at the bottom of the stream to catch nymphs dislodged when the substrate upstream is disturbed. The screen is moved directly and rapidly toward shore. These nets also accumulate the cast skins of moulting nymphs and subimagoes.

Collecting Adults:

A wide variety of collecting techniques is necessary to get a good representation of adult mayfly specimens. Particularly swarming males requires a light, maneuverable net with a very long handle. The net should have a large throat, and a fairly stiff bag. In addition, we can collect adults and sunimagos by light traps.

Preservation of Specimens:

Adults: Some specimens are preserved in alcohol and others are pinned. The wings of adult specimens can be mounted by floating them from clean alcohol onto the slide, arranging them properly in a thin film of alcohol, and covering them with a square cover slip. Male genitalia from dried specimens may need to be softened before mounting. A satisfactory mount results when they are placed for one or two hours in a solution of 10% potassium hydroxide or sodium hydroxide and then dehydrated and mounted in Canada balsam.

Nymphs: Carnoy fluid (glacial acetic acid, 10%; 95% ethanol; 60%; chloroform, 30%) was used, draining off the Carnoy fluid within twenty-four hours when feasible, and replacing it with 80% alcohol.

Key to the families of order Ephemeroptera from Egypt

(Nymphs)

1 First pair of gills reduced to tapering filaments; other gills stacked under a large pair of gill covers (formed from second pair of gills). Larvae found in mud and vegetable debris in still and flowing waters ..... **Caenidae**

- Most gills visible 2

2(1) Gills on abdominal segments 2-7 forked, with margins fringed; mandibles usually with large tusks projecting forward and visible from above head; if tusks absent, head and thorax with pads on long spines ..... **Polymitarcidae**

- Gills on abdominal segments 2-7 variable; if gills forked, margins not forked; tusks rarely present on mandibles 3

3(2) Gills on the 1st abdominal segment ventral and dorsal on segments 2 – 7; a double row of long setae on forelegs ..... **Oligoneuridae**

- Gills are lateral and ovate or cordate, antennae long, length more than three times width of head ..... **Baetidae**

Key to the families of order Ephemeroptera from Egypt

(Adults)

1 Hind wings absent, Fore wings milky with fringed margins in both subimago and imago. Three long caudal filaments present ..... **Caenidae**

- Hind wings present but may be very small 2

2(1) Fore wings hyaline and not fringed in imago, Hind wings small, reduced, two long caudal filaments ..... **Baetidae**

- Hind wings not reduced, three long caudal filaments 3

3(2) Fore wings with many veins, Base of veins MP2 and CuA strongly divergent from base of veins MP1; veins of MA of hind wings unforked ..... **Polymitarcidae**

- Forewing venation greatly reduced, apparently only 3-4 longitudinal veins behind R1; body black ..... **Oligoneuridae**

Diagnosis of Family: BAETIDAE

Most nymphs slender, stream-lined forms. Head deflexed downwards, antennae long, mandibles visible and forming part of the flattened dorsal surface of the head, glossae and paraglossae of labium long and narrow. Legs rather long and slender, claws of all legs similar in structure, usually sharply pointed, rarely spatulate. Postero-lateral margins of abdominal segments usually without backward-projecting spines. Caudal filaments two or three in number; the outer ones with a thick fringe of hairs on the inner margin, few or none on the outer margin; middle tail fringed on both sides. Gills visible, lamellate, present on abdominal segments 1-7, single or with a ventral portion which on the more apical segments may consist only of a minute recurved flap.

Adult mayflies have very diverse sizes and structures; the diversity in size and appearance of the upper and lower divisions of the eyes of the male reaches its maximum development. The middle ocellus smaller than the lateral ones.

Venation greatly reduced. In the fore wing, the posterior branches of media and cubitus detached basally from their respective stems, thus appearing as long intercalaries. Cross veins in the basal costal space often wholly wanting. Behind the subcosta, the other cross veins, relatively few in number, usually arranged in several more or less definite series across the wing. Hind wing much reduced in size, or may be wholly wanting. Venation 2 to 3 longitudinal veins, with or without few cross veins between. The middle and hind tarsi four-jointed; the basal one of these joints tends to become partially fused with the tibia. Claws dissimilar on all tarsi. Two well developed caudal filaments present, terminal filament rudimentary or absent.

The family Baetidae is represented in Egypt by two genera, *Baetis* Leach and *Cloeon* Leach. These two genera may be separated as follows:

A. In the nymph, gills lamellae single on all abdominal segments; the caudal filaments two in some species and three in most species, but the middle one distinctly shorter and weaker than the two lateral ones. In the adult stage, hind wings present; marginal intercalaries of fore wing occur in pairs. ..... ***Baetis*** **Leach**

A.A. In the nymph, gills lamellae double (often with a mere recurved flap on ventral or dorsal surface) on abdominal segments 1-6; the caudal filaments three and approximately equal in length and thickness. In the adult, hind wings absent; in the fore wings, the marginal intercalaries occur singly. ..... ***Cloeon*** **Leach**

General diagnosis of Genus *Cloeon* Leach (Plate I)

Synonyms: 1815: *Cloeon* Leach, Brewst. Edinb. Encycl. 9:137. 1839: *Cloe* Burmeister, Handb. d. Ent. 2: 797. 1843: *Cloe* Picet, Hist. Nat. 2, Epnem. Neurop. p.239. 1861: *Cloe* Hagen, Syn. Neurop. Ins. N. Amer. p. 52. 1885: *Cloeon* Eaton, Revis. Monogr. p.179. 1920: *Cloeon* Ulmer, Stett. Ent. Zeit. 81: 125. 1933: *Cloeon* Spieth, .N.Y. Ent. Soc. 41: 341; 1869: *Centroptilum* Eaton, and 1915: *Procloeon* Bengtsson.

The features characteristic to the genus *Cloeon* may be presented as follows:

Maxillary palp of nymph 3-jointed; almost as long as the entire body of the maxilla. Labial palp 3-jointed, the apical joint somewhat conical, the outer margin-extending out further than the inner one. Canines of mandibles rather short and blunt. Claws very slender at the tips, somewhat widened at the base; usually not more than 1/3 the length of the tibia. Gills double on all segments or on segments 1-6; the larger division of each pair irregularly rounded in outline. The caudal filaments approximately equal in length and thickness.

In adults: length of forewing ranging from 3 to 9 mm. Basal abdominal segments of male images range from whitish to dull olive brown; the paler species often have reddish markings on the tergites. Females paler than males; reddish to pale orange or reddish brown. Turbinate eyes of male moderate to large in size. Posterior margin of head of female very slightly emarginated. Fore leg of male slightly shorter than body. Fore tibia about 1/3 as long as femur; fore tarsus subequal to tibia. In female, femur and tibia subequal, tarsus little more than 3/4 the length of tibia. Basal joint of fore tarsus approximately equal in length of 3rd and 4th joints combined; in female, almost as long as the three other joints combined. Hind tibia 3/4 the length of femur, in both sexes. The hind tarsus of the male about 3/4 the length of tibia and in the female, the hind tarsus slightly shorter than the tibia. In the forewing the marginal intercalaries occur singly; hind wing wholly wanting.

In the male genitalia, the basal joint of forceps short and relatively stout, contracted suddenly near the apex on the inner margin; second joint somewhat conical, becoming narrower apically, and usually longer than wide; third joint rather long and slender, often dilated slightly at the apex distal joint short and more or less clavate. A "penis-cover" usually present between the bases of the forceps; this structure varies somewhat in shape and size in different species. Apical margin of 9th sternite of female almost straight, very slightly extended backwards at the median line.

Genotype: *Cloeon dipterum* (previously included in *Ephemera* L.)

Key to the species of genus *Cloeon* Leach (Nymphs)

1 The six double gills with two plates, one plate much larger than the other and a pointed tip on the larger plate; maxillary palp with two segments; outer corner of last segment of labial palp not elongated ..... ***Cloeon simile*** **Eaton**

- The six double gills with two plates of equal size & without pointed tip; maxillary palp three segmented; outer comer of last segment of labial palp elongated **2**

2(1) Maxillary palp three segmented, the 2nd and 3rd equal; the outer two caudal filaments with two lobe-like dark structures along whole filaments ..... ***Cloeon kaheriensis*** **Abdel Fattah**

- Maxillary palp three segmented, the 2nd and 3rd not equal; the outer two caudal filaments not as such **3**

3(2) Caudal filaments with light rust colour in the joints of segments in the part between the base and the middle band; distal end of femur of the hind legs with distinct dark spots ..... ***Cloeon cognatum*** **Stephen**

- Caudal filaments not as such; distal end of femur of the hind legs without spots **4**

4(3) Caudal filaments dark brown or black in colour in the joints of segments in the part between the base and the middle band and form fairly broad rings; distal end of femur of the hind legs without spots ..... ***Cloeon dipterum*** **(L.)**

- Caudal filaments with 7-9 dark bands in the distal half to the end ..... ***Cloeon moursii*** **Abdel Fattah**

Key to the species of genus *Cloeon* Leach (Adults)

1. The penis trapezoidal in ventral view **2**

- The penis triangular in ventral view **3**

2(1) Forceps of male genitalia slender with small teeth in the inner margin; Costal and subcostal areas of fore wing in female imago dust in colour ..... ***Cloeon kaheriensis*** **Abdel Fattah**

- Forceps stout without teeth; Costal and subcostal areas transparent ..... ***Cloeon simile*** **Eaton**

3(1) The basal segment of forceps is shorter than the 2nd one ..... ***Cloeon cognatum*** **Stephens**

- The two segments similar in length **4**

4(3) Costal and subcostal areas of fore wing in female yellowish brown ..... ***Cloeon dipterum*** **(L.)**

- Costal and subcostal areas transparent ..... ***Cloeon moursii*** **Abdel Fattah**

Genotype: *Cloeon dipterum* (previously included in *Ephemera* L.)

***Cloeon dipterum* (Linnaeus, 1761)**
Synonymy: 1761: *Ephemera diptera* Linne, Fn. Suec., ed. II, nr. P. 1477; 1776: *Ephemera rufula* Muller Ann. Hist.-Nat. Mus. Nat. Hug., 84, 9.61; 1715: *Cloeon pallidae* Lesch, brewst, Edinb. Encyc., IX, p. 137; 1839: *Cloe diptera* Burmeister, Handb. D. Ent., bd, II, Abth. II, p.798; 1914: *Cloeon dipterum* Bengtsson, Ent. Tidsckr. Arg., 35, p.312; 1933: *Cloeon robustum* Bogoescu, Nat. Biol., Bol. I nr.2, p.75.

Nymphs:

The dorsal surface of abdomen dark with two yellow; central spots rather small and directed backwards obliquely. The sides of abdominal tergites 2-9 with a dark little spot near the end of the hind angle. The body of the mandible elongated and twisted, The distal portion inflected. Each mandible terminates in two groups of sharp teeth consisting of four and two or three teeth, respectively. There is a distinct dark spot at the distal end of femur of the median and hind legs. There are rows of tentacles in the fore leg exceeding half the length of the claw. They have seven pairs of rounded gills, the first six each with an additional large lamella. The joints of segments in three caudal filaments dark brown or black.

Adults:

Body colouring fairly light (orange in female), thorax brown or light brown, abdominal segments 2-6 whitish, transparent, with slight elongated rusty-orange spots on the sides of tergites, and sometimes of sternites. Coxa of median and hind legs with a single dusty-orange spot on the inner side. A similar spot visible at the end of femurs. The segments of legs of similar proportions of length, the tarsus of median and hind legs with the second segment twice or slightly more than twice shorter than the first one. Cerci light with distinct violet-black rings, every 2nd ring markedly wider. Wings with the costal and subcostal fields distinctly brown coloured. Female with numerous rudimental cross-veins in the costal field (at least 10). Forceps slender and their basal segment is distinctly shorter than the second one. The last segment of the forceps slender. Penis in the form of a cone bent backwards, fastened to the body with two arms.

***Cloeon cognatum* Stephens, 1835**
Synonymy: 1815: *Cloeon pallidum* Leach; 1834: *Cloeon dimidiatum* Curtis; 1834: *Cloeon onscurum* Curtis; 1834: *Cloeon marmoratum* Curtis; 1835: *Cloeon consobrinum* Stephens; 1835: *Cloeon virgo* Stephens; 1842: *Cloeon affinis* (Rambur); 1882: *Cloeon apicalis* (Costa). All synonymy after Sowa (1975), Ent. Scand., 6: p.216.

Nymphs:

The dorsal surface of abdomen slightly pigmented, light spots prevail on the sides of abdominal tergites 2-9 wholly devoid of dark spots, two large light spots found centrally on particular tergites. The labium with slightly more numerous hairs on its outer surface. Rows of denticles present on the fore legs, reaching almost half the length of the claw. Both claws and denticles slender. The first six gills equal or slightly smaller than the seventh. The joints of segments in the part between the base and the middle band light rust in colour and form narrow rings.

Adults:

Body dark in colour (orange in female), thorax dark brown and sometimes black, abdomen wine-red, with the spots on coxa and femur bright wine-red. The segments of legs of similar proportions of length, the tarsus of median and hind legs have the second segment twice or slightly more than twice shorter than the first one. Cerci light with distinct violet-black rings, every 2nd ring markedly wider. Wings with the costal and subcostal fields distinctly brown coloured and the transverse veins broadly bordered with white. The last segment of forceps rounded and relatively large. Penis cone-shaped bent backwards, fastened to the body with two arms.

Cloeon simile **Eaton, 1870**

Synonymy: 1870: *Cloeon simile* Eaton 1914: *Cloeon praetextum* Bengtsson; 1949: *Cloeon havassei* Verrier). All synonymy after Toth (1992), Ann. Hist.-Nat. Mus. Nat. Hung. 84: p.61

Nymphs:

Dark area with two light dots on either side of each segment, the proximal dot in the form of curved line, the distal round. Usually seen on segments 2-6 at least and sometimes on segments 2-9. Segment 4 sometimes lighter than the rest. The outer hairs of the marginal fringe of the labrum not feathered. The maxilla short and broad, with 5-7 bristles at the apex and on its two segmental palps. Gills pointed, more pointed at the end, with a more distinctly undulating margin. The 7th gill usually more distinctly asymmetrical and the dorsal flap on a few of the first gills more markedly narrowed at the end.

Adults:

Body colour pale green. The 1st segment of hind tarsus about twice the length of that of the second. Two major cross-veins between R_1 and R_2, pterostigma has nine to eleven cross-veins. The 2nd segment of hind leg usually 1.5X as short as first segment. The 2nd segment of forceps stumpy, while the 3rd segment broadened terminally. The penis distinctly trapezoidal in form.

Cloeon kaheriensis **Abdel Fattah**

Nymphs:

Caudal filaments as long as twice the body length, the outer two filaments with two lobe-like dark structures along the whole filaments, while the middle filament without such structure, but with a dark row of hairs alternating with two or three light rows. More than five dark rings on each filament between the tip of the abdomen and the median dark band on the filament. The tarsal region of 3 segments. Mandible elongated and twisted. Each mandible terminating in two groups of sharp teeth consisting of two or three teeth respectively. The right molar surface covered anteriorly with a smooth edged blade of cuticle. From this, there run a large number of ridges found across the pre-oral cavity perpendicular to the anterior surface of the mandible. The ridges decreasing in size towards the mouth and toothed; fine spines project from many of them where they join the blade and at the posterior ends of the biggest are larger spines. Labial palps three segmented. The 1st segment about twice as long as both 2nd or 3rd ones. The 2nd segment about as long as the 1st one, the 1st wider than the 2nd.

Adults:

Body colour light to light brown. The 2nd tarsal segment about one-half or less than that of the 3rd one. The costal and subcostal fields brownish (or rust) in colour, the transverse veins occurring in the costal area few in number and lighter in colour. Two anal veins. The wings provided with short hairs along their inner margins.

Forceps slender with its basal segment distinctly shorter than the 2nd one which is hardly separated from the 3rd. The last segment of forceps slender with small teeth in the inner margin while the outer margin is becoming smooth. Penis somewhat straight anteriorly, backwards, more strongly sclerotized on the ventral side. It is fastened to the body with two arms, may be stuck backwards and move up and down.

Cloeon moursii **Abdel Fattah**

Nymphs:

The ratio between the length of the body and that of the caudal filament 4/3. The 1st segment of the labial palp longer than or at least equal to the length of both 2nd and 3rd segments together. The 3rd segment "terminal segment" separated completely from the 2nd one. The base of the 2nd segment narrow. The median area of labrum provided with two complete rows of hairs restricted along the frontal part. The tarsal region not clearly divided into segments. The claw sharp and curved. The spines numerous and aggregated abundantly on the lower margin of the tibia and tarsus. Median caudal filament, with about 7-9 dark bands between the joints of the distal half of the filament. Distal third of all

the filaments with dark bands between the joints.

General diagnosis of *Genus Baetis* Leach

Synonymy: 1815 : *Baetis* Leach, Brewst. Edinb. Encycl. 9:137. 1840: *Brachyphlebia* Westwood, Introd, Mod. Classif. Ins.2:25. 1843 : *Cloe* Pictet, Hist. nat. 2. Ephen. Neurop. p. 239. 1885 : *Baetis* Eaton, Revis. Monogr. p. 156. 1912: *Baetis* Bengtsson, Ent. Tidskr,, p. 110 *(Acentrella = Baetis,* in part) 1925 : *Baetis* McDunnough, Trans. R.S.C. 19: 214. 1932 : *Baetis* McDunnough, Canad. Ent. 64: 79. 1933 : *Baetis* Spieth, J.N.Y. Ent. Soc. 41: 337.

Nymphs:

The nymphs with slender, stream-lined bodies; rather long and slender legs; claws with numerous fine denticles on the inner margins. A narrow distinct median notch found on the apical margin of the labrum; mandibles roughly triangular, canines large with blunt teeth; maxillary palp two or three-jointed, usually not extending beyond the tip of the galea-lacinia; labial palp three-jointed, the distal Joint distinctly reounded, short, never expanded truncate on the apical margin. Gills present on segments 1-7; single on all segments; pinnately branched, usually obovate, but somewhat variable in shape in different species. A few species with two caudal filaments. In all other known species, three caudal filaments present, but the middle one distinctly shorter and weaker than the two lateral ones.

Adults:

Fore wing ranging in length from 2.5 to 8mm; wings of female slightly longer than in the male. Females more or less unicolorous, usually reddish or brownish, the head and thorax usually paler than in the male. Abdominal segments 2-6 of adult male imago usually hyaline; semihyaline or deep brown. Prothorax relatively small. Near the middle of the metanotum is a short protuberance. Fore leg of male about as long as the body. Fore tarsus as long as or slightly longer than the fore tibia, basal joint very short; second usually slightly longer than the third; fourth and fifth progressively shorter. Fore tibia about one and one-third times the length of the femur. Basal joint of hind tarsus relatively short, not longer than the second and third joints together. Hind femur and tibia subequal; tarsus shorter than tibia. Marginal intercalaries of fore wing occur in pairs. Basal costal cross veins entirely wanting. Hind wing present; variable in size, usually rather well developed. In most species, a costal projection (acute or slightly curved) present near the base of the wing. Longitudinal veins 2 or 3 in number; the 3rd, when present, usually much shorter than the others. In a few species only, there are more or less evident indications of cross veins between these.

Forceps four-jointed, the 2nd and 3rd joints more or less completely fused. The genitalia may be recognized into two distinct types on the basis of differences in the forceps joints, also various modifications of these two main types. In the intercalaries type, the basal forceps joint usually with a tubercle or projection on its inner apical margin; second joint relatively long and slender, usually narrowest at its base. in the *moffati* type, no true tubercle on the inner apical margin of the basal joint, although the inner margin may be prolonged inward; second joint usually shorter than above, distinctly cylindrical, not tapering apically; third joint rather less slender and not noticeably narrower at the base. In each type, the distal joint may be shorter and relatively stout, or rather long and slender, a condition which varies in different species.

Genotype: *Baetis bioculatus* (Previously included in *Ephemera* Linnaeus).

***Baetis cleopatrae* Soldan** (Plate II)

Nymphs:

Brown dorsally; two large plotches found laterally on the 1st segment. The posterior margin covered with strong dents with large base and pointed ends; the posterior angle of tergites armed with strong pointed spines. Paraproct bordered with about twenty peripheral spines and possesses in addition some concave impressions. The postero-inner margin of femur armed with large sized scales, rounded at apex. The tarsal claw very strong and very curved, armed with about 14 unequal denticles, arranged in a single row. Mandibles provided with strong teeth, the anterior ones very rounded in outline and the prosthecae deeply asymmetrical and with fine bristles. The caudal filaments densely covered with strong ciliature internally in the proximal 3/4 its length. All the three filaments possess a large dark brown band.

Adult:

Wings whitish, hyaline and provided with scattered hairs along the anal and outer margin. In fore wing, no marginal intercalaries in subcosta, and with about 4 cross-veins in stigmata area. Hind wing slender, with two longitudinal veins and without costal angulation.

General diagnosis of Family CAENIDAE

The nymphs sprawling forms, more or less densely covered with fine hairs. Body tapering toward the tail. Lateral margins of abdominal segments 2-9 more or less produced into flattened processes bearing postero-lateral spines. Gills present on segments 2-6; usually also a filamentous rudiment on segment 1; gill on segment 2 elytroid, almost completely covering those behind it. Caudal filaments three; hairs quite evenly distributed on both margins of each.

Adults varying in color from pale whitish to deep brownish black. Eyes of males simple, not divided nor grooved, widely remote from one another. Lateral ocelli unusually large and prominent. Tarsi 4-jointed, except in fore leg of male, having an additional short basal joint. Hind wings wholly wanting. Fore wings ample, very well developed, especially in the cubito-anal region. Wings often semiopaque; usually the costa and subcosta tinged with purplish except at the tip; outer and hind margins ciliate even in the imago. No marginal intercalaries. Cross veins few, or at most not very numerous. Forceps base may be entire, sometimes excavated on apical margin; or bearing a median and two lateral divisions on its apical margin. Forceps and penis variable.

General diagnosis of Genus:
***CAENIS* Stephens** (Plate III)

Synonymy: 1835 : *Caenis* Stephens, III. Brit. Ent. 6:61 1839 : *Oxycyphus* Burmeister, Trans. Amer. Ent. Soc. 116(4): 808. 1884 *Caenis* Eaton, Revis. Monogr. p. 141. (in part). 1920 *Caenis* Ulmer, Stett. Ent. Zeit. 81:121. 1923 *Ordella* Campion, Ann. Mag. Nat. Hist. 11, s. 9, 64: 515. 1924 *Ordella* Lestage, Ann Soc. Ent. Belg. 65: 61. 1931 *Caenis* McDunnough, Canad. Ent. 63: 254. 1933 *Caenis* Spieth, J.N.Y. Ent. Soc. 41: 356.

Nymphs:

Head and pronotum narrower than mesonotum. Apical margin of labrum slightly concave. Canines of mandibles wide lobed or toothed apically, inner canines as long as outer ones. Maxilla conical at apex; palp 3-jointed, distal joint longest; entire palp fully twice the length of the galea-lacinia. Labial palp 3-jointed ; basal joint stoutest. Fore leg with claws slender, somewhat curved apically and not pectinate. segment 1 with a well-developed filamentous gill rudiment. The operculate gill on the 2nd segment single; large and quadrate, its outer apical angles somewhat rounded. Each of the gills on segments 3-6 single, deeply fimbricate on the outer 2/3 of the entire margin. Postero-lateral spines on middle segments somewhat prominent, not up curved and much less sharply toothed. A whorl of spines present on each joint of caudal filament.

Adults:

Abdomen pale yellowish white, the tergites often suffused with blackish. Second joint of antenna not more than twice the length of the basal joint. Prostemum narrow, two or three times longer than broad, so that the fore coxae are more or less closely approximated. Fore tibia of male about twice the length of the femur, tarsus shorter than tibia; second joint longer than any of the others. Fore leg of male about as long as body. Middle and hind femora about 1 1/3 times as long as their

respective tibiae; tarsi slightly shorter than tibiae. Claws of fore legs of male similar and blunt; on other legs and on all tarsi of female dissimilar.

Cross veins of wing arranged singly, usually no intercalary region with more than one cross vein; 2 or 3 cross veins only in radial region. Subcosta and radius blackish or purplish except at apex. Short lateral filaments extend backward from the postero-lateral margins of the middle abdominal segments. Caudal filaments three; relatively very long in male, often three times the length of the body; middle filament may be slightly the longest. In the male genitalia forceps base entire, its apical margin slightly convex. Penis united, broad and plate-like; forceps 1-jointed, generally sharp-pointed at the tip. Posterior margin of subanal plate of female entire. Subimagos with more prominently ciliated wing margins and longer lateral filaments on abdomen.

Genotype : *Caenis macrura* Stephens.

Caenis robusta Eaton

Nymphs:

Body length with full grown larvae up to 8mm. Lateral margins of pronotum meet with the anterior margin to form distinct corners approximately right angles; a light median line runs down to head, pronotum and mesonotum; light dots usually found on the mesonotum; claws robust and bent at an obtuse angle.

Adults:

Dorsal surface of abdomen with grayish markings on all tergites. Prosternum with a very narrow inter-coxal process so that, coxae of fore legs are close together; 2nd segment of antenna short and about twice the length of the first segment. Dorsal surface of abdomen with a small median spine on the posterior margin of the 2nd tergite; tail filaments white or yellowish white. Forceps of male imagines small and much shorter than penis-lobes; penis-lobes truncate and undivided.

Caenis horaria (Linnaeus)

Nymphs:

Lateral margins of pronotum meet the anterior margin to form a continuous curve; claws more slender and only slightly curved; sides of pronotum diverge outwards towards the anterior margin so that the lateral margins of the pronotum are slightly concave. Two small tubercles occur near the mid line of the pronotum; the tubercles appear as two darkly pigmented dots in fresh specimens; last visible sternite of abdomen broadly truncate without a deep notch in its posterior margin.

Adults:

Dorsal surface of abdomen with grayish markings on tergites I-V. Prosternum with a very narrow inter-coxal process so that, coxae of fore legs are close together; 2nd segment of antenna short and about twice the length of the first

segment. Dorsal surface of abdomen with a small median spine on the posterior margin of the 2nd tergite; tail filaments white or yellowish white. Forceps of male imagines long and extend beyond the penis-lobes which are truncate and undivided.

Caenis haywardi **Navas, 1926**

Adult:

Body length about 3.3 mm. Wings about 4.4 mm in length. Thorax brownish yellow; pronotum transverse with dark black median longitudinal bands and dark black lateral margin lines. Abdomen inferiorly fuscous, posterior margins of segments brown; the distal end of abdomen white and black annulate; cerci flavous. Legs brown-flavous; fore legs fuscate; with brown articulations; tarsi totally flavescent. Wing hyaline and fuscous at. base; middle of costa, suncosta and radius subtotally fuscate.

Caenis mabroukii **n. sp.** (Plate IV)

Holotype:

Mature nymph collected from Dar El-Salam (Maadi, Cairo) 18.7.1998, by Abdel Fattah M. Amer, and deposited in the collection of Department of Entomology, Faculty of Science, Cairo University, Giza, Egypt.

General description of the new species:

Nymphs:

Light brown and dark laterally; body length about 4.5 mm and caudal filaments about 3mm. The head with two dark spots anterior to the median ocellus. Labrum approximately 2.3 times as wide as long, provided with hairs along its outer margin and with scattered setae restricted in the middle area. The 1st group of canines (outer group) of the right mandible four flattened teeth while the 2nd group (inner group) three teeth. In the left mandible, each of the 1st and 2nd group consists of three and two teeth respectively. The maxillary palp consists of three segments, the basal segment is strong and as long as the terminal one, while the 2nd segment small; the inner margin of the terminal segment provided with hairs. The tip of lacinia provided with two strong teeth and biforked long hairs. Labium strong; labial palp three segmented, the terminal one very small and provided with setae, the first two segments nearly similar and about 2.5 times as long as the third one. Glossa is slightly smaller than paraglossa, and provided with hairs, specially along the outer margin. Fore-leg with enlarged femur; dorsal surface of femur obviously spiculate, with irregular transverse row of about ten spurs, the terminal three spurs fimbriate. The tarsal claw of hind leg with 15 minute denticles.

Abdomen nine segmented; the posteromedian projection of 2nd abdominal tergum somewhat triangular in dorsal view; the posterolateral projections of the middle abdominal segments moderately developed; the 5th

segment approximately 4.5 times as wide as long; and the posterior margin of 9th sternum moderately notched. The operculate gills tan in colour; the middle point of Y-ridge situated in the middle of operculate gill; the median branch of Y-ridge with about seven stout bifurcate setae. The caudal filaments tan in colour; the distal half of each filament with short setae at whorls of every second or third segment, these setae somewhat equal to the space between whorls.

Adults:

Body length about 3mm; milky white in colour; head pale white with black outer margin. Males with two caudal filaments while females, three ones. Wing vein $ICuA_1$ forked with CuA_1 based of $ICuA_1$-CuP cross vein; the anal margin of wing provided with long hairs, and the basal half of outer margin with minute hairs.

Paratypes:

Five Females and 15 nymphs [collected from Dar El-Salam (1998) and Beni Suef & Meniya (2006)]. All preserved in Department of Entomology, Faculty of Science, Cairo University, Giza, Egypt.

General diagnosis of Family: POLYMITARCIDAE

Nymphs:

Head and prothorax without pads of spines; mandibles usually with large tusks projected forward and visible from above head, mandibular tusks curved downward apically as viewed laterally; fore tibiae more or less modified, either flattened or with tubercles and adapted for burrowing; ventral apex of hind tibiae rounded; abdominal gills exposed, lateral or dorsal, gills on abdominal segments 2-7 forked and with margins fringed with hairs.

Adults:

Wings with abundant cross veins. Median vein (M) and anterior branch of cubitus (Cu_1) of fore wing strongly divergent at the base, posterior fork of media very deep and its basal portion strongly bent toward cubitus. Cubital intercalaries in fore wing straight, not attached at base to Cu_1 and marginal veinlets very numerous. Stigmatic area of fore wing never widened, often becoming somewhat narrowed. In hind wings, outer fork wanting; R_4 and R_5 being fused; and costal angulation usually rounded. Legs weak, except fore leg of male, usually long and normally developed; claws weak, slender and blunt. Male fore tarsus five-jointed and the basal joint very short; middle and hind legs of male and all legs of female feeble and nonfunctional. Caudal filaments two in male and three in female (Genus: *Ephoron).* In male genitalia, forceps 4-jointed, and the penis shorter than forceps.

General diagnosis of Genus : EPHORON Williamson

Synonymy: 1802: *Ephoron* Williamson, Trans. Amer. Soc.

Phil. 5: 71. 1868: *Polymitarcys* Eaton, Ent. Mo. Mag. 5: 84, 1883: *P.* Eaton, Revis. Monogr. p. 43. 1920: *P.* Ulmer, Stett. Ent. Zeit. 81:107. 1920: *P.* Needham, Bull. Bur. Fish. 36: 285. 1926: *Ephoron* McDunnough, Canad. Ent. 58:184. 1933: *Polymitarcys* Spieth, J.N.Y. Ent. Soc. 41: 347.

Nymph:

Head with a rounded median frontal prominence. Mandibular tusks long, down-curved, convergent apically, irregularly toothed on outer margin, bearing short spines on dorsal and lateral surface. Long hairs at base on inner margin, a fringe of hairs of graduated length basally on outer margin, longer hairs apically. Labrum almost as long as broad. Maxillary and labial palps each two-jointed. Fore leg short and stout; tibiae and tarsi of middle and hind legs slender, femora moderately stout. Gills dorsal in position; single on segment 1; double on segments 2-7, each gill fringed on each side with short hairs; lateral tracheae numerous and distinct.

Adults:

Wing length from 11 to 12mm. Fore femur of male short; tibia long, 4 to 4.5 times length of femur; tarsus very slightly shorter than tibia. Fore leg about as long as body. Claws very slender, weak, one very slightly shorter than the other. Femur of hind leg is slightly longer than tibia and tarsus shorter than tibia. Wings are slightly translucent in male, distinctly so in female; main veins of costal margin purplish, all others pale. Posterior branch of radial sector forked about 1/4 the distance from base to margin. Hind wing about 1.5 of the distance from base. Venation of both wings copious; cross veins very numerous, especially near outer margin of fore wing, where they form more or less a network with the numerous marginal intercalaries jointed to each other and to the cross veins basally. The caudal filaments two in male and three in female; a very short third rudiment in male. Pleural fold slightly expanded, at posterior margins of segments. Male genitalia with forceps base very narrow, apical margin almost straight. Forceps four-jointed; basal joint short, second one longest; fourth shorter than third, these two together subequal to first. Penis united on median line, apical outer margin of each prolonged into a blunt horn-like process; penis covered by forceps base only at extreme anterior margin. Posterior margin of 9th sternite of female almost straight.

Genotype : *Ephoron virgo* (previously included in *Ephemera* Olivier

***Ephoron savigni* (Pict.) (Plate V)**

Synonymy: 1870: *Polymitarsus savignii*

Nymphs:

Pale yellowish, body length about 16mm., while the puterc-cerci about 6mm. Thoracic segments

with faint brownish marks, abdomen shows indications of a fuscous pattern. Setae on legs falvous; cerci pale and uniform. Fore legs short and stout; tibiae and tarsi of middle and hind legs slender; femora moderately stout. Maxillary palp 2 segmented the terminal one large and curved and the inner margin bearing hairs; lacinia broader apically and covered with hairs. Gills dorsal in position, single and very weak on the 1st segment, double and large on segments 2-7, each gill fringed on each side and with short hairs.

Adults:

Pale whitish, pronotum slightly wider than long. All legs weak and reduced in size except the fore legs of male; coxae and trochanters well developed; tarsus very slightly shorter than tibia. Wings translucent; main veins of costal margin purplish and all others pale. Posterior branches of radial sector forked about 1/4 the distance from base to margin. Venation of both wings copious; cross veins very numerous, especially near outer margin of fore wing, where they form a net work with numerous marginal intercalaries jointed to each other and to the cross veins basally. Caudal filaments three in female and two in male with a very short third one. Base of forceps very narrow, apical margin straight; three segmented, the terminal two segments (2nd & 3rd) covered internally with small hairs; basal segment strong; 3rd segment thinner than 2nd or 3rd segments. Penis covered by base of forceps only at extreme anterior margin. The apical outer margin of each prolonged into a blunt horn-like process. .

General diagnosis of Family: Oligoneuriidae

Nymphs:

Prothorcic notum not enlarged; abdominal gills exposed; gills on abdominal segments 2-7 variable; if gills forked, margins not fringed; gills ventral on the first abdominal segment and dorsal on segments 2-7; tusks rarely present on mandible; fore legs provided with a double row of long setae.

Adult:

Body black; wings milky or grayish with simplified venation; in fore wing, venation greatly reduced, apparently only 3-4 longitudinal veins behind R, M_{1+2} and Cu_1 parallel at their base, Sc not visible or visible at base only and fused with R or absent. Hind tarsi with four movable segments, if a 5th segment is present it is fused with the tibia.

General diagnosis of Genus: *HOMOEONEURIA* Eaton

Synonymy: Homoeoneuria Baton, 1881:197; Edmunds, Bemer and Traver, 1958:376; Edmunds, Bemer and Jensen, 1976:18

Type species: *Homoeoneuria salvmiae* Eaton, by original designation

Adults:

Length: Male body 6.0-10.0 mm, fore Wing 6.8 – 11.0 mm; female body 7.0-11.0 mm; fore wings 6.8-11.0 mm. Eyes of male and female meet on meson of head. Wings membranous and longitudinal veins of fore and hind wings thickly covered with granulate setae and evenly spaced papilla-like setae; vein R, of fore wings absent, cross veins of fore and hind wings absent. Male legs: prothoracic legs approximately 3/4 length of mesothoracic legs, 1.25 length of metathoracic legs; femora of metathoracic legs bowed forming an intersegmental keel with the trochanters; inner margins of trochanters, femora and tibiae of metathoracic legs with blunt spicules; coxae of metathoracic legs longer than either femora or tibiae; claws of a pair bulb-like, surface pubescent, fore claws much larger. Female legs: coxae developed, remaining segments of legs membranous, twisted and vestigial. Male genitalia styliger bar preset; genital forceps absent, penis with developed arms; ejaculatory ducts greatly eversible. Sternum 6 of female with broad, shallow emargination to deep, narrow constriction; sternum 9 posteromedially extended, minutely cleft apically to pointed. Terminal filament slightly, longer than cerci; whorls of setae on articulations in males. In female inner and outer margins of terminal filaments with a narrow longitudinal groove.

Nymphs:

Antennae inserted below eyes, length approximately 4/5 length of head. pedicel approximately twice length of scape. Outer incisors of mandibles broader than inner, incisors, inner lateral margin of incisors weakly serrated; prostheca with 3-4 major branches. Maxillary gills multibranched; segment 2 of maxillary palpi approximately 4 times the length of segment 1. Linguae of hypopharynx broad, dome-shaped apically entire, anteromedian margin bare. Pronotum with prominent posterolateral extension overlapping base of prothoracic coxae. Coxae of prothoracic legs medially enlarged with prominent apical keel; coxae and trochanters with long thick hairs; outer lateral margin of femora with slender spinous setae; tarsi reduced, papilla-like. Coxae mesothoracic legs cylindrical; coxae and trochanters equal in length; tarsi slightly shorter than tibiae, dorsal surface of trochanters with long thick hairs, remainder of segments with long spinous setae, shorter on tibiae and tarsi; tarsal claws slender without denticles. Coxae of metathoracic legs cylindrical with prominent apical keel; trochanters 1/2 length of coxae; tibiae approximately 2/3 length of femora; tarsi approximately 2/3 length of tibiae; trochanters with apical spur; tarsal claws straight, long and slender without denticles; setae as on mesothoracic legs. Posterolateral

spines on segments 8-9; sternum I with a short finger-like posteromedian process; tergum 10 approximately 1/2 length of tergum 9; sternum 9 with a pair of weakly sclerotized posteromedian spines; terga and sterna covered with clubbed setae. Gills I ventral, large multibranched without plate-like lamellae; gills 2-7 slender, without fibrilliform portion, maximum width approximately 1/6 maximum length, flat, anteriorly bordered with moderately long hairs, dorsal and ventral surface glabrous. Cerci slightly longer than terminal filament, with long inner marginal setae; terminal filament with long inner and outer marginal setae.

Homoeoneuria ammophila (Spieth) (Plate VI)

Synonymy: *Oligoneuria ammophila* Spieth 1937:197; 1838:1; Burks 1953: 80; *Homoeoneuria ammophila* Edmunds and Allen 1957: 318; Edmunds, Berner and Traver 1958: 375.

Nymphs:

Body length about 8 mm,; caudal filaments 1.8mm.; vertex with reddish-brown markings extended between eyes; legs pale yellow; antennae yellowish; posterior margin of superlingua strongly curved. Pronotum with thin streak of reddish brown band near posterior margin and anterior margin of fore wing pads. Tarsal claws of med legs approximately 1/3 length of tarsi; tarsal claws of hind legs about 1 1/8 length of tarsi; terga 1-9 with moderately broad dark brown markings near posterior margin; caudal filaments and seta pale yellow.

Adults:

Body length about 9.5 mm.; brownish-yellow to dark brown. Pronotum with prominent posterolateral and posteromedian pale yellow spots, longitudinal veins of fore and hind wings pale yellow; coxae and trochanters brown, remaining segments pale yellow. Terga 1-9 with moderately broad dark brown markings near posterior margins. Penis pale yellow except lateral processes brown. Caudal filaments pale white; light brown setae on articulations.

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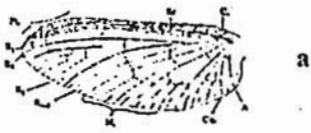
Plate I



a

Cl. dipterum

b

Cl. simile

c

Cl. kaheriensis

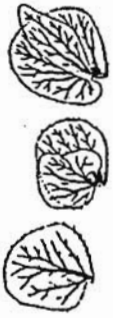
Fig. 2: Wings

c

Cl. simile

b

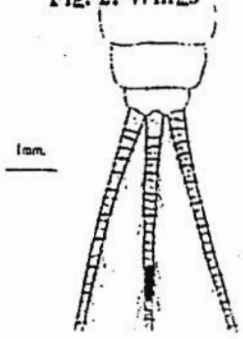
Cl. cognatum



a

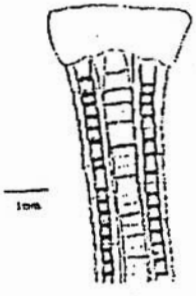
Cl. dipterum

Fig. 1: Gills



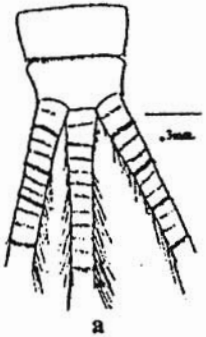
c

Cl. moursli



b

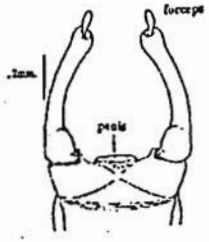
Cl. kaheriensis



a

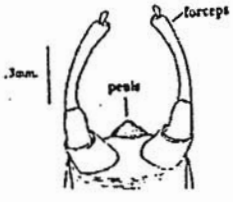
Cl. dipterum

Fig. 3: Caudal filaments



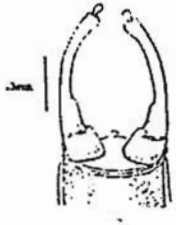
a

Cl. simile



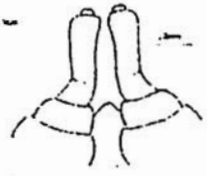
b

Cl. dipterum



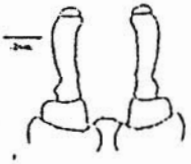
c

Cl. cognatum



d

Cl. moursli



e

Cl. kaheriensis

Fig. 4: Male genitalia

Plate II

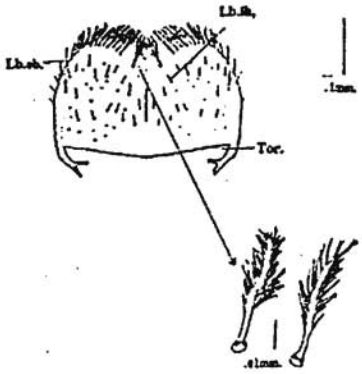


Fig. 1: Labrum & Enlarged bristles of labrum

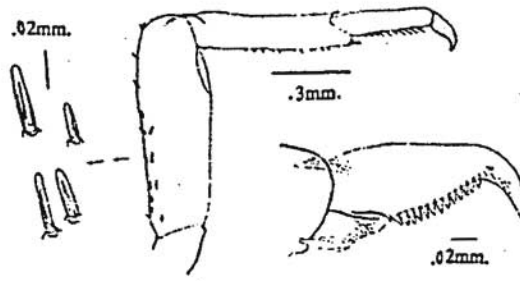


Fig. 2: Mid leg & Enlarged bristles and claw

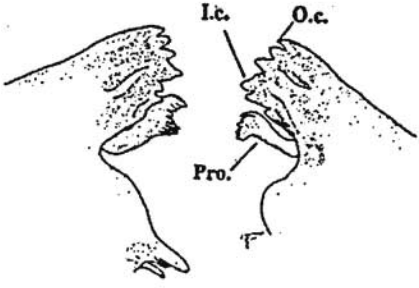


Fig. 3: Rightt & left mandible

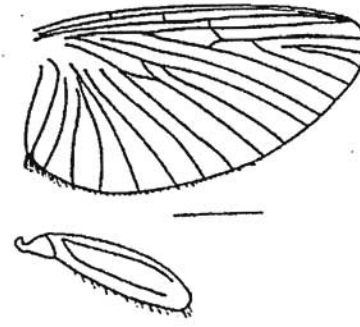


Fig. 4: Fore & hind wing

Plate III

Caenis horaria *Caenis robusta*

Fig. 1: Caudal filaments

Caenis horaria *Caenis robusta*

Fig. 2: Fore leg

Caenis horaria *Caenis robusta*

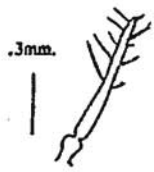
Fig. 3: 1st gill

Caenis horaria *Caenis robusta*

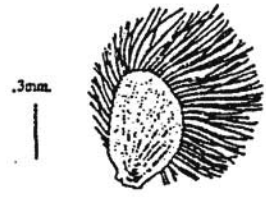
Fig. 4: Male genitalia

Plate IV

1st gill



2nd gill



3 – 7th gills

Enlarged filament of gill

Fig. 1: gills

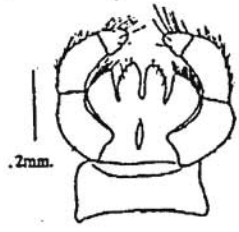


Fig. 2: Labium

Fig. 3: Maxilla

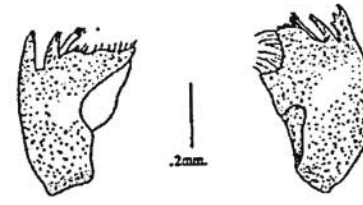


Fig. 4: Left & right mandible

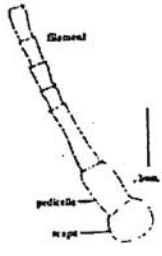


Fig. 5: Antenna

Fig. 6: Fore Leg

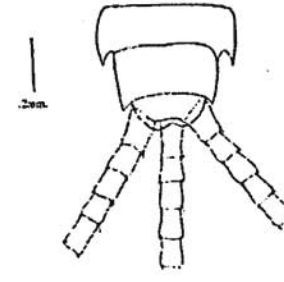


Fig. 7: Caudal filament

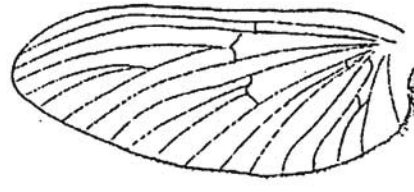


Fig. 8: Wing

Plate V

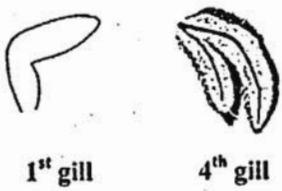


Fig. 1: Gills

Fig. 2: Left mandible

Fig. 3: Maxilla

Fig. 4: Labium

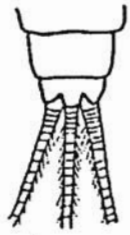


Fig. 5: Caudal filaments

Fig. 6: Male genitalia

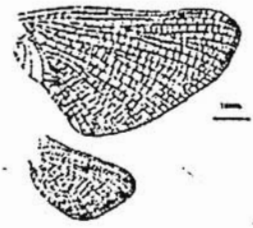
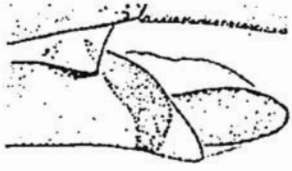


Fig. 7: wings

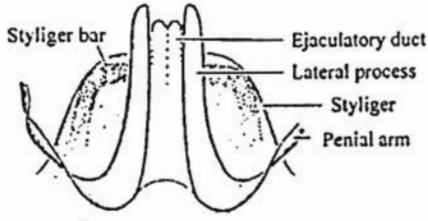
Plate VI

Fig. 1: Hypopharynx

Fig. 2: Claw



Lateral view



Dorsal view

Fig. 3: Male genitalia