

NOTES ON MAYFLIES OF THE SOUTHEASTERN STATES (EPHEMEROPTERA)

By JAY R. TRAVER

PLATE 6

A six-weeks collecting trip in the southeast,* during the latter part of May and the entire month of June, 1936, yielded much material, an account of which is herewith presented. Seven new species are described. Notes on the life history and ecology of previously-known species, and descriptions of hitherto-unknown stages in the life history of others, comprise most of the remainder of the paper. Twenty-one species are added to the list of known North Carolina mayflies. Of the fifteen species reported from Alabama, fourteen are new records for the state. In addition, new records for the occurrence of certain species of mayflies in other southeastern states are presented.

NORTH CAROLINA

Most of the collecting and rearing of specimens was done in the Appalachian region of North Carolina, and in the north-central portion of Alabama. In North Carolina, headquarters were established at Valle Crucis School, Valle Crucis (May 24-June 10), and at Penrose (June 11-June 24). From these points, many trips were made to adjacent areas. Nymphs collected elsewhere were brought back to headquarters for rearing. It was possible to keep rearing cages containing the nymphs in one of the small streams flowing through the valley, at Valle Crucis, and under a fortunate leak in a pipe line leading from a small mountain stream at Penrose. There were no casualties from floods during the past season's collecting, nor were the cages disturbed by too inquisitive humans.

In the Valle Crucis region in which collections were made, drainage is largely northwestward into the Watauga River; however, streams near Sugar Grove flow northward into the New River, while the North Toe and the Linville Rivers flow southwest and south respectively. Some

* This trip was made possible by reason of a grant from the American Association for the Advancement of Science.

of the species found in the Watauga River drainage are the same as those known to occur as far north as New York; others have been taken only in North Carolina or southward. While much new territory was covered on this collecting trip, many of the same streams were visited in which I had found good collecting in previous seasons.

In this connection, the condition of certain of the streams visited, as compared with those same streams in the summers of 1929 and 1930, may be of interest. Thus the Tuckasegee River below Dillsboro is now practically devoid of all aquatic insect life, due to pollution of the stream by industrial wastes. On a pleasant warm June evening spent at Bryson City, through which town the river flows, not one stonefly, caddisfly, nor mayfly was to be found in the town or above the stream. One glance at the dirty, scum-covered black water was sufficient answer to our query as to their absence. In 1929, the stream still afforded fairly good collecting. Portions of the Davidson River, where gravel and sand are being excavated, yielded little or no aquatic life. The lower reaches of the North Fork of the Swannanoa River are reduced to a barren waste, due to silt pollution from similar excavating activities. The main stream of the Swannanoa was likewise a very poor collecting ground in 1936, although many specimens were taken there in previous years. The probable reason for this was not ascertained.

The entire area of the Great Smoky National Park is here considered under North Carolina, although certain of the specimens were taken from the Tennessee portion of the park. Likewise a few specimens taken at Trade, Tenn., just across the border from Sugar Grove, are listed under North Carolina instead of Tennessee.

Family EPHEMERIDAE

Subfamily Ephemerinae

Genus *Hexagenia* Walsh

**Hexagenia marilandica* Trav.

This species has not been reported previously from North Carolina. Nymph skins in abundance were found floating on the surface of the water near shore, at Lake Lanier, N. C. (This is a large artificial lake south of Tryon, almost on the North Carolina-South Carolina line.) A single male subimago was captured as it rested on a clump of reeds beside the shore, before taking flight. It failed to transform to the

* Species for which no references are given are treated fully in the *Biology of Mayflies*,—Needham, Traver, Hsu, 1935; Comstock Publishing Co. References for other species are indicated.

adult stage. No other adult specimens were obtained, in spite of an extensive search of trees, shrubs and low herbage near the lake shore.

Nymph (described from nymph sloughs). Body (including tusks): female, 40-42 mm.; male, 27 mm. Tusks slightly longer, more slender, and less sharply upturned than in the nymph of *H. carolina* Trav. (see fig. 16); frontal process of head of female more dome-shaped, not as conical as in the latter species. Head and thorax dark red-brown above; wing-pads deep blackish brown (somewhat darker than similar areas of *carolina*). Gills and gill-fringes deep purplish. Color and markings of body cannot be determined from nymph slough. In general, this nymph is slightly larger and stouter than *carolina*, a condition which is especially evident in the female.

Male subimago (dried). Body 21 mm.; wing 16 mm. Resembles *H. marilandica* in abdominal markings, in the very short distal joints of the forceps, and in the type of penes. In size, it is nearer to *H. rosacea* Trav., which species I had at first considered it to be. Since the single specimen is a subimago, the relative lengths of joints of the fore leg and the size of the eye cannot be compared satisfactorily with the types of either of these species. See record of this species also from South Carolina.

Hexagenia kanuga sp. nov.

Male imago (specimen in alcohol). Body 20 mm.; wing 16½ mm. Head yellow. Median carina largely blackish; black spot at inner corner of eye, connected to black area on carina by a narrow black line. Ocelli black-ringed at base. Alabaster white areas on vertex and occiput, next to eyes and behind ocelli; narrow red-brown markings on these white patches. Upper portion of eye bright yellow; lower portion black. Pronotum yellow; two wide brown submedian stripes. Mesonotum yellow; red-brown markings along lateral margins and anterior to wing roots; scutellum greyish black. Metanotum dark brown in median area, yellow laterally. Pleura yellow; a dark brown triangle on basal portion of mesothorax, anterior to middle leg; an oblique streak extends upward from this triangle to wing roots. Sternum yellow. Dark brown triangles anterior to middle legs are joined by a median dark area, to form a continuous dark ventral band; from this, two submedian streaks extend backward almost to the metasternum. A purplish brown median patch on prosternum; metasternum largely dark brown. Fore legs missing, except trochanters, which are dark red-brown. Middle and hind legs yellow; claws and distal tarsal joints black, apex of preceding joint dusky. Wings hyaline. Costal strip of

fore wing stained with clear brown; pale at base, becoming more intense toward apex. A few cross veins in radial area basad of bulla are narrowly dark-margined; no large dark spots. Costa and subcosta brown; radius yellow-brown; other veins purplish black. In hind wing, outer margin purplish black in patches, the border thus discontinuous. Several cross veins widely dark-margined, so that 5 or 6 small dark spots are formed.

Abdomen yellow, marked dorsally with blackish brown, with red-brown ventrally. Tergites 1 and 2 largely dark; pale lateral margins and a pair of small pale submedian spots on each. A continuous dark median streak the length of the abdomen dorsally; gradually widened apically. Lateral oblique streaks run from this stripe forward to antero-lateral margin, on tergites 3-7. On 8 and 9, these streaks are shorter, ending in pleural fold halfway from base. On 10, they almost attain the anterior margin. Ventrally, red-brown triangles occupy most of the median area of each sternite. The apex of each triangle reaches only about halfway from base to anterior margin, but a narrow reddish mid-ventral line extends the length of the abdomen. A pair of pale, clear, submedian spots on each sternite, enclosed by dark triangle. On each sternite, next to pleural fold, a short, reddish, transverse dash. Genitalia of the *carolina* type. Forceps and penes yellow, streaked with purplish black; tips of forceps darkened. Distal joints of forceps as in Ulmer's figure* of typical *H. limbata* Guer. Tails largely yellow; beyond base, apical half of each joint may be brown; approximately every fourth joint is almost wholly brown.

This species *may* be synonymous with *limbata*, which is imperfectly known. However, a specimen in the Cornell collection, from Kansas, is much closer to the original description of *limbata* than is this specimen from North Carolina. The Kanuga Lake male differs from *limbata*: (1) meso- and meta-thorax yellowish instead of brown; (2) small but distinct dark spots are present in the hind wings; (3) brown markings of abdominal tergites are somewhat more extensive, especially on the basal segments. The ventral appearance of *limbata* is not indicated in the early descriptions, nor has it been described or figured in any more recent accounts.

Four male subimagos and four female imagos taken at Florence, S. C., seem to be of this species.

Female imago. Body 22-28 mm.; wing 20-22 mm. Body largely yellowish white. Longitudinal veins yellow, cross veins black, no dis-

* 1921—Ulmer, Georg. Ueber einige Ephemeropteren-typen älterer Autoren. Arch. f. Naturg. Abt. A, 6: 237, fig. 7.

tinged dark spots in wings; humeral cross vein infuscated in basal half. Basal abdominal tergites marked as in male, but paler. On all other tergites, a wide purplish black median stripe; faint traces only of the lateral oblique streaks, on tergites 3 and 4. Ventrally, a narrow black mid-ventral line on anterior half of each sternite is the only marking. Tails wholly yellowish.

Holotype—Male imago. Kanuga Lake, near Hendersonville, N. C., July 6, 1935 (L. C. Thomsen). No. 1463.1 in Cornell University Collection.

Allotype—Female imago. Florence, S. C., May 16, 1929 (O. L. Cartwright). No. 1463.2 in C. U. Collection.

Paratypes—Three female imagos, four male subimagos; same data as allotype. No. 1463.3-9 in C. U. Collection.

Genus *Ephemera* Linn.

Ephemera guttulata Pict.

Another species reported for the first time from this state. This handsome and strikingly-marked *Ephemera* was fairly abundant at Valle Crucis. Adults were taken just after dusk, flying low over the creeks, upstream and back again, rather after the fashion of small dragonflies hawking mosquitoes. Only a pale streak could be seen as one of them passed by. The dark-mottled wings contrast sharply with the white body, and are practically invisible in the twilight. Specimens of both sexes were obtained as they repeatedly passed forward and back above the stream bed; however, females were more numerous than males. Most of the specimens were taken May 25-27, although others were seen after that period. A nymph of this species was taken by Prof. Needham from Twenty-Mile Creek, Great Smoky National Park, on Apl. 3, 1934.

Ephemera blanda Trav.

More abundant than the preceding species, and evidently more widely distributed in the state. This species usually flies much higher than *E. guttulata*, but is taken at the same time, just after dusk. It is often found at some distance from any stream. Sometimes great numbers of *E. blanda* are seen flying above a highway, all going in the same direction, and most of them too high to be taken in a net. Returning to Valle Crucis from Heaton, one evening just after sunset, we stopped the car to find out what insects were coming up the road toward us in such numbers. By leaping as high as possible, we were able to catch a few of the low-flying ones, which proved to be specimens of *blanda*. All that we caught that evening were males. Another evening, from just

before sunset until it was too dark for collecting, males and females were taken as they 'danced' above and along the shores of Wildcat Lake, a small lake near Banners Elk. Collections are as follows. Imagos: Valle Crucis, May 25-27, 1936 (J. R. T.) and May 30, 1935 (L. C. Thomsen); Wildcat Lake near Banners Elk, May 31 (J. R. T., L. C. T.); Heaton, June 2; Banners Elk, June 8; Cedar Mountain, June 13 (J. R. T., L. C. T.). Nymphs: Valle Crucis, late autumn, 1934, and Oct. 1, 1935 (L. C. Thomsen); Hazel Creek, Cataloochee Creek, and Twenty-Mile Creek, Great Smoky National Park, Apl. 3-7, 1934 (J. G. Needham).

Subfamily Potamanthinae

Genus *Potamanthus* Pict.

Nymphs of this genus were found in the Davidson River, Pisgah National Forest, not far from the place where *Oreianthus purpureus* was first taken in 1929. *Oreianthus* nymphs inhabited the deeper, swifter portions of the river, beneath very large, flat rocks which could be moved but slightly and with much difficulty. *Potamanthus* nymphs, however, occurred in the shallower, less rapid waters nearer the bank. Although some dwelt in the fine gravel and sand in the lee of smaller rocks, others were clinging to the sides of the rocks, not loosening their hold when their support was lifted from the water. They seemed to prefer angular, sedimentary rocks in water not over one foot in depth, to which they clung, heads upstream, an inch or two above the stream bed.

Potamanthus distinctus Trav.

This species has not been listed hitherto from North Carolina. The nymph has not been described previously. I was able to rear a male and a female adult from nymphs, and thus to determine the species.

Nymph. Body of female, 17 mm.; of male, 14 mm. Head deep red-brown with pale markings. Mandibular tusks of the type of *P. rufus* Ide*, but with fewer spines on the distal portions (see fig. 7). Anterior to median ocellus, a large, pale, mushroom-shaped spot, and two small lateral streaks at its antero-lateral angles. Small pale spot behind median ocellus. Large pale areas around eyes. Median line of occiput pale; pale transverse streaks along this line; two pale submedian spots on hind margin. Eyes separated by a space approxi-

* 1935—Ide, F. P. Life history notes on Ephoron, *Potamanthus*, *Leptophlebia* and *Blasturus* with descriptions (Ephemeroptera). *Canad. Ent.* 67: 121, figs. 6, 6a, Pl. 4.

mately equal to three eye diameters. Thorax deep red-brown. Sagittate median mark on prothorax; lateral margins widely pale; a pair of submedian triangular spots, two pairs of pale submedian streaks, and smaller pale marks laterally. Mesonotum with many pale marks, principal of which are: two pairs of submedian marks, anterior pair elongated, posterior pair rounded; two pale spots on wing roots; four or five other pale spots between wing roots and anterior margin.

Fore tarsus red-brown; wide blackish band at base, narrower dark band apically. Tibia yellowish; blackish median band, also narrow black streak on outer margin near base. Tibial spine quite short. Femur yellowish; wide blackish pre-apical band; apical flange dark; blackish band near base, on outer half only, connected along outer margin with pre-apical band. Long hairs on inner margins of femur and tibia; shorter spines on tarsus. Middle and hind legs yellowish. Base of tarsus dark brown; narrow dark band at base of tibia, dark pre-apical mark on outer margin; pre-apical and basal bands on femur, as in fore leg. Abdomen dark red-brown dorsally, yellowish ventrally. Pale dorsal markings of abdominal tergites 3-8 consist of a short, median dash at anterior margin, and two submedian triangular or conical spots on posterior margin, faint traces of 2 or 3 small dots near lateral margin. On tergites 9 and 10, submedian marks on anterior margin, in addition to the above. Sternites 3-8 each with a curved, brown, lateral mark; a pair of brown submedian spots near anterior margin; posterior to these, a pair of smaller dark dots nearer the median line. Gills pale purplish brown. Tails dark red-brown, paler distally.

The mature nymph of *P. distinctus* is quite similar to that of *P. rufus*. Slight differences in the mandibular tusks, in the coloration of legs and abdominal tergites, and the presence of more extensive dark ventral markings, serve to distinguish it from the latter species. Adults of both sexes, in *distinctus*, possess blackish cross-veins in the wings; in *rufus*, wing-veins of both sexes are wholly pale, and eyes of the male are somewhat smaller. In both species, lateral ruddy markings occur on the abdomen. This reddish coloration of the adults fades very quickly in alcohol, so that the female of *distinctus*, which is so preserved, has already lost the ruddy abdominal markings, the median red stripe on head and thorax, and the ruddy tinges of the fore legs, which were present at the time of emergence. The two male specimens taken last summer are pinned, to preserve the ruddy coloration. It is probable that the female specimens to which I referred in a previous paper* as *Potamanthus* sp. No. 2, are *P. distinctus*.

* 1932—Traver, J. R. Mayflies of North Carolina, Pts. I and II. J. Elisha Mitchell Sci. Soc. 47: 110.

Immature nymphs taken along with the mature ones just described, differ somewhat in the length of the tusks and in the maculation of the abdominal tergites. Color pattern of head is identical with that of the mature nymphs; leg pattern also similar, although the femora appear relatively stouter. Similar dark ventral markings are present. I am considering these nymphs to be of the species *distinctus*. An examination of many specimens of nymphs of *P. walkeri* Ide, from the Potomac River at Brunswick, Md., leads me to believe that the color pattern of the abdominal tergites may be quite variable within the limits of a single species. It would seem that care should be taken to indicate the sex as well as the relative maturity of a nymph, when describing the color pattern.

Subfamily Neophemerinae

Genus *Oreianthus* Trav.

Oreianthus purpureus Trav.

This unique species has been reported to date from three localities only, in North Carolina: the Mitchell River near Mountain Park, Surry Co.; the Tuckasegee River at Dillsboro, Jackson Co.; and the Davidson River in Pisgah National Forest, Transylvania Co. This past summer I succeeded in rearing several male imagos from the Davidson River, so that nymphs and imagos of both sexes are now known. I note that, in previous descriptions of the nymph, no mention has been made of a pair of low, submedian tubercles on the anterior margin of the pronotum. The short, median spine or tubercle on the mesonotum, between the wing cases, was in error stated to be on the metanotum.

Male imago (alcoholic specimen). Body 14 mm.; wing 14-15 mm.; tails 20 mm. Eyes large, rounded; not contiguous apically; separated by about $1\frac{1}{2}$ mm. Lower portion very small, blackish, quite distinct from the large upper portion, which is orange in color. Head and antenna purplish black; the latter with a whitish ring at base. Pronotum deep purplish, lateral margins blackish; posterior margin quite deeply emarginate. Mesonotum deep red-brown; paler laterally, median stripe somewhat paler. A cream-colored line along antero-lateral and postero-lateral margins, on each side; another pale curved line on each side, extending from just above the antero-lateral margin to a point anterior to the scutellum, thence backward on each side toward scutellum. Scutellum and preceding area piceous. A very small tubercle on median line, about the middle of the scutum. Posterior notal

wing processes produced backward somewhat beyond the scutellum; tips somewhat pointed. Metanotum purplish brown. Thoracic pleura deep red-brown, with numerous large pale areas; purplish red shading above and anterior to each leg. A wide purplish black streak extends forward from base of fore wing; a narrower and shorter blackish streak just below it; another black area anterior to middle leg. Sternum deep red-brown; middle of prosternum blackish; intersegmental areas pale.

Fore leg not quite as long as body. Femur purplish red, paler basally, blackish apically; several small pale dots or streaks, on purplish median portion. Tibia piceous; tarsus somewhat paler than tibia, deep purplish brown. 'Knee' pale. Femur about $\frac{3}{4}$ as long as tibia, which is approximately $\frac{3}{4}$ the length of the tarsus. Basal fore tarsal joint very short; second and third joints subequal; fourth joint slightly shorter than third; fifth joint about $\frac{1}{2}$ as long as third. Middle and hind legs very similar to fore leg in coloration. Pale spots on femur more numerous; extreme base whitish. Knee area more conspicuously whitish. Tibia and tarsus concolorous, deep purplish brown; tip of tibia creamy. In hind leg, tarsus only a little more than $\frac{1}{2}$ as long as femur; tibia very slightly longer than femur, fully twice the length of the tarsus. Distal joint of hind tarsus about equal in length to basal and second joints combined. Third joint shortest, second slightly longer, basal slightly longer than second. Wing membrane very faintly milky in most specimens. Costal and subcostal spaces beyond bulla with an almost opaque white cloud, becoming paler at apex. In general, very similar to wings of female. Costal cross veins very weak, especially at base and in stigmatic area; in latter space, strongly anastomosed, dividing the area into two sets of cells, of which the outer series is slightly the smaller. All veins deep purplish black; longitudinal veins heavier than cross veins, costa, subcosta, and radius the heaviest. Humeral cross vein faintly purplish.

Tergites and sternites deep purplish red, with numerous pale dots. Antero-median portions of tergites 2 and 3, and antero-median margins of tergites 4-6, pale. A black median streak on tergites 1 and 2; on 3-6, narrow black submedian streaks enclosing a paler median line; on 7-9, *pale submedian* streaks enclose a *dark median* line. Tracheae faintly etched in paler color. Posterior margins of all segments, both tergites and sternites, pale greyish white, so that abdomen appears distinctly annulate. Intersegmental areas likewise pale. These pale margins widest on sternites 6-8. Pleural fold deep purplish black, except at posterior and anterior margins; blackish shading on each side, on tergites and sternites. A blackish transverse streak across tergite 2.

Middle area of forceps base purplish red; lateral portions paler. Basal portion of forceps, penes, and lateral margin of tergite 10, pale yellowish white, shaded with purplish grey. Apical portion of forceps purplish grey. Forceps *four-jointed*, not three-jointed, as seemed to be indicated in the male nymph. The two distal joints very short; basal joint about $\frac{3}{4}$ as long as the second, distinctly concave on the inner margin, and bearing a protuberance at the inner apical angle (see fig. 8). Penes much as in *Neophemera bicolor* McD. Tails very deep purplish black; in basal portion, a very narrow and inconspicuous paler ring at each joining. All three tails subequal in length.

Male imago (dried specimen). Eyes deep purplish red. Entire thorax deep mahogany brown, very shiny. Pale areas on pleura quite bright yellow; most conspicuous are three stripes (including anterior margin of mesonotum) anterior to wing roots, separated by wider red-black streaks. Tibia of fore leg, and all parts of middle and hind legs, concolorous with thorax; pale spots on femora inconspicuous. Coxa and trochanter of fore leg, and coxa of middle and hind legs, yellowish with purplish red shading. Base of fore femur yellowish. 'Knees' of all legs yellowish. Wings hyaline, no trace of milky tinge seen in alcoholic specimens. A distinct yellow area on membrane at base, on anterior and posterior margins of both wings. Abdomen deep purplish red; pale posterior margins of segments not conspicuous; pale spots barely noticeable.

Female imago (dried specimen). Very similar to male, but head and thorax distinctly dark purple with yellow mottling. Yellow areas on pleura, legs, and wing bases even larger and more conspicuous than in male. Pale spots on femora more in evidence. Posterior margins of all abdominal segments distinctly yellow, likewise anterior portion of pleural fold on segments 8 and 9, and entire pleural margin of 10. Tails deep purplish black.

Allotype—Male imago, reared from nymph. Davidson River, Pisgah National Forest, June 12, 1937. No 1002.2 in Cornell University Collection.

Nymphs of *Oreianthus* are quite hardy, able to withstand unfavorable conditions for a considerable time. Early in June I made a trip to Davidson River from Valle Crucis, at which time four nymphs of this species were captured. On the return trip the nymphs, in a rearing cage, were placed in a pail partly filled with water and carried thus in the car for several hours. Fresh water was provided only twice during the trip. All four nymphs survived the trip, likewise another trip from Valle Crucis to Penrose on June 10. Three of the nymphs died

on June 13. Another nymph survived a long, hot trip of three days (June 26-28) from Penrose to Tuscaloosa, Ala. During this time, the water was changed but a few times each day. The pail, however, was taken out of the car each night and set on the running board. This nymph died on June 29.

From June 11 to June 24, Dr. Lillian Thomsen and I collected seventeen *Oreianthus* nymphs from the Davidson River. Collections were made at three different points in the main stream, and in one small tributary. The nymphs were usually found beneath small, isolated boulders or irregularly-shaped sedimentary rocks in rapid water. In 1929 and 1930, I had found them only under the much larger, flat rocks which form the main bed of the stream. In collecting, one of us held the hand screen downstream from a given rock, whilst the other lifted the rock enough to permit the current to sweep under it. Sometimes two or three nymphs were found under one rock; again, half an hour's work yielded not a single specimen. In one instance only was it possible to determine the position of the nymph in reference to the sheltering rock. In the small tributary just mentioned, a good-sized rock was lifted from the water, and beneath it, clinging to the under surface in the manner of the large stonefly, *Pteronarcys*, was one *Oreianthus* nymph. It did not loosen its hold, even after the rock was well out of the water. Although the current was fairly swift here, the water was shallower than in most points in the main stream, probably not over nine inches in depth.

Oreianthus nymphs have a habit of 'playing dead' when disturbed, much after the manner of nymphs of the genus *Ephemerella*, so that it was not always possible at first glance to be certain that a bit of apparent trash on the hand screen was not a nymph. The same habit was noted in nymphs kept in the rearing cages.

Although we made frequent visits to the river during these days in June, at varying periods of time between 9:30 a.m. and 9 p.m., often watching for several hours at a stretch, we did not see a single *Oreianthus* adult in flight. Nor were any found resting on trees or shrubs along the bank of the river. As to the time of transformation from nymph to subimago, I record my observations on those nymphs kept in the rearing cages at Penrose. Some subimagos emerged in the forenoon, between 8 and 9:30 a.m. Others emerged in the evening, 8 to 9 p.m. One male emerged about 2:45 p.m., one female at 11 a.m. Is it characteristic of the species, that the individuals emerge at such varying times during the day? Is this lack of uniformity in time of

emergence due to the fact that the nymphs were in captivity, or do they behave similarly when undisturbed, in their native haunts?

At Penrose, we made our home in a cabin part way up the side of Fodderstack Mt. Above and behind the cabin, in a spot sheltered by young trees and shrubs from too direct sun-light, the nymphs were reared. The rearing cages were kept in a small tub under the continuous drip from a leaky pipe-line conducting water down from a spring near the top of the mountain. This proved an ideal situation for the rearing of nymphs. Subimagos, when removed from the rearing cages, were put into similar dry wire cages, each containing a small leafy branch of tree or shrub. Sourwood, being abundant, was used frequently for this purpose. Sufficient moisture for transformation of the subimagos was provided by the leaves on this small shoot. Another leafy branch was placed on top of the cage, which was then taken inside the cabin, for protection from sudden showers.

The following item from my field notes might be of interest. "Did not remove two nymph skins until the afternoon of the day on which the subimagos emerged early in the forenoon. Could then find no trace of either whole skin, only the abdomen of one, and small bits of thorax, presumably of the two skins. It looks as though the other nymphs (*Oreianthus* and two *Irons*, in the same cage) must have eaten them." Nymph skins of *Oreianthus* were usually recovered whole; further, the force of water in the tub was not sufficient to have caused the disintegration of the skins. Even then, portions of the abdomen of the second skin would have been found in the cage.

The nymph of another species of *Oreianthus* is described elsewhere in this paper, under Florida.

Family HEPTAGENIIDAE

Genus *Stenonema* Trav.

Stenonema carolina Bks.

Imagos were taken in flight at Cranberry, June 8 (L. C. Thomsen, J.R.T.); at Valle Crucis, May 26-June 9; at the Davidson River, June 16 and 20; and near Banners Elk, June 8. A few specimens were reared at Valle Crucis. Nymphs are from a stream between Boone and Blowing Rock, June 7; near Banners Elk, June 3; and Valle Crucis, May 30. A small, pale, male imago from Conestee Creek, near Cedar Mountain, probably belongs here.

The characteristic greenish cast of the bodies of the male imagos fades quickly in alcohol. There is considerable variation in size no-

ticeable among pinned as well as alcoholic specimens. Associated with the normal specimens,—bodies greenish yellow, posterior margins of both tergites and sternites blackish,—one finds smaller, paler forms,—bodies yellow, only the tergites darkened posteriorly. Markings of head, thorax and legs are similar to those of the normal dark specimens; eyes are as far apart, genitalia exhibit no differences. I am holding such forms as pale varieties of *carolina*.

The nuptial flight of the males was witnessed beside a small stream near Cranberry, on June 8. The highway passes close to the stream on one side; on the opposite bank grow many tall trees. The greenish-yellow bodies of the males, their wings reflecting the sunlight, were noticed some time before sundown, weaving up and down in the manner of most species of mayflies. Most specimens were flying high, fully twenty feet up in the air, like tiny streaks of light against the background of dark foliage. A few minutes of flight alternated with a resting period, when the insects perched on some leaf of a nearby tree, visible to us, but quite safe from our nets. Occasionally one dropped low enough to come within range of the net. Many were dancing high above the roadway; several of these were captured as they dropped down to rest on some low-growing shrubs near the road. Now and again a mating pair was seen; one or two were captured. Several females, flying low over the stream in oviposition, were also taken. Both sexes, however, were quick to elude the net of the would-be collector.

***Stenonema pallidum* Trav.**

A few imagos which seem to be of this species were reared from nymphs taken at Valle Crucis, May 27–June 7, and at Banners Elk, June 3. Two nymphs are from Valle Crucis, June 7. Imagos were taken in flight at the Davidson River, June 16–20 (L.C.T., J.R.T.). From these pinned specimens, I present the following additions to the original description.

Male imago (dried). Body 8 mm.; wing 9 mm. Eyes deep purplish red. Head and thorax deep yellow, the latter almost orange on mesonotum, metanotum, and portions of pleura. Femora deep, bright yellow; tibiae and tarsi duller and much paler. Median band on hind femur may be almost obsolete. Wings highly iridescent; costal and subcostal spaces distinctly amber-tinged. Dorsum of abdomen quite bright canary-yellow, posterior margins of tergites purplish black except near lateral margins. Apical tergites do not differ in color from those pre-

ceding. Venter paler and duller yellow, without dark markings. Tails very faintly ruddy at joinings, in basal half. Other markings as indicated in original description. Very short dark dash below antenna; lateral black streak on pronotum; no dark marks on pleura; no dark stigmatic marks. Basal joint of fore tarsus fully $\frac{1}{2}$ as long as the second joint.

Female imago (dried). Very similar to male. Thoracic notum and pleura not quite so deep in color. Median band of hind femur obsolescent. Costal margin of fore wing even more deeply amber-tinged; cross veins in basal costal space may be somewhat more heavily margined, and more numerous (5 or 6 in female, before bulla,—usually only 4 in male). Less contrast between dorsum and venter of abdomen, both being light canary yellow. Tails whitish, unmarked.

This species flies in the evening, at about the same time as *S. carolina*, and may be associated with it.

Stenonema ithaca Clem. and Leon.

Imagos were taken at Davidson River, June 5–15. Nymphs are from the North Toe River near the little town of Minneapolis, June 8; Cove Creek near Sugar Grove (north of Vilas), June 9; stream near Blowing Rock, June 7. This species also flies at sundown; ovipositing females may be taken as late as it is possible to see them in their flight over the water. Males usually dance at a height of about 8 to 12 feet.

Stenonema pudicum Hag.

As on previous collecting trips in the mountain region of this state, this species was the one most frequently met with. Imagos were taken as follows: stream near Blowing Rock, June 7; near Banners Elk, May 31–June 8; Valle Crucis, May 28–June 9; Cedar Creek near Glenville, June 19; Heaton, June 2. Reared specimens are from Valle Crucis, June 6; Cathey Creek at Cherryfield, June 21. Nymphs are from Valle Crucis and Foscue. Other nymphs were taken by Prof. Needham in the Great Smoky National Park at Hazel Creek, Cataloochee Creek, Twenty-Mile Creek, and Big Creek at Walnut Flats, Apl. 3–7, 1934.

This large, handsome, alert species with the beautifully marked wings was one of the principal actors in the brilliant performance staged at Valle Crucis on pleasant evenings in late May and early June, over Crabapple Creek. Other actors in this dance-drama were *Isonychia sadleri*, *Ephemera guttulata*, *Ephemera blanda*, *Iron rubidus*, *Rhithro-*

gena rubicunda, and *Rhithrogena amica*. These twilight flights of hundreds of mayflies commenced just as the sun was setting, and continued until darkness descended. Similar flights were witnessed during the same period near Banners Elk, where the highway crosses a small stream. Above the bridge the air literally teemed with the dancing figures of mayfly multitudes. Smaller species, of the Ephemereillas and Paraleptophlebias, also *Iron confusus*, often joined the throng. But of them all, *Stenonema pudicum* and *Isonychia sadleri* were the most elusive, the most difficult to capture.

Genus *Heptagenia* Walsh

Heptagenia juno McD.

This species has not been recorded previously from North Carolina. Two male imagos, several female imagos, and nymphs were collected. One male and two females were reared from nymphs. Localities: Valle Crucis, May 29–June 10 (adults and nymphs); Banners Elk, June 3 (adult females, nymphs); Davidson River, June 21 (adult male, nymphs); Cathey Creek at Cherryfield, June 17 (nymphs). Specimens were taken also in the Great Smoky National Park near Elkmont, Tenn.

Heptagenia aphrodite McD.

Specimens are from Valle Crucis, May 27–29 (adult females); Cove Creek near Sugar Grove, June 9 (nymphs); and a tributary of the Rocky Broad River at Lecky Gap, June 16 (nymph). See also a doubtful record of this species from Alabama.

Heptagenia thetis Trav.

Nymphs were collected at Banners Elk, May 31, and at Heaton, June 3. Other specimens were taken by Prof. Needham in Twenty-Mile Creek, Great Smoky National Park, Apl. 3, 1934.

Heptagenia marginalis Bks.

Nymphs were taken in a stream near Blowing Rock, June 7.

Heptagenia julia Trav.

Male and female imagos were reared from nymphs taken in Lecky Gap, June 19–21. Nymphs were also taken near Blowing Rock, June 7. Three of the imagos were pinned, and from these dried specimens it is possible to add the following notes to the original description of the species.

Male imago (dried). Vertex and occiput of head deep red. Prono-

tum dark red-brown in median area, lateral areas yellow. Mesonotum red-brown, tip of scutellum blackish. Pleura paler red-brown in a diagonal band from base of fore leg to base of hind leg; remaining areas yellowish. Prominent black markings above and posterior to fore leg, anterior to and above middle and hind legs. Sternum yellow. Fore femur yellow, tinged with red-brown at base; wide median red-brown band; black line along inner margin apically. Tibia and tarsus light olive brown, tibia with reddish tinge; tip of tibia blackish. Femora of middle and hind legs yellow, no red tinge; median band inconspicuous on hind femur; on each, a short, black dash near apex, on inner margin. Tibia and tarsus yellowish olive. Wings with a faint yellowish or amber tinge. A wide, red-brown band occupies the middle of the abdomen dorsally. Wide, black, posterior margins on tergites in this area. Lateral areas of tergites paler red-brown. Sternites deep yellow; posterior margins purplish red. Segments 8 to 10 with distinct reddish tinge. Tails olive yellow, joinings black.

Female imago (dried). Very similar to male. Tibiae and tarsi of all legs pale yellowish olive. Wings more distinctly amber-tinged than those of male; along the costal margin they appear greenish yellow. Dorsum of abdomen somewhat paler than in male, purplish red; pleural fold pale, likewise lateral margins of tergites 7-10.

Heptagenia spinosa Trav.

Two female imagos, taken at the same time and place as the type male specimen, were found in a vial with specimens of *H. aphrodite*. There seems no reason to doubt that these are the females of *H. spinosa*, hitherto undescribed.

Female imago (alcoholic specimen). Body 7 mm.; wing 7 mm. Yellowish. A purplish black spot between eye and lateral ocellus. Blackish mottling on occiput. Antennal filament somewhat dusky. Median portion of posterior margin of pronotum blackish; blackish markings on posterior half of pronotum, along median line. Mesonotum deeper yellow; scutellum pale. Posterior and lateral margins of metanotum, and triangular areas on each side of pale median line, purplish black. Purplish shading at bases of wings. A narrow, blackish line at apex of fore femur, another along inner margin near apex. Tarsal joinings and line at apex of tibia, narrowly black; distal joint of tarsus, and claws, dusky brownish. Other legs similar, but dark lines at joinings less conspicuous. Basal joint of hind tarsus slightly longer than the second joint. Longitudinal veins in basal half of fore wing pale yellowish.

lowish, except in cubito-anal region, where they are silvery white; cross veins not visible. In apical half of wing, both longitudinal and cross veins are visible, pale yellowish brown; longitudinals slightly heavier than others.

A wide, dark purplish band occupies the posterior half of tergite 1. Tergite 2 largely overlaid with purplish grey shading, leaving as pale areas the lateral margins, median line, and submedian semicircular spots on anterior margin. Median area of posterior margins of tergites 3-6 purplish. Purplish brown shading on median portion of subanal plate. This plate is somewhat conical, margin entire; extends slightly beyond the apex of tergite 10. Tails yellowish, basal half tinged with brown; joinings in this portion purplish black.

Allotype—Female imago. North Fork, Swannanoa River near Black Mt., N. C., June 30, 1930. No. 1115.2 in C.U. Collection.

The type locality was re-visited during 1936, in the hope of obtaining nymphs and more imagos of this unusual species of *Heptagenia*. I quote from my field notes regarding the present condition of this stream, which is the type locality also for several unique species of aquatic insects described by Dr. Banks. "Fished in Swannanoa River at Black Mt. (no luck, very little aquatic life), and in the North Fork. The latter is entirely ruined, in the part where I used to fish, apparently by silt pollution. A gravel company is excavating a big area beside and above it; the course of the stream has been changed, and the aspect of the whole is different. Found practically no aquatic life but snails; the stones are covered with a dirty-looking sediment; the stream does not look clear and inviting any more." It is most unfortunate that this beautiful stream, once so rich in aquatic life, has become so barren.

Genus *Rhithrogena* Eaton

In 1929 and 1930, I obtained partial life histories of four species of this genus, all of which seem to belong to the *anomala* group. These four were described as new species, while two others, of which only the nymphs were known, were designated respectively as *Rhithrogena* sp. No. 1 and *Rhithrogena* sp. No. 2. One of the first group, *R. uhari*, is a piedmont species, and probably does not occur in the Appalachian region. In 1936, four species and a possible fifth were taken in the mountain area of the state. Two have not been recorded before from North Carolina; one of these is a new species. Members of the genus *Rhithrogena* seem to be quite local in distribution, as no individuals of the species *R. exilis* or *R. fuscifrons* were taken during this season's

collecting. The type localities were not visited, as headquarters were too far from these points to make feasible the transportation of nymphs. Both *Rhithrogena* and Iron nymphs die quickly when transported far from their native streams, hence I was unsuccessful in completing these life histories.

***Rhithrogena amica* Trav.**

This species, described from specimens taken near Ithaca, N. Y., is represented in material collected in the vicinity of Valle Crucis. It is a new record for the state of North Carolina. Careful comparison of nymphs and imagos, the latter both dried and in alcohol, with the type material, shows that there is little difference between the New York and the North Carolina forms, aside from the smaller size of the latter specimens. The imagos from North Carolina are somewhat more ruddy as to leg and body markings, but are otherwise similar. A few specimens were reared, but in several cases it was not possible to find the nymph sloughs in the rearing cages. In *Rhithrogena*, these sloughs are either very fragile, so that they disintegrate quickly in flowing water, or else they are fed upon by other nymphs in the cages. Imagos were captured in flight, and many nymphs were taken. Imagos: Valle Crucis, May 30–June 10 (L. C. Thomsen, J.R.T.); Heaton, June 3; near Banners Elk, June 8; Cranberry, June 8. Nymphs: Valle Crucis, May 25–30; Heaton, June 3–6; Banners Elk, May 31. Other nymphs were collected by Prof. Needham on Apl. 3, 1934, in Twenty-Mile Creek, Great Smoky National Park.

***Rhithrogena fasciata* Trav.**

Mature nymphs of this species were quite numerous in Cove Creek, north of Vilas, on June 9. From these, one male and four female imagos were reared. The female of this species has not been described previously. A single nymph, taken near Blowing Rock, on June 7, is probably of this species.

Female imago (alcoholic). Body 8–8½ mm.; wing 8–9 mm. Head flesh-colored. Usual small dark mark below antenna; one large and one or two small black dots on each side, beneath clypeus. Narrow, median, purplish line on median carina (not present on one specimen). A faint dusky or pale purplish band across back of head between eyes, extending forward laterally along margin of eye. Antennal filament dusky in basal portion. Pronotum flesh-colored; anterior, posterior, and lateral margins narrowly darkened; a short, dark streak in postero-lateral angle. In well-marked specimens, a dusky triangular area on

each side of median line. Mesonotum greenish yellow; scutellum and two small areas anterior to it brownish, in dark specimens; postero-lateral fold, and narrow line along antero-lateral margin, dull purplish. Metanotum greenish yellow laterally, median portion brown. Pleura greenish yellow; a dull purplish streak anterior to wing base; brownish markings above legs. Sternum flesh-colored; posterior half of mesosternum, and outlines of other median sclerites, red-brown.

Legs greenish yellow. Customary dark spot on each femur; short, black, longitudinal streak near apex, on inner margin; narrow dark band at apex. Apex of tibia, outer portion of tarsal joinings, apex of distal tarsal joint, and claws, dusky. Wings hyaline. Longitudinal veins in both wings light purplish brown, paler in anal areas; humeral cross vein somewhat deeper in color. Cross veins along costal margin and in apical portion of fore wing pale brownish, elsewhere almost invisible.

Dorsum of abdomen red-brown with a distinct purplish tinge. Intersegmental areas and lateral fold, whitish. Pale median line on each tergite; pale, oblique, submedian streaks on basal and middle tergites, and a pale dot near end of each; on apical tergites, pale submedian dot only. Posterior margins of tergites darkened in middle area, paler laterally. On each tergite, near lateral fold, an irregular, scroll-shaped, dark mark. Sternites much paler than tergites; pinkish, with no dark markings except an indistinct brownish line on basal segments, near lateral fold. Posterior margins narrowly pale whitish. Tails yellowish, joinings narrowly purplish red.

Allotype—Female imago, reared from nymph. Cove Creek, north of Vilas, N. C., June 9, 1936. No. 1121.2 in Cornell University Collection.

The male imago from Cove Creek is somewhat larger and stouter than the holotype,—wing 8 mm. instead of 7 mm. (incorrectly given in original description as 6 mm.). The following additional notes on the species are presented from this more recent specimen. Thorax and apical abdominal segments red-brown, contrasted with the purplish brown basal and middle segments (type specimen paler, less contrast in color). Laterally on each tergite, a semicircular paler area is enclosed by a darker line, which is widened on the inner margin into an oblique streak extending inward and backward from the antero-lateral angle. Pale submedian streaks and dots on tergites, as in female. Sternites very pale purplish brown, apical ones darker; brown lateral streaks on basal segments; ganglionic areas faintly smoky. Tails pale, but tinged

faintly with red-brown at base; joinings purplish. A re-examination of the holotype shows that the tails, instead of being wholly whitish and unmarked, as stated in the original description, are brown-tinged basally, joinings very faintly darker. Longitudinal veins of the holotype are faintly tinged with purplish, not wholly yellowish, as originally stated; all cross veins invisible. I present a new figure of the genitalia of the holotype, drawn after these structures were treated in KOH and re-mounted (see fig. 4).

Rhithrogena rubicunda sp. nov.

A small reddish species of the *anomala* group, allied to *R. fasciata*.

Male imago (specimen in alcohol). Body 8 mm.; wing 8-8½ mm. Head yellowish, with ruddy shading between eyes on posterior margin; a faint purplish line along median carina. Black semicircular mark below antenna; one large and one small black dot beneath clypeus. Antenna dusky; apex of basal segment black-ringed. Thorax reddish brown, notum and sternum darker than pleura. Pronotum margined and shaded with purplish black. Scutellum, two large areas anterior to it, and posterior margin of mesonotum on each side of scutellum, deeper brown. Anterior to wing roots, two purplish streaks: one directed obliquely laterad, the other extending along antero-lateral margin of mesonotum. Metanotum blackish brown except for paler anterior and lateral margins. Pleura light red-brown; a few dark brown markings above leg bases. Posterior margin of prosternum purplish black; middle sclerites of other segments of sternum outlined in dark brown.

Legs yellowish amber. Fore tibia with faint ruddy tinge. Narrow band at apex of fore femur, tip of tibia, joinings of basal and second tarsal joints, claws, and most of distal joint of tarsus, rather dark red-brown. Usual purplish black median spot on femur. On middle and hind legs, the tarsi are faintly shaded with ruddy brown; all tarsal joinings dark red-brown. A small, black mark near apex of each femur; no apical band. Median spot on hind femur somewhat elongated. Wings hyaline. Longitudinal veins and humeral cross vein light purplish brown, those of costal margin heaviest. Cross veins in anterior and apical areas of fore wing similarly colored but fainter, not as heavy as longitudinals but plainly visible. Cross veins elsewhere in both wings paler, becoming silvery white and almost invisible in anal areas. About 4 costal cross veins before the bulla, each sagged basad in middle; beyond bulla, about 3 cross veins before stigma. 14 or 15

stigmatic cross veins, more or less anastomosed, several of them somewhat aslant; faint milky cloud in stigmatic area.

Abdomen dark purplish red dorsally; paler ventrally, but with distinct purplish red tinge; semi-hyaline. Apical segments often with faint yellowish shading. Posterior margins of all tergites reddish black, of all sternites deep rose to purplish red, so that abdomen appears annulate with reddish. Pale, somewhat semicircular areas near lateral margin on each tergite, enclosed by darker line, are much less prominent than in *R. fasciata*. A pair of submedian, pale dots on each basal and middle tergite; on basal ones, traces of a pale median line in anterior portion. Lateral fold brownish; sternites pale next to this fold; ganglionic areas faintly indicated as whitish spots. Tails yellow, somewhat ruddy at extreme base; all joinings narrowly deep purplish red. Genitalia as in fig. 1.

Female imago (specimen in alcohol). Body 8 mm.; wing 9-9½ mm. Similar to male, except as indicated. Head often without ruddy or dusky shading (see notes on paratypes, however, particularly pinned specimens). Thorax somewhat paler than in male, yellow-brown with an olive tinge. All legs similar to middle and hind legs of male, but tarsi not noticeably darker than other joints. Longitudinal veins with a distinct amber tinge; cross veins visible also in disc of wing. Abdomen more or less opaque, except in spent females. Venter less distinctly ruddy-tinged, but reddish annulations of all segments evident. Egg valve and 8th sternite purple-tinged. Tails usually not ruddy at base. Lateral margin of 9th tergite with more or less purplish red shading. Considerable variation, also, as to depth of color of both thorax and abdomen; some paratypes are fully as ruddy on tergites and sternites as the type male. Others show ruddy or powder-white markings on pleura. In one specimen, the scutellum and adjacent areas are ruddy; distinct ruddy shading also, on posterior part of head.

Male (dried). Entire head, except narrow frontal margin, flushed with red. All femora very deep amber; fore tibia without reddish tinge; tarsi duller and paler than tibiae. Wings highly iridescent. Veins appear much paler than in alcoholic specimens. Dorsum of abdomen dark red-brown with purplish tinge; apical tergites bright red-brown. Greater contrast in color between dorsum and venter than in alcoholic specimens. Pale dots and pale lateral areas on tergites almost invisible. Anterior margins of basal and middle tergites narrowly pale; sternites 8 and 9 brighter reddish than preceding ones. In one specimen, from Valle Crucis, eyes deep purplish black (wholly

blackish in others). Scutellum and adjacent areas distinctly reddish. Tergite 10, and lateral margins of 9, bright yellowish orange. Wing veins almost whitish, except those on costal margin.

Female (dried). Entire head reddish. Distinct contrast between dorsum and venter of abdomen. Tergites 1-6 dull, dark red-brown with purplish tinge; 7 slightly paler; 8-10 much paler, with yellowish instead of purplish tinge. Venter paler purplish red.

Holotype—Male imago (dried). Banners Elk, N. C., June 5, 1936 (J. R. Traver). No. 1458.1 in Cornell University Collection.

Allotype—Female imago (dried). Banners Elk, N. C., June 8, 1936 (J. R. T.). No. 1458.2 in C. U. Collection.

Paratypes—Seven male imagos, eleven female imagos; Valle Crucis, N. C., May 25-June 8, Banners Elk, N. C. June 5-8, 1936 (J. R. T., L. C. T.). Some dried, others in alcohol. No. 1458.3-20 in C. U. Collection.

This species is about the size of *R. fasciata*, and of small specimens of *R. amica*. From the former it may be distinguished by the reddish annulations of the abdomen; less prominent lateral pale areas on tergites; cross veins on wing of male visible in anterior and apical areas. The distinct contrast in color between dorsum and venter of abdomen, and the almost total lack of reddish shading on pleura and femora, as well as the paler and less prominent wing veins, separate it from small specimen of *amica*. In genitalic type, it is quite close to *fasciata*; however, the apical portions of the penes are thicker, more rounded, while the spatulate process on each division of the penes is distinctly wider.

I do not know the nymph of this species, as imagos were taken only in flight. There is a possibility that the nymphs I am describing as *Rhithrogena* sp. No. 3 may be the immature forms of *rubicunda*. These nymphs occurred in considerable numbers in the same streams above which I took the adults of *rubicunda*. Seeming evidence against this theory is that the nymphs were not yet mature on June 10, although imagos of *rubicunda* were taken as early as May 25. The only mature nymphs taken from streams in this area, during the period of flight of *rubicunda*, were those of *amica*, and smaller specimens which I cannot distinguish from typical *amica*. These I assume to be the nymphs from which came the small specimens of apparent *amica*, mentioned previously. So similar in general appearance are the imagos of many species of *Rhithrogena*, that it was only after mounting the genitalia and comparing the specimen point by point in the laboratory that I realized there were two species among the specimens, all of which I had assumed to be *amica*.

Rhithrogena sp. No. 2

The nymph of this species was described in my previous paper on the Heptageniidae of the state.* A few of the orange nymphs were collected during 1936 from that tributary of the Rocky Broad River which flows through Lecky Gap; from these a single female imago was reared. A male subimago died when half out of its nymphal skin; genitalia not sufficiently developed to show details of structure. The femoral markings of the imago indicate that it is a member of the *anomala* group. Since the nymph slough of the female imago could not be found, and since further, the female bears a marked resemblance to those of two other species of this group, I am holding the specimens under the original designation.

Female imago. Body 7 mm.; wing $7\frac{1}{2}$ mm. Head pale yellowish; usual dark mark below antenna. A narrow purplish black line on posterior margin of head, slightly widened at each end, near eye. Filament of antenna dusky. Thorax, including scutellum, yellowish. Anterior and posterior margins of pronotum very narrowly darkened; a small area of purplish shading laterally, just above leg base. Posterolateral areas of mesonotum below scutellum shaded with purplish. Metanotum largely purplish brown. Posterior half of mesosternum brownish. On pleura, a small dark spot just above bases of middle and hind legs. Very minute dark dot at antero-basal angle of middle and hind coxae; on middle coxa, small dark dots also at postero-basal and postero-apical angles.

Legs pale yellowish; each femur with usual purplish black median mark (not streak). Tarsal joinings, claws, narrow line at apex of tibia, and somewhat wider mark at apex of femur, darkened. Wings hyaline. The first four longitudinal veins of the costal margin are pale purplish brown, as are also the cross veins between them; subcosta of hind wing similarly colored. All other veins and cross veins silvery white, the latter almost invisible.

Abdomen yellowish with pale pinkish tinge. Tergites 1-8 shaded with purplish, most apparent on tergite 3. Intersegmental areas paler; posterior margins of apical tergites appear narrowly darker. Lateral margin pale. Sternites paler than tergites; intersegmental areas whitish. Tails yellowish, tinged in basal portion with very pale red-brown; joinings narrowly darker.

* 1933—Traver, J. R. Mayflies of North Carolina, Pt. III. The Heptageninae. J. Elisha Mitchell Sci. Soc. 48: 172.

The female imago is very similar to that of the allied species *R. exilis* and *R. fuscifrons*. From each of these it may be distinguished by the absence of definite darker posterior margins on the basal and middle tergites. The dark posterior margin of the head separates it from *exilis*; the entire body, particularly head and thorax, are much paler than in *fuscifrons*.

I note that in nymphs taken in the past season the entire head is thickly freckled with small dark dots; however, specimens from previous collections do not show this character. Posterior margins of all tergites narrowly darker. Two small dark, submedian dots near anterior margin; between and connecting them, a narrow, dark, transverse band. The nymph of *R. uhari* is likewise uniformly orange on the dorsum, but considerably paler than *Rhithrogena* sp. No. 2. The femora also are much paler, the head somewhat narrower, the gills (in life) distinctly grey. It is difficult to distinguish the nymphs of *Rhithrogena* sp. No. 2 from dark forms of *fasciata*, in alcoholic material, except for the deeper and more uniform orange color of the dorsum. I believe, however, that *Rhithrogena* sp. No. 2 is worthy of specific rank.

Rhithrogena sp. No. 3

Known only in the nymphal stage. A species of the *anomala* group; very similar to *R. fuscifrons* in general appearance, but more strikingly banded with alternating dark and pale areas.

Nymph. Body of immature nymphs, 6-8 mm.; tails 7 mm. Head as in well-marked specimens of *fuscifrons*. Large chestnut brown patch occupies middle area of head, from frontal margin backward between bases of antennae, and lateral ocelli, to posterior margin. Lateral portions yellowish, except for a light brown spot near outer margin, laterad of each eye. Antennae yellowish brown; in distal portion paler, joints shaded with purplish black, a black spot at each joining. Pronotum, and anterior portion of mesonotum to base of middle leg, dark red-brown; a few very faint paler markings on pronotum, two dark streaks on mesonotum between wing bases. Posterior portion of mesonotum, wing cases except at base, and entire metanotum, yellow. Fore and middle femora yellow in apical half or third; basal portion dark red-brown, with usual irregular pale median patch and purplish median spot. Tibiae yellowish, brown along outer margin, 'knees' brown; tarsi red-brown. Hind femur brown except for pale median streak in basal half; usual purplish median spot. Tibiae and tarsi as in other legs. Ventrally, dark brown markings near bases of fore and middle legs.

Abdominal tergites 1-2 and 8-10, wholly pale yellowish; tergite 7 may be wholly pale, or dark in basal half. Tergites 3-6, and sometimes base of 7, dark red-brown. Inner half of each gill on segments 2-5, and basal inner portion of gill on segment 6, deep purplish; gills of first and seventh pairs, and remaining portions of others, pale creamy white. Gill tufts purplish grey. In a female nymph slough, only the basal portions of gills on 2-5 are darkened. All sternites pale yellowish, unmarked. Tails yellowish brown; a narrow dark ring at each joining.

These strikingly-marked nymphs were quite numerous in the streams at Valle Crucis and in several streams near Banners Elk, from May 25 to June 10; up to this time, no mature nymphs had been seen. On June 11, I moved to Penrose. No nymphs of this species were found other than in the Valle Crucis region. A single female nymph slough was found in a rearing cage with a female imago, on June 6, and I supposed that this nymph slough belonged to the imago. Examination of it in the laboratory, however, showed that the wing cases were not long enough for those of a mature nymph. The female imago taken with it appears to be of the species *amica*, and I have no adults of *Rhithrogena* sp. No. 3. See note under *R. rubicunda*.

Nymphs of *Rhithrogena* sp. No. 3 bear a close superficial resemblance to those of *fuscifrons*. The following differences may be noted: (1) larger size; (2) pale strip including posterior half of mesonotum, all of metanotum, and the two basal segments of abdomen (in *fuscifrons*, entire thorax brown, usually also tergites 1 and 2); (3) brown apical area of third femur, as contrasted with yellow in corresponding areas of fore and middle legs (apices of all femora yellow in *fuscifrons*); and (4) the prominent purplish areas on the middle gills.

Rhithrogena sp.

Adult females of an undetermined species of this genus were taken at Valle Crucis by Dr. Lillian Thomsen, May 27-30, 1935. These females are very similar to *R. amica* in general appearance, but larger. Body 10-11 mm.; wing 12-13 mm.

A single nearly mature nymph of a small species was collected in the Davidson River on June 20. Wholly whitish except for a very small median purplish mark on each femur, and a row of relatively long, dark spines on the posterior margin of each. Body 5 mm.

Genus *Cinygmula* McD.

Cinygmula atlantica McD.

A new state record, unless this species is really synonymous with *C. subaequalis* Bks. Dr. Banks' specimens were taken from the North

Fork of the Swannanoa River in May. As stated previously, this stream supports no aquatic insect life at the present time. Mature nymphs of *C. atlantica* were found at Valle Crucis, Banners Elk, and Heaton, during the last week of May, but were by no means numerous. Attempts to secure a male imago were unsuccessful, but three females were obtained by rearing the nymphs, and one was taken in flight. The latter specimen is slightly larger than the reared forms, but similar in other respects. Females and nymphs have been compared with reared specimens of *atlantica* from the vicinity of Ithaca, N. Y. Imagos: Valle Crucis, May 28-30.

Genus *Iron* Eaton

In a previous paper* I have designated two groups of species in this genus, which occur in North Carolina, distinctions being based principally on nymphal structures. These are respectively, Group I, the *humeralis-rubidus* allies; and Group II, species of the *dispar* type. A third division, Group III, which includes species of the *longimanus* type, is represented in my collections of last summer. Nymphs of Group III may be characterized thus: (1) Gills of first pair have the anterior lobe greatly developed; this pair of gills is considerably larger than any succeeding pair; and the anterior lobes lie under the body of the nymph, tending to approach one another. (2) Gills of seventh pair tend to meet beneath body of nymph. (3) Head definitely widest near frontal margin, as in Group II. (4) Postero-lateral spines on middle abdominal segments relatively short and rather blunt, as in Group II. (These spines are present on segments 1-7, in all *Iron* nymphs, but are poorly developed on the basal segments.)

Species of the genus known to occur in North Carolina are as follows. Group I,—*I. rubidus* Trav., *I. subpallidus* sp. nov. (designated originally as *Iron* sp. No. 2), and *Iron* sp. No. 1, a piedmont form; Group II,—*I. dispar* Trav. and *Iron* sp. No. 4; Group III,—*I. confusus* Trav. and *Iron* sp. No. 5.

Iron rubidus Trav.

As originally described, males of this species ranged in body size from 8 to 9 mm.; females from 9½ to 11 mm. It should be noted here that the other specimens among the type material are somewhat larger. Thus, several males have a body and wing length of 10 mm., while some

* 1933—Traver, J. R. Mayflies of North Carolina, Pt. III. The Heptageniinae. *J. Elisha Mitchell Sci. Soc.* 48: 156.

of the females reach 12 mm. in length. There is considerable variation also as to body markings and depths of color of the thoracic notum in the male. During 1936, I collected several nymphs of *rubidus* from Lecky Gap, others from Cherryfield, and from these was able to rear a few imagos. From a pinned male specimen (Lecky Gap, June 20) I present the following additions to the original description, which was drawn from a specimen in alcohol.

Male imago (dried). Eyes deep red-black. Entire head suffused with bright red. Thorax deep yellow. Pronotum largely suffused with bright red. Posterior and lateral margins and oblique lateral line, black. Scutellum and posterior margin of mesonotum blackish, as are the median projection and posterior margin of metanotum. Reddish shading anterior to wing base and on pleura above each leg. Black markings above leg base quite prominent. Narrow reddish line along anterior margin of mesosternum; median area of this sclerite red-tinged in posterior half. Fore femur largely ruddy; black bands prominent. Fore tibia with reddish flush; tarsus wholly pale yellowish white. On middle and hind legs, femur amber yellow, reddish only at apex; purplish streak on margin near median dark mark. Tibia red-tinged except in median area; tarsus pale. Abdomen yellow, venter rather paler than dorsum. Basal tergites shaded laterally with purplish. Middle and apical tergites with distinct rose-red lateral patches based on posterior margin, these being most prominent on tergite 8. Whitish area next to pleural fold, on tergites 9 and 10, and on lateral portions of sternites 8 and 9.

Many nymphs were taken in and near Valle Crucis, during 1936, which very much resemble those of *rubidus*, but seem a trifle larger; gills purplish red; color of body olive brown in life. From these, many imagos were reared, and various others of both sexes were captured in flight. Although showing some variation, both as to size and markings, from type material of *rubidus*, I can point to no character or constant marking by which either nymphs or imagos may be distinguished from *rubidus*. The nymphs are doubtless those to which I referred in a previous paper as *Iron* sp. No. 3. I propose to regard these specimens, for the present at least, as *Iron rubidus*, dark form. Since, however, they may represent a distinct species, I present descriptions of both sexes, from pinned specimens.

Iron rubidus, dark form

Male imago. Body $10\frac{1}{2}$ mm.; wing $10\frac{1}{2}$ mm. Head creamy white between eyes, elsewhere suffused with red. Antenna wholly dusky.

Thorax rather dark red-brown. Purplish red shading laterally on pronotum. Very deep red-brown median strip extends length of mesonotum. Scutellum, postero-lateral margins, and posterior margin, black. Anterior to scutellum, two paler reddish streaks. Prominent black markings on pleura; black streak above fore leg. Median portion of posterior half of mesosternum deeper brown, enclosing two reddish submedian streaks. Fore femur deep amber brown, faintly red-tinged; tibia paler, red-ringed; tarsus pale grey, last two joints dusky, all joinings and claws darker. Other legs similar but paler; no red flush on tibiae; apical half of tarsi distinctly dusky; usual dark mark on femora. Longitudinal veins yellowish; cross veins paler, but visible throughout most of wing.

Abdomen pale yellowish white, middle segments largely hyaline. Posterior margins of tergites narrowly purplish black; more or less pale brown shading laterally and along posterior margin (leaving area next to pleural fold whitish); small brown mark at each spiracle. Short black streaks on posterior half of median line, on middle and apical tergites; may be absent from basal ones. Tergites 8-10, and sternites 8 and 9, opaque, with alabaster markings on an orange-red background. Tips of forceps smoky. Tails smoky brown at base, becoming paler distally; indistinctly pale at joinings.

Variations of the above. All femora flushed with reddish brown; tarsi wholly dusky. Dorsum of abdomen more or less suffused, except in pale area next to pleural fold, with orange-brown, more intense on apical tergites. Rose markings on apical portion of forceps base.

Female imago. Body 10½-11 mm.; wing 12-13 mm. Head, posterior to lateral ocelli, creamy with very faint pink flush; anterior portion of head reddish. Pronotum reddish brown, margined and shaded with black. Remainder of thorax rosy, with extensive creamy white markings. Black pleural markings as in male. Fore femur red-brown, others amber-brown; usual dark median spot. Tibiae greyish, tinged at each end with lavender. Tarsi dusky at tips, elsewhere greyish, all joinings darker. Humeral cross vein almost wholly purplish (in male, pale next to costal margin). Dorsum of abdomen, except pale lateral area, flushed with brown or orange-brown (reddish, before eggs are laid). Otherwise as in male.

Iron subpallidus sp. nov.

Iron sp. No. 2 in Traver, J. Elisha Mitchell Sci. Soc. 48: 160. 1933.

A member of the *humeralis-rubidus* group. Distinct by reason of

the relatively short postero-lateral spines on abdomen of nymph. Imago rather pale.

Male imago (alcoholic specimen). Body 11 mm.; wing $11\frac{1}{2}$ mm. Very similar to *I. rubidus*, but paler and somewhat larger. Head pale yellowish; bases of ocelli blackish; antennal filament dusky, two very small black dots beneath clypeus. Eyes slightly larger than in *rubidus*, contiguous apically (in some specimens of *rubidus*, eyes do not quite meet dorsally). Thorax pale yellowish brown, paler than in *rubidus*. Posterior and lateral margins of pronotum *not* darkened; lateral oblique dark dash on this sclerite reduced to a faint trace; very pale brownish shading on posterior half. Two purplish spots on pleura, above leg base. Scutellum of mesonotum, and posterior margin of sclerite on each side of scutellum, dark brown. A pale band along median area of mesonotum. Metanotum yellowish; median projection and posterior margin brown. One small black spot and faint black pencilings on pleura above base of each leg; much less prominent than in *rubidus*.

Fore femur brownish yellow; tibia yellow, tarsus yellowish white; tip of tibia dusky; median purplish spot on femur, no other markings, other than a very small dark mark on each coxa. Middle and hind legs yellow; tarsi shaded with pale brown, joinings darker. Hind tibia about $\frac{3}{4}$ as long as femur. Wings hyaline; faint milky cloud in stigmatic area. Humeral cross vein deep purplish black in posterior half, white next to costa. Longitudinal veins in anterior and apical portions of fore wing pale yellow, all other veins pale, practically invisible. Abdomen yellowish white. Short dark marks on median line of each tergite, as in *rubidus*; posterior margins of tergites faintly shaded with dark grey, in median area only. No oblique, lateral streaks nor short, dark dashes near spiracles; no darker shading on tergites. Apical segments yellow. Tails smoky at base, pale distally. Genitalia very similar to *rubidus*.

Female imago (alcoholic specimen). Body 12 mm.; wing 14 mm. Similar to male, except as indicated. Small dark dot on median line of pronotum, near to middle of sclerite; lateral margins of pronotum very faintly greyish. All legs similar to middle and hind legs of male; tarsi concolorous with tibiae, joinings slightly darkened. Longitudinal veins of fore wing very pale yellowish brown except in anal region; cross veins in apical portion similar, distinct; elsewhere pale, invisible. About 10 stigmatic cross veins; 3 between bulla and stigma, basal costals very faint. *Two* dark dots on coxae of middle and hind legs, one only on fore coxa.

Nymph. Described previously, as *Iron* sp. No. 2. A comparison of the postero-lateral spines on segments 6-7 of nymphs of *rubidus* and *subpallidus* is shown in figs. 18 and 19. This nymph is unique among others of the *humeralis* group, because of the relative shortness of these spines, which do not much exceed in length the postero-lateral spines of nymphs of the *longimanus* group.

Holotype—Male imago, reared. Cedar Creek near Glenville, N. C., June 20, 1936. No. 1457.1 in Cornell University Collection.

Allotype—Female imago, reared. Same locality, June 21, 1936. No. 1457.2 in C. U. Collection.

Paratypes—One female imago, reared. Same locality, June 16, 1936. Two female imagos, reared; in same locality, July 10, 1930. No. 1457.3-5 in C. U. Collection.

Iron dispar Trav.

Several nymphs of this species collected at Valle Crucis were reared, and imagos of both sexes obtained. No imagos were taken in flight. Imagos: Valle Crucis, May 25-June 10; and Cherryfield, June 25. Nymphs: Valle Crucis, during same period (J. R. T.), and in autumn of 1934 and 1935 (L. C. Thomsen); Foscue, May 25; Forney's Creek, Aug. 26, 1931 (J. G. Needham); Deep Creek, Aug. 25, 1931 (J. G. N.); Twenty Mile Creek, Apl. 3, 1934 (J. G. N.). The last three localities are in the Great Smoky National Park area. The nymphs from Forney's Creek were previously included in the vial with specimens of *Iron* sp. No. 4.

Iron sp. No. 4

Only two specimens of this species, from Forney's Creek, Aug. 26, 1931 (J. G. Needham). These nymphs are quite similar to *I. dispar*, but distinguished from that species by the dark red-brown abdominal tergites and the distinctive reddish brown shading on the abdominal sternites.

Iron confusus Trav.

This species, a member of the *longimanus* group, has not been previously recorded from North Carolina. Imagos agree well with the type specimens taken in the vicinity of Ithaca, N. Y. Nymphs vary from the New York forms as follows: (1) Ventral markings of last three abdominal segments usually more extensive, consisting of lateral streaks, a pair of submedian spots near anterior margin, and two smaller dots posterior to these; (2) anterior lobes of first pair of gills may be more

prolonged, and so held by the nymph as to be approximated beneath the body; (3) median line of short, fuzzy hairs on abdominal tergites more evident. (Such hairs, usually short and inconspicuous, occur on many Iron nymphs, but are much shorter and weaker than in nymphs of the genus *Ironodes*.)

There is a possibility that the species *I. confusus* Trav. is synonymous with *I. fragilis* Morg.; in that case, however, the size limits of *fragilis* would have to be considerably extended. The only *bona fide* nymphs of *fragilis* that are in the Cornell collection are in such poor condition that it is not possible to be certain whether the gills of the first pair actually meet beneath the body, as indicated in Prof. Needham's figure.* None of the imagos of this species which were reared by Dr. Morgan are now in existence. Nymphs of *confusus* agree well in size with the nymph described by Prof. Needham as *Iron* sp. (8 to 10 mm., depending on the sex of the nymph; he states 9 mm.). However, the imago of *fragilis*, on which the description of the species is based, is stated to have measured but 7 mm., wing 7 mm.; *confusus* has a body length of 9 to 10 mm., wing 10-11 mm. Until this apparent discrepancy in size can be unraveled, we retain the name *confusus* for the larger forms. It should be noted that the nymphs of *confusus* typically hold the gills of the first pair so that the anterior lobes are not directed toward one another beneath the body. However, it is possible to move them, on a dead nymph, so that the tips almost meet. I note, further, that many specimens of typical *confusus* nymphs do have faint dark spots on the abdominal tergites; an apparent statement to the contrary appears in my key to Iron nymphs (*Biology of Mayflies*).

Several nymphs of this species were reared, and a few imagos taken in flight. The period of flight is in the early evening, just after sunset. Imagos: Valle Crucis, May 27-June 6; and Banners Elk, May 31-June 8. Nymphs: from above localities; also North Toe River at Minneapolis, June 8; and Heaton, June 3. Other specimens were taken by Prof. Needham from Twenty Mile Creek in the Great Smoky Mts., Apl. 3, 1934.

Iron sp. No. 5

Nymphs of this species were collected in Dutch Creek, Valle Crucis, on Feb. 26, 1936 (L. C. Thomsen). None are fully mature; some appear to be only half grown. Male nymphs, body 10 mm.; female

* 1905—Needham, J. G. (*Ephemera* in) *Mayflies and Midges of New York*, N. Y. State Mus. Bull. 86: 57, Pl. 7, figs. 6-7.

nymphs, 12-13 mm. In alcohol, the general body color is dark red-brown tinged with olive. Dark markings on occiput between eyes and ocelli, and a V-shaped mark from base of antennae to frontal margin. Indistinct dark scroll-like markings on notum. Base of femur, knee, tip of tibia, and entire tarsus, blackish, on each leg. Pale hatchet-shaped mark on basal half of femur; in head of hatchet, the usual purple spot. Anterior and posterior margins of all tergites narrowly black. Dark, paired, submedian spots usually present on tergites 3-9. Gills brown on outer margin; a white strip occupies remainder of outer half; inner half of each, pale purplish. Gills of first pair may meet beneath body of nymph. Tails red-brown, joinings blackish. Venter marked as in *confusus*.

Other nymphs very similar to the above are from Twenty Mile Creek, Great Smoky Nat. Pk., Apl. 3, 1934 (J. G. Needham). In these nymphs, the hairs on the median line of the abdominal tergites are better developed than in any others of the genus *Iron* which I have studied. Otherwise they agree well with the nymphs from Valle Crucis.

Family BAETIDAE

Subfamily Siphonurinae

Genus *Ameletus* Eaton

No imagos of this genus were collected, nor do I have any nymphs among my specimens. However, many nymphs were collected by Prof. Needham in April 1934, in certain areas of the Great Smoky National Park.

Ameletus sp. No. 2

1932—Traver, J. R.—J. Elisha Mitchell Sci. Soc. 47: 199.

Mature nymphs which seem to be of this species are from Twenty Mile Creek and Big Creek in Walnut Flats, Apl. 3-7 (J. G. N.). Many of these specimens are more uniformly red-brown dorsally than is indicated in my previous description. Yellow areas present on all tergites: postero-lateral angles; lateral patches; traces of pale median line basally, on apical tergites. A pair of dark, red-brown, submedian streaks in anterior half of each tergite. Inner margin of gill may appear brownish or both margins may be yellow. In some well-marked specimens, tergites 1-2, 7-8, and 10 are distinctly paler.

Ameletus sp. No. 3

A single immature nymph, Cataloochee Creek, Apl. 6, 1934 (J. G. N.). Smaller than the preceding species,—body 7 mm. Frontal portion of head red-brown, occiput yellow. Pronotum yellow; two brown, submedian streaks. Meso- and metanota yellow with many irregular brown markings. Legs yellow; indistinct broad, median, femoral band; tibia and tarsus brown at base and apex; claw brownish. Abdominal tergites 1-2, and 7-8, yellow; posterior margins of 7-8 brown, also faint submedian streaks. Tergites 3-5 largely brown; lateral margins except posteriorly, antero-lateral areas, and large, rounded, submedian spots, yellow. Tergite 6 largely yellow; posterior margin, median triangle based on posterior margin, and smaller submedian triangles based on anterior margin, dark brown. Tergites 9-10 uniformly dark brown. Gills wholly pale. Venter yellowish; sternite 9 largely brown. Usual blackish band across tails.

Genus Isonychia Eaton**Isonychia sadleri** Trav.

Another new state record. The large, dark brown nymphs of this species, strikingly marked with a broad, white, dorsal stripe, were very numerous in the streams of the Valle Crucis region. Several were reared. Most of the imagos, however, were taken during their twilight nuptial dance. Great numbers of both sexes congregated over Crabapple Creek at Valle Crucis, and over a stream near Banners Elk. Often they danced high in the air; again, individuals as well as mating couples drifted down almost to stream level. They were strong, tireless dancers, the first to appear and the last to leave the scene of festivity. Imagos: Valle Crucis, May 27-June 6 (J. R. T., L. C. T.); Banners Elk, June 8. Nymphs: Valle Crucis, same period; Cataloochee Creek, Apl. 26, 1934 (J. G. Needham).

Isonychia notata Trav.

Three bronze-brown nymphs taken in Cove Creek north of Vilas are tentatively referred to this species. The tibial spine is shorter than in the type specimens of *notata*. In size and color pattern, however, there are no discrepancies. Two of these nymphs were transported to Penrose, where they lived until June 25. On this date, as I was preparing to move to Alabama, all nymphs in the rearing cages were killed.

Isonychia sp. No. 1

A single female imago, taken in flight near Davidson River, Pisgah National Forest, June 20. Two or three males were seen also, flying very high, headed for the tops of the tallest trees; none could be captured. By the structure of the subanal plate of the female, this species is a member of the *albomanicata* group.

Female imago (dried). Body 13 mm.; wing 13 mm. Frontal portion of head purplish red. Posterior to ocelli, yellow; red shading in antero-lateral angle and on anterior fourth of median line; posterior margin shaded with black, especially next to eye. Antennae dusky. Pronotum shaded with rose in median area, blackish laterally. Remainder of thorax mahogany red-brown; rose-red markings on pleura. Fore femur and tibia deep purplish brown; tarsus purplish grey. Other legs yellow, claws and last tarsal joint dusky. Venation pale brown. Abdomen deep red, brighter than *I. sadleri*. Dorsum and venter very similar; posterior margins narrowly blackish, anterior margins pale. A faint but discernible paler mid-dorsal stripe. Tails white; joinings reddish, in basal portion.

Subfamily Leptophlebiinae

Genus **Paraleptophlebia** Lestage**Paraleptophlebia guttata** McD.

In the early forenoon of June 19, hundreds of males of *P. guttata* were engaged in their nuptial flight, over the Davidson River and above the adjacent willows. The sunlight glinted on their iridescent wings and silvery white bodies as they flew upwards, to glide slowly down with tails and legs outstretched. This was not a continuous performance. All the dancers rested, at intervals of several minutes, on the willow leaves. Now, scarcely one could be seen in flight; another second, and the air was filled with them. Many males and a few females were captured from this dancing throng. Nymphs and imagos were collected from a tributary of the Davidson River on June 20 (J. R. T., L. C. T.); one nymph, Valle Crucis, June 8.

Paraleptophlebia swannanoa Trav.

Immature nymphs were taken at Valle Crucis, May 27; a stream near Blowing Rock, June 7; Cherryfield, June 17; and a tributary of the Davidson River, June 20. No imagos were obtained.

Paraleptophlebia mollis Etn.

This species has not been known before from North Carolina. The mating flight of *P. mollis* takes place just after sunset. Imagos are

represented among material captured in and near Valle Crucis at twilight, May 27–June 2. Other imagos: Banners Elk, May 31–June 8; Cranberry, June 8; mountain road near Penrose, June 12.

Paraleptophlebia adoptiva McD.

Another species of the genus which is recorded for the first time from the state. Imagos: Valle Crucis, early spring, 1936 (L. C. Thomsen), and June 1. Nymphs: Valle Crucis, May 30–June 7; and Foscue, May 25. Other nymphs were taken by Prof. Needham in the Great Smoky National Park, as follows: Moore's Spring on Gregory Bald, Apl. 17, 1929; Twenty Mile Creek, Apl. 3, 1934; Cataloochee Creek, Apl. 6, and a tributary of this stream, Apl. 7, 1934.

Genus **Habrophlebiodes** Ulmer

Habrophlebiodes betteni Ndm.

Another species not reported previously from North Carolina. One male imago was taken at Davidson River, June 20; another, a short distance over the state line into Tennessee, near the little settlement of Trade, Tenn., June 9 (L. C. Thomsen).

Genus **Blasturus** Eaton

Two undetermined species of this genus are represented: a small species from Hazel Creek, Great Smoky National Park, Apl. 3, 1934 (J. G. Needham); and larger nymphs from Dutch Creek, Valle Crucis, Feb. 26, 1936 (L. C. Thomsen).

Subfamily Baetiscinae

Genus **Baetisca** Walsh

Baetisca thomsenae* sp. nov.

Closely allied to *B. carolina*. Wings of imago with less intense orange shading; forceps of male relatively longer and more slender. Lateral spine on thoracic shield of nymph somewhat longer, better developed.

Male imago (dried). Body 10–11 mm.; wing 11–12 mm. Eyes red-purplish black. Frontal portion of head red-brown; ocelli with reddish tinge. Base of antenna brownish, filament yellowish. Thorax dark red-brown. Pronotum and posterior portion of head concealed beneath the large eyes. Yellow shading on anterior and antero-lateral margins of mesonotum, and to a lesser degree along the median strip.

* I take pleasure in naming this species for Dr. Lillian Thomsen, who accompanied me on this collecting trip and captured many of the specimens.

Scutellum and adjacent areas purplish red. Yellow shading anterior to base of fore wing, and a streak anterior to middle leg. At base of each wing and above hind leg, a reddish area. Bifurcate process between bases of fore legs quite prominent. Fore legs amber, tinged with reddish brown; all joinings darker. Middle and hind legs very similar in color, slightly paler, joinings less distinctly darkened. Wings hyaline. Entire costal strip of fore wing strongly amber-tinged; a paler tinge of amber extending along membrane for a short distance beyond the base. Extreme bases of both wings deep reddish orange. In hind wing also, an orange flush on membrane for perhaps half the width of the wing. Humeral cross vein red-brown, paler apically; subcosta and radius deep yellow, other longitudinal veins pale purplish brown. Cross veins hyaline, invisible except in stigmatic and anal areas. About 10 stigmatic cross veins; simple, straight.

Dorsum of abdomen rather bright red-brown. Posterior margins, and a small mark at spiracle, black; faint traces of blackish median line; dorsal 'hump' on tergite 6 black at tip. Pleural fold, and adjacent areas of tergites 1-5, deep, dull purplish; faint indications of same, on tergite 6. Pleural fold paler on tergite 7, becoming yellowish on 9. Tergites 9 and 10 lighter red than preceding segments. Venter tan, with faint reddish or purplish tinge. Posterior margins of all sternites black. Purplish red shading laterally and on anterior margins of basal and middle sternites, most evident on basal ones. Genitalia yellowish brown. Tails red-brown, joinings black. See fig. 6 for appearance of genitalia.

Female imago (dried). Body shrunken; wing 13 mm. Similar to male, except as indicated. Entire head rather bright red-brown; narrow dark line at middle of posterior margin; ocelli rose-red. Thorax rather more distinctly reddish than in male. Pronotum extensively shaded with black. Orange tinge on fore wing more restricted, in basal area, than in male. In hind wing, no orange tinge beyond basal third. Abdominal segments 1-6, both dorsum and venter, duller and more distinctly shaded with purplish; apical segments quite similar. Tails somewhat brighter red-brown.

Male imago (alcoholic specimen). Head and thorax olive brown. Purplish shading on pronotum, and pleura of mesothorax. Sternum tinged with red-brown. Scutellum black-margined laterally. Legs yellowish. Longitudinal veins of both wings, intercalaries in cubital region, and cross veins in anal area of fore wing, red-brown; all other cross veins pale, invisible. Fore wing flushed deeply with orange at

base, and with a fainter stain of same color along costal margin to bulla; in some specimens, entire basal half of wing may be faintly orange-tinged. Hind wing deeply orange at base; in some, wholly pale beyond, in others, entire wing faintly orange-flushed, but much less deeply than in typical *carolina*. Abdomen olive brown, posterior margins of all segments purplish. Basal and middle segments shaded with purplish red. Irregular darker dots laterally on tergites 1-6, near pleural fold; on each of the five basal sternites, a larger *black* dot next to pleural fold. Tails yellow, slightly darker at joinings.

Female imago (alcoholic specimen). Body $10\frac{1}{2}$ -11 mm.; wing 14-14 $\frac{1}{2}$ mm. Very similar to male. Head and middle area of pronotum with dusky shading. Much purple shading on mesothoracic pleura. Notum more olive green than in male. Purplish markings on thoracic sternum, at posterior margins of pro- and mesosterna. Wings much as in male, but orange tinge on hind wing confined to base, and to a barely visible discoloration of the anal area. Abdomen orange to reddish brown, due to presence of eggs. Strong purplish tinges as in male; lateral purplish black shading on tergites more prominent. Tails deep yellow; joinings narrowly dark brown.

Subimagos. Wings much as in *B. carolina*; in female, rather darker (more blackish). Amount and exact distribution of dark coloring variable in individuals, as is true also of *carolina*. Hind wing of male shows orange flush only at extreme base (in *carolina*, entire basal two-thirds of wing orange-tinged). Entire body duller and darker than in imagos. Black markings at all leg joinings; on tarsi, outer half of each joining a broad black line. Tails olive to reddish brown.

Nymph. Body of male, $8\frac{1}{2}$ -9 $\frac{1}{2}$ mm.; of female, 10-11 mm. Color very variable, ranging from yellow to blackish brown. Many lines and streaks of fine dark dots mark the thoracic shield. In some specimens, the entire background of thorax and abdomen, dorsum and venter, may be obscured by many fine, dark dots close together. Legs banded. In pale specimens, obscure and incomplete dark shading on tibia and tarsus only. In dark forms, femora also are shaded with dark brown. Typically, a distinct black median streak on abdominal tergites; oblique submedian streaks extending *inward* from anterior margin, and other dark marks nearer the pleural fold. Lateral spine of thoracic shield, and forward extension of gena, yellow, the tips piceous. Ventrally, two pale, median spots on mesosternum; a lateral row of pale spots on each side of abdomen, on basal and middle sternites; ganglionic areas of these segments may be yellowish. On pale specimens, these

pale markings are obscure; transverse bands of small, dark dots occupy the middle portion of each sternite. Tails red-brown.

Holotype—Male imago, pinned. Reared from nymph. Valle Crucis, Crabapple Creek, June 5, 1936 (J. R. T.). No. 1459.1 in Cornell University Collection.

Allotype—Female imago, pinned; reared from nymph. Same data. No. 1459.2 in C. U. Collection.

Paratypes—1 male and 1 female imago, pinned; Valle Crucis, N. C., May 26, June 2, 1936 (J. R. T.): 5 male, 2 female imagos, in alcohol; June 2-14, 1936; Valle Crucis, N. C. Same collector. No. 1459.3-11 in Cornell University Collection.

Differences between this species and *B. carolina* may be summarized as follows. Nymph: (1) anterior extension of gena slightly more upturned; (2) lateral spine of thoracic shield better developed, especially in male, so that the entire shield is relatively wider; (3) claws slightly shorter and more slender; (4) spines on 8th abdominal segment tending to turn downward and inward, rather than upward and outward, as in *carolina*. Imagos: (1) forceps of male longer, and more slender in basal portion; (2) median projections on subanal plate of female shorter and stouter; (3) orange tinge in both wings less intense, may be reduced in extent as well as intensity. In both stages, the size is consistently larger than in specimens of *carolina*. Although all of the differences listed are relative, I consider this to be a good species, and one distinct from the closely-allied *carolina*. See plate for figures showing relative differences between the two species: figs. 9, 10, 11, 12, 14, and 15.

On the morning of May 26, a fine male imago of *Baetisca thomsenae* was resting on the window screen of my room at the Valle Crucis School. It was quickly captured, and became my first specimen of this species. I located a few *Baetisca* nymphs that day in Dutch Creek; some were in the riffles, others among sand and gravel in water over a foot in depth. In the forenoon of June 2, many *Baetisca* nymph sloughs were found clinging to rocks near a ford in Crabapple Creek. So I started to search for the nymphs. Remembering my previous experience in collecting *Baetisca* in the piedmont, I held a hand screen in the current and stirred about among the rocks and gravel upstream. Each time the screen was lifted from the water, it held several *Baetisca* nymphs. I was most curious to discover the exact habitat of these nymphs, in relation to the stones, gravel and sand in the stream bed. Presently, as I rested from collecting, I noticed a slight stir among the fine gravel in the lee of a

rock. It was a *Baetisca* nymph, shifting its location. Looking more closely, I was able to make out the dorsal shields of several other nymphs, each partly buried in the fine gravel or sand, resting with head upstream. If disturbed, a nymph would be carried a short distance downstream by the current, but usually swam slowly upstream again, short tails vibrating. Coming to rest on a stretch of sand, a few rapid kicks served to conceal it again, and anchor it against the push of the current. Whether yellowish or blackish, the nymphs so resembled tiny pebbles in the stream bed that I frequently picked up a pebble, thinking it to be a nymph. A few days later, in a series of riffles below the ford, I watched a *Baetisca* nymph for some time, as it alternately rested and shifted from place to place. *Baetiscas* were found in the same location also, in one of the streams near Banners Elk. They could be picked up by hand readily, once they were located.

Although I watched forenoon, afternoon, and evening, I was unable to see a single imago in flight. None were represented in my collections of specimens taken at sunset each day. Nor were any found resting on vegetation near the stream. Do they emerge very early in the morning, or late at night? And at what hour does the mating flight occur? I do not know. Nymphs in rearing cages usually transform to the subimago stage in the forenoon, and the imago stage is likewise attained between 7 and 11 a.m., in cases observed. Thus it is possible that the nuptial flight takes place between 11 a.m. and 2 p.m.

Subfamily Ephemerellinae

Genus *Ephemerella* Walsh

I. *Bicolor* group

Ephemerella doris Trav.

A single male imago, taken at Valle Crucis on May 30, is placed tentatively in this species. Although it does not conform to the type material in all respects, it is certainly very closely allied to *doris*, if not an actual variant of that species.

Ephemerella funeralis McD.

This species has not been reported previously from North Carolina. Several nymphs are present in material collected by Prof. Needham in the Great Smoky National Park, Apl. 3-7, 1934. Specimens are from Cataloochee Creek and Big Creek at Walnut Flats.

Ephemerella coxalis (?) McD.

Another new state record. Three nymphs, taken at Valle Crucis in late autumn, 1934 (L. C. Thomsen), are so closely allied to *coxalis* that I hold them tentatively under that species.

Ephemerella temporalis McD.

Several nymphs were collected by Prof. Needham from Hazel Creek, Great Smoky National Park, Apl. 4, 1934.

II. *Invaria* group.**Ephemerella dorothea** Ndm.

This species is of common occurrence throughout the piedmont and Appalachian regions of the state. Several imagos were reared from nymphs taken at Valle Crucis and Heaton, while many others were captured during their evening nuptial flight. There is a considerable size range among individuals of this species, both in nymphs and imagos. Thus, male imagos collected during 1936 vary in length of body from 6 to 8 mm. Females vary also as regards the amount of ruddy coloration on head, thorax, and abdomen. Some are wholly pale except for a black line on anterior margin of pronotum, and dark posterior margins on the basal and middle abdominal segments. In small females from the Davidson River, the head is quite bright red; entire dorsum of thorax and abdomen ruddy brown, only the lateral margins of the apical tergites creamy; ruddy shading on posterior portion of prosternum; fore femur distinctly reddish. Males are more uniformly creamy white; eyes ruby-red; posterior margins of basal and middle abdominal tergites may be faintly smoky. In a small male from Davidson River, however, the dusky bands on the tergites are more prominent than usual; a longitudinal red streak is present on each side of tergites 5 and 6, traces of same on 4 and 7; middle area of tergites 8-9 rather dark red-brown. In both sexes, the tails of the imagos may exhibit faint reddish rings at the basal joinings. Nymphs from the vicinity of Valle Crucis and Heaton have more dark markings dorsally than the more uniformly colored specimens from the piedmont. These dark specimens have a pale band on the head between the antennae; pale lateral angles on pronotum, pale paired spots on posterior margins of tergites.

Imagos: Valle Crucis, May 27-June 7, Heaton, June 3, Davidson river, June 11-20 (L. C. T., J. R. T.). Nymphs: Valle Crucis, same period; North Toe River, June 8; and Heaton, June 3.

Ephemerella dorothea—Variety A.

Several imagos captured near Banners Elk on May 31 are so similar in general appearance to typical specimens of *dorothea* from Valle Crucis and Heaton, that I am unable to distinguish them except on genitalic structure. The penes of the Banners Elk males bear an unusual number of spines, 12 or 13 on each side (see fig. 3); the usual number of spines for this species is 6 to 9 on each side, typically 7 or 8. Unfortunately, all of these specimens were taken in flight, none were reared. All reared males from Valle Crucis and Heaton are normal as to number of spines on the penes. Nymphs collected at Banners Elk are similar to many of those from Valle Crucis. Therefore I am holding the Banners Elk specimens as a variety, perhaps an aberrant form, of *dorothea*.

Ephemerella rotunda Morg.

Many nymphs of this species were collected by Prof. Needham, Apl. 3-6, 1934, in the Great Smoky National Park, from Cataloochee Creek and Twenty Mile Creek.

Ephemerella fratercula (?) McD.

This species has not been reported hitherto from the state. A single male imago was taken in flight at Valle Crucis, on June 5. As this may prove to be a new species, closely allied to *fratercula*, I present a description of the single specimen, which is preserved in alcohol.

Male imago. Wing 8 mm. Eyes bright orange. Frontal portion of head yellow, vertex olive brown. Pronotum yellow, median area shaded with brown. Mesonotum light reddish brown, rather sharply contrasted with the yellowish pleura and sternum. Faint brownish markings along lateral margins of mesonotum; tip of scutellum creamy white; median anterior area with brownish shading. Metanotum yellow, posterior margin dark brown. Fore legs missing. Middle and hind legs whitish, tarsi very faintly smoky; tarsal joinings narrowly pale brown. Wings hyaline. Longitudinal veins of both wings very pale brown, cross veins invisible; costal margin silvery white except at apex. Dorsum of abdomen smoky to olive brown; posterior margins of basal tergites darker. Basal and middle segments semihyaline, apical segments opaque. Venter much paler than dorsum, but with faint smoky tinge; posterior margins of basal sternites deeper smoky. Tails pale smoky at base, becoming whitish distally; not darkened at joinings. Genitalia shown in fig. 2.

The spining of the genitalia, as well as the general coloring, resembles

fratercula so closely that I am holding the single specimen under that name. I would call attention to the following differences, however. Tails *not* dark-ringed, as in typical *fratercula*; venation pale brown instead of hyaline; no mid-ventral ganglionic markings, as in that species.

III. *Needhami* group.

Ephemerella septentrionalis McD.

Another species not reported hitherto from North Carolina. One male and three female imagos were taken in flight at Valle Crucis, May 25-27. No nymphs were collected. The extraordinarily long legs of this species, both in the nymph and the imago stage, are distinctive.

Ephemerella catawba Trav.

Many nymphs were collected at Valle Crucis, and in the Watauga River between Valle Crucis and Vilas. A female imago and a subimago were reared; two other imagos were taken in flight. No males were obtained. The female has not been described heretofore.

Female imago (alcoholic specimen). Body $8\frac{1}{2}$ mm.; wing $9\frac{1}{2}$ mm. Head and thorax greenish yellow; remainder of thorax deeper yellow. A low carina on pronotum, its anterior projection faintly dusky. Margins of mesonotum, and submedian triangular areas anterior to scutellum, dark brown. Posterior portion of mesosternum brownish. Legs yellow; tarsal joinings faintly darkened; claws dusky. Wings hyaline; stigmatic area faintly milky. Costa, subcosta, and radius of fore wing yellowish, all other veins paler, whitish; 8 to 9 stigmatic cross veins, wholly pale, anastomosed near costal margin, somewhat aslant. Abdomen discolored, due to presence of eggs. Pleural fold pale; sternites appear to be paler than tergites. Posterior margins of tergites narrowly darkened; those of sternites subhyaline, pale. Tails yellowish white, pale brown at extreme base; all joinings distinctly black-ringed.

Among my pinned specimens (Valle Crucis, May 25) are two females which I take to be *E. catawba*. Note differences between alcoholic and dried specimens, as to color of head and thorax.

Female imago (dried). Frontal portion of head yellow, antennae dusky, vertex and occiput pale red. Pronotum red-brown, with blackish shading on the low median carina. Mesonotum light red-brown; submedian triangles anterior to scutellum darker. Pleura and sternum flesh-colored, with many creamy markings. Legs yellow. Fore femur faintly flushed with pink, somewhat dusky at apex. Apical margins

of tarsal joinings on all legs faintly dusky. Dorsum of abdomen reddish brown with olive tinge; posterior margins blackish. Tergite 10 rather brighter red-brown. Sternites 1-6, and 9, yellow; 7 and 8 shaded with reddish. Tails as in alcoholic specimens.

Allotype—Female imago, reared. Watauga River near Valle Crucis, May 29, 1936 (J. R. T.). No. 1094.2 in Cornell University Collection.

Other specimens (nymphs): Great Smoky National Park, June 11, 1931 (J. G. Needham); Conestee Creek, June 20, (L. C. Thomsen, J. R. T.); North Toe River at Minneapolis, June 8 (L. C. T.); Linville River at Linville Falls, June 2 (L. C. T., J. R. T.); twenty Mile Creek, Great Smokies, Apl. 3, 1934 (J. G. N.); Banners Elk, June 3.

Ephemerella sp. No. 3

A single nymph, taken in Twenty Mile Creek, Great Smoky National Park, Apl. 3, 1934 (J. G. Needham), is intermediate in its characters between *E. catawba* and *E. rotunda*. General color, dark red-brown. Paler spots on head, anterior to each eye; occiput indistinctly mottled. Entire lateral margin of pronotum yellow. Meso- and metanota unmarked. Tibiae and tarsi dark-banded. Spines on fore femur mainly along posterior margin; do not form a continuous band across dorsal surface. A pair of short, submedian spines on posterior margins of tergites 3-8. No pale markings on abdomen. Whorls of spines at tail joinings prominent in basal half. Body (male nymph) $8\frac{1}{2}$ mm. A quite similar nymph, from Cataloochee Creek, Apl. 6, 1934 (J. G. N.), has a broad, pale, dorsal band the entire length of the body, as in one color phase of *E. needhami*.

Ephemerella sp. No. 4

Allied to *E. aurivillii* but larger; body (female nymph) 10-12 mm. Dorsal abdominal spines much better developed. General color red-brown. Two submedian, small, white spots on frontal margin of head; a large, rectangular, white spot anterior to middle ocellus; a smaller pale spot laterad of lateral ocellus. Occiput and entire dorsum of thorax mottled with darker blotches. Legs pale red-brown. Femora mottled with yellowish blotches; on fore femur, a small cluster of spines near posterior margin, but not forming a band across dorsal surface. Inner apical angle (tibial spine) of fore tibia slightly produced. Neither tibiae nor tarsi dark-banded. Claws with many pectinations, as in *E. catawba*. Pale submedian blotches may be present on tergites 5 and 6, next to inner margin of gills; on outer edge of this pale blotch, a deeper red streak. Postero-lateral extensions and spines yellowish;

no dark transverse band. Dorsal abdominal spines well developed; present on tergites 1-9, longest on 4-7. A series of short spines or tubercles extends from base of each spine forward almost to anterior margin of tergite. Tails yellowish red, darker apically; whorls of very short spines at joinings in basal half. Paler ventrally, posterior margins of sternites narrowly darkened; indistinct lateral line of marks near pleural fold. No mature male nymphs.

Ephemerella sp. No. 5

A small species of the *needhami* group, allied to *E. catawba*. Body of mature female nymph, 6-6½ mm., of male, 5-5½ mm. General color light red-brown; dorsum of abdomen with some purplish shading. Pale marks on head: anterior to median ocellus; anterior to eyes; submedian spots on posterior margin; epicranial suture. Lateral margins of pronotum pale; also irregular lateral markings. Mesonotum with irregular dark brown markings between and anterior to wing roots. Legs pale red-brown; no dark bands. Spines on fore femur numerous before apex, but not forming a continuous band. Postero-lateral extensions of abdomen well developed. Paired, submedian, dorsal spines on tergites 4-8; anterior to each spine, a series of small tubercles. Posterior margins of tergites purplish black; lateral areas shaded with purplish; middle segments may be white-blotched next to gills. Tails wholly reddish brown; whorls of spines at joinings in basal half. Ventrally, traces of a lateral line of dark dashes, one pair to a sternite, nearer to pleural fold.

IV. *Fuscata* group.

Ephemerella cornutella McD.

Nymphs of this species in my collection are from Valle Crucis, May 27-June 8; Heaton, June 3; stream near Blowing Rock, June 7; Cove Creek near Vilas, June 9; Davidson River, June 20; Lecky Gap, June 25; and Little River, Great Smoky National Park, June 26.

Ephemerella cornuta Morg.

Imagos: Lecky Gap, June 16; Valle Crucis, June 10. Nymphs: Heaton, June 3; North Toe River, June 8; Cove Creek, June 21; Valle Crucis, May 27-June 10.

Ephemerella longicornis Trav.

A few immature nymphs from the type locality, Cedar Creek near Glenville, June 15, and one nymph from a stream near Banners Elk, June 3.

Ephemerella lata Morg.

One nymph, Valle Crucis, May 28.

Ephemerella cherokee sp. nov.

E. tuberculata Morg., as treated in Traver, J. Elisha Mitchell Sci. Soc. 47: 175. 1932.

Nymphs and imagos from North Carolina, which I had previously considered to be *E. tuberculata* Morg., do not agree in many respects with Canadian specimens which Dr. McDunnough has reared. The type material, a single nymph taken near Ithaca, is no longer in existence. Dr. Morgan's figures indicate a tibial spine even longer than in the Canadian forms; occipital tubercles large, slightly convergent apically. The description calls for a "double row of distinct brown spots" ventrally. As the Canadian specimens seem nearer to the original description than do those from North Carolina, I am considering the latter as representing a new species.

Imago (alcoholic specimens). Body of male, 10 mm.; female, 9-10 mm.; wing of male, 10 mm.; female, 10-10½ mm. Distinguished from the Canadian specimens (on which the description in *Biology of Mayflies* is largely based) by the much darker venation, and the entire lack of dark ventral markings on the abdomen of the female. All longitudinal veins yellowish at extreme base, distinctly red-brown beyond. Cross veins in stigmatic area and in adjacent subcostal space pale red-brown; all others very pale, invisible except in apical area of radius of fore wing, and subcostal space of hind wing. Those of stigmatic area strongly anastomosed near costal margin. Eyes of male smaller in the North Carolina form; notum and sternum of thorax darker, blackish brown. No dark lateral dash on each sternite, next to pleural fold; other ventral markings in male diffuse, most evident on apical segments, obsolescent on basal ones. In female, no dark markings ventrally.

Nymph. Size very slightly larger than Canadian specimens. General color of body light red-brown; in life, greenish, often with a prominent whitish mid-dorsal stripe. Somewhat less hairy than Canadian form. Rather fewer tubercles on dorsal surfaces of femora, especially noticeable on the second leg. Tibia of second leg fully as long or slightly longer than femur; in Canadian forms, slightly shorter. Tibial spine of fore leg extends forward only about $\frac{1}{3}$ the length of the tarsus, while in Canadian specimens it extends almost half the length of the tarsus. Tubercle on lateral margin of pronotum much smaller than in Canadian

form; submedian tubercles on anterior margin of mesonotum, and median tubercle between wing cases, lower and more rounded. Paired submedian spines on abdominal tergites 3-7 relatively shorter. Lateral margin of 8th segment practically straight, the spine slightly incurved. In Canadian specimens, this margin is convex in basal portion, slightly flaring beyond, somewhat as in *E. allegheniensis*; spine barely or not at all incurved. Ventral abdominal markings much less distinct; when evident, reddish brown. Canadian specimens have a row of prominent blackish lateral streaks on each side.

Holotype—Male imago, reared. Cedar Creek near Glenville, N. C., July 25, 1930 (J. R. T.). No. 1460.1 in Cornell University Collection.

Allotype—Female imago, reared. Ocona Lufty River near Cherokee, N. C., June 28, 1930 (J. R. T.). No. 1460.2 in C. U. Collection.

Paratypes—Two female imagos, reared. Conestee Creek near Cedar Mt., N. C., July 19, 1930 (J. R. T.). No. 1460.3-4 in C. U. Collection.

Ephemerella sp.

Many female imagos were ovipositing in the Davidson River in the early forenoon of June 5, and again on June 16. They came flying steadily upstream toward the riffles where we were collecting, two or three to a dozen at a time. Occasionally one would dip down toward the surface of the water. They were unaccompanied by males.

The sprinkling of black dots on the femora indicates a relationship to the *fuscata-tuberculata* division of this group. There are no traces of black ventral markings on the abdomen, as in *tuberculata*; size smaller and venation paler than in *cherokee*; body color and venation darker than in *fuscata*, the red vertex of that species replaced by brownish black. Specimens seem too large to be *wayah*, imagos of which are not known.

Female imago (alcoholic specimen). Body 6-7 mm.; wing 8-9 mm. Frontal portion of head dark red-brown; vertex and occiput blackish, as is the pronotum. Thorax deep blackish brown, pleura somewhat paler. Venation light red-brown, longitudinal veins distinct. Fore legs blackish brown; femora of middle and hind legs olive brown, tibiae and tarsi yellowish; all femora with sprinkling of small black dots. Brownish shading at extreme base of both wings. Abdomen dark olive brown with reddish tinge; slightly paler ventrally. No apparent darker markings. Tails deep smoky brown, narrowly pale at joinings. Pinned specimens very similar. Specimens taken on June 16 are slightly smaller than those of June 5, otherwise similar.

V. *Serrata* group.**Ephemerella deficiens** Morg.

Imagos: Banners Elk, June 8; near Penrose, June 12; Davidson River, June 19-20. Nymphs: Valle Crucis, May 27-June 8; Heaton, June 3; Davidson River, June 17; Lecky Gap, June 16.

VI. *Simplex* group**Ephemerella** sp. No. 1

A single specimen of this species, a mature female nymph, was taken in a stream near Blowing Rock on June 7 (L. C. Thomsen). Body $6\frac{1}{2}$ mm. in length. Femora definitely wider than in *E. simplex*, to which it is allied; lateral margins of abdomen likewise more expanded, so that body appears wider. Tails distinctively marked: except at base, a series of three or four brownish joints alternate with one pale joint; joinings darker on brown areas. This appears to be a distinct species.

Undetermined female imagos

Among the specimens taken in flight in and near Valle Crucis are a dozen or more female imagos, representatives of four or five species. Some are evidently of the *invaria* or the *needhami* group, others seem to be of *serrata* or *simplex* group. I am unable to determine these as to species at the present time.

Subfamily Baetinae

Genus **Callibaetis** Eaton**Callibaetis** sp.

Two nymphs of an undetermined species of this genus were taken at Valle Crucis in the autumn of 1934 (L. C. Thomsen).

Genus **Baetis** Leach**Baetis incertans** McD.

A single male imago was reared from nymph; Valle Crucis, May 30. Nymphs: Valle Crucis, June 8; Cove Creek north of Vilas, June 9.

Nymph. Body of male, $4\frac{1}{2}$ mm. Head and thorax red-brown. Legs dark-banded. Abdominal tergites 1-3 and 6-8 largely brown; lateral margins and middle line at anterior margin pale, on 1-3. Median and lateral areas of tergite 4 pale, remainder brown. Tergite 5 largely pale, except for two dark submedian dots and narrow dark antero-lateral streak. Tergites 9-10 pale, unmarked. A pair of obscure, dark, submedian dots on tergites 6-8. Sternites 6-8 faintly dark-shaded;

posterior margins narrowly dark. Gills obovate; white, margins narrowly brown, main trachea visible in basal half only. Tails pale, tips darker.

Baetis cingulatus (?) McD.

A single male imago taken in a spider's web near Trade, Tenn., June 9 (L. C. Thomsen). This species has not been reported previously, either from North Carolina or Tennessee.

Baetis sp.

Several female imagos, caught in a spider's web at Conestee Creek, above the town of Cedar Mountain, June 28.

Two species of nymphs from Valle Crucis, May 26 and June 8. One species from Cove Creek at Sugar Grove, north of Vilas, June 9. One species, Twenty Mile Creek, Apl. 3, 1934 (J. G. Needham).

Genus **Acentrella** Bengtsson

Further study of the specialized Baetine group, Neotropical and Palaearctic as well as Nearctic, has convinced me that many genera are involved, and that it may not be possible in all cases to be certain of the genus unless both the nymphs and imagos are known. The nymph of Bengtsson's genus *Acentrella* is distinct from all species of *Baetis* except those allied to *bicaudatus* Dodds, by reason of its two-tailed condition. In the imago, the costal angulation of the hind wing is wholly wanting; a rounded or somewhat truncate 'penis-cover' is present on the male genitalia, between the bases of the forceps. Given both nymph and imago, it is possible to separate a certain group of *Baetis*-like species from all others in the subfamily; it is to members of this group that Bengtsson's generic name applies. I am convinced now that this group is worthy of generic rank, as I have indicated in *Mayflies of North Carolina*, although the species are treated under the genus *Baetis*, in the *Biology of Mayflies*.

Acentrella ampla Trav.

A small, rounded penis-cover is present between the forceps cases, in this species. The original figure merely suggests the presence of this structure; it was, in fact, not clearly indicated until the genitalia had been treated in caustic potash and re-mounted.

Genus **Centroptilum** Eaton

Centroptilum sp.

Females of two undetermined species of *Centroptilum* were taken in flight. One species, in which the body is rather uniformly reddish

brown, venter of abdomen paler, is represented by specimens taken at Banners Elk, May 31, and Cranberry, June 8. A single female of the second species, smaller and yellow-brown, was taken in the Pisgah National Forest on June 20.

Genus *Pseudocloeon* Klapalek

Pseudocloeon carolina Bks.

A single nymph, Valle Crucis, June 6.

Pseudocloeon dubium Walsh

This species is represented by nymphs from Cove Creek, June 9; stream near Blowing Rock, June 7 (L. C. T.); and the Great Smoky National Park, June 11, 1931 (J. G. Needham).

Pseudocloeon sp.

Undetermined female imagos of this genus were taken in flight at Davidson River, June 20; Penrose, June 12; near Blowing Rock, June 7; Conestee Creek, June 22.

Several nymphs of the *carolina-cingulatum* group are from Valle Crucis, May 25; Banners Elk, May 31; and Heaton, June 3. These resemble *carolina* in general coloration, but are more slender.

Genus *Cloeon* Leach

Cloeon sp.

A single undetermined female imago, Valle Crucis, June 7.

ALABAMA*

In Alabama, Tuscaloosa was selected as headquarters for collecting trips and for the rearing of nymphs. Tanks of running water, in the Zoology Department of the University of Alabama, were made available to us for rearing purposes, thanks to the kindness of Dr. Septima Smith of the Zoology Department of that institution.

* Small streams in northern and central Alabama, in which we made collections, are relatively poor in mayfly, stonefly, and caddisfly faunas. This paucity of the mayfly nymphs in the small streams was very marked, in contrast with the rich collecting we had just left, in the mountains of North Carolina. It was also in striking contrast to the wealth of material to be obtained in the Odonate group, both dragonflies and damselflies. In only one stream of a dozen or more in which we collected assiduously, did we find more than six or eight mayfly nymphs, and that after an hour or more of endeavor. The larger rivers yield representatives of the Ephemeroidea, as well as a few species of the other two families. No attempt was made to collect in the Black Warrior River in or near Tuscaloosa; it appears to be much polluted as it passes through that city.

All species listed here, with the exception of *Hexagenia bilineata*, have not been reported previously from the state of Alabama.

Family EPHEMERIDAE

Subfamily Ephemerinae

Genus *Hexagenia* Walsh

Hexagenia bilineata Say

Imagos of both sexes were numerous on the store windows in Tuscaloosa on the evening of July 2. On July 4, many imagos and subimagos were seen on a bridge over a river between Birmingham and Decatur. Many were tangled in spiders' webs. Great numbers of nymphal skins were floating on the surface of the water, but we were unable to obtain any of them. The following day, many imagos were taken from low vegetation along the shore of Wilson Lake, just above the dam at Muscle Shoals.

Hexagenia orlando Trav.

Three male imagos taken in Tuscaloosa, June 29–July 2, correspond quite closely to specimens of *orlando* taken at Spring Creek, Ga. The type specimen of this species is paler, due to immersion in alcohol for a longer period of time, but is similar in essential features. In the Alabama specimens, the middle and hind legs are wholly yellow except for claws and distal tarsal joints, which are black; in typical *orlando*, all joinings of these legs are brown. Four females taken along with the males are evidently of the same species. Another female accompanying them has the dark markings on dorsum of abdomen much reduced; it may be only a very pale form of the same species. Nymphs of this species are not known.

Hexagenia sp.

Nymph (described from specimens taken at Cooley Creek). Body (including tusks): female, 30 mm.; male, 22 mm. Mandibular tusks as in fig. 17. Frontal process of head rounded laterally, anterior margin flattened. Head and thorax reddish brown. Legs yellow, with usual fringes of dark orange hairs. Abdomen yellowish white. A wide, grey, mid-dorsal band encloses pale, broken, submedian lines; from each end of this dark band, on the posterior margin, an oblique grey streak extends antero-laterally. Gills and gill fringes deep purplish grey. Tails white to yellowish, fringed with yellow hairs. Ventrally, traces of purplish transverse dashes at postero-lateral margins, and in

median area of sternites 7 and 8. In male, black, submedian, transverse dashes on anterior margins of basal and middle sternites.

Specimens were taken at Cooley Creek, between Tuscaloosa and Birmingham, July 4. An immature nymph was taken from Big Sandy Creek near Coaley, on July 2 (R. E. Hodges); nymph skins of the same species floated near the shore of Thompson's Lake, near Tuscaloosa, on June 29. Unfortunately, no adults were reared, nor were any found in the same vicinity as the nymphs. Can this be the nymph of *H. orlando*? It is evidently a species whose habitat is small lakes and streams, rather than the large rivers usually inhabited by *H. bilineata*.

Genus *Pentagenia* Walsh

Pentagenia vittigera Walsh

Two females were captured from store windows in Sheffield, on the evening of July 4.

Family HEPTAGENIIDAE

Genus *Stenonema* Trav.

Stenonema interpunctatum Say

Imagos of this or a closely allied species were taken from vegetation on the shore of Wilson Lake, on July 5. A single female from the North River near Tuscaloosa may be of this same species.

**Stenonema smithae* sp. nov.

A species of the *pulchellum* group; superficially very similar to *S. integrum* McD., but differing in details of genitalic structure.

Male imago (dried). Body $7\frac{1}{2}$ mm.; wing $7\frac{1}{2}$ –8 mm. Head pale. A faint ruddy transverse band across median carina. Tip of basal segment of antenna, and filament, dusky. Eyes large; piceous. Thorax pale yellowish white; mesonotum, also areas on pleura, flesh-colored. Scutellum white. Fore femur and tibia yellow; ruddy median and apical bands on femur; tip of tibia black. Tarsus paler, yellowish white; claws and tip of distal joint, and all joinings, dusky. Middle and hind legs yellowish white; ruddy bands on femora, as in fore leg; tips of tibiae, claws and distal tarsal joints, dusky. Basal joint of fore tarsus less than half the length of the second. Wings hyaline. Venation of fore wing brown, rather darker than in *integrum*; subcosta and radius yellowish white.

* I take pleasure in naming this species for Dr. Septima Smith, who extended to us many courtesies during our stay in Alabama.

low; all longitudinal veins finer than cross veins. Humeral cross vein infuscated, also base of subcosta. Cross veins more regularly distributed than in *integrum*,—less tendency toward serial arrangement. Usually three costal veins before the bulla. Stigmatic cross veins 7 or 8 in number; simple, straight. Very faint reddish tinge in stigma. Venation of hind wing wholly pale; outer margin very narrowly dusky in apical portion only.

Abdomen pale yellowish. Stigmatic dots well developed. Posterior margins of tergites narrowly dark, most evident in median area. Apical tergites faintly flesh-colored. Pleural fold yellow. Sternites unmarked. Tails whitish, alternate joinings narrowly purplish black. Genitalia more distinctly L-shaped than is the case in *integrum*.

Male imago (alcoholic specimen). Dusky markings at middle of anterior margin of mesonotum, and along its antero-lateral angle. A faint dusky streak on prothorax, above leg base; on mesothoracic pleura, very faint dusky pencilings above leg bases. Fore femur with faint ruddy tinge; apical ruddy bands of all femora more distinct and more reddish than median ones. Abdominal segments 1-7 whitish, not yellowish as in dried specimen.

Female imago (alcoholic specimen). Body $7\frac{1}{2}$ -8 mm.; wing 8-9 mm. Similar to male except as indicated. Reddish stigmatic tinge may be more evident than in male, or it may be wholly obsolescent. At bulla, cross veins in first three spaces are: 1, 2, 2. Cross veins somewhat more numerous than in male; tend to be arranged irregularly in series. A blackish longitudinal penciling extends the length of each femur, near middle of outer surface. A faint reddish tinge may be present on basal third of each tibia. Dusky pencilings on thoracic pleura, spiracular dots, and dark posterior margins of abdominal tergites, more evident than in male. Thorax and apical abdominal segments more yellowish. Lateral tracheae dusky, on apical segments. Dusky margin of hind wing more extensive.

Nymph. Head dark brown; frontal portion thickly freckled with small pale dots. Pale area along outer margin of eye; one dark spot in this pale border. A fleur-de-lis shaped pale mark anterior to median ocellus. Pale areas next to inner margin of eye, and a diamond-shaped pale median area between eyes. Bases of antennae dark brown, filament paler. Thorax dark red-brown; pronotum darker and less red than mesonotum. Pale markings on pronotum: narrow median line; a pair of submedian dots; lateral triangular marks; middle portion of lateral margin, and an inwardly-directed anterior arm from same.

Median line of mesonotum pale; a few small and indistinct pale dots anterior to wing roots. Femur largely dark except at base, apex, a pre-apical band, and small pale median areas enclosed by dark color. Near apex, a reddish band as in imago. Tibia yellow; a narrow basal and a wider median dark brown band. Apical half of tarsus pale.

Abdominal tergites 1-5 pale laterally, and irregularly in median area, elsewhere dark brown. Tergites 6-10 largely dark brown; a pale lateral triangle on 6 and 7; anterior margins of 9 and 10, and submedian dashes from anterior margin of 9, likewise pale. Venter yellowish. Brown streaks along lateral margins of sternite 9. Very faint indications of dark submedian dashes from anterior margin of each sternite, and a dark dot near end of each. On sternite 9, a faint dark median spot at anterior margin; a transverse dark line extends laterad from it. Tails red-brown at base, followed by a yellow area, in which joinings are brown; in apical two-thirds, three dark joints alternate with one pale joint. Gills purplish grey; tracheae black.

Holotype—Male imago, pinned. Reared from nymph. Spencers Mill, Tuscaloosa, Ala., July 1, 1936 (J. R. T.) No. 1461.1 in Cornell University Collection.

Allotype—Female imago, in alcohol; reared. Same locality, July 3, 1936 (J. R. T., S. C. Smith). No. 1461.2 in C. U. Collection.

Paratypes—Three male imagos, two female imagos; same locality, June 30—July 8, 1936 (J. R. T., S. C. Smith). No. 1461.3-7 in C. U. Collection.

Nymphs of this species were collected at Spencers Mill near Tuscaloosa, Ala., and reared in tanks in the Zoology Laboratory at the Univ. of Alabama. The imagos differ from the allied species *S. integrum* McD. as follows: (1) Larger size; (2) genitalia of male distinctly L-shaped; (3) cross veins in wings less regularly arranged in series; (4) spiracles marked by a distinct dark dot rather than a dash; (5) no median dorsal markings on tergites.

Stenonema alabamae sp. nov.

Another species of the *pulchellum* group, allied to *S. integrum* McD. Basal joint of fore tarsus longer than in any known species of this genus.

Male imago (dried). Body 6 mm.; wing 7 mm. Frontal portion of head pale; a wide, dark, transverse band across median carina. Much ruddy shading on vertex and occiput. Pronotum clay-colored, median areas dusky. Pleura and sternum of mesothorax flesh-or-clay-colored; alabaster white areas on pleura, and on sternum between middle legs.

Anterior to wing roots, and on pleura, distinct ruddy shading. Blackish pencilings above leg bases. Mesonotum blackish brown; tip of scutellum, and small area anterior to it, whitish. Fore legs yellowish white; femora faintly smoky. Median and apical ruddy bands on femora; darker shading at base. Tips of tibiae blackish. Claws, most of distal joints of tarsi, and all joinings, dusky. Basal joint of fore tarsus *fully three-fourths as long as the second*. This is true of both legs. Is it an abnormality? On this character, the species would fall into *Cinygmula*; but genitalia, venation, and all other characters are that of the genus *Stenonema*.

Middle and hind legs whitish; femora twice-banded with reddish; tibial and tarsal joinings, claws and tips of tarsi, dusky. Wings hyaline. No crowding of cross veins at bulla; in first three spaces, these are: 1, 2, 2. Base of costa and subcosta, and humeral cross vein, infuscated. Three main veins of costal margin yellow, well developed; other longitudinals much finer than cross veins, brown. Cross veins blackish brown; some tendency toward serial arrangement as in *S. integrum*. Five costals before bulla; seven or eight in stigmatic space; simple, may be slightly aslant. Distinct reddish stigmatic stain; seems wholly confined to subcostal space. A wide smoky border on hind wing occupies fully one-fourth of the width of the wing. Abdominal segments 1-7 semihyaline. Wholly white ventrally; tergites with distinct smoky tinge. A rather wide dark brown posterior border on all tergites; spiracular dots present, but more or less obscured by the dark margins. Segments 8-10 opaque. Tergites 8-10 rather bright red-brown; a pale median spot on tergite 10. Sternites whitish. Tails whitish; alternate joinings purplish brown. Genitalia much as in *S. rubrum* McD.

Female imago (dried). Body 6-7 mm.; wing 8 mm.

Head whitish; band on carina usually present, as in male. Thorax flesh-colored; sternum whiter than pleura. Fore leg pale yellowish, other legs whitish; marked as in male, the femoral bands purplish red. All longitudinal veins yellowish, fine; cross veins very heavy, dark brown; as in male, a tendency for these to be arranged in a series, but the wide interspaces thus formed appear *before* the bulla (in *integrum*, these are *beyond* the bulla). At bulla, cross veins may be: 1, 2, 2; or 1, 3, 3. Wide smoky border on hind wing, as in male, but somewhat paler smoky. Abdomen yellow, when filled with eggs, otherwise whitish. Spiracular dots large, distinct; posterior margins narrowly black. Sternum unmarked. Tails as in male, but the darker joinings may be obscure in the basal portion.

Holotype—Male imago, pinned. Store window at Sheffield, Ala., July 4, 1936 (J. R. T., L. C. Thomsen). No. 1462.1 in Cornell University Collection.

Allotype—Female imago, pinned. Same data. No. 1462.2 in C. U. Collection.

Paratypes—Eight pinned females, two females in alcohol. Same data. No. 1462.3 12 in C. U. Collection.

The somewhat larger size, differences in venation and genitalia, and unusual length of basal fore tarsal joint of male serve to distinguish this species from the allied *S. integrum* McD.

Stenonema exiguum Trav.

A single female imago of this species was found on the radiator of the car on June 27. It had been collected somewhere between Birmingham and Tuscaloosa.

Genus **Heptagenia** Walsh

Heptagenia minerva McD.

Hundreds of these tiny and very dainty mayflies crowded the store windows of Sheffield on the evening of July 4. We collected until our cyanide jars would hold no more. Did they come from the Tennessee River, or from some small tributary which we did not see?

Heptagenia aphrodite (?) McD.

A single nymph taken in Cooley Creek on July 4 is doubtfully referred to this species.

Family Baetidae

Subfamily Siphonurinae

Genus **Isonychia** Eaton

Isonychia fattigi Trav.

A single male imago which agrees well with the type material of this species was removed from the radiator of the car on the evening of our arrival in Tuscaloosa, June 27. It had been picked up somewhere between Birmingham and Tuscaloosa. Five female imagos which may be of this species were collected on store windows at Sheffield, July 4.

Isonychia circe (?) Trav.

Nymphs of this species were fairly abundant in the small stream above Spencers Mill, near Tuscaloosa, in Cooley Creek between Birmingham and Tuscaloosa, and in the North River about fifteen miles from the latter city. Several were reared in the Zoology Laboratory.

From nymphs taken in the North River, two females emerged, but no males. Nor were any imagos caught in flight, although two were seen at twilight over North River. The female imago bears a close resemblance to the type material of *circe*, aside from its slightly larger size (body 11 mm.; wing 10 mm.).

Mature nymph (Cooley Creek specimen). Body of female, 11 mm. General color dark red-brown. Basal joints of antenna marked with white; remainder dark brown, no distinct dark band. A wide, pale, median stripe on head is continued backward over the entire thorax, and more indistinctly for the length of the abdomen. Laterally on pronotum, two pale, crescentic marks, and one small round spot. Tibial spine of fore leg relatively long, extending fully one-half the length of the tarsus; curved slightly outward. Spines on outer surface of tibia few in number, 12 to 15 only. Fore leg dark red-brown; pale median and apical bands on femur; claw, and distal half of tarsus pale. On other legs, pale bands also at base of femur and at each end of tibia. Anterior margin of tergite 10 pale, apical portion black. Posterolateral spine on segment 9 distinctly longer than that on 8. Traces of narrow, black, submedian lines bordering the paler median area, on tergites. Ventrally, traces of pale submedian streaks from anterior margin. Gills largely deep purplish.

A mature male nymph taken at Big Sandy Creek near Cooley may be of this same species. However, the fore femur is largely yellowish; tibial spine shorter and stouter. General appearance similar to Cooley Creek specimens. Body 10 mm., which is rather larger than one would expect the male of this species to be. Other nymphs in the Cornell Collection, from Huntsville, June 18, 1931, agree well with the Cooley Creek specimens except for the fore femur, which again is largely pale.

Subfamily Ephemerellinae

Genus *Ephemerella* Walsh

Ephemerella doris Trav.

One nymph, the only representative of this genus collected in the state, was found in Cooley Creek on July 4.

Subfamily Caeninae

Genus *Caenis* Stephens

Caenis jocosa (?) McD.

Among the swarming multitudes of mayflies on the windows at Sheffield on the evening of July 4, was one female *Caenis*, which appears to be of this species.

Subfamily Baetinae

Genus *Acentrella* Bengtsson*Acentrella propinqua* (?) Wlsh.

One male and one female imago were taken at Sheffield on July 4. As I am not certain that these specimens are *propinqua*, I present a brief description of each sex. Genitalia of male as in fig. 5.

Male imago. Body 4 mm.; wing 4 mm. Turbinate eyes very large, set on very short stalks; bright red-brown. Antennae dusky. Head and thorax black-brown; intersegmental areas of thoracic pleura somewhat paler. Legs white. Wings hyaline. Costa and subcosta dark brown at extreme base; humeral cross vein dusky; longitudinal veins in anterior half of fore wing pale brown, all other veins colorless. Abdominal segments 2-6 white, hyaline; posterior margins very faintly yellowish; at each spiracle, a black circle (*not* a dot). Tergites 7-10 reddish to maroon; sternites paler, somewhat dusky. Tails white, unmarked.

Female imago. Body deep orange; thorax somewhat paler and duller than abdomen. Legs greenish brown. Longitudinal and cross veins, and marginal intercalaries, dark brown.

Genus *Pseudocloeon* Klapalek*Pseudocloeon dubium* (?) Wlsh.

One male subimago and several female imagos, taken on the windows at Sheffield, July 4, are held under this name.

Genus *Centroptilum* Eaton*Centroptilum* sp.

Two female imagos of an undetermined species of this genus were taken at Sheffield, July 4.

FLORIDA

Family EPHEMERIDAE

Subfamily Neoephemerinae

Genus *Oreianthus* Trav.*Oreianthus* sp. No. 1

Mature nymphs of a species of *Oreianthus* much smaller than *O. purpureus* were taken in the Sweetwater Branch, Liberty Co., on Apl. 3, 1927, by Prof. Needham. Since the differences noted between these

nymphs and those of *O. purpureus* might be generic rather than specific (the nymph of the closely-allied genus *Neophemera* is not known), I designate this species by number only.

Nymph. Body of female, 9–10 mm.; of male, 8–8½ mm. General color, dark red-brown. Head, thorax, and abdomen finely mottled with tiny, pale dots. Crescentic, pale mark on head anterior to median ocellus; diamond-shaped pale spot between base of antenna and inner anterior corner of eye. Lateral margin of pronotum widely flaring at each angle, the middle area concave (see fig. 13). The short, submedian tubercles on anterior margin of this sclerite are closer together than in *purpureus*, almost approximated at the median line. Lateral margin, usually also a narrow, median line, pale yellowish. Projections at anterior margin of mesonotum yellowish, extending out only slightly beyond margin of pronotum. The median tubercle between the wing cases is rather better developed than in *purpureus*. Median spine on mesosternum much as in that species. Legs yellowish to pale red-brown. No distinct markings dorsally. Ventrally, a small, dark dot at apex of trochanter; triangular area on apical portion of femur pale yellowish. Tip of tibia not produced anteriorly, as in *purpureus*. Claws slightly longer and more distinctly curved than in that species.

Median line of abdominal tergites may be wholly pale, or with a pale spot at extreme anterior and posterior margins only. Posterolateral projections paler red-brown than main portions of segments. These projections are rather more flaring than in *purpureus*, especially that on segment 9, which is also relatively longer and more slender. The distinct median tubercle present on the posterior margins of the middle tergites in *purpureus* is here much reduced. Ventrally, a lateral row of dark dots on each side, located at anterior margin of each sternite; traces of a dark streak extending backward from each of these. Ganglionic area of each basal and middle sternite a paler, rounded spot. Tails light red-brown.

GEORGIA

Family EPHEMERIDAE

Subfamily Neophemerinae

Genus *Oreianthus* Trav.

Oreianthus sp. No. 1

Specimens of this species in the Cornell Collection are from Upatoi Creek, Apl. 29, 1931; Oconee River near Greensboro, Apl. 9, 1931; and Town Creek, May 14, 1931 (P. W. Fattig).

Family HEPTAGENIIDAE

Genus **Heptagenia** Walsh**Heptagenia thetis** Trav.

Several females, taken at Swamp Creek near Dalton, May 26, 1931
(P. W. Fattig).

SOUTH CAROLINA

Family EPHEMERIDAE

Subfamily Ephemerinae

Genus **Hexagenia** Walsh**Hexagenia carolina** Trav.

One male subimago, Clemson College, June 4, 1931 (D. Dunavan).

Hexagenia marilandica Trav.

A male imago and one subimago, Clemson College, June 23, 1933
(B. M. Latham).

Hexagenia kanuga sp. nov. (described under North Carolina)

Florence, May 16, 1929 (O. L. Cartwright).

MARYLAND

Family EPHEMERIDAE

Subfamily Potamanthinae

Genus **Potamanthus** Pict.**Potamanthus inaequalis** Ndm.

Imagos of both sexes, taken at Conococheague Park, near Hagerstown, July 22, 1926 (V. Argo).

Potamanthus walkeri Ide

Several nymphs, the Potomac River near Brunswick, June 19, 1926
(V. Argo).

Family HEPTAGENIIDAE

Genus **Heptagenia** Walsh**Heptagenia lucidipennis** Clem.

About twenty-five specimens, adults of both sexes, were collected from a store window in Frederick, on the evening of May 21, 1936
(J. R. T., R. Rice).

EXPLANATION OF PLATE 6

- Fig. 1. *Rhithrogena rubicunda*. Penes.
- Fig. 2. *Ephemerella fratercula* (?). Penes.
- Fig. 3. *Ephemerella dorothea*. Variety A. Penes.
- Fig. 4. *Rhithrogena fasciata*. Penes.
- Fig. 5. *Acentrella propinqua*. Male genitalia.
- Fig. 6. *Baetisca thomsenae*. Male genitalia.
- Fig. 7. *Potamanthus distinctus*. Mandibular tusk and part of head, nymph.
- Fig. 8. *Oreianthus purpureus*. Male genitalia.
- Fig. 9. *Baetisca carolina*. Subanal plate, female imago.
- Fig. 10. *Baetisca thomsenae*. Subanal plate, female imago.
- Fig. 11. *Baetisca thomsenae*. Claws of nymph. A—1st claw; B—2nd claw; C—3rd claw.
- Fig. 12. *Baetisca carolina*. Claws of nymph. A—1st claw; B—2nd claw; C—3rd claw.
- Fig. 13. *Oreianthus* sp. No. 1. Pronotum and anterior portion of mesonotum, nymph.
- Fig. 14. *Baetisca thomsenae*. Lateral portion of mesothoracic shield, nymph.
- Fig. 15. *Baetisca carolina*. Lateral portion of mesothoracic shield, nymph.
- Fig. 16. *Hexagenia marilandica*. Mandibular tusk, nymph.
- Fig. 17. *Hexagenia* sp. Mandibular tusk, nymph.
- Fig. 18. *Iron rubidus*. Lateral spines on abdominal segments 6 and 7; nymph.
- Fig. 19. *Iron subpallidus*. Lateral spines on abdominal segments 6 and 7; nymph.

PLATE 6

