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## The Mayfly Nymphs (Order: Ephemeroptera) of Rawalpindi District

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### 1. INTRODUCTION

According to L. R. Usinger (1956), "Insects as Mayfly nymphs and midge larvae serve as primary converters of plant material into animal protoplasm". Both the adult and nymphal stages of mayflies constitute an important item in the diet of many species of fishes. Taxonomic study of mayflies (Order: Ephemeroptera) was not attempted before in Pakistan. Little work is done on the taxonomy of these insects in India. Eaton (1883—1888) in a monograph on this order, recorded *Cloë n dipterum* Linnaeus from Europe to Northwestern India and *Epeorus psi* Eaton from Kulu in Punjab (India). Hora (1930) reported the nymphs of *Baetis* spp. from the torrential streams and the nymphs of *Ecdyonurus* from the hill streams of India. Traver (1939) in her paper on the Himalayan Mayflies described five new species, namely, *Caenis srinageri* from Srinagar, *Cloëon Kashmiri* from Kashmir, *Baetiella ladakæ*, *Ameletus primitious* and *Ororotsia hutchinsoni* from Ladak. D. E. Kimmins (1942) described *Cloëon harveyi*, *Cloëon bicolor*, *Cloëon bengalanse*, *Cloëon viridis*, *Caenis piscina* and *Caenis pisca* as new species from Calcutta. M. T. Gillies (1949 and 1951) described the following new species from different parts of India: *Baetis fluitan*, *Baetis palmyrae*, *Baetis dipsicus*, *Baetis thurbonis*, *Baetis solitarinus*, *Pseudocloëon inopinum*, *Cloëon sicum*, *Cloëon septinum*, *Cloëon julia*, *Pseudocloëon bimaculatus*, *Thranlus hindustanicus*, *Thranlus parvalus*, *Habrophleboides semicatones*, and *Isapurpurea*. The above-mentioned worker has also described *Cryptonella* and *Isca* as new genera. Kapur and Kirpalani (1961) described *Baetis*

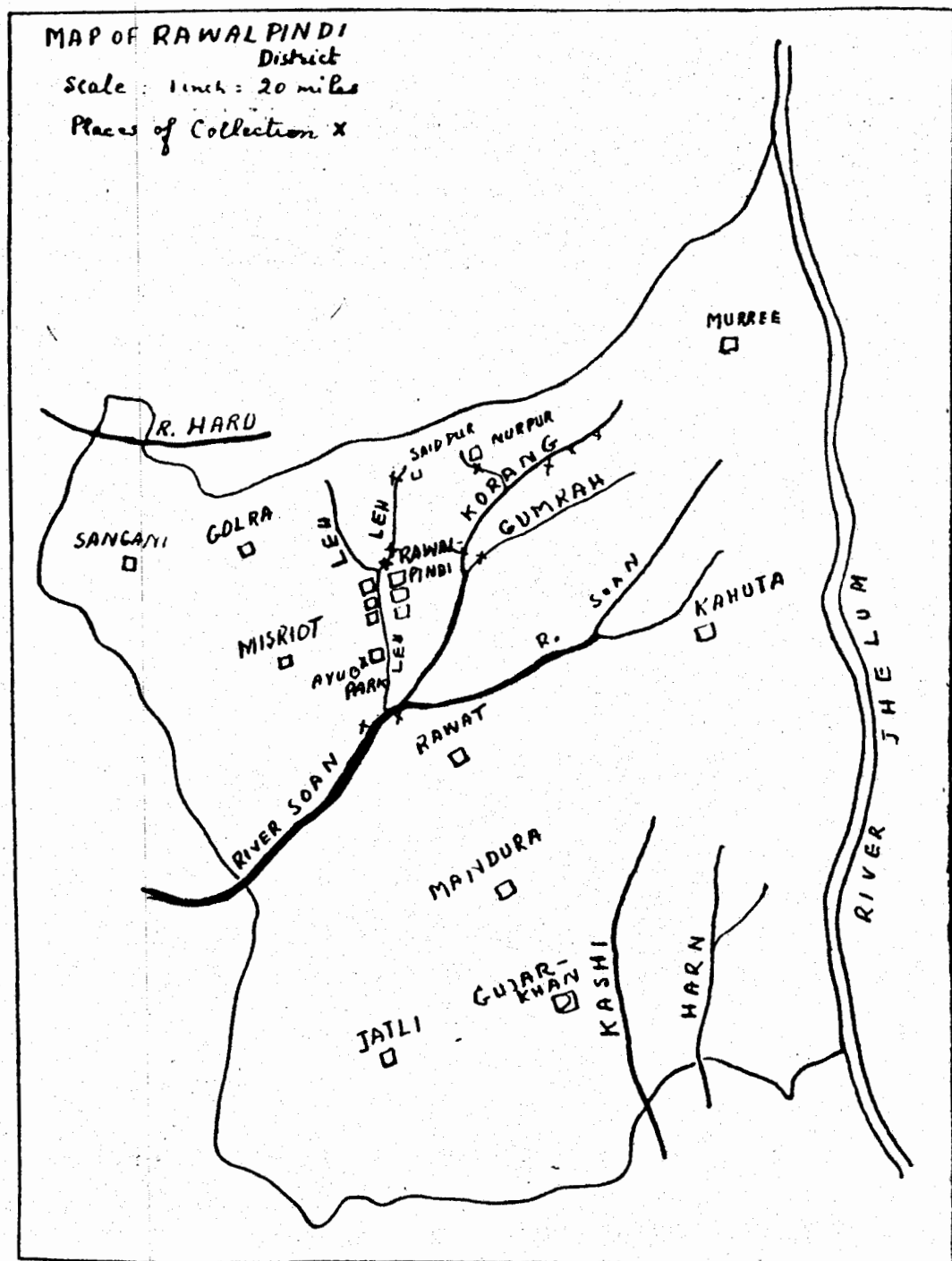
*simplex*, *Baetis chandra*, *Baetis himalayana*, *Baetis punjabensis*, *Baetis festivus* and *Eperous lahaulensis* as new species from Kulu and Lahaul Spiti valley, Punjab (India).

The author in this paper described the nymphs of the following new species:—

*Ephemera soanica*, *Ecdyonurus islamabadicus*, *Baetis macanis*, *Baetis mecheanis*, *Cloëon gillican*, *Choroterpes qadricus*, and *Gaenis kimminsis*. As far as the author is aware the genera *Ephemera* and *Choroterpes* are not recorded from India, and Nepal.

### 2. PHYSICAL FACTORS

Rawalpindi district is located in the lowlands of southern Himalayan slope. Its elevation rising 1500 feet at Gujjar Khan 1600 feet at Rawalpindi to 7500 feet in the Hill station of Murree. There are two rivers and a number of streams around Rawalpindi. The Soan River arises from the Murree Hills, runs towards southwest and drops into the Indus River. The Haro River arises from the hills of Hazara, runs westwards and discharges into the Indus River. The main streams are Korang, Gumrah, Kashi, Ling, Harn, and Leh. There are two artificial lakes that is Rawal and Misriot, and a few ponds in Ayub National Park. The bottom of the river and streams consists of small stones, boulders and rocks. The average minimum temperature is 30.8 F in January and maximum temperature rises up to 115°F in the summer. The relative humidity is low most of the year. This may rise up to 60 per cent during the months of July and August. There are two periods of rainfall that is winter and summer, the average rainfall is about 36 inches per annum.



### 3. PLACES OF COLLECTION

The bulk of the collection of mayfly nymphs has been done from the following places:—

(a) The Korang Stream at Salgran, Chatter, and Gulpur on Murree Road.

(b) The Korang and Gumrah Streams crossing the Lethrar Road.

(c) The Leh stream near Holy Family Hospital.

(d) Rawal Lake.

(e) The streams of Nurpur and Saidpur.

(f) The Soan River crossing the Grand Trunk Road.

(g) Ponds of Sultanpura, Gordon College New Campus and Ayub National Park.

Location Map of Rawalpindi is attached.

### 4. METHODS

Surber, Ekman samplers and dip nets were used for the collection of mayfly nymphs. Surber sampler was used in shallow running waters of streams, Ekman in pool areas, and dip net along the banks of ponds and streams. Nymphs were preserved in dilute formalin.

Temporary glycerine mounts of nymphs were used for the study. For permanent mounts, specimens were treated with 10 per cent KOH (cold) for varying length of time depending upon the size, and after usual process of dehydration and clearing, mounted in canada balsam. Mouthparts, legs and gills were dissected in clove oil. Final sketches were made with the help of camera lucida.

### 5. SYSTEMATIC ACCOUNT

The nymphs of five families, six genera and seven species were collected.

The key which follows, is for the families of the mayfly nymphs of Rawalpindi district :—

1. Mandibles with external tusks projecting forwards, visible from above; gills two-branched; margins heavily fringed.... *Ephemeridae*.

Mandibles with no such tusks; gill never heavily fringed....<sup>2</sup>

2. Eyes placed laterally, body not strongly flattened dorsoventrally....<sup>3</sup>

Eyes placed dorsally; body strongly flattened.... *Ecdyonuridae*

3. Cerici (outer tails) hairy on inner side only, postero-lateral angles of apical abdominal segments not produced into flattened spines.... *Baetidae*

Cerci hairy on both the sides are set with short setae....<sup>4</sup>

4. Seven pairs of abdominal gills.... *Leptophlebiidae*

Five or six pairs of gills on segments, 1—6, first pair rudimentary, second large and quadrangular covering the remaining pairs .... *Caenidae*

Family : *Ephemeridae*

Genus : *Ephemer* Linnaeus

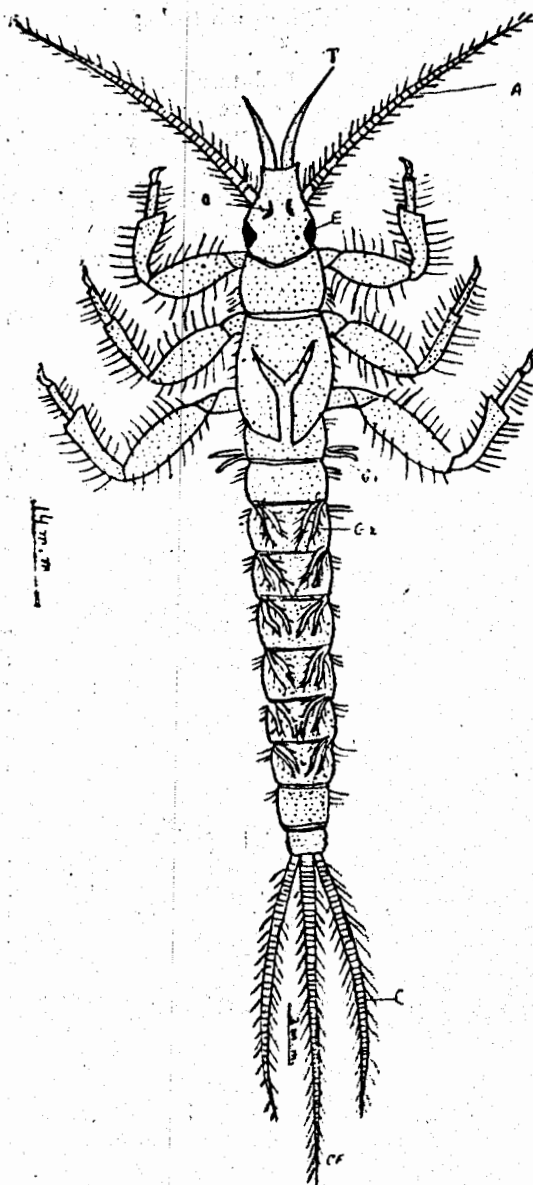
The frontal process of the head has a conspicuous sharply projecting angle at each lateral margin. The mandibular tusks are long, slender and smooth with a few small tooth-like rasps, on outer side near the base. The apex of the labial palp is broad and truncate.

*Ephemer* *soanica* sp. nov. (Plates I, II.)

It is found in the sandy bottom of streams and rivers. Length of the body is 14 mm, median caudal filament is 3.5 mm, and anal cerci are slightly shorter than the filament.

Body is elongate, perfectly cylindrical tapering at either end. It is dark brown dorsally and pale on the ventral side. The head is prognathous with mandibular tusks projecting sharply in front. The anterior part of the head is produced into a truncate rostrum. Eyes are lateral and ocelli are also present. Antennae are short, and broad with numerous hairs.

Labrum is wide in front, slightly narrow behind; a shallow notch in the centre of the apical margin; a row of long and stout bristles along the sides, a row of smaller bristles in the centre (Fig. 1). Mandibles have long and curved tusks on which hairs are present. Canine areas

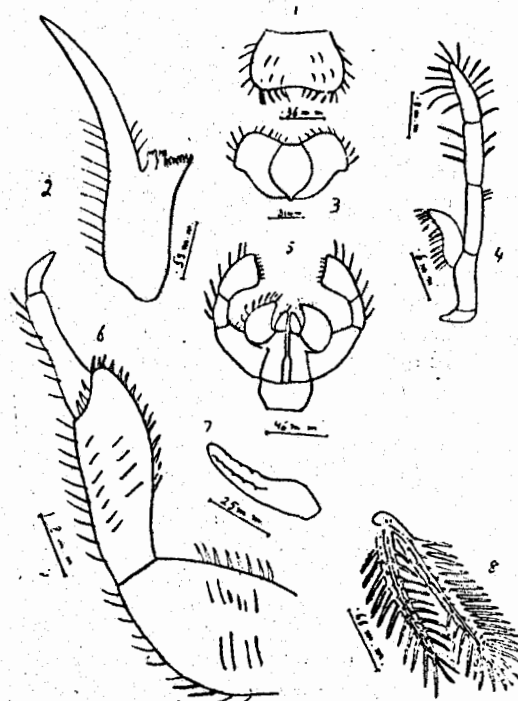
Plate I. Dorsal view of *Ephemerella soanica*.

have well developed pointed teeth: (Fig. 2). Maxillae are slender, maxillary palps have 3 segments, the last segment consists of numerous long hairs. Galea-lacinia terminates into 4 teeth along the anterior end, posterior to these teeth there are numerous bristles (Fig. 3). Labial palps

are much bigger than glossae and paraglossae and form an arclike structure in front; they are 3-segmented, the last segment is truncate and has bristles towards the distal end; bristles are also present on glossae and paraglossae (Fig. 4). Lateral lobes of the hypopharynx are not elongated.

Legs vary in size and shape. The last leg is the biggest. Femurs are short and broad; tibiae of the first pair of legs differ from the others in being broad and boat shaped; tibiae of the last pair are longest; the distal ends of the tibiae of the second and third legs have inward projections. Long hairs are present on coxa, trochanter, femur, tibia and tarsi; numerous stout bristles are present on tibia and a few small bristles on tarsus; claws are elongated and consist of 2 rows of flat ventral denticles (Figs. 6, 7).

The gills of the first abdominal segment are rudimentary and each has two minute lamellae. According to Morgan (1913), the first pair of gills are single lamellae.

Plate II. Figs. 1-8, *Ephemerella soanica*. 1, Labrum; 2, left mandible; 3, high maxilla; 4, labium; 5, hypopharynx; 6, leg; 7, tarsal claw; 8 gill.

The gills on segments 2-7 are well developed, bilamellate; each lamella is further divided into numerous fine filaments; tracheation is prominent. These gills are turned upwards over the abdomen. Median caudal filament and cerci are short, and divided into joints. Dense hairs are present on both sides of the caudal filament and cerci (Fig. 5).

Family: *Ecdyonuridae*

Genus : *Ecdyonurus* Eaton

Body is flattened dorsoventrally, especially the head, the side margins of which in the mature nymphs are rounded, eyes dorsal. Hind angles of the pronotum are strongly produced backwards. Seven pairs of abdominal gills covering tufts of branchiae. Three caudal filaments, setae arising from joints. General colour of nymphs is brownish or greenish with pale or yellowish markings. Tarsi usually darker at apex, tarsal claws with teeth.

*Ecdyonurus Islamabadicus* sp. nov. (Plates III and IV)

It is found crawling on the under-surface of submerged stones.

Length of the body is 14 mm, caudal filaments are longer than the body. General colour is brown. Head is flattened more than twice as its length, widest at the level of the anterior portion of eyes. Epicranial and coronal sutures are pale. Eyes dorsal, ocelli are also present. Antennae are short.

Labrum (Fig. 10) is short and wide, its width is four times the length, it is fringed with long hairs and short bristles towards the apical margin. Mandibles are broad in grinding areas and slender in the basal halves. Anterior canine has teeth on both sides, posterior canine has three elongated teeth towards the tip and three minute teeth along the outer margin, long hairs arise between these teeth. Protheca is represented by 10 or 11 spines. Molar surface is well developed with irregularly scattered bristles. Long hairs arise from the outer and inner margins of mandibles (Figs. 11, 12 and 13). Maxillae are well developed; maxillary palps are three

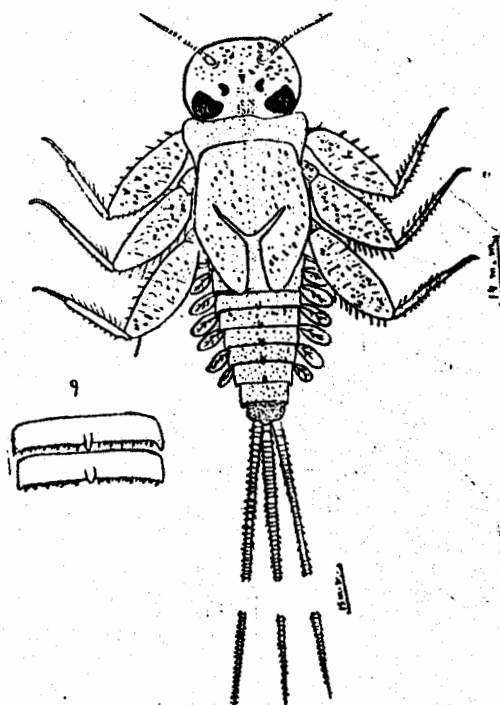


Plate III. Dorsal view of *Ecdyonurus islamabadicus*; 9, abdominal tergites.

segmented, the second segment is fringed with two series of long hairs on the outer margin. Along anterior margin of galea-lacinia there is a series of hook like teeth, a number of spines are present on the rest of the surface, hairs arise from the inner surface of galea-lacinia (Fig. 15). Labium (Fig. 16) is large in size, labial palps are broad and two segmented, the distal segment is thickly beset with bristles on outer margin. Glossae are rounded and widely separated paraglossae are laterally elongated, both glossae and paraglossae are thickly beset with long hairs. Lateral lobes of hypopharynx are somewhat rounded and beset with hairs (Fig. 14).

Pronotum is short, slightly wider than head, with delated rounded lateral margins which are prolonged behind and fixed to the sides of mesonotum, with dark colour on either side of the median line.

Legs are equal in size, femora are broad and flattened, long spines are present on the

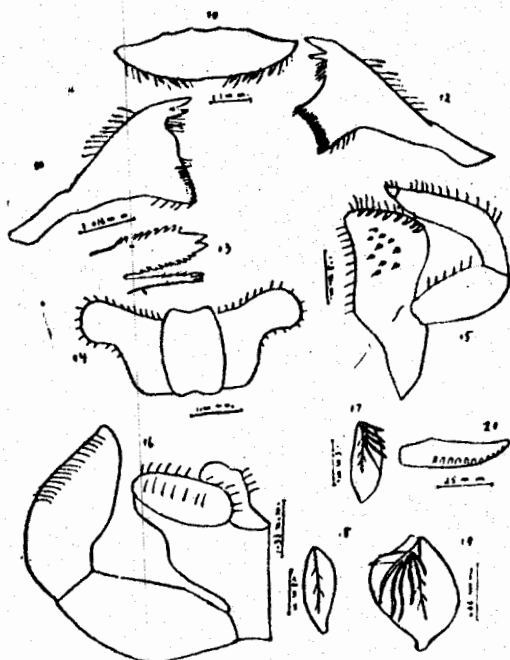


Plate IV. Figs. 10—20. *Ecdyonurus islamabadicus*. 10, labrum; 11, left mandible; 12, right mandible; 13, canine area; 14, hypopharynx; 15, right maxilla; 16, labium; 17, first gill; 18, last gill; 19, 2nd gill.

outer margin, short and stout spines on the rest of the surface. Long hairs are present along the margin of tibiae and tarsi, between hairs are stout spines, along the inner margin of tibiae there are short spines. Claws are long and beset with 11 or 12 teeth. Along the posterior margin of each tergite from 1-9 there is a row of pointed teeth like structures, between these teeth there are minute teeth. A median ridge like structure projects from the posterior margin of each tergite. Presence of these teeth and median projections is not mentioned by any worker in this genus before.

Gills are present on abdominal tergites from 1 to 7, they are lamellate, each with a tuft of filaments on ventral side except the last, tracheation is pinnate. The first and 7th pairs of gills are smaller than the other gills, lamellae from 2 to 6 are broadly oval with a projection towards the posterior end (Figs. 17, 18 and 19).

Caudal filaments are equal in length, longer than the body. They are stout and straight and have whorls of minute spines along the joints.

Family: *Baetidae*

Genus : *Baetis* Leach

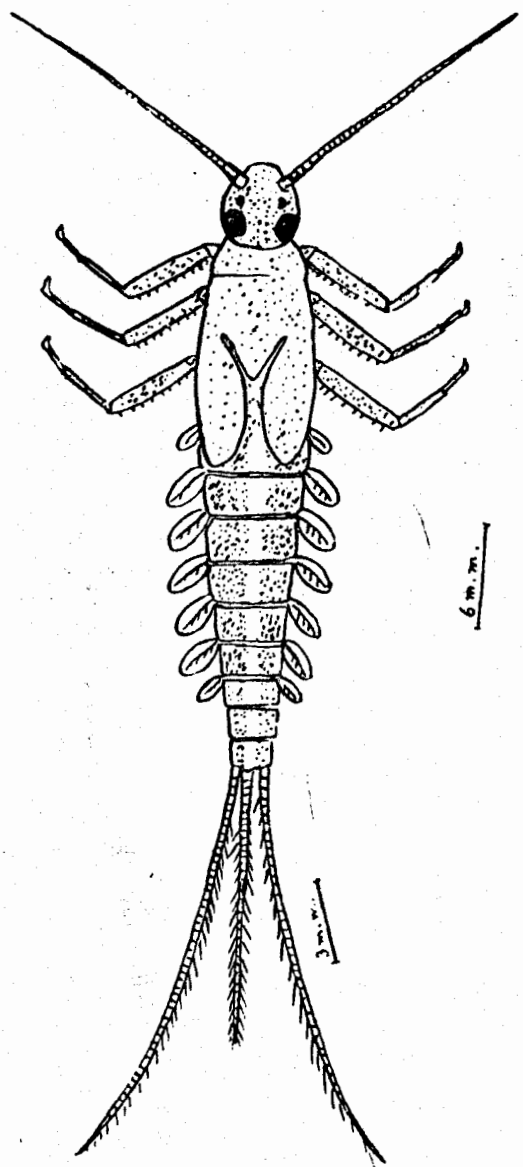
Nymphs are streamlined and live in shallow running water. They are most commonly found under stones and among debris or emergent vegetation along the banks of brooks or creeks. The labrum with a deep notch towards the anterior end. Just inside the front margin these are finely and closely frayed. In most species there is a transverse row of stout and longer bristles. On the under surface of the labrum epipharynx is present consisting of long fine curving hairs. Mandibles are robust, pyramidal structures, consisting of inner molar and outer canine areas. In most species there are seven teeth on canine area with a minute extra tooth between 4th and 5th counting from outside. Below the canine area the mandibular palp or prostheca is present. The prostheca of the left mandible bears on its outer margin a series of teeth of which upper are short and lower are long; the prostheca of the right is smaller and consists of bristles. The maxillary palp may be two or three-segmented; the palp may extend the tip of galea-lacinia. Teeth and bristles are present on galea-lacinia. Glossae and paraglossae are distinct. The labial palp has 3 segments, the inner distal corner of middle is produced into a process which varies in size and shape. The terminal segment towards the tip bears numerous fine hairs and robust spines.

Along the femur there is row of long spines usually a single row except at the base and open. Claw with rows of ventral denticles.

Gills are simple lamellae present 1-7 segments. The margin except the basal third is finally denticulate and there is a minute hair between each tooth.

*Baetis macanis* sp. nov (Plates V & VI)

Length of the body is 5 to 6 mm; cerci area 3 mm and median caudal filament is 2

Plate V. Dorsal view of *Baetis macanics*.

mm in length. There are two dark brown patches on the posterior side of the head between the eyes; thoracic and abdominal tergites have dark brown markings.

The head is hypognathous, slightly narrower towards anterior end, epicranial

suture is prominent, clypeus has a blackish sclerotised area; antennae are long and arise from the anterior end, minute hairs arising from antennal joints. Eyes are lateral.

Labrum is quadrangular wider than long, a deep-rooted in the centre of apical margin, from the inner side of the anterior margin a row of plumose bristles arise, posterior to this there is another row of longer bristles which are few in number, on the dorsal surface bristles are scattered, on the ventral surface in the middle there are two rows of long bristles (Fig. 21). Mandibles are well developed, canine teeth are nearly pointed, 8 teeth are present on the left and right mandibles. The first tooth is set back; in addition to these there are 4 minute teeth along the inner margin of canine area of the left mandible and 5

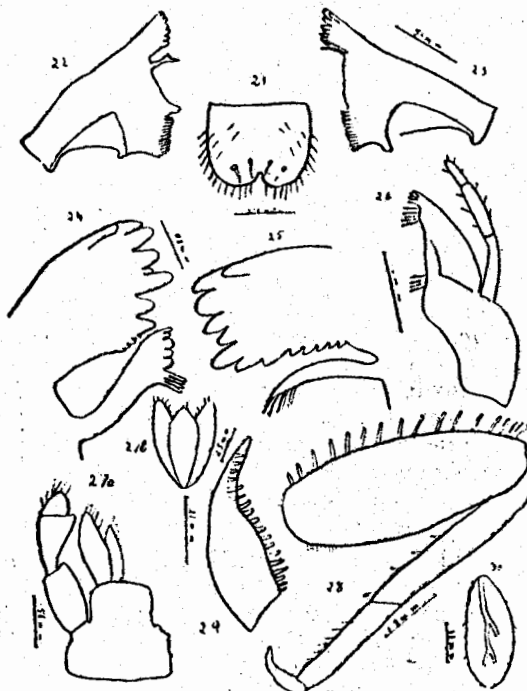


Plate VI. Figs. 21—30 *Baetis macanics*; 21, labrum; 22, left mandible; 23, right mandible; 24, canine and prosthema of left mandible; 25, canine and prosthema of right mandible; 26, right maxilla; 27a, labium; 27b, hypopharynx; 28, leg; 29, claw; 30, gill.

on the right mandible; this character was not mentioned in any genera before.

Posterior to the canine area there is an elongated process known as prostheca, it consists of 5 short teeth towards the outer side and 4 long teeth towards the inner side of the left mandible; the prostheca of the right mandible has a number of bristles. Molar teeth of the left mandible has a process towards the outer side. (Figs. 22, 23, 24 and 25). Maxillary palp is 3-segmented and extends to anterior and of galea-lacinia, the last segment is the smallest and consists of minute spines; 4 well developed teeth and a number of bristles are present at the anterior end of galea-lacinia, and a few hairs are present along the inner margin (Fig. 26). Labial palps are 3 segmented; second segment has a distal projection towards the inner side; last segment is the smallest and dome-shaped; it has numerous fine bristles; paraglossae; are slightly longer than glossae, numerous bristles are present along the anterior and outer sides; glossae are broader towards the base, spines are present along inner and outer margins (Fig. 27a). Middle and lateral lobes of hypopharynx are near, equal and spines arise from their margins (Fig. 27b).

Legs are similar, femora are not broad; a row of long spines are present along the outer margin of the femur, numerous short and broad spines on the rest of the surface; on the inner side towards the proximal end of femur there are minute hairs. A row of spines are present along the inner margin of tibiae and tarsi; on the rest of the surfaces there are short and broad spines; minute hairs are present between the spines on femora, tibiae and tarsi. Claws are pointed and consist of well developed ventral denticles.

Gills have single lamellae, they are somewhat oval in shape; the margin is denticulate; and a minutes hair arises from each denticle; tracheation is prominent and tracheae are branched. First and the last gills are smaller in size (Fig. 30).

Cerci (outer filaments) are longer; long and dense hairs are present on both sides of median filament and on the inner side of cerci, along the outer side of cerci there

are minute setae.

*Baetis mecheanis* sp. nov. (Plates VII and VIII).

Length of the body is 5 mm and cerci are 3 mm long, median caudal filament is very short. Dark brown markings on the head, thorax, and abdomen.

Body is broader than *B. macanis*. antennae are short, eyes are lateral, ocelli well developed.

Labrum resembles to that of *B. macanis*, but is short in length. (Fig. 31) Canine areas of each mandible have eight teeth, 3 minute teeth along the inner margin of the canine of the left mandible and 4 minute on right mandible. The prostheca of left mandible has 5 short and 3 long teeth and that of right mandible has several pointed teeth (Figs. 32, 33, 34 and 35). Maxillae resemble to those of *B. macanis*, but their palps are very short

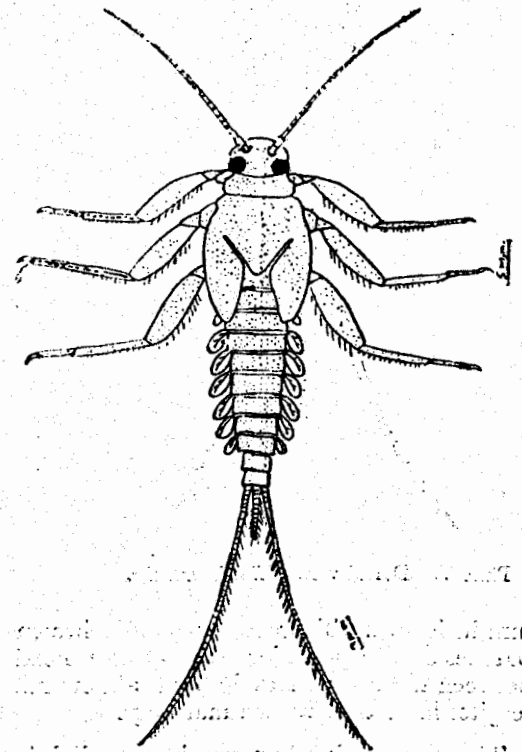


Plate VII. Dorsal view of *Baetis mecheanis*.

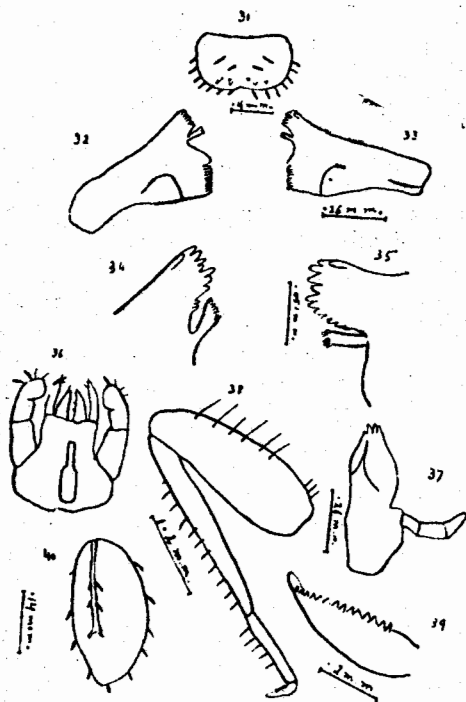


Plate VIII. Figs. 31—40. *Baetis meehanisi* 31, labrum; 32, left mandible; 33, right mandible; 34, left canine and prostheca; 35, right canine and prostheca; 36, labium; 37, right maxilla; 38, leg; 39, claw; 40, gill.

(Fig. 37). Labial palps are 3-segmented. second segment has a blunt projection towards distal end, the last segment is flattened (Fig. 36). Thorax is broader as compared to *B. macanis*. Femora are broad, there is a row of long bristles along the outer margin of femora, tibiae and tarsi, while there are minute spines on the inner side; claws consist of 11 or 12 teeth (Fig. 38 and 39). Gills are 7 pairs, they are broad, first and seventh gills are smaller than the rest.

Median caudal filament is very short and consists of 11 or 12 joints, and consists of hairs and setae on both sides; cerci area long and curved outwards, hairs are present on the inner sides, and minute setae are present along the articulations.

Genus: *Cloeon* Leach

Both maxillary and labial palps have

three segments; each tarsal claw is relatively short, broad at the base, slender at the tip, and bears a single row of minute ventral denticles; the abdominal gills are sheet like, undulated and double with tracheation branching palmately; the three caudal filaments well developed.

*Cloeon gillican* sp. nov. (Plates IX and X)

Length of the body is 6 to 5.5 mm, cerci and caudal filaments are 4 mm long. Colour of the body is brown, head is hypognathous; eyes are lateral, and antennae are long.

Labrum with a deep notch in the centre of apical margin; there is a marginal row of plumose bristles; a row of longer bristles towards the inner side, and a

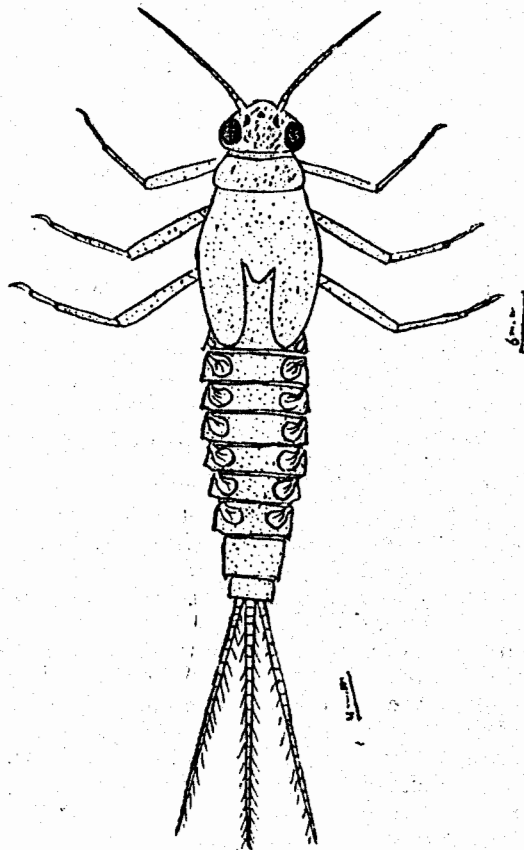


Plate IX. Dorsal view of *Cloeon gillican*.

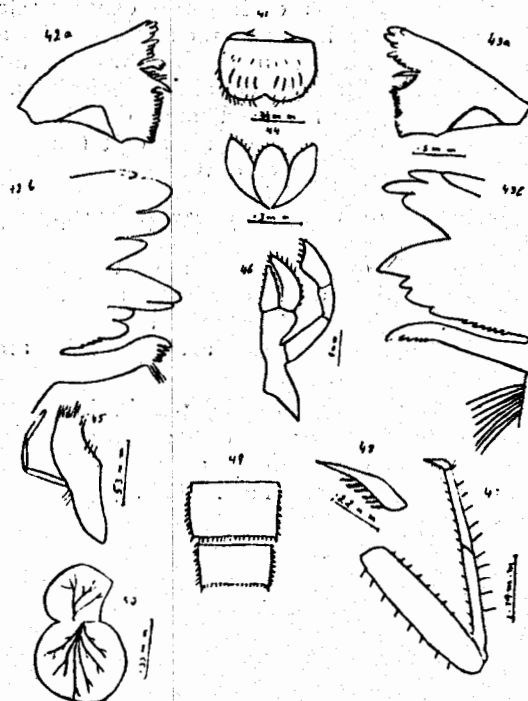


Plate X. Figs. 41—50. *Cloeon gillican*; 41, labrum; 42a, left mandible, 42b, left canine and prosthema; 43a, right mandible, 43b, right canine and prosthema; 44, hypopharynx, 45, left maxilla; 46, labium; 47, leg; 48, claw; 49, abdominal tergites; 50, gill.

number of bristles scattered on dorsal surface (Fig. 41). Each mandible consists of 2 canine projections, four teeth are present on each projection, 4 minute teeth along the inner margin of the inner projection. Of the left mandible and six on the inner margin of the inner canine projection of the right mandible. This character is not mentioned by previous workers. The prosthema of the left mandible has 5 short and three long teeth, that of the right consists of 5 short teeth. On both mandibles between canine and molar areas there are numerous long bristles. The molar area consists of crenate bristles (Figs. 42a, 42b, 43a and 43b). Maxillae are slender, in addition to 4 maxillary teeth there is a row of pointed bristles; maxillary palps are three-segmented, spines are present on all segments (Fig. 45). Labial palps are 3-segmented, the third segment is truncate with pointed bristles

along the free end; paraglossae and glossae are elongated; longer spines on paraglossae and short spines on glossae (Fig. 46). Middle lobe of hypopharynx is small (Fig. 44).

Legs are slender, femora are thin, spines are present on inner side of femora, tibiae and tarsi, hairs are present on the outer side of all joints. Claws with a row of well developed teeth.

Tergites of abdomen have spines along the sides. Towards the posterior margins of terga and sterna of abdomen there is a row of pointed teeth like spines. Gills 1-7 are similar, bilamellate except the last, dorsal lamellae are smaller, tracheation is palmate. Gills are turned towards the back.

Cerci and caudal filaments are straight. From the inner side of each cercus and the both sides of the median caudal filament number of long hairs arise; setae arise from both sides of joints of cerci and caudal filaments, setae also arise from the articulation of joints.

Family: *Leptophlebiidae*

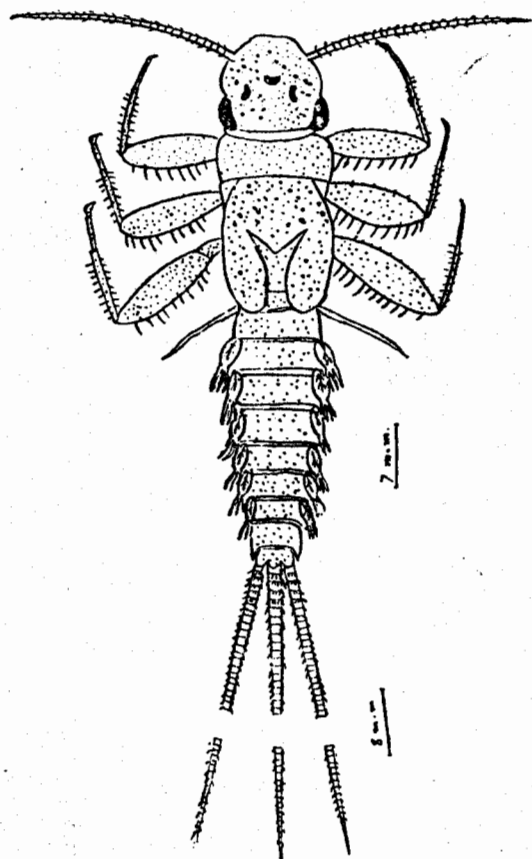
Genus: *Choroterpes* Eaton

Head and body dorsoventrally flattened. There are three segments in each of the labial and maxillary palps. The labrum is quadrate and strongly prognathous. Each tarsal claw is single relatively short, thick at the base and provided with one or two rows of ventral denticles. The first abdominal segment bears a pair of single filamentous gills, 2 to 7 have each a pair of bifid lamelli form gills, each lamina has a spatulate terminal extension which varies in shape among different species. The median caudal filament is longer than cerci.

*Choroterpes gadricus* sp. nov. (Plates XI and XII).

Length of the body is 6 mm and median caudal filament is 8 mm long, cerci are short.

The colour of the body is brown, there is a blackish patch between the eyes; and an elongated patch on each abdominal tergite. Head is quadrangular; eyes are relatively

Plate XI. Dorsal view of *Choroterpes gadricus*.

small and placed laterally. Antennae are long.

Labrum is broad with a shallow notch towards the anterior end, bristles are present along the margin; there are rows of bristles on dorsal side (Fig. 51). Mandibles are rounded towards the anterior side from where long bristles arise; there are 2 projections in the canine areas. Outer canine projection of each mandible has 4 teeth. The inner projection of the left mandible has 2 long teeth on the tip and 3 minute teeth along the outer margin, the inner canine projection of the right mandible has 3 teeth at the tip, 3 behind along outer margin. The prostheca of each mandible is bifurcated and each branch consists of bristles; the molar area consists of crenate

bristles (Figs. 52; 53, 54 and 55). Dense hairs are present on the anterior end of galea-lacinia, and a row of long hairs along the inner border; maxillary palps are 3-segmented, the last segment is the smallest and has bristles, hairs are present on all segments; paraglossae are much wider; glossae are small, dense bristles are present on both (Fig. 57). The lateral lobes of hypopharynx are expanded (Fig. 58).

Long spines are present on the outer side of femora only, and short spines on the inner side of femora, tibiae and tarsi. Claws consist of well developed teeth (Figs. 61 and 62).

Gills are well developed, present from 1-7 abdominal segments; the gill of the first pair is long and filamentous, the rest of the gills are bifid, each lamina has three filaments which contain tracheae (Figs. 59,

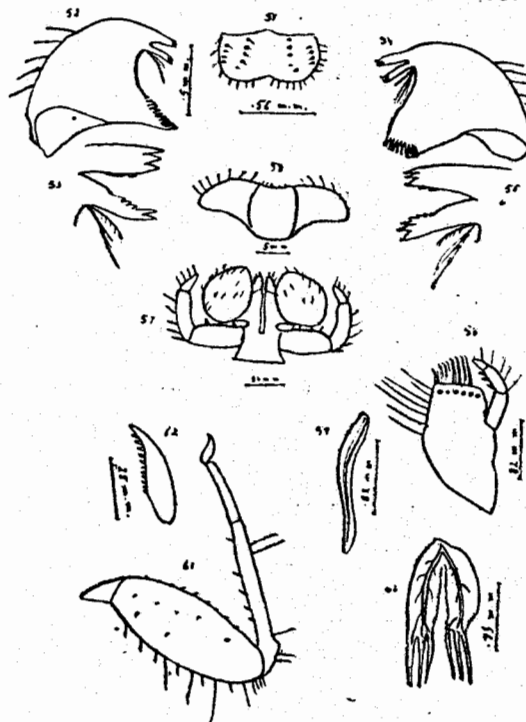


Plate XII. Figs. 51-60. *Choroterpes gadricus*; 51, labrum; 52, left mandible; 53, canine and prostheca of left mandible; 54, right mandible; 55, canine and prostheca of right mandible; 56, right maxilla; 57, labium; 58, hypopharynx; 59, first gill; 60, second gill; 61, leg; 62, tarsal claw.

and 60).

The lateral margin of each abdominal tergite ends into a pointed projection facing posteriorly, minute hairs are present along the lateral margin.

Cerci and median caudal filaments are long, short hairs arise from both the sides of cerci and caudal filament; articulations of points have toothlike setae.

Family: *Caenidae*

Genus: *Caenis*

The body is flat, the width of the pronotum is narrower than mesonotum. The head is smooth without tubercles, each antenna is twice as long as the head and pronotum combined. The legs are relatively short and stout; the claws are small and slender, have extremely minute tubercles. The first abdominal segment bears a pair of prominent single filament gills; the gills of second segment are quadrate and operculate. The gills on 3 to 6 segments are single plate like, each gill has margins deeply fissured to produce a marginal fringe of long filament, each filament is secondarily divided near the tip to produce two or three smaller filaments. Caudal filaments are straight with a whorl of three or four setae at each articulation.

*Caenis kimminsis* sp. nov. (Plate XIII)

Length of the body is 5 m.m. and caudal filament is 4 mm.

The body is dark brown on the dorsal surface and pale on the ventral side. There are dark markings on head and thorax. A few hairs arise from the anterior margin of ear; antennae are more than twice in the length than head and pronotum combined; hairs arise from second joint.

Labrum is broad with a shallow notch towards the anterior end (Fig. 61). Each mandible has two canine projections; there are 4 teeth on outer and 2 elongated teeth on inner canines; prosthecae consists of a minute projection ending into bristles;

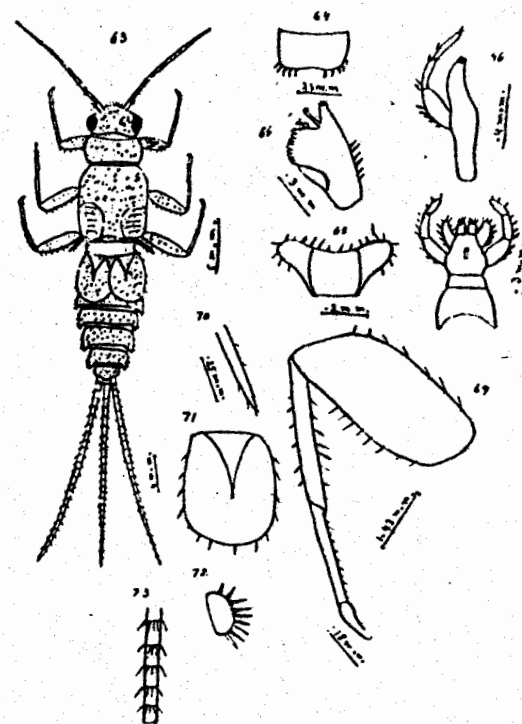


Plate XIII. Figs. 63-73, *Caenis kimminsis*; 63, dorsal view of *Caenis kimminsis*; 64, labrum; 65, right mandible; 66, left maxilla; 67, labrum; 68, hypopharynx; 69, leg; 70, first gill; 71, second gill; 72, 3rd gill; 73, caudal filament.

molar areas have plumose bristles (Fig. 65). Maxillae are slender, maxillary palps have 3 segments; last segment is the longest and consists of spines at the tip (Fig. 66). Labial palps are 3-segmented, glossae are rounded; bristles are present on palps glossae and paraglossae (Fig. 67). The lateral lobes of hypopharynx are expanded laterally (Fig. 68).

Pronotum is broader towards the anterior end, minute spines are present on the sides. Femora are broad and consist of long spines along the outer side and a few hairs on the inner side; there are a few long hairs on the outer side of tibiae and tarsi, and spines along the inner side; the claws are pointed and have ventral denticles (Fig. 69). Abdominal tergites have posterolateral spine

like projections, numerous minute spines are present on lateral margins of tergites, from the posterior margin of tergites hairs arise.

First pair of gills are small and have single filament with spines (Figs. 70, 71, 72) Second pair of gills are large and operculate with spines along the margin; rest of the gills are single plate like with fissured margins.

#### Caudal filaments

Cerci and caudal filament are long, pines are present on both sides of cerci and caudal filament, setae arise from the articulations of joints (Fig. 73).

#### DISCUSSION

*Ephemera soanica* was found in pool areas of streams and the Soan River; it is bottom-dweller and its legs are modified for digging.

*Cloeon gillican* was found in temporary and permanent ponds and Rawal Lake. It was also collected from ponds of Khor, Distt. Campbellpur. *Baetis macanis* was collected nearly from all running waters; it was collected from Kalopani, Hazara Distt. at 7500 ft. height, and a canal in Musa Khel, Mianwali Distt. while other mayfly nymphs were found in all running waters.

Number of teeth in canine area of mandibles are of great importance in the identification of species, row of minute teeth which the author found in *Baetis macanis*, *Baetis mecheanis* and *Cloeon gillican* were not mentioned before by any other worker; prosthecae on mandibles; armature of spines on femors, antennae and caudal filaments were also used for the identification of species.

Along the posterior margin of abdominal tergites of *Ecdyonurus islamabadicus* and *Cloeon gillican* there is a row of pointed teeth like structures which were not mentioned by any worker before.

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