Reprinted from Pakistan Journal of Science, Vol. 22, No. 3 and 4, May-July, 1970

Certain Mayflies (Order : Ephemeroptera) of West Pakistan

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Both the adult and nymphal stages of mayflies (Order : Ephemeroptera) constitute an important item of the food of many fishes. According to Meehean (1967), Meehean and Ali (1967) and Ali and Hussain (1968) many fishes live on mayfly nymphs. Virtually no work has been done so far on the taxonomy of mayflies in Pakistan. The author (1967) described *Ephemera soanensis*, *Baetis macani*, *Baetis meeheani*, *Caenis kimminsi*, *Cloeon gilliesi*, *Choroterpes quadrii* and *Ecdyonurus islamabadensis** as new species from Rawalpindi district.

A number of workers have described a few new genera and more than forty new species from India : Eaton (1888) recorded *Cloeon dipterum* (L) from Europe to north India ; Chopra (1927) described *Polymitarcys* sp., *Povilla corporaali* (Lestage), *Polymitarcys annandali* (Chopra), *Anagensia pita* (Gravely), *Anagensia minor* (Eaton), *Anagensia robusta*, *Anagensia lata* (Walker), and *Mortogenesia mesopotamica* (Morton); Taver (1939) described *Caenis sringeri*, *Cloeon kashmiri*, *Orortsi hutchinsoni*, *Amelatus primitivus* and *Baetilla ladakae* as new species ; Kimmins (1942) described *Cloeon harveyi*, *Cloeon bicolor*, *Cloeon bengalense*, *Cloeon viridis* and *Caenis pisca* from Calcutta ; Gillies (1949 & 1951) described *Baetis fluitan*, *Baetis palmyrae*, *Baetis dipicus*, *Baetis, thurbonis*, *Baetis solitarinus*, *Pseudocloeon bimaculatus*, *Pseudocloeon inopinum*, *Cloeon sicum*, *Cloeon septinum*, *Cloeon julia*, *Thraulus hindustanicus*, *Thraulus parvalus*, *Harbophleboides semicastanea*, *Iscapurprea* as new species ; and Kapur and Kirplani (1961) described *Baetis simplex*, *Baetis chandara*, *Baetis himalayana*, *Baetis punjabensis*, *Baetis festivus* and *Epecrus lahoulensis* from Northern Himalayas as new species. Gillies (1949 & 1951) described *Cryptonella* and *Isca* as new genera. The author recorded genera *Ephemera* and *Choroterpes* from Rawalpindi district, were not mentioned before by any other worker on Indian mayflies.

The author in this paper described the adults of *Ephemera striatus*, *Heptagenia hazaraensis*, *Eatoni khyberensis* and *Cloeon karachiensis*. *Eatonia* is a new genus, *Ephemera striatus*, *Heptagenia hazaraensis*, *Eatonia khyberensis* and *Cloeon karachiensis* are new species.

Material and Methods

Mayflies were collected on light from Abbottabad, Karachi and Peshawar. These insects were preserved in 70% alcohol, or killed in cyanid bottle and kept dry in vials. For the study wings of one side were removed and mounted with a drop of alcohol on a slide and covered with a coverslip which was fixed by strips of sticky paper and studied under the microscope. The permanent mounts of legs, genitalia and other parts were prepared after treatment in 10% KOH solution (cold), usual process of dehydration and clearing, mounted in canada balsam. Final sketches were made with the help of camera lucida.

Systematic Account

The Key which follows for the families of mayflies ;

1. Veins M and CU_1 of fore wing strongly divergent, with M_2 strongly bent toward CU_1

*Revised list given at the end.

basally ; outer fork (Of) in hind wing wanting ; hind tarsi 4-jointed.....EPHEMERIDAE, Veins M and CU_1 little divergent at the base and fork of M more nearly symmetrical ; outer fork (Of) in hind wing present or absent ; hind tarsi 4 or 5-jointed.

2. Hind tarsi with 5 freely movable joints ; cubital inter-calaries in 2 parallel pairs, long and short alternately ; venation never greatly reduced; eyes of male simple.... HEPTAGENIIDAE. Hind tarsi with 3 or 4 freely movable joints ; cubital intercalaries not as above ; venation sometimes greatly reduced, eyes of males often divided..... BAETIDAE.

Wing venation is used for taxonomic study; certain characters of male imago are much more important, e.g. eyes, size of fore leg, number of tarsal joints in hind leg, number of segments of genital forceps, shape of penial lobes, presence or absence of penial hooks, while other characters are similar to those of females, Gillies (1951) described new species of may-flies without mentioning the characters of female imago.

FAMILY : *Ephemeridae*

Ephemera striatus sp. nov. Plate I (Figs. 1-6)

Male imago. Length of the body 14 m.m. of forewing 12 m.m. and caudal filaments 17 m.m. Head dark brown, broader than long ; ocelli black towards the base ; eyes black, large and lateral, separated by a wide space on the meson ; antennae brown. Thorax dark brown dorsally, pronotum narrow anteriorly, lateral margins rounded ; mesothorax well developed ; metathorax short, metanotum notched posteriorly. Legs (fig. 2-4) shorter in length than the body ; fore legs longer than middle and hind legs. Proportions of legs : fore leg ; femur ; tibia ; tarsus 17: 22 : 20 ; tarsal joints 1 : 6 : 5 : 4 : 4 ; middle leg ; femur : tibia : tarsus, 12 : 22 : 8 ; hind leg ; femur ; tibia ; tarsus 18 : 22 : 8. Fore leg dark brown in colour ; first tarsal joint smallest, second longest and six times as long as the first, and third, fourth and fifth nearly equal ; tarsal claws dissimilar, the smaller pointed and bigger blunt. Middle and hind legs brown ; each tarsus with four movably asticulated joints, 1-3 equal, 4th shortest and the last

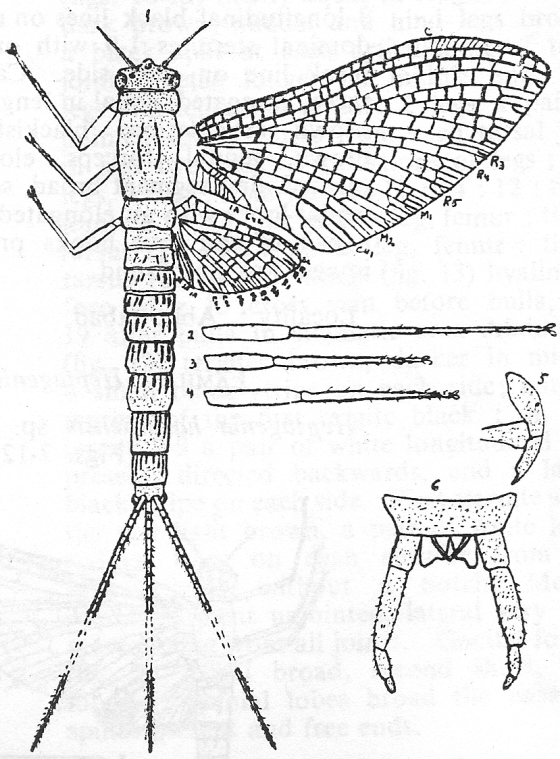

PLATE I (*Ephemera striatus*)

Fig. 1 Male imago.
Fig. 2 Fore leg.
Fig. 3 Middle leg.
Fig. 4 Hind leg.
Fig. 5 Claws.
Fig. 6 Male genitalia.

longest ; hair on all joints. Wings (fig. 1) hyaline, brown in colour, cross veins shaded with black and numerous, in fore wing cross veins well developed, 14 cross veins before bulla, 24 after bulk in stigmatic area ; M and CU_1 broadly divergent at the base ; several intercalary veins present ; several cross veins between IA and the wing margin. Hind wing with costal angle, all the longitudinal veins well developed, R_4 and R_5 separate, IA intercalary present between main veins. Abdomen (fig. 1) brown ; tergites darker than sternites.

On the second tergite, two longitudinal black lines on each side ; tergites from 3-9 with three longitudinal lines on each side.

According to Kimmins (1942) in Ephemera lineata (Eaton), abdominal tergites 5-9 with 3 longitudinal black lines on each side. Abdominal sternites 1-9 with one longitudinal black line on each side. Caudal filaments three, elongated, equal in length, colour dark brown articulations blackish. Genitalia brown, genital forceps elongated, 4-segmented, first segment broad, second longest; penial lobes with an elongated outer process; a pair of chitinous hooks present. Female imago was not found.

Locality : Abbottabad.

FAMILY : *Heptageniidae*

Heptagenia hazaraensis sp. nov. Plate II (Figs. 7-12)

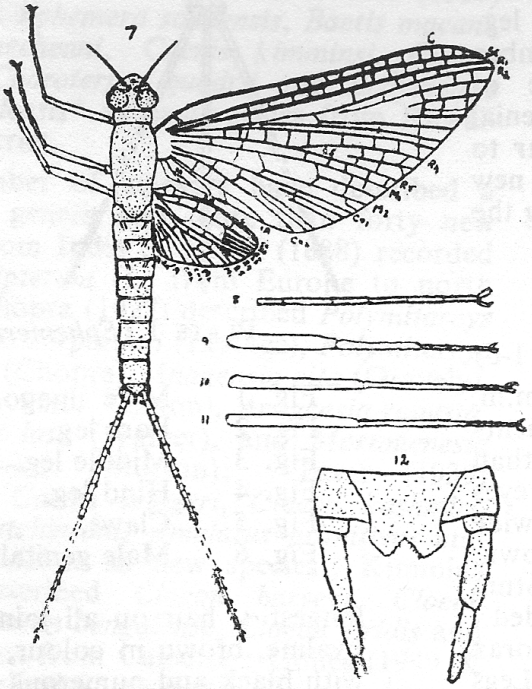

PLATE II (*Heptagenia hazaraensis*)

Fig. 7 Male imago.
Fig. 8 Fore tarsus.
Fig. 9 Fore leg.
Fig. 10 Middle leg.
Fig. 11 Hind leg.
Fig. 12 Male genitalia.

Male imago. Length of the body 7 m.m. and of fore wing 7 m.m. Head dark brown ; ocelli white, median smaller ; eyes black, large and contiguous on the meson ; antennae dark brown; thorax dark brown; legs (figs. 8-11) shorter than body in length, fore leg black femur longest, second tarsal joint twice as long as the first, joints 3-5 nearly equal ; middle and hind legs brown smaller than fore leg ; tibiae longest, tarsi shortest, first tarsal joint longest, the rest nearly equal in length, tarsal claws dissimilar ; hair on tarsal joints minute. Proportions of legs : fore leg, femur : tibia : tarsus, 32 : 30 : 24 ; tarsal joints 4 : 8 ; 4 : 4 : 4 ; middle leg, 44 ; 32 : 1 ; hind leg, 42 : 33 : 11. Wings (fig. 7) hyaline, brown in colour ; longitudinal and cross veins well marked ; in costal region cross veins before bulla and 9 after bulla in stigmatic area ; 4 cubital intercalaries, 1 A and 3 A bifurcated anal intercalary absent. In hind wing costal angle well marked, R4 and R5 separate.

Abdomen (fig. 7) dark brown, a pair of longitudinal markings on tergites 2—9; 9th sternum truncate ; median caudal filament minute with 4-segments, lateral longer than the body, dark-brown in colour. Genital : (fig. 12) forceps 4-segmented, brown in colour, first segment short and broad, second longest, penial lobes broad, united at the base, minute setae on penial lobes.

Locality : Abbottabad.

Eatonia gen. Nov.

Large sized and well built mayflies (fig. 13) Eyes large, pale dorsally and blackish towards ventral side, in male eyes contiguous, in female separated by a wide spore on meson. Pronotum wide with a median notch posteriorly. Mesonotum well developed, a median projection arising posteriorly from each meso and metanotum. Both fore and hind wings well developed, venation typical to the family, longitudinal and cross veins well marked, in forewing cubital intercalaries 8 in number and somewhat transverse and not longitudinal as in other genera of the family, 1A and 2A bifurcated, a pair of intercalaries between 1A, 2A and 2A, 3A ; in hind wing intercalaries between and veins. Legs much longer than second each middle and hind legs with 5 movably articulated tarsal joints, first joint longer than 2-4 ; claws similar and

pointed. Median caudal filament (fig. 13) rudimentary. Genital forceps (fig. 21) with five segments, penial lobes conical.

Eatonia khyberensis, sp. nov. Plate III (Figs. 13-21).

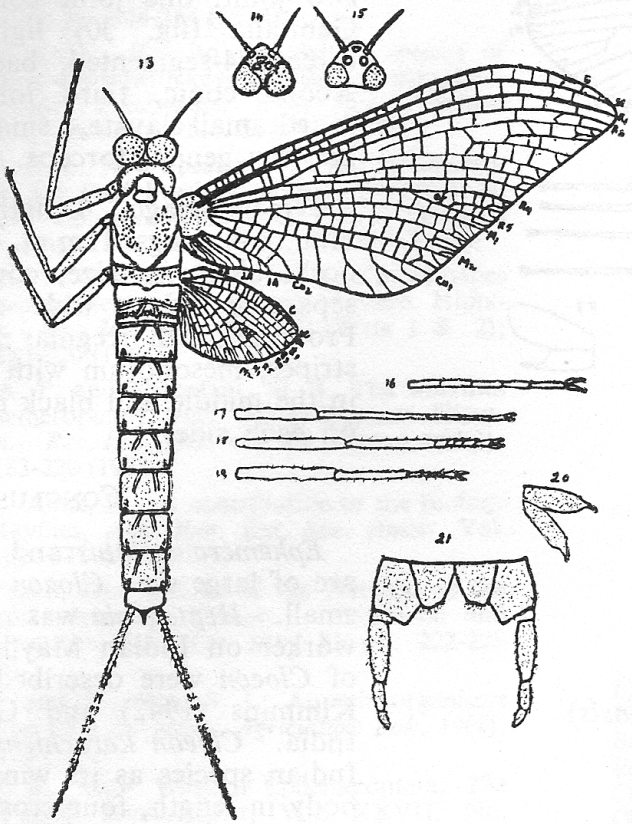

PLATE III (*Eatonia khyberensis*)

Fig. 13 Male imago.
Fig. 14 Male head.
Fig. 15 Female head.
Fig. 16 Fore tarsus.
Fig. 17 Fore leg.
Fig. 18 Middle leg.
Fig. 19 Hind leg.
Fig. 20 Claws.
Fig. 21 Male genitalia.

Male imago. Length of the body 13 m.m. of fore wing 12 m.m. and of lateral caudal filament 19 m.m. Head brown, ocelli blackish ventrally, median ocellus smaller than lateral ocelli; eyes contiguous; antennal light brown. Thorax white, pronotum brown, anterior margin blackish; mesonotum with a pair of blackish patches on each side ; metanotum broad, and light black ; sternites with brown spots near coxae. Legs (figs. 16-19) nearly equal in length ; fore leg dark brown, middle and hind legs brown ; a black spot at each articulation of tarsal joints ; setae longer on middle and hind legs ; articulation of last 2 legs a pair of pointed spines arise from each tarsal joint in legs two legs. Proportions of legs ; fore legs, femur : tibia : tarsus 17 : 14 : 12 ; tarsal joints 2 : 4 : 3 : 3 ; middle leg, femur : tibia : tarsus 21 : 16 : 7 ; hind leg, femur : tibia : tarsus 18 : 15 : 7, wings (fig. 13) hyaline, in fore wing 13 cross vein before bulla, and 19 after bulla in stigmatic area Abdominal (fig. 13) tergites brown, darker in middle, a small black stripe on each side; anterior margin of the first tergite black ; on each tergite 2-9 a pair of white longitudinal lines present, directed backwards, and a lateral black stripe on each side. First sternite white, the rest light brown, a pair of white longitudinal lines on each sternite from 2-9, 9th sternum without a notch. Median caudal filament unjointed, lateral very long, setae arising from all joints. Genital forceps (fig. 21) basal broad, second short, third longest ; penial lobes broad the base and spines present and free ends.

Female imago. Length of the body 15 m.m. of wing 14 m.m. and of caudal filament 20 m.m. Body stouter than male. Head pale, eyes small and separated by a wide spore on meson. On abdominal tergites 2-6 a pair of beaded brown stripe present, from 1-9 tergites a pair of white curved stripes present in the middle region of each segment tergite, laterally a black stripe present on each abdominal tergite the 10th. On each sternite 2-9, a pair of light brown stripes present; 9th sternum without a notch.

Locality : Peshawar University Campus.

FAMILY : *Batidae*

Cloeon karachiensis Plate IV (Figs. 22-30).

Male imago. Length of the body (fig. 22) 4 m.m., of fore wing 3.5 m.m. and of caudal filament 6 to 7 m.m. Head (figs. 23, 24) red brown, Ocelli white, compound eyes very large, divisible into upper orange and lower

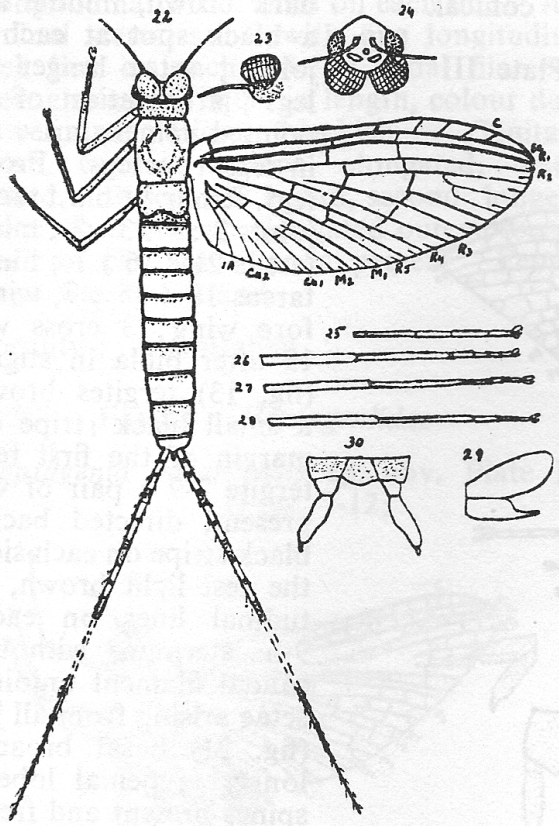

PLATE IV (*Cloeon karachiensis*)

Fig. 22 Male imago.
Fig. 23 Male head side view.
Fig. 24 Male head Anterodorsal view.
Fig. 25 Fore tarsus.
Fig. 26 Fore leg.
Fig. 27 Middle leg.
Fig. 28 Hind leg.
Fig. 29 Claws.
Fig. 30 Male genitalia.

black portions ; antennae brown, first two basal segments, apically blackish in colour. Pronotum red brown Mesonotum large, red brown with two black curved lines on each side. Legs (figs. 25-28) nearly equal in length; femur of fore leg smallest, tarsus longest, first tarsal joint smallest, claws dissimilar (fig. 29); in middle and hind legs tarsi smallest, each tarsus with four joints. Only fore wings present wings (fig. 22) hyaline, all longitudinal and most the cross views brown, 4 cross veins in stigmatic area a few cross veins in rest of the Intercalaries numerous. Abdominal tergites shaded with red brown, on each tergite from 2-8, a black longitudinal line on each side ; sternite median caudal filament minute with 3 joints, lateral filaments elongated white in colour, articulations black, at the interval of every two joint, one joint completely blackened. Genitalia (fig. 30) light brown, genital forceps 4-segmented, basal segment broad, second conic, third long and stout and fourth small clavate, a small median projection between genital forceps.

Female imago. Length of the body 4.5 m.m., of wings 4 m.m. and brown, lateral ocelli bigger in size, compound eyes black separated by a wide space on meson. Pronotum with irregular red brown transverse stripes, mesonotum with 2 red brown bank in the middle and black irregular curve lines on each side.

CONCLUSION

Ephemera striatus and *Eatonia khyberensis* are of large size, *Cloeon karachiensis* is very small. *Heptagenia* was not recorded by any worker on Indian Mayflies. A few species of *Cloeon* were described by Traver (1939), Kimmins (1942) and Gillies (1949-51) in India. *Cloeon karachiensis* differs from the Indian species as its wings are shorter than body in length, four cross veins in stigmatic area of costal region and articulations of caudal joints blackish, after every two joints, one joint is completely blackened.

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Revised list of the mayfly nymphs of Rawalpindi District

Old Names*	Revised Names
Ephemera soanica	*Ephemera soanesis*
Ecdyonurus islamabadicus	*Ecdyonurus islamabadensis*
Baetis macanis	*Baetis maeani*
Baetis meeheanis	*Baetis meeheani*
Cloeon gillican	*Cloeon gilliesi*
Choroterpes qadricus	*Choroterpes quadrii*
Caenis Kimminsis	*Caenis Kimminsi*

*Old names were published in *Pakistan Journal of Science*, Vol. 19, No. 3, May 1967; pp. 73-86.