

averaging perhaps two thirds grown) were thrown into the tank twice daily in sufficient numbers so that each day a few remained over, uneaten. They were simply thrown on the bottom where they were snapped up promptly so long as the fish were hungry. The number disposed of during the preceding interval was recorded at each feeding. The average number eaten by the half grown *Chrosomus* was 11 per day, by the full grown ones, 25 larvae per day. The largest number was disposed of at the first feeding, but the figures were maintained fairly uniform after the third day; evidently these larvae are choice food for *Chrosomus*. The experiment was abandoned after 22 days because of the great difficulty found in supplying sufficient *Chironomus* larvae.

That the adult midges are quite as attractive food for *Chrosomus* as are the larvae is indicated by the following field observations made by Mr Ferguson:

It is very interesting to watch the fish feeding. The midges hovering over the water seem to attract them most. Usually the minnows are satisfied to wait till the midges touch the surface of the water, but quite often they spring several inches out of the water to catch them.

NEW DATA CONCERNING MAY FLIES AND DRAGON FLIES OF NEW YORK

May flies

(*Ephemeridae*)

Under this heading will be included a brief account of the May fly fauna of Old Forge, and descriptions of a few new forms collected by Dr C. Betten at Buffalo and vicinity in the summer of 1906. At Old Forge, May flies were abundant, and no place in which I have ever collected better exemplifies the need of different methods, and of collecting from different types of situation, and at different hours of the day, if one would really know the May fly fauna. There was a very familiar group of species (*Siphylurus*, *Epheremella*, *Heptagenia* etc.) that settled upon the outside of the hatchery and that could be found anywhere about the banks of Old Forge pond where shelter and good resting places offered. Then there were some others (*Caenis*, *Chloeon*) that were only to be found at night at the time of their emergence from the water. A few, like *Leptophlebia*, *Chloroterpes* and *Bactis* could be found on still afternoons swarming in great companies in the hollows of the wood, especially over little pools or in their vicinity, and there

was one (*Ephemerella dorothea*) that was only to be obtained by rearing it from the nymph, it being very secretive as to its adult habits. I collected chiefly by hand from the hatchery walls, by trap lanterns at Old Forge pond and on Moose river, and by sweeping nets along the banks of Beaver Meadow brook, and along the Adirondack League Club road to Little Moose lake. In a breeding cage maintained in a hatchery trough by my window, I reared a considerable number of May fly nymphs, verifying the breedings of former years, and adding a few new life histories, that will be given in the following pages:

Siphylurus alternatus. This species was common in trashy places in the borders of the ponds. I found the nymphs abundant in Bald Mountain pond. Adults were taken hovering at First lake on June 24th in mid afternoon. They settled in hundreds on the outside of the hatchery and could be taken constantly through June and July.

Blasturus cupidus. But few specimens of this elsewhere common species were seen. One was taken on the hatchery the first of July and several on piers about Old Forge pond in the latter part of June.

Leptophlebia mollis. This was another very common species. The nymph lived in slow-flowing clear streams, perhaps in other places as well, for I found the adults everywhere. A few at the hatchery; swarms of them on the Mountain Lodge "carry" opposite Dog Island in First lake, where they were flying underneath a high canopy of birch boughs, rising and falling in rapid succession through a distance of 25 feet, scarcely descending within 50 feet of the ground. I found them in Beaver Meadow brook, both in the meadow itself, and in the rocky part of the stream, at the fish ponds where four of them emerged within my tent trap. Nymphs taken from the stream at this place were reared in the hatchery on the sixth of August.

Callibaetis hageni. This species was common at the hatchery inside as well as outside, and during the latter part of July and the whole of August, subimagos could be collected in the hatchery windows. Adults could be picked up from the piers about the border of Old Forge pond. These specimens appeared to differ in no respect whatever from others obtained from the type locality in California.

Baetis posticatus. This delicate little May fly was to be found in the same situations with *Leptophlebia*. It was abundant

through July and August. It emerged in considerable numbers, as shown by the preceding table, from my tent trap, 6 square feet of the bottom of Beaver Meadow brook, yielding 271 specimens in a single month. This is the species previously mentioned as giving such a beautiful example of the May fly dance under the birch trees at the crossing of the Beaver Meadow brook by the Adirondack League Club road.

Chlceon mendax and *C. vicinum*. These two delicate little May flies (and a third apparently undescribed) were obtained with a trap lantern near the foot of First lake just after nightfall. Dr. Betten and I rowed up to First lake on several evenings that did fair to furnish good trap lantern collecting, and just at nightfall before the chill that is characteristic of the Adirondack evening had settled down, a few of these specimens came to light to reward our effort. Later in the evening no more could be obtained, but we had reason to believe that they were not uncommon at that place.

Ephemerella dorothea n. sp. This species lives in Beaver Meadow brook, amid the soil gathering moss that covers the stones there, as described in the account of our tent trap. Adults were obtained only by rearing them, and this notwithstanding their abundance, as evidenced by the abundance of their nymphs at that place. We did much collecting along the banks of that brook, sweeping the vegetation with nets, all up and down it, and not a single adult specimen was encountered. It was the sort of May fly easily to be overlooked, not alone on account of its habits, but also because of its general appearance. The best specimens that I have obtained of these are when fully mature, exceedingly fragile and have very little color. They look at first glance much like poor specimens of some of the stronger species. I append a description of both nymphal and adult stages.

Imago. Length, 5 to 6 mm; expanse, 15 to 18 mm; setae of the female, 8 mm; of the male, 8 to 9 mm; first femur of male, 7 mm; of the female, $4\frac{1}{2}$ mm; a small yellowish species, pale even when fully mature, somewhat darker on the dorsum of the head and the abdomen, with hyaline iridescent wings, and pale yellowish white legs; infuscated only on the tips of the tarsi. Caudal setae white; forceps of the male, stout, the long second segment regularly tapering to near the apex, there suddenly internally dilated in a rounded knob. The first and third joints of the male forceps are of about equal length, each being about $\frac{1}{8}$ of the length of the second joint, terminal joint subspherical. The ninth sternite of the female is produced in a broadly truncated lobe which projects posteriorly to the level of the posterior apex. The foretarsus of

the female has the second joint about equal to the third in length, and longer than the fourth which in turn about equals the fifth, and is about $\frac{3}{5}$ of the length of the second. The basal joint (fused with the tibia) is about $\frac{1}{4}$ as long as the second joint; tarsus and tibia are about equal length. The foretarsus of the male is longer than the tibia, and its third joint is longer than the second which about equals the fourth, and is twice the length of the fifth.

The wings are wholly hyaline (dull hyaline in the subimago) with weak cross veins. There are no accessory sectors in the median fork, but there are two behind the bisector of the cubital fork and the vein Cu_2 is more or less detached.

Nymph. Length, 7 mm, with setae 4 mm; antennae, 2 mm. This nymph is less depressed in form than others of the genus. Its colors are bronzy green and brownish, paler below and on all appendages, and sprinkled all over the dorsum with very fine pale dots or granulations. There is a pale line across the top of the head in front, and there is a pale dot on each of the fore angles of the prothorax, and another between the inner basal angles of the wing cases; antennae, pale, except the basal segment.

The body is widest on the mesothorax; the abdomen about as long as head and thorax together; the prothorax is wider than the head. Its sides are incurved anteriorly where they end in obtuse angles that project forward behind the eyes; the fore femur is much stouter than are the other femora, and darker in color externally; all the claws are strongly curved, and each is armed beneath with a comb of eight or nine pointed teeth. The abdomen is depressed, it lacks the double row of dorsal tubercles that is characteristic of other members of this genus. In outline it is ovate, widest on middle segment, and it tapers more or less abruptly from the eighth to the posterior end. Segments 8 and 9 terminate laterally in flat triangular spines. Gills are present on segments 3 and 7, and diminish regularly in size from the front backward. The inferior respiratory lamina of each is bifid, and its divisions are fimbriate-lamelliform. The covering lamellae on each of segments 2 to 6 overlaps only very slightly the base of the one immediately behind it. That of the 7th segment, however, is of small size and is wholly covered. The middle seta is longest, and all three setae are clothed basally with minute spines and bear long hairs in the middle portion, and are bare and darker colored at the tips.

This is the most generalized nymph yet made known in the *Ephemerella* group of May flies. None of its gill covers are wholly elytroid. It has no dorsal abdominal hooks. The thorax is high, almost compressed, and the abdomen is only moderately depressed.

I name this species in honor of little Miss Dorothy Burke, who played beside the delightful streamlet wherein I found it.

Caenis diminuta. This little white dusk-flyer abounds in every submerged weed patch, its close clinging, flat-bodied, silt-covered nymphs adhering closely to the fallen stems among which they clamber. It has already been mentioned in the preceding pages as swarming into our trap lanterns, as being found in the hatchery windows after emergence from the fish troughs, and as constituting a very considerable portion of the food of young sunfishes. It was abundant throughout July and August.

Tricorythus allectus. Since I described this species from Ithaca in 1905 [N. Y. State Mus. Bul. 86, p. 47] as *Caenis allecta*, I have concluded that it should more properly be referred to the genus *Tricorythus*.¹ Since that date I have found it abundant in two new localities, at Watertown, Massachusetts, in the summer of 1906, where spiders' webs on the bridges across the Charles river were draped with innumerable tangled specimens, and at Moose river, behind the hatchery at Old Forge. One of its favorite swarming places was the open area above the pole bridge shown in the middle of the photograph reproduced in plate 1. Here it swarmed at midday filling the air like snowflakes, with dragon flies, and robber flies lurking around the edges of the swarm, capturing as many specimens as they could eat.

Choroterpes basalis. This pretty red brown species I observed several times in small companies swarming about the balsam firs on Wintergreen point in August.

Habrophlebia vibrans n. sp. This delicate little reddish brown species I captured by hundreds near the outlet of Bald Mountain pond, where the brook crosses the road and begins its descent among the fern clad boulders. White winged companies of them were dancing up and down under the birch canopies, the lowest of them within reach of my net. I have been unable to determine from Bank's description and figure of *H. americana* [Ent. News. 1903, 11:235], what relation this species may bear to that one from New Jersey. The nymph of that one as described by Berry (*Amer. Nat.* 37:27-29, 1903) does not belong to this genus at all: it is a typical *Leptophlebia*. I present herewith a figure of the venation [pl. 10, fig. 1] and of the appendages of the male, and add the following further characterization of the male imago, the only form found:

¹See also Cockerell & Gill. *Tricorythus, a genus of Mayflies*. Univ. of Col. Studies 3:135-37. A paper that has appeared since the above was written.

Length, 4.5 to 5 mm; setae about as long, or the middle one slightly longer. Foreleg, 6 mm; expanse of wings, 10 mm.

Color clear brown; paler beneath, with the eyes blackish inferiorly. Wings hyaline, except the extreme base, which is of an amber tint. Legs white except the forefemur which is brown, and a pale brown spot at the apex of the foretibia. Forceps beyond the base, and setae white, the latter with a few of the basal articulations narrowly annulate with brown. Abdomen transparent, whitish ventrally and to a less extent dorsally on the middle segments, the sides of the dorsum being tinged with brownish purple.

Many specimens, all males, taken swarming July 1, 1905.

Heptagenia pulchella. This species was common here, as at Saranac Inn, and my collection of it shows a number of dates running through July and August.

Heptagenia interpunctata. This species was taken by our trap lanterns from Moose river on the west side of the town, and a number of adults were taken from the hatchery walls.

Ephemera varia. Only a few specimens were seen, and these were taken by trap lantern from Moose river back of the town.

Potamanthus diaphanus n.sp. Under this name I describe an interesting species collected by Dr Betten at Squaw Island in the Niagara river near Buffalo on the 24th of July, 1906.

Length, 8-10 mm; expanse, 20 mm; setae of the male, 18-20 mm; fore leg, 13 mm; body and wings pale yellowish white, hardly darker on the top of the head and thorax but with a satiny sheen on the thorax and on tip of abdomen; tips of femora, tarsi and tibia very faintly infuscated, a subapical inferior spot on the foretibia being more distinct; setae, white, with the incisures scarcely darker; forceps white; eyes and ocelli, black; forceps of the male, regularly arcuate; basal segment twice as long as the two terminal ones together and rugose within; inner appendages united almost to the tip, half as long as forceps, with a W-shaped apical outline. The lateral margins are contracted in the middle and narrower, with parallel sides, in the basal half [see pl. 10, fig. 5].

Nymph. Measures 13 mm in length; setae 4 mm additional; antennae 1 mm long, their tips hardly surpassing the prongs of mandible, which unlike those of other species of the genus hitherto described, are longer than the head. Each prong is contracted just beyond the base and terminates in a straight, bare, brown point.

Body elongate; little depressed; prothorax wider than the head, with broadly rounded, flaring lateral margins; fore legs longer than the others; the tibia much longer than the femur, beset with long hairs internally, and bearing a stout, straight apical spur, almost half as long as the tarsus; middle legs shorter and more slender than the hind legs; abdomen regularly tapering posteriorly; gills rudimentary on the first segment, almost equal on segments 2 to 6,

deeply bifid, with the two divisions deeply fimbriate; setae, short, densely bearded, both sides of the middle portion bare at the ends, and paler toward the tips; there is a middorsal pale line along the abdomen and there are two rows of spots each side which sometimes become confluent.

Dr Betten's observations concerning the habits of this species are as follows:

Returning on the boat from Buffalo I happened to look up, and saw a swarm about 20 feet above the water. I was able to take a few, but most of them were out of reach from the upper deck. It was too dark for me to see the manner of their flight. I returned next evening for further observation, but a strong wind prevented. I found the cast skins, however, belonging to this species floating upon the water, and drifting upon the shore.

It is rather surprising that this interesting species, so common in a place much frequented by collectors, has escaped observation hitherto.

(?) *Choroterpes betteni* n. sp. Under this name I describe another May fly collected at Hamburg, N. Y., on the first of July by Dr Betten, in whose honor I name it. Its reference to this genus is a doubtful one.

Length, 5 to 6 mm; expanse, 10 to 11 mm; setae of the male, 5 to 6 mm and of the female $4\frac{1}{2}$ to 5 mm; color nearly uniform, dark reddish brown, slightly paler on the middle abdominal segments in the male; wings hyaline; veins, pale brown; legs, yellowish brown; hind femur with two darker bands; forefemur of the male wholly dark; setae pale yellowish with brown joinings, three in number, equal; forceps of the male, pale brownish, darker beneath, with one very long basal, and two very short apical segments [see pl. 10, figs. 7 and 8].

The most remarkable thing about this species, a thing apparently quite unique among May flies, is that the female possesses a sort of rudimentary ovipositor. This is formed by a backward prolongation of the sternum of 7th segment combined with a downgrown horny process from the sternum of the 8th [pl. 10, fig. 6]. The sternum of the 9th segment is prolonged in two separate obtuse triangular lobes far beyond the apex of the 10th segment [pl. 10, fig. 6a].