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MAYFLIES OF NORTH CAROLINA

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[Continued*]

Appalachian region.

Almost every stream in this region, in which any collecting was done, yielded one to several species of *Ephemerella* nymphs. The streams which yielded the largest numbers of species of this genus were the Ocona Lufty River near Cherokee, and the Davidson River in Pisgah National Forest, from each of which six different species of the genus were taken; and Wayah Creek in Jackson Co., near Franklin, with four different species.

Fuscata group

Ephemerella cornutella McD.

This was the commonest species of the mountain region, being found in twenty-three different stations. Extremely variable in coloration, it is nevertheless fairly constant in size, and can be separated from other North Carolina nymphs of the *cornuta* division of this group by the short, blunt tibial spine of the foreleg; the great relative width of the fore femur, which is almost as wide as long; and the relatively short curved frontal horns. It is likewise consistently smaller than either of

* All the plates for this article were published with the first part in the preceding number of this Journal.

the other species of the *cornuta* division taken in this region. Color variations range from light red through darker red to dull olive brown, some being found that were so dark as to appear black.

In the mountains of North Carolina, the species matures from the latter part of June to mid-July. It was collected in the Catawba River and its tributaries; the Swannanoa River and its tributary Flat Creek; Davidson River and two tributaries; Wayah Creek; Pigeon River and three tributaries; Cataloochee Creek near Jarvis Palmer's camp, north of Waynesville; a tributary of the French Broad at Selica; two tributaries of the Cullasaja River south of Franklin; streams entering the Nantahala River; Rocky Broad River at Lecky Gap; Ocona Lufty River; South Toe River; a branch of Laurel River, south of Hot Springs; and in Collins Creek, above Smokemont.

Dr. McDunnough verified my identification of this species.

***Ephemerella cornuta* Morgan—variety A.**

Another member of the *cornuta* division, larger than *E. cornutella* and about the size of *E. longicornis*, n.sp., which is described next, and which it most resembles. Comparison of this species with the latter, however, shows that the frontal horns of *E. cornuta* are not as long and are more curved; that the tibial spine of the foreleg is slightly shorter and does not curve outward so definitely at the tip; and that the hind margin of the fore femur is somewhat more rounded.

The nymph corresponds almost exactly with Miss Morgan's original material on this species, but the imagoes differ slightly, hence I am calling the southern form *variety A*. In my specimens, the foreleg of the female, and of the male except the tarsus and in some specimens the femur, are reddish brown. The tails of both sexes are purplish to purplish brown.

Nymphs of this species were taken from the Catawba River, above Old Fort; Flat Creek; a tributary of the Rocky Broad, at Bat Cave; Cedar Creek, near Glenville; the Ocona Lufty River; one tributary of the Pigeon River at Waynesville, and another near Hazelwood; and in the Little River near the town of Cedar Mt. Several imagoes were reared. They emerged from mid-June to mid-July.

***Ephemerella longicornis*, sp. nov.**

A member of the *fuscata* group. Quite close to *E. cornuta*. Imago with postero-lateral spines on segments 8 and 9, the latter slightly

MEASUREMENTS IN MM.

| | BODY | TAILS | FOREWING | FORELEG |
|----------------------------------|------|--------|----------|---------|
| Male nymph (4 specimens)..... | 8-9 | 5-6 | | |
| Female nymph (6 specimens)..... | 9-10 | 5½-7 | | |
| Male subimago (2 specimens)..... | 7-8 | 10 | 8-8½ | 5 |
| Female imago (1 specimen)..... | 9 | Broken | 9 | 5½ |

longer. Indentation at apex of penes deeper than in *E. cornuta*. Tails dark purplish brown. Nymph distinguished from *E. cornuta* by 1) the very long tibial spine of the foreleg, which turns outward sharply in its distal half; 2) the longer and straighter frontal horns; 3) the sharper tubercle below the median ocellus; and 4) the straighter hind margin of the fore femur.

Male (subimago from which the exuvia has been artificially removed)

Head—Median carina, a transverse band between the bases of the antennae, and antenna, brown.

Thorax—Pronotum olive brown, margined with greyish white. Median line narrowly white. A round white spot on each side of median line posterior to center. Elsewhere, the median line is margined with dark brown. Irregular dark transverse lines on each side. Mesonotum olive brown mottled with yellowish. Median line dark in central portion. Metanotum and borders of mesonotal spine dark brown. Anterior to wing roots, a grey-lavender streak. Pleura olive brown and cream-color. Sternites and antecoxal pieces dark brown; intersegmental areas cream-colored. Axillary cords of fore wing produced into spinous processes on each side of mesonotal spine.

Legs—(subimago) Fore femur yellowish brown, margined and shaded distally with dark brown. Tibia and tarsus dark brown except last tarsal joint and claw, which are lighter brown. Femur and tibia of second and third legs yellow, margined narrowly with brown. First three tarsal joints dark brown; last joint and claw lighter brown.

Wings—Hyaline, brownish at base. Costal margin of fore wing brown in basal half. Longitudinal and a few cross veins of fore wing yellowish brown. Cross veins of stigmatic area anastomosed. Cu_2 and 1st anal not fused at base.

Abdomen—Spines on postero-lateral angles of segments 8 and 9, that on 9 being the longer. Tergites dark reddish brown; 1 lighter in central

portion. Each tergite has a cream-colored triangular patch on each side of the median line, its base on the anterior margin. Tergites darker brown posteriorly and next to the greyish white pleural fold. In this dark margin an irregularly crescentic light mark. Ventrally, yellowish. Sternite 1 brown; 2-4 shaded with grey or lavender. On each a brownish lavender bar parallel and near to the posterior margin. A purplish brown longitudinal streak on each, bordering the whitish pleural fold. Two oblique white marks, one on each side of median line at anterior margin; small whitish dot ringed about with brown on each side of median line, posterior to the center.

Genitalia as on Pl. 9, Fig. 22.

Tails—Dark reddish brown.

Female imago

Differs from male as follows.

Head—Light yellow-brown. Median carina purplish. Antenna light lavender. Two yellow crescentic marks on occiput, near median line.

Thorax—Prothorax yellowish brown, marked with purplish. Median line dark. A large pear-shaped yellow spot on each side of median line near center, each outlined in lavender. A V-shaped lavender area at anterior border, on median line. Posterior and lateral margins shaded with lavender. Mesonotum, metanotum and pleura yellowish brown; intersegmental area cream-colored. Prosternum olive brown. Mesosternum cream-colored anteriorly and on median line; two large lateral areas and antecoxal pieces of second leg chestnut brown.

Legs—Foreleg brown; femur tinged with olive, tibia and tarsus purplish. Other legs yellowish white, tibia and tarsus tinged with brownish lavender.

Abdomen—Eggs dark purplish brown, imparting this color to abdomen. Pleural folds light grey, also posterior margins of tergites. Tergites 9 and 10 dark chestnut brown. Ventrally, posterior margins light grey, wider than on tergites. Sternites 1 and 2, median area of 3, 4 and 7, and all of 8 and 9, washed with chestnut brown. Sternite 8 marked with purple at opening of egg valve. Median line of all sternites light grey. No marks as in male. Postero-lateral spine on 8 turns out at tip more definitely than in male. Apical margin of extension of 9th sternite as on Pl. 9, Fig. 25d.

Tails—Dark purplish brown.

Nymph

A large nymph, light reddish in color.

Head—No occipital tubercles. Frontal horns very long, almost straight. (See Pl. 9, Fig. 14). Sharp tubercle below median ocellus. Frontal shelf fringed with long white hairs. Mouth-parts very similar to *E. cornuta*.

Thorax—In most specimens which are not completely matured, the dorsum of the thorax is definitely checkered with light and dark areas, these being very evident on the pronotum and parts of the mesonotum. Fully mature nymphs may not show these areas.

Legs—Fore femur with prominent spines on fore margin, the hind margin almost straight. Tibial spine very long, extending beyond the middle of the tarsus, and in its distal half turning sharply outward. See Pl. 9, Fig. 10. Legs yellowish, with indistinct reddish bands. Two such bands on femur, one on tibia.

Abdomen—No dorsal abdominal spines. Postero-lateral spines of abdominal segments somewhat longer than in *E. cornuta*. Abdomen sometimes lighter in color than head and thorax, but if so, each tergite is darker on posterior margin. Ventrally yellow. A row of dark marks on each side, parallel to lateral margin. Sternites 2-8 hairy, especially along lateral margins. Hairs fine but fairly long, light grey. Gills greyed lavender.

Tails—Yellow to yellowish brown, often becoming purplish brown in fully mature nymphs. In most specimens, each tail has a single dark reddish ring a short distance from the base.

Holotype—Female imago. Reared. Cedar Creek, near Glenville, N. C., July 14, 1930. No. 1095.1 in C. U. collection.

Allotype—Male subimago. Reared. Same locality, July 25, 1930. No. 1095.2 in C. U. collection.

Paratypes—2 male subimagoes, 4 female subimagoes, 30 nymphs. Cedar Creek, July 1929 and July 1930. No. 1095.2-38 in C. U. collection.

The nymphs of this species of the *cornuta* group were less common than either *E. cornuta* or *E. cornutella*. In life they possess a definite checker-board pattern of light and dark markings on the dorsum of the thorax, with a considerable variation of ground color. They were found on the sides or near the tops of large rocks in the swiftest current, often clinging to the small crevices and irregularities of the rock surface. They

did not move for some time, when the rock was lifted from the water. From my field notes I quote the following;—I found many different shades, colors and patterns (of these nymphs),—it seemed, colored to match the rocks they were on,—but there may have been but two species.—This proved to be true, as both *E. longicornis* and *E. cornuta* were taken from Cedar Creek, where these observations were made. The nymphs were found only at Cedar Creek, which is tributary to the Tuckaseegee River, and in a small stream on Cowee Mt., tributary to the same river. Subimagoes emerged from the 12th to the 25th of July.

Although several subimagoes of both sexes were reared, very few of them were successful in their final transformation. However, several of the males were sufficiently mature to enable me to remove the subimaginal skin for purposes of study.

Ephemerella conestee, sp. nov.

MEASUREMENTS

| | BODY | TAILS | FOREWING | FORELEG |
|---------------------------------|------|--------|----------|---------|
| Male nymph (4 specimens)..... | 5½-6 | 2-2½ | | |
| Female nymph (7 specimens)..... | 5-7 | 2¼-4 | | |
| Male subimago (1 specimen)..... | 6 | 3 | 7 | 4 |
| Female imago (1 specimen)..... | 6¼ | Broken | 7¼ | 3 |

This species belongs in the *fuscata* group. It is a late-maturing form, imagoes appearing the last week in July. Male adult with orange to rose-tinged abdomen. Body and legs marked with purplish rose. Genitalia of the *fuscata* type. Wings tinged at base with purplish brown, veins very faintly yellowish. Tails brown, orange-tinged at base.

Nymph with very short frontal horns. Anterior margin of fore femur with spines. Short dorsal abdominal spines present on segments 2-7. Strikingly marked with yellow and brown; quite variable in size and color. Some specimens show distinct rose markings on head, thorax, femora and dorsal aspect of abdomen.

Male (subimago from which exuvia has been removed, to show colors of imago)

Head—Light brown tinged faintly with purplish. Compound eyes yellowish to orange.

Thorax—Pronotum with rather prominent median carina; purplish rose except semicircular dark greyish area at center of anterior border. Mesonotum light olive brown, strongly tinged with lavender, especially at median line and lateral borders. Spine bordered with dark brown, also lavender-tinged. Metanotum brown tinged with purplish rose. Pleura light olive brown, cream colored to whitish at sutures. A rose-colored streak from wing-roots to pronotum, another from wing to base of fore leg. Ventrally darker olive brown.

Legs—Fore femur greyish, streaked with purplish rose. Tibia and tarsus dark olive brown. Other legs very light olive-brown, joinings and claws dark brown.

Wings—Hyaline. veins faintly yellowish. Tinged with purplish brown at base of forewing. Cross veins of stigmatic area anastomosed. Several indistinct cross veins before the bulla.

Abdomen—Tergites 1-3 deep purple, tinged with rose. Tergites 4 and 5 orange marked with bright purplish red; darker on each side of median line, halfway to pleural fold, and at center of pleural fold. Posterior margins narrowly greyish, also postero-lateral angles. Tergites 6-9 similar to 4 and 5, but lighter in color, due to a definite wash of yellow, thus appearing light orange. Ventrally, sternite 1 greyish lavender; 2 and 3 light purplish tinged with rose; 4-6 greyed purplish rose; 7-9 yellow with rose tinge.

Tails—Orange brown at base, shading into smoky olive brown. Joinings slightly darker.

Genitalia—Forceps base orange brown, forceps smoky brown; penes deep rose. *Fuscata* type of genitalia. See Pl. 9, Fig. 5.

Female imago

Differs from the male as follows.

Head—yellow. Antennal sclerite bordered with rose; antenna greyish purple at base, filament grey. Purple spot below each compound eye, between eye and outer margin of antenna.

Thorax—Pronotum yellow; purplish rose markings at center of anterior border; several streaks of same color on lateral margins; narrow smoky markings in central portion. Mesonotum yellow, the median line and borders brown; spine and its margin likewise brown. Pleura light yellow, a faint rose streak anterior to wing roots. Ventrally, prosternum and anterior of mesosternum white, other portions yellow. Metasternum purplish.

Wings—Tinged at base with purplish rose. Costal border of fore wing purplish brown, as also vein M1 (Morgan). Veins Sc and Rs light brown, also other forks of M, and Cu. Other veins colorless or yellowish white.

Legs—Fore femur as in male. Fore tibia purplish grey, darker distally, and margined with purplish rose. Distal two-thirds of first three tarsal joints, and large spot on claw, dark purplish grey; remainder of tarsus white. Other legs yellowish white, claws purplish.

Abdomen—Yellowish white. Segment 10 yellowish brown, tergites 8 and 9 opaque white. Eggs give abdomen a rose-purple tinge. Tergites 1-3 have a dark purplish brown streak next to the pleural fold, and on 2 and 3 a transverse streak below anterior margin, halfway from median line to pleural fold. Apical extension of 9th sternite as on Pl. 9, Fig. 25 c.

Tails—Whitish basally, no dark joinings. Distal portion missing from specimen.

Nymph

Head—Very short blunt frontal horns, not extending beyond second antennal joint. Pair of short, conical tubercles on occiput, and two shorter pairs anterior to these, on vertex, tending to be slightly more prominent in female nymph. Clypeus fringed with white hairs. Slight prominence over each ocellus. Two basal segments of antenna dark brown, remainder yellowish. Compound eyes black in center with amber outer rims. Head brown, mottled with yellow and darker brown, this being most prominent on vertex and occiput. For appearance of head, see Pl. 9, Fig. 8.

Thorax—Pronotum wide; slightly wider at anterior margin, its lateral margin incised slightly in its posterior half. Yellow, irregularly mottled and bordered with dark brown. No tubercles, but irregularities in surface on each side of median line. Usually two dark dots on each side of median line, near posterior border. Mesonotum yellow to yellowish brown, streaked longitudinally with brown bars in anterior half and before wing roots. On anterior margin on each side, two dark brown dashes near lateral border, and lateral border itself dark brown. Tips of wing-buds dark brown.

Legs—Yellowish to light yellowish brown, banded indistinctly with brown and bordered with dark brown. Two dark bands on each femur, as well as a dark bar at each end. Fore femur with spines on anterior margin. See Pl. 9, Fig. 17. Short brown tubercles on upper surface

of each femur. Tibiae margined but not barred with dark brown, except some young specimens, which have a brown bar near the distal end. Tarsi with brown bar near basal end. Claw shown on Pl. 9, Fig. 16.

Abdomen—Dorsal spines present on 2-7; very short on 2, increasing slightly in length posteriorly. Tergites 1-4 brown, mottled with yellowish white on lateral borders. Tergites 5 and 6 yellow; 7 and 8 yellow mottled with brown; 9 and 10 dark brown. This description applies to a specimen intermediate in color, neither the lightest nor the darkest collected. In light forms, tergites 5-8 are yellow, and 2-4 are yellowish brown marked with brown. Some specimens show distinct rose shadings on the dorsum of the abdomen. In all forms, segments 3-9 with short postero-lateral spines; shortest on 3. Ventrally, yellowish shading into yellowish brown posteriorly. Sternite 9 dark brown.

Gills purplish, a large whitish oval area in the anterior portion. Gills present on 3-7, not operculate on 3.

Tails—Amber yellow to yellowish brown, becoming brown in distal fourth. Crossed by four to seven narrow bands of white.

Holotype—Male subimago. Reared. Tributary of Pigeon River, N. C., near Hazelwood, August 2, 1930. No. 1096.1 in C. U. collection.

Allotype—Female imago. Reared. Same location, July 30, 1930. No. 1096.2 in C. U. collection.

Paratypes—8 nymphs. Same location, July 20, 1930. No. 1096.3-10 in C. U. collection.

The nymphs of this species were among the most abundant in the genus *Ephemerella*, in the Appalachian region. Immature nymphs were taken at many stations during June and July, the mature forms appearing only during the latter part of July. Only two nymphs were successfully reared, both of these being from a small tributary of the Pigeon River about four miles west of Hazelwood, in Haywood Co. Had it been possible for me to remain longer in the mountains, it is quite probable that others could have been reared. This species is the last to reach maturity of any of the *Ephemerellas* collected.

Stations and dates of collection of this species are as follows. A small tributary of the Tuckaseegee River, on Cowee Mt., first taken June 28, 1929, and others at later dates; several small tributaries of the Nantahala River, including Hyde Mill Creek east of Robbinsville, on June 29, 1929; Cedar Creek, a tributary of the Tuckaseegee, near Glenville, June 30

and later dates; a small tributary of the Cullasaja River, eight miles south of Franklin, July 1, 1929; Wayah Creek at the base of Wayah Mt., in Jackson Co., July 1, 1929, and several later dates; Mingus Mill Creek, a tributary of the Ocona Lufty River, July 12, 1929; three small tributaries of the Pigeon River, one of them Allen's Creek, all near Waynesville and Hazelwood, on July 15, 1929, and succeeding dates; a small tributary of the North Fork of the Swannanoa River near Swannanoa, June 15, 1930; Rock Creek, tributary to the French Broad River, near Rosman, July 10, 1930; and Conestee Creek (for which the species is named), a tributary of the Little River, July 12, 1930.

Ephemerella wayah, sp. nov.

MEASUREMENTS

| | BODY | TAILS | FOREWING | FORELEG |
|-----------------------------------|------|-------|----------|---------|
| Male nymph (2 specimens)..... | 6 | 2½-3 | | |
| Female nymph (7 specimens)..... | 6-7 | 2-3½ | | |
| Female subimago (1 specimen)..... | 6½ | 4 | 7½ | 3 |

A species of the *fuscata* group. Nymph much flattened, hairy, with spines on the front margin of the fore femur, very short frontal horns, antennae set in notches on each side of a broad frontal shelf, and abdomen very hairy ventrally. In life, grey-green in color, becoming brownish yellow in alcohol. Color descriptions from alcoholic specimens.

Nymph

Head—Clypeus carved out at each side, the antennae fitting into these notches. Genae very well-developed; projecting forward and outward bluntly to form one side of the notch receiving the antennae. Short inconspicuous frontal horns present. No occipital tubercles. Lateral ocelli larger than median ocellus. Conspicuous fringe of long hairs bordering genae and clypeus. Head yellowish brown. Antenna dark brown at base, remainder light brown. Dark brown mark at center of clypeus. Antennal sclerite and frontal horn also dark brown. A dark spot on each side of vertex behind each lateral ocellus, and another on each side of occiput, at margin of eye. Head and mouth-parts shown on Pl. 9, Figs. 2, 6, 7, 9, 12, 13 and 20.

Thorax—No tubercles. Pronotum slightly wider posteriorly, the anterior margin almost imperceptibly incised. Yellowish brown, marked

irregularly with darker brown. Mesonotum same color, likewise marked with dark brown. Marks are: in anterior half, a wedge-shaped area on the median line; a streak on each side of the median line, anterior to the wing roots. Tips of wing buds dark brown. Finely hairy throughout. Yellowish ventrally.

Legs—Femora much flattened; fore femur with teeth or spines on front margin. Tubercles on dorsal surface of all femora, and many long hairs on each margin, particularly in the basal half. Tibial spine short and blunt on foreleg; a blunt projection also at this point on other legs. Femur dark brown at each end, and with a dark bar near each end, usually very indistinct in the central portion. Dark brown bar near base of tibia, and a wider one in the distal half, not reaching the distal end. Basal half of tarsus dark brown. Claws orange brown. See Pl. 9, Figs. 18 and 19.

Abdomen—Tergites yellowish to light olive brown. A light specimen is yellow dorsally; tergites 2-4 with dark brown transverse bar on each side between median line and pleural fold. Lighter brown bars similarly placed on 5-7; a narrow dark brown median line. A dark form is olive-brown dorsally, tergites 8-10 washed with yellow. An intermediate form is olive-brown on tergites 1-5; 6 and 7 yellowish brown, the lateral margins yellow; 8-10 yellow. All color forms have the spinous extensions of the abdomen dark brown in the anterior half of the outer margin; postero-lateral spine white at tip; and a small black mark above each pair of gills. Abdomen very hairy dorsally.

Ventrally, yellow. A line of dark marks on each side, between median line and pleural fold; on sternites 1-3 these marks are round, on 4-9 elongate. On dark forms, anterior borders of 1-4 are dark brown except at center; a dark oblique mark is present on each side of 5-8; 9 is light brown except at center of posterior border. All color forms have venter very hairy on entire surface of 9, and lateral margins of 3-8, thus forming a partial 'adhesive disc' of the type so well developed in *E. doddsi*. In *E. wayah*, however, there are no hairs across the abdomen anteriorly.

Gills present on 3-7. Light purplish grey, whitish oval region near center.

Tails—Dark brown at base, then banded alternately with yellow and dark brown, each color band being 2 to 3 segments in width.

Female subimago

Head greyish white. Base of antenna greyish white, filament brown.

Thorax—Pronotum olive brown with ruddy shadings. Rather pro-

nounced carina on median line. A small rounded grey blotch at center of sclerite, on median line; another on each side of median carina, anterior to the central mark. At posterior border on each side, a large somewhat dumb-bell-shaped mark occupying most of the border. Mesonotum greyish white marked with olive to chestnut brown in anterior portion; on each side of central area opposite wing roots; and on lateral borders of mesonotal spine. Pleura greyish white with faint brown markings. Ventrally greyish white.

Legs—Yellowish white. Fore leg margined and faintly streaked on femur with olive-brown. Claw and all joinings darker brown.

Wings—Smoky olive brown.

Abdomen—Lateral margins somewhat flaring; 8 and 9 with very short backward-projecting spines. Greyish white; eggs impart a purplish brown color. Apical extension of 9th sternite as on Pl. 9, Fig. 25a.

Tails—Purplish brown, greyish white at tip.

A male subimago, only partially transformed from the nymphal stage, shows dark olive-brown abdominal tergites, becoming lighter posteriorly; the flaring lateral margins whitish; a dark median dorsal line. Ventrally, very light olive brown, marked with dark brown lateral lines and oblique bars on each sternite.

Notes on this species

The nymph is rather similar to that of *E. fuscata*, but differs in these respects: 1) spines on fore margin of femur are more numerous and more prominent; 2) tibial spine of fore leg longer; 3) femur of second and third legs not as wide, lacking the prominent backward extension present on *E. fuscata*; 4) body and legs more hairy; 5) slightly smaller in size;—body 6–7 mm., that of *E. fuscata* 6½–8 mm.; 6) genae not quite as prominent.

Holotype—Female nymph. Wayah Creek, near Franklin, N. C., July 1, 1929. No. 1097.1 in C. U. collection.

Paratypes—Female subimago. Allen's Creek, N. C., July 15, 1929. Male subimago, 9 nymphs. Wayah Creek, July 1, 1929. No. 1097.2–12 in C. U. collection.

This interesting grey-green flattened nymph was found at two stations only. It was first collected from Wayah Creek near Franklin, on July 2, 1929, and named for this delightful little stream which arises on Wayah Mt. (This, as well as many other euphonious geographic

names of western North Carolina, is of Cherokee Indian derivation. Wayah is said to mean 'wolf.') A considerable number of nymphs were taken from this same stream on July 8, but all were destroyed in a flood which washed away the rearing cages in which they had been placed. No others could be obtained that summer.

What appear to be nymphs of the same species were taken on July 15, 1929, from Allen's Creek near Hazelwood, and from these one female subimago was obtained. Wayah Creek was visited again on July 27, 1930, at which time but one of the grey-green nymphs was obtained. It was not reared.

These nymphs were found on the upper surfaces or sides of rather small rocks in the main current, these rocks being overgrown with small algae and diatoms. The nymphs themselves, being hairy, were also thickly covered with ooze and diatoms. As they did not move for some time after the rock was lifted from the water, they were very difficult to locate. I quote from my field notes: 'I notice that the flat grey-green Ephemerellas sit with their backs (thoracic region) humped up, and often cling to the side of rocks in swift water, much as *E. doddsi* is described as behaving!'—The nymphs clung so tightly to the rock that it was difficult to remove them without danger of injury. The semi-disc of hairs on the ventral surface of the abdomen, much less developed than in *E. doddsi*, but apparently the same sort of device for clinging, would seem to account for this ability to hold to the rock.

Ephemerella tuberculata Morgan

Nymphs of this species were taken from Cedar Creek on June 30 and July 21, 1929, and on July 23, 1930; from the Ocona Lufty River near Cherokee on June 22 and July 28, 1930; a tributary of the Swannanoa River, July 8, 1930; and from Conestee Creek on July 12, 1930. Several imagoes were reared from these nymphs emerging from the middle to the end of July.

Nymphs of *E. tuberculata* were found on the sides or upper surfaces of large stones, often those which were much overgrown with water mosses, sometimes in company with *E. longicornis*, or in other localities along with nymphs of *E. catawba*. Like these, the nymphs did not move for some time, and could usually not be distinguished from the stone or moss until they did move. In life, some of these nymphs possess a prominent whitish dorsal stripe. They are semi-flattened forms, and tend to cling tightly to the rock, but may be quite readily removed without injury. Genitalia shown on Pl. 9, Fig. 27.

Ephemerella lata Morgan

Nymphs were found in Davidson River June 19, 1929, and at several later dates during June and July of 1929 and 1930. Imagoes were reared from nymphs collected here in 1930, emerging from July 19 to 24. Two nymphs were found also in Flat Creek in June 1929, but were not reared.

They were sometimes found in company with nymphs of *E. cornutella*, and like this species were obtained by hand-picking. Small stones in rapid water seemed to be preferred by them in Davidson River, where many were collected from small stones in the most rapid current, being especially numerous where the water was $1\frac{1}{2}$ to 2 feet in depth. Genitalia shown on Pl. 9, Fig. 1.

*Invaria group***Ephemerella dorothea** Needham

Nymphs were taken from Flat Creek, and subimagoes captured as they emerged from the waters of that stream, in the second week of June, 1929.

Ephemerella rotunda Morgan

The only record of the occurrence of this species within the state is found in several nymphs collected by Dr. J. S. Gutsell from Scott's Creek and its Monteith branch, near Sylva, on April 8, 1930.

Ephemerella catawba Traver

From nymphs taken from the Catawba River on June 20, 1929, a male emerged on the following day. Other nymphs, from which no imagoes were reared, were taken from the following stations. Dr. J. S. Gutsell collected several from Scott's Creek near Sylva on April 8, 1930. Prof. Needham found these nymphs near Highlands on April 7, 1929, and near Chimney Rock on April 8, 1929. My collections are: Ivy River, June 15, 1929; Bottomless Pools near Chimney Rock, June 17, 1929; small stream on Cowee Mt., June 28, 1929; Davidson River, June 20, 1930; Ocona Lufty River, June 22 and July 28, 1930; Laurel River near Hot Springs, June 29, 1930; Rock Creek, July 10, 1930; and Conestee Creek, July 11, 1930.

My original supposition that two species were represented in this

material seems not to be justified. Differences in size and coloration among the nymphs are not supported by structural differences. Large and small forms are similar in habits and habitat, as well as in shape, but vary considerably in color, as already noted. They were usually obtained from moss-covered stones in the swift current. If such a stone be lifted from the water, in five minutes or more these nymphs begin to push their way from among the roots and stems of the moss, and then for the first time become visible. Their characteristic attitude is to hold the tail erect over the back. In life, they blend quite perfectly with their environment.

Simplex group

Ephemerella sp.? No. 1 (near *E. simplex*)

Small flattened nymphs, with fore femora much expanded and 'saw-tooth' lateral extensions of the abdomen, were found in the small stream on Cowee Mt., in the Ocona Lufty River, and in Little River near the town of Cedar Mt., during the latter part of June and early July. A female measured 6 mm. in length, a male 5 mm. These nymphs are quite similar to those of *E. simplex*, but differ in these respects: 1) the body is slight, narrower than in *E. simplex*; 2) posterior edges of the postero-lateral spines are more sharply curved; 3) light reddish brown in color; fore femur slightly wider; 4) distal joint of labial palp somewhat shorter; and 5) central portion of hypopharynx narrower.

Others not included in groups

Ephemerella deficiens Morgan

Nymphs were taken from the North Fork of the Swannanoa River; Little River near Cedar Mt.; Ocona Lufty River; Davidson River and a tributary; and from Bald Creek. From the latter stream the subimagos were emerging on July 6, 1930, the day on which the nymphs were taken. Both here and in the Ocona Lufty River, these nymphs were found among the moss and other plant growth which thickly covered the tops of all the larger rocks, and they could be seen only after the rock had been left out of water for some minutes, when they began to scramble about. Nymphs of *Isonychia notata*, *Ephemerella catawba*, a species of *Baetis*, nymphs of large stoneflies and larvae of the caddisfly *Hydropsyche* were also numerous in this alga association.

Ephemerella sp? No. 2

This species of very small nymph was found in a tributary of the Pigeon River at Waynesville; at the Bottomless Pools, near Chimney Rock; in Davidson River; and in Wayah Creek. It was taken during the latter part of June and early July. No imagoes were obtained. A short description of this nymph follows.

Size—Body of male nymph, $3\frac{1}{4}$ mm; of female, $3-3\frac{1}{2}$ mm. Tails of male nymph, $1\frac{1}{4}$ mm.; of female, $1-1\frac{1}{2}$ mm.

Body cylindric. Occipital and prothoracic tubercles present, likewise dorsal abdominal spines. Lateral margins of abdominal segments prolonged somewhat into flattened processes, with many rather prominent spines on the outer margins. Postero-lateral spines short except on 9, on which the spine is very prominent. Femora somewhat flattened. Gills present on 3-7. Dark olive-brown, mottled with yellowish white. Short maxillary palp.

Head—Antenna white basally, remainder light brown.

Thorax—Pronotum widely white on each lateral border, and a small whitish area at center of posterior margin. Mesonotum mottled brown and yellowish.

Legs—Yellow with dark brown bars. Wide bar at base of femur, enclosing a small yellow spot; narrower dark band at distal end. Basal half of tibia dark brown, likewise all of tarsus except a yellowish streak near the distal end.

Abdomen—Tergites 4-6 whitish in center, between the gills; 10 all whitish yellow. Gills smoky grey. Ventrally, dark olive brown, no definite markings. Tails blackish brown basally, then yellowish white, crossed by a blackish band a short distance from the tip.

GENUS SIPHLONURUS Etn. 1868

Siphonurus mirus Etn.

The black-masked nymphs of this species were collected from the lake near Liberty in the spring of 1929 and again in 1930. From these several imagoes were reared successfully, establishing the identity of the species. Nymphs were taken in 1929 on March 24 and again on April 23. In 1930 the first of these were collected on Feb. 18, and a few more on March 16. The time required for one female to complete its sub-imago stage was 36-40 hours; it emerged on the afternoon of Apl. 13. A male which emerged the afternoon of Apl. 16 required $51\frac{1}{2}-53\frac{1}{2}$ hours to complete its transformation. Mature nymphs of this species were also taken at Highlands, N. C., on April 4, 1929, by Prof. J. A. Needham.

Siphonurus quebecensis Prov.

Nymphs of this species were quite abundant in the lake near Liberty and in Hamburg Lake. From each of these localities numerous nymphs were reared to adults. The subimagoes usually emerged indoors from 8 to 10 a.m., though a few emerged about 3 p.m. At Hamburg Lake they were observed emerging from 3 to 4 p.m. The subimago stage lasted from $47\frac{1}{2}$ to $52\frac{1}{2}$ hours, in nine specimens whose emergence and final transformation were carefully timed. Of these, six required exactly 48 hours. The nymphs were collected from the lake near Liberty on the same dates as those of *S. mirus*, and from Hamburg Lake on Mch. 31 and Apl. 5 in 1929, and Feb. 24 and April 17 in 1930.

Siphonurus marginatus, sp. nov.

A few nymphs of a different species, collected at the lake near Liberty in the spring of 1929, proved on being reared to be a new species. This is a small form, both nymphs and adults possessing a black mid-ventral line. However, as adults of *S. securifer* McD. and *S. decorus*, n. sp. have similar ventral markings, this character is not in itself sufficient for determination. The tergites of the adults, when viewed from above, appear to be margined laterally and posteriorly with dark brown, hence the specific name.

MEASUREMENTS

| | BODY | TAILS | FOREWING | FORELEG |
|-----------------------------------|-------------------|-------------------|----------|----------------------------------|
| Nymph..... | 9-9 $\frac{1}{2}$ | 4-4 $\frac{1}{2}$ | | |
| Male imago (4 specimens)..... | 9-10 | 12-14 | 9 | 7 $\frac{1}{2}$ -9 $\frac{1}{2}$ |
| Female subimago (1 specimen)..... | 10 | 9 | 9 | 9 |

Nymph

Head—Light tan with brown marks. Two longitudinal parallel brown bars on vertex and occiput, one on each side median line. Brown spot on subgena. Frons brown except for cream colored band in center and triangle on each anterior angle. Ocelli small. Antennae cream colored. Mouthparts not differing materially from *S. mirus* or *S. quebecensis*.

Thorax—Light tan marked with brown. A brown spot on each side of center, on posterior margin of pronotum; two dark spots in each anterior lateral angle. Few irregular brown marks on meso- and meta-notum. Brown mark just above each coxa. Cream-white ventrally.

Legs—Cream colored, femur light tan. Brown spot on each coxa. Foreleg without marks except one dark spot at tibio-tarsal joining. Second and third legs with brown stripe near basal end of femur and another one-third from distal end. Dark spots anteriorly at joints and near basal end of tibia. Tarsus equals $\frac{3}{4}$ of femur; tibia slightly shorter than tarsus.

Abdomen—Light tan dorsally, marked with dark brown. Tergites 2-4 with 4 indistinct marks in posterior angle of pleural extension. One mark in center of pleural extension of tergite 5, two on 6. 7-9 with one long brown streak in this position. In general, the tergites are marked as follows. A dark brown blotch in the posterior lateral angle, becoming a mere line on tergites 7-9. An oblique bar anteriorly on each side of median line, in some tergites not based on the anterior margin; this usually reaches to center of tergite. On outer side of this bar another brown bar, in 7-9 as long as and broader than the one near the median line. Also in tergites 7-9, these bars are connected at their anterior ends by a cross-bar. On tergites 3 and 6, a large irregular brown mark occupies the center of the tergite, in 6 sometimes shaped like a clover leaf. Tergite 10 with only two bars, one on each side of median line, and the posterior lateral angles margined with black. Posterior margins of tergites 1-8 brown except in center and on pleural extensions. 6-10 with dark spot on posterior margin near beginning of pleural extension. Ventrally cream colored, a continuous median black line on sternites 3-9, a short black bar medially on 2. Posterior lateral angles of 10 black; an oblique brown bar on each side of median line.

Gills white, tracheae black. Gills double on 1 and 2 only.

Tails cream colored, ringed narrowly with light brown at joinings. Every third or fourth joining near base has wider brown band. All three tails crossed by black band two-thirds from basal end, a narrower one nearer the tip.

Male imago

Head—Yellowish brown. Compound eyes grey-lavender, contiguous posteriorly. Ocelli white, ringed with purplish brown. Basal joint of antenna cream-white, margined with brown. Filament light brown. Dark brown spot beneath antenna, on each side of median carina. Grey-lavender spot on median carina.

Thorax—Bright yellowish brown, darker on meso- and metathoracic spines, mesosternum and margins of mesonotum. Posterior lateral

angles of prothorax cream-white. Dark brown triangle in center of pronotum. Pleura same, somewhat lighter; sclerites dark brown.

Legs—Foreleg light tan to second tarsal joint, remainder of tarsus greyish white. Joinings dark brown. Indistinct olive-brown area near center of femur. Second and third legs whitish; joinings, claws and distal half of last tarsal joint brown. Indistinct brownish band near distal end of femur. Tarsus almost 3 times length of tibia.

Wings transparent. Apical portion of costal and subcostal cells milky white. Longitudinal veins brown. Cross veins along inner margin of fore wing light brown; most others indistinct whitish or yellowish.

Abdomen—Dorsally olive brown, lighter on venter. Tergites 1-8 with dark posterior margin, somewhat lighter at median line. In posterior lateral angle of each is a dark brown spot, rather oblong. Forward and inward from this runs a narrower dark brown line, attaining the anterior margin halfway between median line and pleural fold. Viewed from above, each tergite thus appears to be bounded by a wide dark brown band. Tracheae indicated by dark lines. A dark bar on each side from anterior margin to center of tergite (in one specimen, not reaching anterior margin). Posterior to these bars, a short transverse band crosses the center of each tergite. Between the dark lateral border and the pleural fold is an olive cloud, becoming cream-white near the anterior margin. Tergites 9 and 10 similar to others, but pattern less distinct.

Sternites 1 and 2 light olive-brown, margined posteriorly with white. 10 dark olive brown; 9 similar, except for white area on each side of center on posterior margin. 3-8 silvery white, with light olive band on each side near pleural fold, extending length of sternite. A very dark brown median stripe extends continuously from the base of 1 to the end of 9, widened in each sternite near the posterior margin. In center of each sternite, a small black dot on each side of this median stripe, quite close to it. Further out from the median stripe and nearer the anterior margin is an oblique brown mark on each side.

Tails yellowish white, joinings dark reddish brown.

Genitalia as on Pl. 11, Figs. 1 and 6.

Male subimago

Quite similar to imago, but head and thorax creamy white except mesonotum, which is yellowish and margined with brown. Abdominal

markings similar, but background of tergites darker. Tails light brown, joinings dark red-brown.

Female subimago

Quite similar to male subimago, with these differences. Abdomen dorsally very light tan, the tergites lacking the dark posterior border, but with the typical brown markings on each side. All legs yellowish white, joinings brown.

Holotype—♂ imago. Lake near Liberty, N. C. Reared from nymph, May 1, 1929. No. 1023.1 in C. U. collection.

Allotype—♀ subimago. Same. No. 1023.2 in C. U. collection.

Paratype—♂ imago. Same. No. 1023.3 in C. U. collection.

The smaller size of this species, the lighter coloring and the very different genitalia serve to separate this species from *S. securifer*, which has similar ventral markings. By both color and structure of genitalia it is distinguished from *S. decorus* n. sp., which will now be described.

***Siphonurus decorus*, sp. nov.**

On April 11, 1929, Prof. Needham collected *Siphonurus* imagoes from Goshen Swamp and Burncoat Swamp in the coastal plain region of the state. Among these are many specimens having prominent purplish-rose markings, the posterior sternites powder-white, and a black mid-ventral line. Comparison of these with the description and figure of the genitalia of *S. securifer* McD., which they most resemble, seems to indicate that the species under consideration is not this. The color of the two species differs considerably, except for the similarity of the dark mid-ventral line. However, this line is present also in *S. marginatus* n. sp. The genitalia bear a general resemblance to the figure given for *S. securifer* by McDunnough, but differ in possessing, in most cases, spines on the ventral lobes of the penes. Moreover the species is smaller than *S. securifer*. The differences seem sufficient to warrant the erection of a new species for this material. The general similarity of the genitalia and the presence of the dark mid-ventral line and its associated markings in the three species *S. securifer* McD., *S. marginatus* n. sp., and the species now under consideration would suggest that these three belong in the same group within the genus.

MEASUREMENTS

| | BODY | TAILS | FOREWING | FORELEG |
|---------------------------------|------|--------|----------|---------|
| Male imago (7 specimens)..... | 9-10 | 16½-19 | 9-10 | 9-11 |
| Female imago (2 specimens)..... | 9 | 12½-13 | 10-10½ | 4½-5½ |

Male imago

Head—Dark purplish brown, with white transverse band along lower margin of frons and another just below ocelli. This leaves a purplish band across the face below the antennae, crossing the frontal carina. Compound eyes purplish, basally crossed by two greyish white bands and margined posteriorly with same. Ocelli pearly white, ringed broadly with purplish black at base. Proximal half of basal joint of antenna whitish; remainder brown.

Thorax—Dark olive-brown. Mesonotum light tan along median line in anterior portion, and a lateral similarly colored line on each side of center. Pleura with cream colored markings, superimposed on which are conspicuous patches of purplish rose. Rose patch on each side anterior to meso- and metanotal spines. Whitish transverse bands on pro-, meso- and metasterna; between legs on prosternum, just anterior to legs on other divisions.

Legs—Light brown, darker at joinings. Purplish rose spot on each coxa. Conspicuous brown band on each femur, one-third from distal end. Foreleg generally as long as body. In a few specimens slightly shorter, in others slightly longer. Spines on tibia of foreleg and protuberances on first two tarsal joints very prominent. Tarsal joints of foreleg, in descending order; 3, 1 and 2 (equal), 4, 5. Tarsus almost three times as long as tibia.

Wings—Transparent, except apical portion of cells C and Sc, which are milky. Longitudinal veins of forewing dark purplish brown, also humeral cross-vein. Longitudinal veins of hind wing, and all other cross veins of both wings, brown.

Abdomen—Tergites and first two sternites dark olive-brown with cream colored markings. Tergites 2-6 with anterior half of mid-dorsal line light-colored. On 7-9, a light streak along each side of median line, which is itself dark. A dark brown stripe on each side of this light streak, wider at base. Lateral to this a dark brown triangle, its base on posterior margin, its apex not reaching the anterior margin. Two light triangular areas on each side are thus formed, one between the first stripe

and the apex of the triangle, the second occupying the anterior lateral angle. Tergite 10 dark brown in center, light brown on each side. Ventrally, sternites 3-6 purplish grey, silvery anteriorly and along posterior margins. A dark purple-brown median line extends continuously from posterior margin of 1 to posterior margin of 10, widened at anterior and posterior margins of each sternite. A small black dot appears on each side very close to this line (touching it on sternites 7-9) at the center of the sternite. On each side of the dark stripe and anterior to the center on each side is a larger dark brown somewhat oblong spot. Parallel to the pleural fold on each side is a narrow band of purplish black, not quite reaching the upper and lower margins of each sternite. On sternites 3 and 4, this band is somewhat widened posterior to the center. Sternites 7 and 8, and posterior lateral portions of 9, powder-white except for median stripe and lateral spot and bar.

Genitalia—as on Pl. 11, Figs. 9, 15, 16 and 18. Forceps and forceps base light brown with purplish rose markings. Genitalia somewhat resemble those of *S. securifer*, but differ in details. A certain amount of variation in the penes is observable, principally as to the presence of spines on the inner surface of the ventral lobes. On one specimen no spines are present. In all others examined one, and in one case two spines appear on each side. These show variation in size on different specimens, and even on the two sides of the same specimen.

Tails—Dark brown basally, soon becoming light tan. Joinings dark purplish brown.

Female imago

Very similar to male, with these minor differences. Lateral greyish stripe on each side of mesonotum slightly wider. Anterior sternites flushed with pale pink. Sternites 7-9, on some specimens, lack the powder-white markings. Tails greyish white, joinings as in male. Apical margin of sternite 9 as on Pl. 12, Fig. 18.

Holotype—♂ imago. Goshen Swamp, N. C. Taken in flight by Prof. J. G. Needham, April 11, 1929. No. 1024.1 in Cornell collection.

Allotype—♀ imago. Same data. No. 1024.2 in C. U. collection.

Paratypes—7♂ imagoes, 2♀ imagoes. Same data. No. 1024.3-11 in C. U. collection.

Siphonurus decorus, light form

Along with the specimens showing the characteristic coloring of *S. decorus* are several others of both sexes, predominantly brownish, but a

few of which show slight indications of rose markings. The powder-white of the posterior sternites is lacking in both sexes. Genitalia are so similar to those of *S. decorus* as to be indistinguishable from them, as are also the relative lengths of the joints of the foreleg. Some are slightly smaller than the purple-marked forms, others are fully as large. The color description of *S. securifer* does not differ widely from these forms, but their smaller size and the presence of spines on the penes would seem to prevent placing them in this species. For the present, therefore, they will be considered as *S. decorus*, light form.

GENUS SIPHLOPLECTON Clemens 1915

Key to Siphloplecton Nymphs

1. Gills double on segments 1-3..... 2
 Gills single on all segments..... 4
2. Venter of abdomen with three uninterrupted longitudinal brown lines, one median and the others lateral. Claws of second and third legs almost equal to respective tarsi in length.....*basalis*
 Venter of abdomen not marked as above. Claws of second and third legs $\frac{3}{4}$ to $\frac{2}{3}$ length of their respective tarsi (i.e., relatively shorter than in *S. basalis*)..... 3
3. Venter of abdomen with but one longitudinal brown streak along median line.....*signatum*
 Venter of abdomen with very dark brown median longitudinal streak, and on each side of this near the pleural fold a row of black dots, two on each side of each sternite.....*speciosum*
4. Only ventral markings are a black ganglionic area on median line of each sternite. Claws of second and third legs approximately equal to respective tarsi in length.....*Sp?* No. 1.

Distribution of Siphloplecton in the state

Three species of the genus *Siphloplecton* were taken, all of them from the piedmont region. One of these is represented by nymphs only, one by adults only, the third by nymphs and reared imagoes.

Siphloplecton basalis Wlk. ?

On March 24, 1929, a pair of imagoes were taken in flight over a small stream in a wooded area seven miles northeast of Spero. Comparison of the male with a specimen of *S. basalis* sent by Mr. F. P. Ide to the Cornell collection, and with the description of this species by Clemens (as *S. flexus*) show it to be very similar, but with these differences: 1), eye color dark grey, not dark brown; 2), wing darker—brown areas of costal region darker in color, and basal dark areas of both wings more extensive; 3), red areas along median ventral line of abdomen either absent

or much reduced, while the dark dots on each side are more prominent; 4), tails darker brown; 5), spines present on penes (none observed on *S. basalis*); 6), end joints of forceps relatively shorter; 7), spines of fore tibia stouter; 8), head, thorax and abdominal tergites lighter in color but latter with approximately same color pattern. The posterior margin of the 9th sternite of the female is shown on Pl. 12, Fig. 29. No female of *S. basalis* is available for comparison. No nymphs of this species were found. For the present, this species will be considered as a probable *S. basalis*.

Siphloplecton signatum, sp. nov.

On Feb. 18, 1930, three mature nymphs of *Siphloplecton* were taken from a small artificial lake about three miles west of Liberty, N. C. All three emerged before 8 p.m. that evening. On March 16, several more mature nymphs were taken from the same lake. By Mch. 19 these had all emerged. They proved to be representatives of a new species, the adults being lighter in color than *S. basalis*, and differing from the light-colored *S. interlineata* as is indicated further on. The description of the new species is as follows.

MEASUREMENTS

| | BODY | TAILS | FOREWING | FORELEG |
|---------------------------------|--------|-------|----------|---------|
| Male nymph (4 specimens)..... | 11-13 | 3½-5 | | |
| Female nymph (2 specimens)..... | 13-16 | 5 | | |
| Male imago (1 specimen)..... | 14 | 25 | 11½ | 14 |
| Female imago (4 specimens)..... | 15-16½ | 17-18 | 13½-15 | 7½-10 |

Slightly larger than *S. interlineata* Wlsh., but in general very similar to it, the male having the same whitish abdomen. Distinguishable however from this species by the lack of a "coarse medial black line immediately below the third vein of the costa" (Walsh, 1862, p. 369); by the pattern of the abdominal tergites and the color of the tails; and by the lack of a white band between the hind coxae, in the male. From *S. basalis* Wlk., which it resembles in size, it may be separated by the whitish abdomen and the lighter color of the thorax. The nymph has but a single brown median ventral streak, which character separates it from other known nymphs of this genus.

Nymph

Head—Light brown; labrum and tips of mouthparts darker. Compound eyes black. Ocelli ringed with black, the median smaller than the lateral ones. Basal and last two or three distal segments of antenna dark brown, remainder light tan. Mouthparts very similar to *S. basalis*.

Thorax—Light tan dorsally, with irregular brown blotches on each side of mesonotum anterior to the wing roots. Cream colored to light tan ventrally.

Legs—Cream colored in younger nymph, light brown in mature forms. Two light brown transverse bands, one-sixth from basal end and one-fourth from distal end of each femur. Brown transverse bands also at center of tibia, and one-third from basal end of tarsus, the latter sometimes a darker brown. Claws of second and third legs approximately four-fifths of tarsus. Femur of second and third legs about equal to tibia and tarsus combined. Femur of foreleg about two-thirds of combined tibia and tarsus. Fore tarsus 1 as long as tibia; corresponding joint of other legs very similar in length.

Abdomen—Cream colored with brown markings. Narrow dark line along center of anterior margin of each tergite, and a brown spot in center of each pleural extension. Tergite 1 brown in anterior third. Tergite 2 with two short brown marks on each side of median line, from anterior margin. On 3 to 5, a triangular brown blotch (wide and long on 3, short on 4 and 5) at some distance from median line on each side. Laterad of this mark are two narrow oblique parallel lines. Tergite 6 with large irregular brown blotch on each side of center, extending backward to posterior margin and laterally to pleural extension. Dark wedge-shaped spot on median line at anterior margin. Oblique brown line in center of anterior lateral angle. 7 and 8 with two small brown spots on each side near anterior margin, one near median line, the other halfway to pleural fold. On each side of median line at center of tergite, a short brown streak. 9 marked like 8, but in addition a large brown wedge-shaped blotch occupies the center of the tergite on each side of the median line. 10 has two brown spots on each side, one above the other near the median line, and two brown streaks on the median line, one just back of the anterior margin, the other near the center. A brown mark in anterior lateral angle.

Ventrally, a wide dark brown streak occupies the median line. It is continuous from 3 to beyond the center of 9, except for a few short breaks at anterior and posterior margins of 3 and 4. Represented on 2 by

three spots, the anterior one largest. Streak varies in width, widening most at ganglionic area and again near center of each sternite. Two short bars on each side of 10, on anterior margin.

Gills—Double on segments 1-3, single on all others.

Tails—Cream colored in immature nymphs, brown in mature ones. All three crossed near distal end by very dark brown band.

Male imago

Head—Compound eyes dark grey, lighter on upper portion; contiguous. Ocelli whitish, ringed with dark brown. Basal segments of antenna white, filament brown, lighter again at tip. Frons greyish white with brownish area on each side of median carina. A transverse band beneath bases of ocelli.

Thorax—Pronotum greyish white in posterior third; anterior part dark brown. Mesonotum cream colored to light tan, bordered laterally with dark brown; posterior spine also brown. Metanotum dark brown. Pleura tan, sutures dark brown. Prosternum greyish white. In anterior half a brown median stripe, and a transverse brown streak between coxae. Central anterior portion and posterior margin of mesosternum very dark brown; remainder light brown margined laterally with dark brown, except for greyish white transverse band anterior to second pair of legs. Metasternum dark brown.

Legs—Femur of foreleg light brown, other joints cream colored to light tan. Light brown at joinings except femoro-tibial joint, which is dark brown. Claws purplish brown on outer margin. A transverse brown band near distal end of femur. Second and third legs light brown, joinings dark brown. Transverse brown bands on femur near distal end, and on tibia one-third from basal end. Claws as in foreleg. Tarsal joints of foreleg, in descending order: 1, 2 and 3 (equal), 4, 5. Tarsus three times length of tibia. Tibia five-sixths of femur. Tarsal joints of third leg: 1, 2, 5, 3, 4. Tarsus and femur approximately equal. Tibia two-thirds of femur and of tarsus.

Wings—Brown areas in both fore and hind wings much as in *S. basalis* Wlk. Wings transparent in other parts. Longitudinal veins in upper half of forewing dark brown, all but the three of the costal border shading into light brown apically. Other longitudinal veins light brown, also in upper half of hind wing. Cross veins of cell areas C., Sc, and Rs of forewing, also most of those in disc of wing, margined with dark brown. Other cross veins likewise brown except those near margins, which are mostly yellow. Veins in lower half of hind wing yellow.

Clouded areas at base of fore and hind wings as extensive as in *S. basalis*.

Abdomen—Tergite 1 dark brown except a white band next to posterior margin. Brown marks are a semicircular portion on each side of median line, superimposed on a lighter rectangular area. Center of posterior margin dark brown. Tergites 2-5 with cream background and light brown markings. On each a crescentic brown area next to pleural fold. A triangle with its base on the posterior margin extends forward along the median line, its apex reaching the anterior margin. From base of this triangle on each side are two forward projections ending in elongated spots near center of tergite. Bounding this brown area on the outside are two parallel rows of blackish-brown dashes, extending from near the center of the anterior margin outward and downward to the posterior margin on each side of the brown triangle. On posterior margin a median dark brown spot and a larger dash on each side. 6-8 mainly dark brown, but with a large cream colored triangular area on each side near pleural fold, its base on anterior margin, its apex extending beyond center of tergite. On each side of median line at center of tergite, two whitish dashes. On 6, parallel dashes as on 2-5, but darker and more numerous. 9 entirely dark brown save for small triangle on each side anteriorly. 10 dark brown, lighter on sides, median line darker.

Ventrally, sternite 1 dark brown bordered on sides and posteriorly with cream-white band. Sternites 2 and 8 light tan; 9 and 10 slightly darker brown. Other sternites cream colored, with very small dark reddish brown spot over ganglionic area of each, and indistinct tan bars arising from posterior margin, parallel to median line, and extending forward beyond center of sternite.

Tails—Light tan with reddish brown joinings, alternate ones wider. Finely pilose throughout length.

Genitalia—Light brown. Very similar to *S. basalis* in general appearance. See Pl. 11, Figs. 5 and 13.

Female imago

Differs from male in following respects. Antennae brown basally. Vertex and occiput olive brown. Thorax lighter dorsally and laterally. On some specimens mesonotum light olive brown. Prominent white band anterior to mesothoracic legs. Femur and tibia of foreleg light brown, tarsus dark brown, joinings darker. Markings of tergites somewhat as in male but more extensive, and reddish brown on flesh-colored

background. No blackish dashes in parallel rows on each side. All tergites marked much like 6-8 of male. In addition, on 6-9 a whitish streak anteriorly on each side of the dark bar next to the pleural fold. Median line indistinctly darker on posterior segments in some specimens. Anterior segments bordered widely and posterior ones narrowly with white along center of posterior margin. Sternites flesh-pink, median line a deeper pink. No ganglionic mark. On each side of sternites 2-7, above center in anterior segments but at center in others, a small brown oblong spot. Behind this and nearer the center line, a very minute dark dot, indistinct on some segments. On 8 and 9, two dark bars parallel to median line, one on each side. Forewing as in male. Hind wing lacking clouded basal area. Apical margin of 9th sternite as on Pl. 12, Fig. 31.

Holotype—♂ imago. Small lake near Liberty, N. C. Reared from nymph, Feb. 18, 1930. No. 1021.1 in C. U. collection

Allotype—♀ imago. Same location. Reared same date. No. 1021.2 in C. U. collection.

Paratypes—2 ♀ imagoes. Same location. Reared March 19, 1930. No. 1021.3-4 in C. U. collection.

Siphloplecton sp.? No. 1.

Immature nymphs of a species of *Siphloplecton* were taken on Oct. 19, 1929, from Big Alamance Creek, south of Greensboro. These proved to be neither *S. basalis* Wlk., *S. signatum* n. sp., nor a new species from Georgia, *S. speciosum*. The Alamance Creek nymphs differ from the others in their color pattern and in the fact that on all the segments the gills are single. There remains the possibility that these may be nymphs of *S. interlineata* Wlsh. or *S. fermorata* Say, the only two species in the genus the nymphs of which are not known. A brief description of these nymphs follows. As they were immature, no measurements are given.

Antennae white with black tips. Mouthparts very similar to *S. basalis* and *S. signatum*. Legs long for length of body, the foreleg being equal in length (in immature nymph) to head, thorax and first two abdominal segments. Claws of second and third legs equal or nearly equal to tarsus in length. Tibia of these legs shorter than tarsus; femur approximately equal to tibia and tarsus combined. Tarsus of foreleg only slightly longer than tibia; femur five-sevenths of combined tibia and tarsus. Two transverse bands on femur; tibia and tarsus unmarked.

Gills single on all segments, more simple in form than those of *S. basalis* or *S. signatum* (see Pl. 12, Fig. 16.). Tails with black band near distal end. Dark brown spot in center of each pleural extension. Ventral abdominal markings consist only of a small black spot at the ganglionic area in each sternite. There is no slightest indication of a continuous ventral dark stripe.

Siphloplecton speciosum, sp. nov.

Prof. P. W. Fattig, of Emory University, Ga., collected many nymphs of a new species of *Siphloplecton* during March and April, 1931, which were sent to Prof. J. G. Needham at Cornell University. Several of these Prof. Fattig reared successfully to the imago stage. These nymphs were taken from a creek near Macon, Ga., on March 22; from Big Indian Creek and Flat Creek on April 3; from Oochee Creek near Groveton, and Echeconee Creek near Macon, on April 10. Subimagoes emerged from April 15 to 17, usually requiring approximately 48 hours to complete their transformation.

This is a beautiful species, both in the nymphal and the imaginal stages. Nymphs have a continuous dark brown mid-ventral line from sternite 3 to 9; two black dots on each side of the sternite near the pleural fold; and white gills with black tracheae. Imago males have silvery abdominal sternites, no clouded areas on either wing, whitish eyes, very dark thorax, and the anterior and posterior abdominal tergites likewise very dark brown.

MEASUREMENTS

| | BODY | TAILS | FOREWING | FORELEG |
|---------------------------------|--------|-------|----------|---------|
| Male nymph (7 specimens)..... | 9-12 | 3½-3¾ | | |
| Female nymph (7 specimens)..... | 13-16 | 4½-5 | | |
| Male imago (8 specimens)..... | 9-12 | 14-19 | 8½-10 | 9½-12 |
| Female imago (3 specimens)..... | 11-12½ | 14-18 | 11 | 6-6½ |

Nymph

General color of mature male nymph cream-yellow; of female nymph brown dorsally, light tan ventrally. Both marked with brown.

Head—Dark brown transverse band across frons below bases of antennae. Antennae light tan, black near tip; extreme tip white.

Thorax—Mottled irregularly with brown.

Legs—Light brown, marked with darker brown as follows. A dark

band near each end of each femur; one at basal end of tibia; a narrower one one-third from basal end of tarsus. Claws of second and third legs approximately equal to three-fourths of their respective tarsi. Femur of second and third leg equal to combined tibia and tarsus. Femur of first leg less than combined tibia and tarsus. Tibia of second and third leg shorter than tarsus, each about equal to four-fifths of tarsus. Tibia of foreleg slightly longer than tarsus.

Abdomen—Tergites 1, 6 and 9 often with large brown blotches; others with smaller brown blotches, as indicated. Blackish brown spot on each tergite in center of pleural extension. Posterior margins of tergites dark brown at center, then lighter, then another dark spot. A grey-brown patch near center of tergites 3-5, 7 and 8. Posterior to this on each side a similar patch. Anterior to it on each side a somewhat darker patch. Near it on each side a very small dark spot. Near pleural fold a dark brown oblique band. Ventrally a black or very dark brown rather wide median stripe, continuous from middle of sternite 3 to end of 9. Small dark spot on ganglionic area of 3; 10 lacking central stripe. Greenish brown median triangle from posterior margin of each sternite from 1 to 7, its apex on anterior margin, through which the blackish band extends. Near pleural fold on each side a narrower greenish band, and on this in each sternite from 2 to 7 are two black spots, one near each margin. In 8, anterior one only is present. On 9, two longitudinal stripes.

Gills—Double on segments 1-3, single on 4-7. White with prominent black tracheae.

Tails—In immature nymph, light yellow. In mature nymph, middle tail yellow, outer ones light brown. Joinings purplish brown. All three crossed by black band near tip.

Male imago

Head—Frons white, crossed by wide brown band beneath bases of antennae. Vertex and occiput brown. Compound eyes greyish white, crossed near the base by a wide and a narrow purplish band. Ocelli greyish white. Basal segments of antennae brown except for whitish outer surface. Filament brown in basal half, distally greyish.

Thorax—Very dark brown. Posterior lateral margins of pronotum white. Mesonotal spine margined anteriorly with cream color. Pleura lighter brown than tergites and sternites; white between sclerites. White transverse band posterior to fore legs. Similar bands anterior to coxae of second and third pairs of legs. Prosternum, anterior sclerite of

mesosternum, and posterior margin of metasternum, much darker than other portions.

Legs—White spot on outer side of each coxa. Femur and tibia of foreleg brown, femur with wide reddish brown band near distal end, and indistinct darker band basally. Tarsus grey to grey-brown, darker at joinings. Femora of other legs light brown, dark band near each end. Tibia and tarsus grey, former with wide band near basal end. Joinings darker. Foreleg as long as body. Tarsal joints, in descending order: 1, 3, 2, 4, 5. Tarsus equals three times length of tibia. Tibia equal to four-fifths of femur. Tarsi of second and third legs equal $1\frac{1}{2}$ length of tibia.

Wings—Transparent. No dark clouded areas on either wing, nor cross veins widely bordered with brown, as in other species of the genus. Apical portion of cells C and Sc milky. Humeral cross vein, bases of upper longitudinal veins, and median vein of fore wing light purplish brown. Other longitudinal and cross veins hyaline. At bulla, three purplish black spots; first on vein Sc; second, on vein second below Sc; third, on second vein below the latter.

Abdomen—Tergites 1 and 2, posterior half of 7, all of 8 and 9, and central portion of 10, very dark brown. Lateral margins of 8 and 9, and posterior lateral angles of 10, white. Tergites 3-6, and anterior half of 7, white with darker markings. 2 to 6 margined posteriorly with purplish red. On anterior half of these tergites, a similarly colored streak on mid-dorsal line, and similar short marks in center of each, just lateral to median line. A light brown triangle based on the posterior margin occupies the posterior lateral angles of 2-6; in this triangle, two irregular reddish marks. A smaller triangular spot on posterior margin on each side of median line. Two parallel rows of indistinct black pencillings from center of anterior margin outward and downward to posterior margin.

Ventrally, sternite 1 dark brown, margined narrowly with white. Sternites 2-6 silvery white; 7-9 opaque powder-white. 5 and 6 faintly tinged with yellow. On 2, an oblong brown spot on each side in anterior half, a little distance from median line. Below it and nearer the center, a smaller dark dot. Very small reddish ganglionic mark on 2-6. On 7 and 8 this mark is larger and quite distinct. On 8 an oblong brownish mark in center of sternite, one on each side of median line.

Genitalia—Greyish white. Quite similar to *S. basalis* and *S. signatum*, but differing somewhat in shape of penes and in presence of several short spines on basal portion of latter. See Pl. 11, Figs. 2 and 19.

Tails—Greyish white. Joinings purplish.

Female imago

Differs from male in these respects. Thorax light red-brown, marked with white as in male. Tergites red-brown, margins and pleural folds white. Purplish red spots as in male. Small dark spot in center of posterior margin on 1-7, and median line dark brown in anterior half of all tergites. In posterior lateral angle of pleural folds of 3-7, a small black spot. Sternite 1 brownish red. Sternites 2-10 flesh-colored; small dark ganglionic spot on 5-9.

Holotype—♂ imago. Echeconee Creek, Ga. Reared from nymph by Prof. P. W. Fattig, April 16, 1931. No. 1022.1 in C.U. collection. Allotype—♀ imago. Same data. No. 1022.2.

Paratypes—1 ♀ imago, 5 ♂ imagoes. Same data, but dates April 14-17. No. 1022.3-8.

GENUS AMELETUS Eaton 1885

Key to Ameletus nymphs of eastern United States

1. With three distinct stripes on venter of abdomen..... 2
Without any ventral abdominal markings.....sp? No. 2
2. Stripes continuous, both lateral and medial ones..... 3
Median stripe continuous only on 8-10; discontinuous anteriorly...sp? No. 1
3. Stripes wide, their edges not clearly defined; fused on last three posterior sternites. No continuous white line between each lateral stripe and the pleural extensions.....*ludens*
Stripes relatively narrower, edges clearly defined; fused only at posterior margin of sternite 9. Continuous white line present between each lateral stripe and the pleural extension.....*lineatus*

Distribution of Ameletus in the state

Three species of this genus were taken in the state, two from the piedmont and one from the Appalachian region, the latter collected by Prof. J. G. Needham. Two of these are represented by nymphs alone. Only one species of *Ameletus* has hitherto been described from eastern North America,—*Ameletus ludens* Needham. Comparison of the three species from North Carolina with type material of *A. ludens* indicates that the latter is not represented among them. The specimens from North Carolina seem to represent new species.

***Ameletus lineatus*, sp. nov.**

The nymph of this species is recognizable by its relatively large size and the three conspicuous brown stripes on the venter of the abdomen.

MEASUREMENTS

| | BODY | TAILS | FOREWING | FORELEG |
|------------------------------------|-------|-------|----------|---------|
| Female nymph (4 specimens)..... | 12-14 | 3½-5½ | | |
| Female subimago (3 specimens)..... | 11 | 9-10 | 11-12 | 5-6 |

The subimago differs from *A. ludens* in the lack of any dark markings over the ganglionic areas.

Nymph

Head—Brown. Basal segments of antenna brown; yellowish white area for about one-third of remaining length, beyond which is a broad dark brown band not extending to the tip, which is white. Two parallel longitudinal brown bars on vertex, and brownish areas at median line on posterior margin of occiput. *Mouthparts* quite similar to *A. ludens*, but maxillary palp is slightly longer proportionately. Maxilla shown on Pl. 12, Fig. 6.

Thorax—Dorsally, cream yellow mottled with light brown. Pleura and ventral surface whitish, the former with a few brown marks. Legs relatively much stouter than in *A. ludens*. Light brown, marked with dark brown as follows. Brown bands at proximal end of femur; one-third from distal end of femur; at proximal ends of both tibia and tarsus; narrow band at distal end of tibia; wide band at distal end of tarsus. Claw brown, somewhat stout at base. Femur of foreleg equal to 1½ length of tibia. Tibia slightly longer than tarsus. Claw of third leg equal to ½ length of tarsus.

Abdomen—Dorsally, cream yellow and dark brown. Tergites 1-5 mottled cream white and brown, the brown areas being on anterior and posterior margins, center and next to pleural fold of tergites, thus leaving central region on each side of median brown area cream colored. Dark brown spots near posterior lateral angles of pleural extensions. Tergites 6 and 7 predominantly cream colored, the brown areas being restricted to the margins and median line, and a dark bar enclosed in a cream colored area on each side median line at center of tergite. 8 with oblong cream colored marks near anterior margin. 8-10 predominantly dark brown. Cream colored bar in anterior lateral angle of each. Posterior margin cream-yellow, 10 cream colored also on median line.

Ventrally, whitish on anterior and yellowish on posterior sternites. Three continuous wide dark brown streaks extend the entire length of abdomen; one is median, two are lateral. The lateral streaks enclose a

light spot near the anterior margin on each sternite. A white streak separates each lateral streak from the pleural extension. A small dark spot on each side, sometimes indistinct, close to median line at center of sternites 4-7.

Gills—Whitish, with narrow brown line just inside each outer margin.

Tails—Yellowish white, barred as in other species of the genus with two dark brown bands, a broad one one-third from base, a narrow one at the tip.

Female subimago

Head—Yellowish brown. Two parallel dark brown lines on vertex and occiput. Antenna dark brown. Ocelli ivory-white, widely ringed with black at base. Compound eyes purplish grey, a darker line marking off an upper and a lower portion.

Thorax—Dark yellowish brown. Mesonotum olive-brown in center, margined anteriorly and laterally above wing roots by dark chestnut brown. Mesonotal spine margined laterally with blackish brown. Two longitudinal dark bars on pronotum, one at extreme lateral edge, other somewhat toward the center from first. Pleura darker between sclerites. Posterior portions of pro- and mesosterna darker than other parts of the venter.

Wings—Uniform smoky brown.

Legs—Brown. Coxa, distal end of last tarsal joint, and joinings, very dark brown.

Abdomen—Tergites orange-brown, margined posteriorly with darker border. Pleural folds cream colored to light tan. An indistinct darker spot on each side of median line near center of each tergite.

Ventrally, lighter orange-brown, except sternite 7, which is as dark as tergites. An indistinct dark spot on each side of median line near center of each sternite, much as in tergites. No marks at ganglionic areas.

Tails—Very dark brown. In basal half, narrow black ring at each joining.

Female imago

Two of the female subimagoes died while endeavoring to complete their transformation. The subimaginal skin was carefully removed from one of these, and the coloration of the imago thus observed. It differs from the subimago just described in these particulars.

Prothorax margined narrowly on posterior border by purplish black.

Mesonotum clear greenish yellow, no darker markings, except blackish lateral margins of mesonotal spine. Pleura, thoracic sternites and legs lighter than in subimago, except posterior portions of pro- and mesosterna, which remain dark brown. Tergites of abdomen flesh-colored, each margined rather widely on sides next to pleural fold and along posterior border with orange-brown. Indistinct darker markings on each side of median line. Sternites 1-6 likewise flesh-colored, but 6 with purplish median mark. 7 flesh-colored in anterior half. Posterior half of 7, and 8-10, light olive-brown. Whitish triangles in anterior lateral angles of 8. Tails purplish brown, joinings darker. Apical margins of 9th sternite as on Pl. 12, Fig. 26.

Holotype—♀ subimago. Reared from nymph, Big Alamance Creek, N. C., Feb. 20, 1930. No. 1079.1 in C. U. collection.

Paratypes—2 ♀ subimago. Same data, Feb. 28, 1930. No. 1079.2-3 in C. U. collection.

On March 10, 1929, several nymphs of *Ameletus lineatus* were taken from Big Alamance Creek, in an area of gravel-and-sand bottom and not very rapid water. Again on Mch. 17 a few of these nymphs were collected from the same stream. In a small rapid-flowing tributary of the main stream several others were found. All but one of these died without transforming.

On Feb. 25, 1930, several more nymphs were collected from the same small tributary stream and also from the main stream of Big Alamance. Of these, three became subimagoes, but none successfully reached the imago state. All of these nymphs were females.

Ameletus sp? No. 1

Four small bluish grey nymphs were found in the tributary of Alamance Creek on March 10, 1929, along with the much larger nymphs of *A. lineatus*. No adults were reared from them. These seem quite distinct from both *A. ludens* and *A. lineatus*, but due to lack of adult forms will be considered only as *Ameletus* sp? No. 1. All of these were females. A description of these nymphs follows.

Nymph

Size—Body, 9-9½ mm.; tails 4½ mm.

General appearance—Bluish grey, varying in different nymphs in the extent to which it is present on the parts of the body. One very young

nymph (not included in above measurements) shows this color in thorax and gill only. One mature nymph has the posterior abdominal segments brownish, the remainder of the body bluish grey.

Head—Two brown streaks on vertex, light brown triangular areas on each side of posterior margin of occiput, near median line. Brown spot at base of mandible; other brown spots laterad of ocelli and bases of antennae and between ocelli. Antenna white basally, crossed near tip by a light brown band; tip white. *Mouthparts* very similar to *A. ludens*.

Thorax—Bluish, marked with brown. A band on each side of center of prothorax, and along lateral margin. Irregular brown markings on mesonotum, including one on each side near anterior margin, and two on each side of median line near posterior margin. Metanotum with brown mark on each side of median line, continued laterally from the posterior end as a border parallel to the posterior margin. Brown spots on pleura above and anterior to each coxa. Thoracic sternites uniform bluish grey.

Legs—Coxa, trochanter and basal portion of femur of each leg bluish. Remainder of leg yellowish white marked with brown. Brown spot on each coxa; near each end of femur; at base of tibia; and at basal and distal ends of tarsus. Femur of foreleg equal to $1\frac{2}{3}$ length of tibia. Tarsus slightly longer than tibia. Claw of third leg slightly exceeding one-third the length of the tarsus.

Abdomen—Tergites marked with brown as follows. A small dark spot in posterior lateral angle of each pleural extension, and a round dark spot in center of anterior lateral angle. Oblique brown mark extending from anterior margin on each side of median line on tergites 2, 3, 6, and 7. Tergites 1, 4, 5, and 8 with large brown blotch occupying middle of each, on median line; this blotch widest posteriorly and just anterior to center. Tergite 9 with brown blotch shaped like a right-angle triangle on each side of median line, its base on anterior margin. 10 with a brown streak on each side of median line, connected basally with another brown streak extending laterally to pleural fold.

Ventrally, three brown streaks, two lateral and one median in position, of which the median is discontinuous except on sternites 8–10. It is represented on 7 by a brown triangle near the posterior margin, its apex extending beyond center, and by a small brown line at the anterior margin. 4, 5 and 6 have each a brown mark posterior to the center; wedge-shaped on 6, rather oblong on 4 and 5. 1–3 lacking any median marks. Lateral lines continuous from 3–9, enclosing small white marks near anterior margin of each sternite. An indistinct oblique line extend-

ing a short distance from anterior margin, on each side of median line, on sternites 2-5.

Gills—Bluish grey. Along each margin a narrow brown line.

Tails—Light tan basally, yellowish distally. Crossed by wide blackish band one-third from base, and by narrower one at tip.

Ameletus sp.? No. 2

Several mature nymphs were collected by Prof. Needham at Highlands, N. C., on April 7, 1929. No adults were reared from them. A brief description of these nymphs is given.

Nymph

Size—One male nymph was among the specimens. Its body measured 8 mm., tails 4 mm. The bodies of three females measured 9-11 mm., tails 4-4½ mm.

General color yellowish brown.

Head—Without distinct marks, except two brown bars on frons, one below each antenna. Antenna black-tipped; just below this tip a white band. Remainder light brown, slightly darker distally. Maxillary palp relatively longer than in the other eastern species; end joint and basal joint longer respectively. See Pl. 12, Fig. 12.

Thorax—Marked dorsally with light brown. Metanotum with dark bands along anterior margin and beside median line. Unmarked ventrally.

Legs—Yellowish. Brown at joinings. Light brown band at center of femur, darker band at distal end of tarsus. Spines on femur brown. Femur of foreleg not quite equal to 1½ length of tibia. Tarsus slightly shorter than tibia. Claw of third leg almost equal to one-third length of tarsus.

Abdomen—Tergites 1, 2, 7, 8 and 10 predominantly yellowish. Others mainly brown, except for yellow areas along pleural extensions and at center of each tergite halfway between median line and pleural fold. Tergite 1 with brown area occupying center. Two small oblique marks on 2, on each side of median line, below anterior margin. 7 and 8 brown along anterior margin, extensions to center along median line, and brown blotch in posterior lateral angle near pleural fold. Two brown blotches on each side of median line of 10; anterior one larger. Brown spot on posterior lateral angles of pleural extensions 1-8. Ventrally, no markings.

Gills—Yellowish white, outer margins brown, wider on inside.

Tails—Yellowish basally, silvery distally. Crossed by usual broad blackish band near base, narrower one at tip.

GENUS *ISONYCHIA* Eaton 1871

Key to North Carolina species of Isonychia—Imagoes

1. Tails ringed at each joining with red or brown..... 2
Tails not ringed with red or brown, except a few joinings near base..... 3
2. Wing of female 13 mm. in length. Second leg purplish brown on tarsus and distal end of tibia; last two segments of third leg same color.....*notata*
Wing of female 10 mm. in length. Second and third legs purplish brown only on claws, distal portion of last tarsal segment, and tarsal joinings...*annulata*
3. Genitalia of the 'albomanicata' type. Tails largely whitish, joinings opaque. 4
Genitalia of the 'arida' type. Tails largely dark brown..... 6
4. Venation dark brown. Abdomen light in color (flesh-colored to light orange). Fore tarsi not lighter than remaining segments of foreleg.....*pacoleta*
Venation very light brown. Abdomen dark red. Fore tarsi lighter than remaining segments of foreleg..... 5
5. Forewing of female 13 mm. in length. Tarsi and claws of second and third legs of both sexes whitish. Tails ringed at base with very light red
albomanicata
Forewing of female 11 mm. in length. Tail reddish at base, with red joinings at base only. Claws and last tarsal segment of second and third legs of female light purplish grey.....*sicca* var. *manca*
6. Fore tarsi somewhat lighter in color than remaining segments of foreleg..... 7
Fore tarsi not lighter in color than remaining segments of foreleg..... 8
7. Incurved portion of penes 'saw-toothed,' bearing 7-8 teeth or spines. Last three tarsal segments of second and third legs purplish.....*serrata*
Incurved portion of penes bears but 2 teeth or spines on inner angle. Only distal segment of second and third tarsi purplish.....*georgiae*
8. Venter of abdomen marked with definite dark brown or purplish color pattern. 9
Venter of abdomen without dark brown or purplish color pattern, except at openings of oviducts in female.....*aurea*
9. Fore wing of male 11 mm. Outer distal angle of penes acute, a deep indentation beneath it. Mesonotum of male very dark purplish to mahogany brown.....*obscura*
Fore wing of male 12½ mm. Outer distal angle of penes rounded, no indentation beneath it. Mesonotum of male light mahogany brown.....*similis*

Key to North Carolina species of Isonychia—Nymphs

1. Antenna white at base. One dark spot in outer margin of gill..... 2
Antenna brown at base. Two dark spots in outer margin of gill..... 3
2. Large species, females 13-16 mm. in length. Fore tibia with distinct wide greyish brown band in central portion.....*albomanicata*
Smaller species, females 11 mm. in length. Fore tibia yellow except for narrow brownish streak at center of fore margin.....*sicca* var. *manca*

- | | |
|---|-----------------|
| 3. Antenna crossed by dark transverse band, about three segments wide, one-third of distance from base..... | 4 |
| Antenna not crossed by a dark transverse band as above..... | 8 |
| 4. Small species, under 12 mm. in length..... | <i>annulata</i> |
| Larger species, 12 mm. or over in length..... | 5 |
| 5. Fore leg predominantly yellow, with brown marks..... | 6 |
| Fore leg predominantly brown with narrow yellowish markings..... | <i>serrata</i> |
| 6. Spines on fore tibia very numerous (over 30 in number)..... | <i>similis</i> |
| Spines on fore tibia less numerous (fewer than 25 in number)..... | 7 |
| 7. Gills dark purple. Nymphs distinctly bronze in color..... | <i>georgiae</i> |
| Gills greyish lavender. Nymphs distinctly dark reddish brown in color..... | <i>notata</i> |
| 8. Spines on fore tibia few in number (fewer than 15). Tergite 10 entirely reddish brown in color..... | <i>pacoleta</i> |
| Spines on fore tibia very numerous (over 35 in number). Tergite 10 yellowish in basal third..... | <i>aurea</i> |

Notes on the Genus *Isonychia*

A comparative study of the nymphs and imagoes of ten species of this genus from North Carolina, as well as of the imagoes of *I. arida* and *I. sicca*, seems to justify the following conclusions, which are in the main in accord with Dr. McDunnough's notes regarding the genus (see *Canad. Ent.* **63**: 157-163. 1931). However, until more convincing evidence has been brought forward to indicate a synonymy between *I. bicolor* Wlk. and *I. albomanicata* Needham, I shall continue to regard the two as distinct species, of which *I. bicolor* is known only as a female subimago.

Imagoes

On the basis of the male genitalia and the apical extension of the 9th sternite of the female, the genus appears to fall into two main groups. The first of these I have termed the "albomanicata" group (Dr. McDunnough's "bicolor" group); the second, the "arida" group. In each case, the characteristic type of genitalia is known by the same name as the group. *I. intermedia* Etn. is not included in this grouping, although Eaton's description would seem to throw it into the first group.

Species of the "albomanicata" group have the penes more or less truncate distally, never with an incurved basal or lateral portion bearing teeth or spines. The distal border of the forceps base is deeply incised, so that the penes are visible above its margin for most of their length. Females of this group have the outer distal angles of the apical margin of the 9th sternite sharply acute, and the spaces between them deeply incised, either angularly or rounded. In this group I place *I. sicca* Walsh, *I. sicca* var. *manca* Etn., *I. sicca* var. *campestris* McD., *I. rufa* McD.,

and the new North Carolina species, *I. pacoleta*. Because of the simplicity of the penes lobes, the "sicca" species and varieties might be considered one subdivision, and the other species placed in a second subdivision. In the latter, the outer angle of the penes is broadly rounded, the outer margin undulating. For appearance of genitalia of *I. pacoleta*, see Pl. 10, Fig. 14.

To the "arida" group belong species in which the genitalia bear spines or teeth on an incurved flap-like portion located on each side at some distance below the distal outer angles of the penes. The distal border of the forceps base is only shallowly incised, thus hiding the penes except for the extreme distal portion. Females of this group have the distal outer angles of the 9th sternite rounded, the space between them only slightly incised, or with no real indentation present. To this group belong *I. arida* Say, *I. georgiae* McD., the four new species *I. annulata*, *I. obscura*, *I. similis* and *I. serrata*, and probably also *I. aurea* and *I. notata*. The two latter species are represented by females only, but the 9th sternites of these are similar to other females of the "arida" group. For the structure of the penes of the four new species first mentioned, see Pl. 10, Figs. 6, 16, 17, 19, 21, 22, 23, 24.

Nymphs—Generally speaking, the nymphs of the different species of *Isonychia* are very similar one to another. Aside from evident differences in size, certain structural differences are recognizable. Each fore femur bears a flange at its distal end, overlapping the basal end of the tibia. Each fore tibia bears on its forward border a double row of very long tawny hairs, and on its hinder border and its upper surface, few to many spines. The claws of each leg are serrate or dentate on the inner margin, the appearance of these varying somewhat in the different forms, as is shown in the figures presented under each of the new species, also for *I. albomanicata* and *I. manca*. The shape of the gills, while subject to considerable variation on each nymph, nevertheless seems to show specific differences in some instances. See figures of the third gill, under each of the new species. The frontal carina varies slightly in shape in different species, but it has not been considered advisable to attempt its use as a specific character. Mouthparts have been found so similar in all the species studied, as to be practically worthless for the separation of species. The figures of the mouthparts of *I. albomanicata* Needham (N. Y. State Bull. 86: pl. 6. 1905) serve well for any known species of the genus.

Color differences, always subject to individual and age variations, are sometimes useful. Thus the markings of the antennae differ somewhat

in different species, being whitish at the base in some and dark basally in others; in several species, crossed about one-third from the base by a transverse black or brownish band. The gills vary as to the color of the base and central disc, of the margins and mid-line, and as to the number and color of spots in the outer margin. Presence or absence of marks on the head, pro- and mesonotum, and abdomen, have been used to help distinguish one species from another. The ground color and markings of the legs are likewise useful for this purpose. The two outer tails are fully a third longer than the middle one, and are often broken at the tips. A short account of the appearance of the tails of *I. albomanicata* will serve equally well for any of the others, except that the color in the basal half varies somewhat in the different species, as noted in the descriptions. Basal half dark reddish brown, fringed on the inner margin with purplish hairs. A blackish brown band crosses the middle of the tail; beyond this, a wide yellowish white area, then another dark band, about twice as wide as the first one. The extreme tip is usually whitish.

Distribution of the genus

Ten species of *Isonychia* were taken within the state, seven in the Appalachian region and four in the piedmont. Six of the seven from the Appalachian region and one from the piedmont proved to be new species. Descriptions of these are herewith presented. Besides these ten species, many nymphs were taken from the mountain region which were not reared. The eastern species *I. sicca* and *I. arida* are not represented among the imagoes in my material. I have not seen the type material of *I. intermedia*, described from Arizona, but a comparison of the description of this species with all the purplish-marked North Carolina forms leads me to believe that I do not have *I. intermedia*. Dr. McDunnough's two new species, *I. rufa* and *I. sicca* var. *campestris* seem also not to be represented. As to the species which I am tentatively calling *I. sicca* var. *manca*, the imagoes are quite similar in appearance to specimens sent to the Cornell collection by Mr. Walley, but the genitalia are not exactly similar to those figured by Dr. McDunnough.

Species from the piedmont

Isonychia albomanicata Needham

Immature nymphs were caught in a branch of the Uharie River, near the little settlement of Farmer. N. C., on April 3, 1929. None of these

was reared. Mature nymphs were taken from the rapids of Big Alamance Creek, south of Greensboro, May 17, 1929. By May 25, most of these had transformed. One female, emerging at 7 p.m., required from 22 to 26 hours to complete her transformation.

Isonychia sicca var. *manca* Etn.

As previously stated, I refer my specimens tentatively to this species. Several nearly-mature nymphs were collected from Little Alamance Creek on Sept. 15, 1929. These were reared, and by Sept. 18 a male and a female had completed their transformation. This appears to be an autumn species, as contrasted with *I. albomanicata*, which matured in the spring. However, no evidence is at hand to prove that one or both of these species may not be two-brooded. Genitalia shown on Pl. 10, Fig. 25.

Isonychia pacoleta, n. sp. (See description under Appalachian species).

A single female was reared from a nymph taken in Big Alamance Creek on Oct. 1, 1929. No other specimen of this species was taken in the piedmont.

Isonychia annulata, sp. nov.

MEASUREMENTS

| | BODY | TAILS | FOREWING | FORELEG |
|---------------------------------|--------|-------|----------|---------|
| Male nymph (2 specimens)..... | 9-10½ | 4 | | |
| Female nymph (5 specimens)..... | 10-11½ | 3½-6½ | | |
| Male imago (1 specimen)..... | 10 | 15 | 13 | 5¼ |
| Female imago (1 specimen)..... | 11 | 12 | 9½ | 5 |

Imagoes with large whitish blotches on the abdomen, between purplish brown markings. Tails ringed at each joining with purplish red. Veins of wings dark brown in male, especially in basal area and central disc of fore wing. Fore femur light basally; fore tarsus somewhat lighter than remaining joints of foreleg. Two dark spots in outer margin of gills of nymph.

Male imago

Head—Yellowish brown. Compound eyes grey with purplish tinge. Antenna light brown.

Thorax—Pronotum whitish with greyish purple markings. Mesonotum yellowish brown, on anterior portion and central area; reddish brown on sides and on mesonotal spine, which is margined posteriorly with dark brown. Whitish patch anterior to wing roots. Pleura creamy white, with light brownish markings. Prosternum creamy white, meso- and metasterna reddish brown.

Legs—Femur of foreleg whitish in basal half; distal half of femur and all of tibia except extreme basal end, light reddish brown. First four joints of tarsus light greyish brown; last joint and base of claws purplish grey. Second and third legs yellowish white except for claws, tarsal joinings, and last tarsal joint, which are faintly purplish grey.

Wings—Basal area and central area of forewing with very faint brownish cast, not distinct enough to form a cloud. Veins dark brown, darker in basal area. Stigmatic area faintly opaque whitish. Veins of forewing from 1st anal to margin united with one another in several places by cross veins. Very few marginal intercalaries in hind wing.

Abdomen—Cream white marked with purplish brown. Dorsally, a wide cream-white central streak extends the length of the abdomen, bordered on each side by a purplish brown line. Each tergite has a rather wide purplish black posterior border, except at the center. A purplish triangle, its base on the posterior margin halfway between median line and pleural fold, extends forward about three-fourths the length of the tergite. An irregular purplish mark, shorter than the triangle, extends forward from the posterior margin along the pleural fold, occupying all but the extreme angle of the posterior lateral area, which latter remains cream-white. Pleural fold margined narrowly with purplish black.

Posteriorly, sternite 1 entirely brownish. Sternites 2-5 each with a large central purplish-brown area, widest on posterior margin, bifurcated anteriorly, leaving the anterior half of the ventral region cream-white. On 6-9 a purplish bar or streak on each side of the median line, these bars approaching each other posteriorly on 8 and 9. A purplish black line parallels the pleural fold on each side, from posterior margin to center of sternite. At its upper end, a blackish dash. Between the pleural fold and the black line, a purplish area.

Tails—Cream-white, tinged with brown basally. Each joining purplish red.

Genitalia—Penes quite different from any thus far figured except *I. arida* and *I. georgiae*, which they resemble in a general way. Upper margin somewhat as in *I. albomanicata*; outer distal angle sharp-pointed,

each side indented slightly below the angle and then flaring out into a rounded projection. See Pl. 10, Figs. 21, 23. Outer margin of forceps base extending forward almost to the tips of the penes, but excised angularly in the center. Terminal joint of forceps limb slightly shorter than the penultimate joint. Forceps limbs purplish brown.

Female imago

Similar to male, except as indicated.

Head—Yellowish. Black marks as follows: one at each posterior angle of the occiput, extending onto the compound eyes and along their inner margin; one just cephalad of each compound eye; another on each side below the lateral carinae, between the margin and the median carina.

Thorax—Pronotum, mesonotum and pleura yellowish. Pronotum black in center of posterior margin. Irregularly marked with purplish brown. Ventrally with two purplish brown transverse bands, the anterior one broken at the posterior margin of the prosternum. Mesosternum flushed with purplish anteriorly, a median carina-like process likewise purplish.

Wings—Venation purplish brown except on costal border, which is yellowish brown. No indication of brownish cast in basal area and disc of forewing, as in male. Stigmatic area opaque whitish.

Abdomen—Very much as in male, but the first seven segments flushed with light purplish orange, probably due to presence of eggs. On tergites, the anterior portion of each dark triangle tends to become separated from the posterior or basal portion. All dorsal markings reddish brown rather than purplish as in male. Ventral markings reddish lavender. Posterior margin of each sternite pinkish lavender. Apical margin of both sternites as on Pl. 10, Fig. 7. Distal angles rounded, not sharp-pointed as in *I. albomanicata*. Incisure between these very shallow and rounded.

Tails—Faintly flushed with pink at base. Joinings as in male.

Subimagoes

Very similar to imagoes, but wings dusky brown, all coloring duller. Tails light greyish tan, joinings dark purplish brown.

Nymph

Bright reddish brown; head and thorax lighter than abdomen, and slightly yellowish in one specimen.

Head—Frontal carina white. Whitish median streak posterior to

the median ocellus, in one specimen mottled with light brown. Antenna dark brown at base, light tan for a short distance thereafter, then barred by a dark-brown band three joints in width. Remainder cream-white. Mouthparts very much as in *I. albomanicata*.

Thorax—Whitish median streak on pronotum, extending narrowly on to anterior edge of mesonotum. Pronotum with crescentic yellow marks on each side of the median line. Small white spots at and anterior to wing roots on mesonotum, and one on each side of the median line at level of wing roots. Lighter ventrally.

Legs—Dark reddish brown. Whitish bar between the dark markings. Distal half of tarsus, each end of tibia, each end and center of femur, light in color. Tibial spur of foreleg as on Pl. 10, Fig. 15e. Flange on distal end of fore femur as on Pl. 11, Fig. 4f.

Abdomen—In fully-mature nymph, the dorsal pattern is very similar to that of the adult insect, the markings very dark brown. Immature nymphs show, instead of this pattern, four white marks on each side. One on each side of median line at anterior edge; behind this and nearer the lateral margin, another round spot; one in each anterior lateral angle; another opposite center of pleural fold, a short distance in from the edge of the fold. Tergites 8 and 9 with black dashes in the place of the first pair of white ones, in anterior tergites. Tergite 10 white anteriorly, black posteriorly.

Ventrally, mature nymphs show the anteriorly-bifurcated dark central triangle of the adult insect, also a brownish purple border next to the pleural fold on each side, and a row of blackish dots just below the anterior margin at the inner edge of this border. Immature forms show faintly the same lateral border and row of dots, but near the center of each sternite are two indistinct whitish dashes in the anterior half, one on each side of the median line. Below these and between their lower ends are two dots, each near the median line.

Gills—Dark purplish brown on central disc, margined anteriorly with light brown, laterally and posteriorly with white. Two dark brownish spots in the outer margin, the posterior of these the larger. Third gill shown on Pl. 10, Fig. 8.

Tails—Very similar to *I. albomanicata*.

Holotype—Male imago. Reared from nymph. Big Alamance Creek, N. C., May 22, 1929. No. 1088.1 in C. U. collection.

Allotype—Female imago. Reared from nymph. Same data. No. 1088.2 in C. U. collection.

Paratype—Male subimago. Reared from nymph. Same data. No. 1088.3 in C. U. collection.

Species from the Appalachian region

Isonychia georgiae McD.

Nymphs taken in Davidson River in July 1930 were reared, the imagoes emerging on July 9 and 21. The genitalia of the male are so similar to the figure given by Dr. McDunnough of the genitalia of *I. georgiae* as to make it very probable that my North Carolina form is of that species. However, as my male specimen differs somewhat from the description given by Dr. McDunnough, I give a brief description of it, as well as of the undescribed female and nymph of this species.

Male imago

Head—Compound eyes dark grey-lavender. Greyish white between ocelli. Base of antenna purplish, filament grey. Keel of median carina red-purple. Black spot on each side, below lateral carina. White ventrally.

Thorax—Pronotum light brown in central area, greyish laterally. Posterior margin greyed lavender. Mesonotum yellow, borders light brown; spine purplish. Pleura cream-colored and light brown, washed with lavender on side and anterior to wing roots. Ventrally, posterior portion of prosternum purplish grey. Remainder red-brown.

Legs—Fore femur white basally, purple distally. Base of tibia white, remainder greyed lavender. Tibia very slender. Tarsus very light greyed lavender. Other legs white, washed with yellow. Tarsal joinings, claws and last tarsal segments, faintly purplish grey.

Wings—Veins purplish black. Slight tendency to anastomosis of cross veins in stigmatic area. Veins from first anal to margin tend to be twice branched, sometimes connected by cross veins.

Abdomen—Background of tergites light red-brown. Cream-white border next to pleural fold. Markings purplish brown with wash of red. Central light median streak entire length of abdomen. Anterior lateral angle, and band next to pleural fold, cream-colored. Between these light areas, a wide dark purplish brown band, bounded on each side by a somewhat crescentic bar. Pleural fold narrowly margined with dark purple. Ventrally, purplish with brown wash. Dark median area, divided into two portions by narrow light grey mid-ventral line. Dark purplish border next to pleural fold. Between these dark areas,

a lighter band, becoming wider posteriorly. Anterior margins light grey. Posterior margin of sternite 1 white, of others greyed lavender. On 2-8, light marks on central dark area, seeming to be etched on the dark surface. A curved dash on each side of median line, below anterior margin. On 2, four transverse light dots below this. Two such dots on 3-8. Black spot in anterior lateral angle, and dark bar from this along pleural fold.

Tails—Greyed purplish brown. Joinings slightly darker.

Genitalia—As figured by Dr. McDunnough (Canad. Ent. 63).

Female imago

Differs from the male as follows.

Head—Yellow. Dark purplish in posterior lateral angle of occiput.

Thorax—Pro- and metanotum yellowish.

Legs—Distal half of fore femur, and fore tibia, dark purple-brown. Tarsus dusky yellow to greenish brown. Other legs white. Tarsal joinings very narrowly purplish, claws purplish near base. Last tarsal joint faintly grey.

Abdomen—Background purplish rose. Median light dorsal line as in male, and similar dark crescents bordering it. Lateral crescents very slender, except on tergites 1-3, not reaching to anterior margin. Space between this and the central crescent light rose-purple except for dark posterior margin. Ventrally, a dark rose-purple streak next to pleural fold in posterior half of each sternite. Dark spot in anterior lateral angle as in male. Rose-colored median line quite distinct. Bordering this on each side, an irregular dark rose-purple streak; wide posteriorly, narrowing somewhat but wide again at center, narrow anteriorly. Light dashes and dots as in male, but indistinct. Posterior margin of egg valve with greyish border, the main portion purple. A dark brown spot on each side of posterior margin of egg valve, on sternite 8. Wide light space on each side of each sternite, between dark central area and dark lateral border. In posterior sternites this space is cream colored flushed with rose. Anteriorly it is deep rose. Apical margin of sternite 9 as on Pl. 10, Fig. 10.

Tails—Dark red-brown basally, becoming somewhat lighter brown in central portion, the distal third tan with rose tinge. At tip, greyish white. Joinings at base not evident; in central area, darker red-brown than joints; distally, rose-lavender.

Size—Body, 15 mm.; tails, 20 mm.; forewing, 13½ mm.; foreleg, 6 mm.

Nymph

Entire body bronze.

Head—Carina whitish. Antenna dark brown basally, yellow in remaining portion, except for black transverse band one-third from base. Occiput and venter mottled.

Thorax—Indistinct whitish marks on each side of pronotum, and anterior to wing roots on mesonotum.

Legs—Foreleg yellow, except for black band near base of tarsus, brown shadow near center of tibia, and two light brown bands on femur, one near each end. Tibial spine, and flange on distal end of femur of foreleg, and claw of third leg, as on Pl. 10, Fig. 15c, and Pl. 11, Fig. 4g. Hairs on foreleg bright orange in certain lights. Second and third legs yellow, banded with dark brown.

Abdomen—Tergites 1-5 show indistinct white spot on median line at anterior margin. Faint whitish dashes arise from each side of this spot, extending backwards slightly beyond the center of the tergite. On tergites 6-9, these dashes arise at the anterior margin. At the center on each side of each tergite, a little distance from the pleural fold, a round white spot. Tergite 10 yellow basally, dark red-brown distally. Ventrally, male shows the whitish central markings of the imago, with a dark spot on each side near the anterior lateral angle. White marks absent from female, except on last four sternites; present here, but indistinct. No dark spots.

Gills—Very much as in *I. serrata*. Dark purple, outer margin white, with two brown spots. See Pl. 11, Fig. 11.

Tails—Marked as in *I. albomanicata*. Deep bronze at base.

Size—Body, male nymph, 12 mm.; female, 13-15 mm. Tails of female, 7 mm.; broken in male specimens.

Isonychia notata, sp. nov.

MEASUREMENTS

| | BODY | TAILS | FOREWING | FORELEG |
|--------------------------------|------|-------|----------|---------|
| Male nymph (1 specimen)..... | 12 | 5½-6 | | |
| Female nymph (1 specimen)..... | 13 | 5 | | |
| Female imago (1 specimen)..... | 13 | 19 | 12 | 5 |

Thorax of imago greenish yellow. Abdomen yellow to light orange, marked with purplish brown. Basal half of fore femur yellowish, fore

tarsus only slightly lighter than tibia. Tails light purplish brown at base, greyish white distally, joinings prominently dark purplish brown. Nymph very dark reddish brown, lighter ventrally. Gills greyish lavender, two brown spots in outer margin.

Female imago

Head—Greenish yellow. Dark purplish spot in posterior angles of occiput. Antenna purplish. Black spot below lateral carina on each side, another anterior to each compound eye. Compound eyes bluish grey.

Thorax—Pronotum yellowish. Dark purple at center of posterior margin. Lateral borders marked with purplish grey. Mesonotum and pleura greenish yellow. Mesonotal spine faintly marked with lavender, also its lateral aspects. Pleura marked with greyish lavender. Metanotum yellowish brown, purple at center of posterior margin. A purplish brown spot on each side of median line at center of sclerite. Ventrally, two dark transverse bars, the anterior one discontinuous, between fore legs. Central sclerite of metasternum brown. Its anterior portion, and the median area of the metasternum, purplish.

Legs—Basal half of fore femur yellowish; distal half purplish brown, borders darker. Tibia greyed purplish brown, darker in basal half. Tarsus greyed lavender, joinings and claws darker. Tarsus and distal fourth of tibia of second leg, and last two tarsal joints of third leg, purplish brown with olive tinge. Other portions of these legs greenish white, the second tibia with a brown stain near each end of the whitish portion.

Wings—Transparent, iridescent. Venation light purplish rose. Stigmatic area opaque white. No forking nor anastomosis of cross veins in this area. Some of veins from 1st anal to margin, twice forked.

Abdomen—Dorsally, yellow tinged with light orange; 10th tergite brighter yellow, unmarked. Median light dorsal streak, bordered on each side by a dark purplish brown line extending the length of the tergite. Posterior border of each tergite dark purplish brown except at median line. Arising from the posterior margin halfway between the median line and the pleural fold, a light purplish brown mark, widest at the base, curves forward and outward, not quite attaining the anterior border. Between this and the pleural fold, a crescentic mark of the same color. One end of the crescent is in the pleural fold, the other in the space between this fold and the dark line mentioned above. Thus the crescent occupies most of the posterior lateral angle, its open side

toward the center of the tergite. Posterior half of pleural fold on each tergite margined with lavender.

Ventrally, light yellow. Posterior margin of each sternite purple. On each side of the light median line, an interrupted purplish brown streak, extending the length of the sternite, on 1-6, but on 7 and 8 not reaching the posterior margin. Central portion of lip of egg valve reddish purple. Between the longitudinal streaks on 8, a chestnut transverse bar, connected on each side to the outer edge of the egg valve by a short arm. On posterior portion of each sternite, a reddish purple streak borders the pleural fold. In the anterior portion of each, in line with this streak, a dark purple spot. Apical margin of 9th sternite as on Pl. 10, Fig. 1.

Tails—In basal two-thirds, light purplish brown; distal third greyish white. A short transition between these, light tan. Joinings dark purplish brown, quite prominent.

Nymph

Mature nymph dark reddish brown, lighter ventrally. Immature nymph deep orange-brown.

Head—Median line of vertex and occiput mottled whitish. White spots laterad of each lateral ocellus, and cephalad of median ocellus. Frontal carina whitish. Antenna dark brown at base, remaining portion yellowish brown, crossed by black transverse band one-third from base.

Thorax—Median line of entire dorsal aspect a wide whitish band, in immature nymph. In mature nymph, whitish band wide at anterior border of pronotum only, becoming narrower until it almost disappears at the mesonotal spine. Crescentic whitish mark on each side of pronotum, not far from median line. Halfway to lateral border, a large white blotch. One or two smaller white dots toward lateral border from this blotch. White spot on each side of median line of mesonotum, between inner margins of wing pads. Several small white spots anterior to wing roots. Pleura and ventral surface light reddish brown.

Legs—Dark reddish to purplish brown, with yellowish markings. Tarsi narrowly yellow at basal end, distal half also yellow. Fore tibia narrowly lighter at each end, other tibiae with rather wide yellow band distally. Femora yellow narrowly at each end, a wider discontinuous blotch near the center. Tibial spine and femoral flange of fore leg, and claw of third, as on Pl. 10, Fig. 15b, and Pl. 11, Fig. 3.

Abdomen—Immature nymph with wide dorsal median line. On mature nymph, only the anterior segments are light for their entire

length; others light at anterior border only. A yellowish white streak on each side of median line, arising from the white line near the anterior border, extends beyond the center of the tergite. A white spot on each side at the center, near pleural fold. Tergite 10 yellow basally, blackish brown distally. Ventrally, each ganglionic area is a large white blotch, from which extends on each side a white line outwards and backwards to the center of the sternite. Four white dots arranged transversely at center of each sternite. On posterior sternites, median line posterior to ganglionic area is likewise white. A dark spot near each anterior lateral angle.

Gills—Greyish lavender, the borders and median division brownish. Two purplish brown spots in the outer margin of each. See Pl. 10, Fig. 5.

Tails—Reddish brown as far as the first black transverse bar.

Holotype—Female imago. Reared from nymph. Bald Creek (tributary of Cane Creek in Yancey Co.) near town of Bald Creek, July 17, 1930. No. 1087.1 in C. U. collection.

Isonychia similis, sp. nov.

MEASUREMENTS

| | BODY | TAILS | FOREWING | FORELEG |
|---------------------------------|--------|--------|----------|---------|
| Male nymph (2 specimens)..... | 12 | Broken | | |
| Female nymph (3 specimens)..... | 14½-15 | 7-8 | | |
| Male imago (1 specimen)..... | 12 | 18 | 12½ | 7 |
| Female imago (2 specimens)..... | 15-15½ | 20-21 | 15 | 7 |

The male described above is a specimen that died trying to shed its subimaginal skin, so that the lengths of tails and forelegs given above probably apply to the subimago stage, but the description is of the imago after the cuticle was artificially removed.

Male very dark purple-brown, marked with bronze. Female imago with greenish yellow thorax, abdomen flesh-colored with purplish rose markings. Tarsus of forelegs not lighter than other joints of the foreleg. Tails dark brown in basal half, lighter distally. Nymph dark olive brown washed with purplish red. Gills greyish lavender.

Male (subimago with cuticle removed)

Head—Yellowish brown. Compound eyes greyish purple, bordered with reddish purple. Median and lateral carinae reddish purple on

keels. Black bar below lateral carina. Base of antenna and basal half of filament purplish brown; distal portion greyish lavender.

Thorax—Pronotum red-brown; light tan on lateral borders, lavender along posterior margin. Mesonotum mahogany brown, margins and spot just cephalad of spine cream colored to light tan. Metanotum very dark mahogany brown. Pleura cream colored to light tan, with lavender markings anterior to wing roots and above third leg. Ventrally, pro- and mesosternum light brown, metasternum very dark mahogany brown.

Legs—Fore femur light purplish at base. Remainder of femur, tibia and tarsus very dark purple. Other legs greenish yellow, claws and tarsal joinings purplish grey.

Wings—Dusky brown before removal of subimaginal skin. Imaginal wings transparent, veins dark purple. Stigmatic area faintly opaque, the cross veins tending to fork and to anastomose. Numerous intercalaries and cross veins on outer margin of hind wing.

Abdomen—Tergite 1 entirely dark purplish brown, except for light spot on posterior margin at median line. Similar white spots, also a narrow light streak on anterior portion of median line, on tergites 2-6. A deep purple area borders this narrow light median line, becoming continuous with a wide purplish brown line on the posterior margin, occupying the posterior half of tergites 2-6. Along the pleural fold this dark area reaches almost to the anterior margin. This dark area is wide on 2-4, a narrow band or streak on 5-9, and on the latter more brown than purplish. On 2-5, a purple streak halfway between median line and pleural fold, from anterior margin to wide dark posterior band. Light bronze areas are thus left in the anterior half of these tergites, divided into two parts by the lateral purple streak. Tergites 6-8 similar, but median bronze strip wider, and the anterior bronze areas darker in color. Tergite mainly bronze, with dark posterior and lateral borders and a dark stripe on each side of center.

Ventrally, sternite 1 entirely deep purple. Sternites 2-5 light bronzen or tan in anterior half, purplish brown posteriorly. Each has four lighter dots arranged transversely at the center, at the upper edge of the purplish area. Sternites 6-9 mainly light bronze or tan, the posterior margin deep purple and the posterior half of each sternite washed with lavender. No central light dots. Dark purple spot in each anterior lateral angle next to pleural fold. Behind this and next to fold, a purplish streak.

Tails—Purplish rose, slightly darker at extreme base, the distal third somewhat lighter. Joinings dark purplish brown.

Genitalia—Of the 'arida' type. Incurved portion of penes bears two large and two small teeth or spines. See Pl. 10, Figs. 6 and 16.

Female imago

Differs from male as follows.

Head—Yellowish white. Faint lavender shadow in posterior angle of occiput. Base of antenna flushed faintly with lavender, filament greyish.

Thorax—Pronotum yellowish, bordered with purple. Mesonotum yellowish with green tinge. Purplish at anterior margin on median line, and the lateral aspects of the spine purplish grey. Pleura greenish yellow with faint lavender markings. Ventrally, greenish yellow in anterior half. Central sclerite of mesosternum reddish brown, metasternum light purple.

Legs—On one specimen, basal third of fore leg whitish. Basal joint of tarsus on second and third legs greyish.

Wings—Venation purplish brown, darker than in male. Some of veins from 1st anal to margin twice-forked.

Abdomen—Tergites 1-7 orange, 8-10 yellow. Median line orange, bordered on each side by a purplish-brown streak, widest at base on 2-7, anteriorly on 8 and 9. Posterior margin and posterior lateral angles purplish brown. Tergite mainly orange. No dark band beside median line, but a lavender mark at the center of the tergite. Indistinct small lighter 'eye-spot' at upper end of each dark posterior lateral area. Ventrally, sternites 1-7 light orange, flushed with rose. An indistinct lighter median line. A light dot on each side of the median line near the center of sternites 2-4. Sternites 8-10 yellowish, 10 most definitely of this color. Posterior margin of egg valve purplish brown. Lavender streak beside pleural fold in posterior half of each sternite. A purple dot in anterior lateral angle, in line with this streak.

Tails—Very dark purplish brown basally, lighter brown in distal half. Joinings darker brown.

Nymph

Body of mature nymph dark olive brown washed with purplish red. Immature forms dark brown with purplish markings.

Head—Yellowish spot cephalad of median ocellus, and laterad of each lateral ocellus. White median stripe on clypeus. Frontal carina brown. Vertex deep purplish brown, occiput olive brown with median light stripe at posterior margin. Antenna dark brown at base, other-

wise light yellowish brown. Indistinct dark brown transverse band one-third from base.

Thorax—Whitish median line, forming round blotch at anterior margin of pronotum. Three dark marks and two yellowish blotches on each side, between median line and lateral border. Whitish median line also on meso- and metanotum. On mesonotum, a wide triangle is formed at the anterior margin, and another between the inner margins of the wings, on the median line. On each side, a whitish spot and a dash on the inner borders of the wing pads, in line with the second white triangle. Several white spots anterior to wing roots, the largest in the anterior lateral angle. A purplish streak on each side of white median triangle at anterior margin. Metanotum mottled with purplish. Ventrally, light purplish grey.

Legs—Yellow, banded with purplish brown. Fore femur with purplish band one-third from base, another on hind angle of distal end. Tibia purplish in basal third. Tarsus with narrow basal and wider distal yellow area, the central portion very dark purple. Tarsi of second and third legs similar; femora all purplish but a yellow band one-third from distal end; tibiae purple in basal, yellow in distal halves. Tibial spine and femoral flange of fore leg and claw of third leg, as on Pl. 10, Fig. 15a; and Pl. 11, Fig. 4e.

Abdomen—Last three segments darker than anterior ones. Median dorsal line whitish in anterior half of tergites 1-6; on 7-9, only a light triangular spot at the anterior border. A dark purplish brown mark arises from the median line on each side, just behind the anterior border, extending outwards and backwards slightly beyond the center of the tergite, on 2-5. On 6-9, this is replaced by a narrow dark line paralleling the median line on each side, and attaining the posterior margin. Very small and indistinct white spots may be present at the posterior end of this dark mark, on 2-5. Posterior margin of each tergite purplish. Lateral margins of posterior tergites light brown. A white spot at center of tergite a short distance in from the pleural fold, bordered on the outer side by a very dark purplish mark. Tergite 10 yellow in basal half; distally blackish brown.

Ventrally, a white spot at each ganglionic area, these increasing in size posteriorly. Lateral margins light greyed lavender. Pleural fold margined with purple. A narrow purplish line at inner edge of the light margin. In mature nymphs, a dark spot in this line, near the anterior margin. Each sternite narrowly purplish on the posterior border. Four whitish dots arranged transversely across center of each sternite. Sternites 7-9 considerably darker than preceding ones.

Gills—Light greyish lavender; median line, margins, and two dark spots in outer margin, brown. Tracheae prominent,—lavender in color, as are also the gill tufts. See Pl. 11, Fig. 8.

Tails—Very dark brown at extreme base; from base to first dark transverse bar, yellowish brown. In mature male nymphs, outer tails purplish in this portion.

Holotype—Female imago. Reared from nymph. Cedar Creek (tributary of Tuckasegee River) near Glenville, N. C., July 29, 1930. No. 1092.1 in C. U. collection.

Allotype—Male imago. Reared from nymph. Same location. July 24, 1930. No. 1092.2 in C. U. collection.

Paratype—Female imago. Reared. Same data as holotype. No. 1092.3 in C. U. collection.

Isonychia obscura sp. nov.

A dark purplish brown species. Represented by male imago only. Rather similar to *I. georgiae* McD. and the new species, *I. serrata*, but differing in the details of the penes. In general, a darker form than either of the latter species. I have not seen the type of *I. intermedia* described from Arizona, but from Eaton's description the North Carolina forms appear to be distinct from that species.

Size—Body, 12 mm.; tails, 17; forewing, 11; foreleg, 7½.

Head—Dark purplish brown. Purplish red spot at union of median and lateral carinae. Purplish spots below the antenna, two on each side of the head. Antenna dark purplish. Compound eyes bluish purple, the transverse band blue.

Thorax—Very dark purplish to mahogany brown, lighter at lateral borders of pronotum and on the pleura. Lavender mark anterior to wing roots. Mesonotal spine and metanotum so dark as to be almost black. Ventrally, light grey-purple on posterior portion of prosternum, otherwise very dark red-to-purple brown.

Legs—Basal half of fore femur light yellowish brown. Distal half of femur and all of tibia very dark purplish brown. Tarsus same color, a shade or two lighter. Second and third legs (judging by the one example that is preserved) white with faint greenish flush. Tarsal joinings and spot near center of claw purplish grey.

Wings—Venation dark purplish. Stigmatic area rather opaque white. Tendency for the cross veins of the stigmatic area to fork. Outer margin of hind wing with several intercalary and cross veins.

Abdomen—All of first tergite, posterior two-thirds of tergite 2, and posterior halves of tergites 3–6, dark purple. Anterior portion of the same tergites light purplish brown. Anterior lateral angle and an extension from this inward and backward for a short distance, light grey with lavender tinge. Extreme posterior angle same light color. Space between these, very dark purple. Extending backward from the anterior margin on each side of the median line, a dark purple streak, wider at its origin, reaching to the center of the tergite. A similar dark purple streak, arising from the posterior border between the first-mentioned streak and the pleural fold, reaches almost to the anterior margin, there expanding into a purplish blotch. Tergite 9 dark purplish brown with olive cast; two dark lines on each side at anterior margin. Tergite 10 light golden brown. Pleural fold margined with lavender.

Ventrally, lighter than in dorsal aspect. Sternites 2–6 purplish rose except a lighter median streak and a rather wide lateral border next to the pleural fold, which are cream to light greyed lavender. General effect is of a central light streak, bordered on each side by a band of purplish rose, this in turn bordered by grey. A very dark purple bar is parallel and close to the pleural fold in the posterior half of each sternite. Before reaching the anterior margin, it ends in a darker dash. Sternite 1 entirely deep purplish rose. Posterior margin of each sternite greyish purple. On 2–5, a transverse row of four light dots is seen. Sternites 7–9 lighter purplish rose, with an interrupted brownish streak on each side of the median line, ending at the center of the sternite as two dark dots.

Tails—Basal half very dark purplish brown, darker at joinings. Distal half very light grey, joinings reddish lavender. A short transition area of light grey with lavender wash is between the dark and light portions.

Genitalia—Of the 'arida' type. See Pl. 10, Fig. 24. Forceps base dark reddish brown. Forceps limbs purplish brown except light distal joint.

Holotype—Male imago. Penrose, N.C. Caught on window screen, July 17, 1930. No. 1086.1 in C. U. collection.

Isonychia pacoleta sp. nov.

Male imago, light orange, each abdominal segment bordered posteriorly with purplish brown. Fore tarsus light grey-lavender. Tails

MEASUREMENTS

| | BODY | TAILS | FOREWING | FORELEG |
|---------------------------------|-------|--------|----------|---------|
| Male nymph (2 specimens)..... | 10-11 | 7 | | |
| Female nymph (3 specimens)..... | 13-15 | 7 | | |
| Male imago (2 specimens)..... | 11-12 | 23½-26 | 10 | 5½-7 |
| Female imago (3 specimens)..... | 13-14 | 20-20½ | 11-13 | 5-5½ |

white. Wings translucent, venation hyaline. Nymph reddish brown, broken white median line on dorsum of thorax. Gills greyish lavender.

Male imago

Head—Yellowish brown. Lateral carina margined with purple. A purplish black spot at inner anterior margin of each compound eye, cephalad of each lateral ocellus. Antenna greyish white, washed faintly with lavender. Compound eyes purplish grey.

Thorax—Pronotum yellowish brown, lateral margins and posterior angles yellow. Mesonotum yellow, the spine, posterior margin, and a small central area near anterior margin dark red-brown. Metanotum yellowish brown, posterior margin dark red-brown. Pleura flesh to cream yellow, marked with lavender at wing roots and above third leg. Ventrally, prosternum white between legs, posteriorly brownish lavender. Meso- and metasternum reddish brown washed with purple.

Legs—Fore femur purplish, darker on outer and inner margins and distal end. Tibia purplish brown, basal end cream white. Tarsus white, faintly marked with lavender. Other legs white, tinged faintly with yellowish. Tips of claws and tarsal joinings very faintly purplish grey.

Wings—Translucent, almost semi-opaque in certain lights. Veins faintly yellowish to hyaline. On costal border of forewing, with yellowish tinge. Radius purplish at extreme base, on upper surface. Stigmatic area opaque white. Tendency for some cross veins in this area to fork near costal margin.

Abdomen—Light orange to bronze, the first three or four segments darker and washed with rose. Posterior margins of tergites widely purplish brown, the dark band partially broken at the median line on 1-6. A very faint greyish streak borders the median line on each side. Pleural fold greyish white with faint lavender streak. Ventrally, each sternite bordered narrowly on posterior margin with greyish purple, and central area of each flushed faintly with the same color. Sternite 1 dark

purplish brown. Across the center of sternites 2-7, very indistinct light dots are arranged transversely. Four dots discernible on 1-3, two only on 4-7.

Tails—White, very faintly flushed at base with flesh color to light lavender. Joinings not distinct nor different in color.

Genitalia—Of the 'albomanicata' type. Distal joint of forceps limb shorter than penultimate joint. See Pl. 10, Fig. 14.

Female imago

Similar to the male except as indicated.

Head—Yellowish white. Posterior angles of occiput purplish. Antenna whitish, base of filament slightly lavender.

Thorax—Pronotum greenish yellow. Posterior border and center of anterior margin purple. Mesonotum and metanotum except posterior border, and most of pleura, light greenish yellow. Posterior margins of these sclerites purple. Ventrally, a black transverse bar between the forelegs. Mesonotal spine-like process purplish black.

Legs—Fore tarsus pure white, the joinings and tips of claws purple.

Wings—Longitudinal veins of forewing somewhat more distinct than in male.

Abdomen—Flesh colored rather than orange. First sternite, and central anterior portion of first tergite, purplish brown. Each segment bordered posteriorly as in male. No trace of greyish streak on each side of median line. Pleural fold margined with purple except in anterior third of each segment. Ventrally, an indistinct orange triangle based on the posterior margin of sternites 3-6, extends broadly forward to anterior margin. Whitish ganglionic area evident in each. Sternite 2 purplish in posterior two-thirds. Four dots transversely arranged in center of sternite 2, rather indistinct. Posterior end of each oviduct purplish grey. A dark purple crescent near the point where these enter the common sac. Area over sac purplish rose. Lip of egg valve rose in center, sides grey lavender. Sternites 8 and 9 washed in central area with brownish lavender. Apical margin of 9th sternite as on Pl. 10, Fig. 2. Outer distal angles sharp-pointed, margin between these considerably indented.

Nymph

Deep bronze to reddish brown.

Head—Frontal carina brown. White median streak on vertex and occiput. In one specimen, white on posterior border and outer edge of

compound eyes. Antenna dark brown basally, remainder light yellowish brown, without a dark transverse band.

Thorax—Median line of pronotum narrowly white. A white dot close to median line on each side, at center of pronotum, and toward the lateral margin from these, two crescentic yellowish marks on each side. White dot on each side of median line on mesonotum also, just cephalad of the mesonotal spine. Another white dot, almost in line with the first pair, nearer the wing on each side. Faint whitish spots anterior to the wing roots.

Legs—Dull olive brown, with yellowish marks. Fore femur and tibia dark brown except for lighter fore and hind margins. Tibia narrowly yellow at base, the distal two-thirds yellow. Hairs on foreleg orange. Other legs with yellow bands at each end of the femur and tibia, and a band across the center of the femur. Tarsus as in first leg. Tibial spine and femoral flange of foreleg and claw of third leg, as on Pl. 10, Fig. 13a; and Pl. 11, Fig. 4b.

Abdomen—Median dorsal white line the entire length of the abdomen in some specimens. In others, only the first half or two-thirds of each tergite is white on this line. A whitish dash on each side of this central white line, beginning below the anterior margin and extending outwards and backwards to or beyond the center of the tergite. A white spot on each side, toward center and slightly anterior to the posterior lateral angle. Tergite 10 reddish brown, darker on posterior margin. Ventrally, a whitish line or dash on each side of median line, extending backwards to or beyond the center of each sternite. A dark purplish mark at anterior margin, halfway to pleural fold. Posterior sternites darker red-brown than the anterior ones.

Gills—Greyish lavender, gill tufts lavender. Margins of gills narrowly brown on extreme edge. A whitish area between the brown edge and the lavender central disc. Two rather indistinct brown spots in outer margins of each. See Pl. 11, Fig. 17.

Tails—Dark reddish brown basally. The first darker cross bar rather indistinct.

Holotype—Male imago. Reared from nymph. Pacolet River, near Tryon, N.C., July 15, 1930. No. 1091.1 in C. U. collection.

Allotype—Female imago. Reared from nymph. Same data. No. 1091.2 in C. U. collection.

Paratypes—Male imago, two female imagoes, two female subimagoes. Same location. July 15–17, 1930. No. 1091.3–7 in C. U. collection

Isonychia serrata sp. nov.

MEASUREMENTS

| | BODY | TAILS | FOREWING | FORELEG |
|---------------------------------|-------|-------|----------|---------|
| Male nymph (2 specimens)..... | 14 | 5 | | |
| Female nymph (5 specimens)..... | 14-16 | 6-8½ | | |
| Male imago (1 specimen)..... | 14 | 22 | 12 | 9½ |
| Female imago (1 specimen)..... | 16 | 19½ | 14½ | 7½ |

Male imago with anterior half of each abdominal tergite light bronze, posterior half purplish brown. Fore femur light at base; fore tarsus light grey-purple. Venation dark purple-brown. Tails very dark brown. Nymph dark red-brown, with light dorsal median streak on head, thorax and abdomen. Gills purplish, two brown dots in outer margin of each.

Male imago

Head—Brown. Black transverse bar below lateral carina. Red-purple spot at each end of keel of median carina, another on outer side of base of antenna. Antenna light grey-lavender. Compound eyes dark grey-lavender.

Thorax—Pronotum brown with purple tinge. Mesonotum yellow-brown. Pleura cream colored with brown and lavender markings. Mesonotum bordered with cream color, and cream colored spot anterior to mesonotal spine. Metanotum and posterior edge of mesonotal spine dark brown. Ventrally dark purple-brown, darkest on metasternum and central sclerite of mesosternum.

Legs—Fore femur grey at each extremity; remainder of femur and all of tibia dark purple. Tarsus lighter grey-purple; distal half of last segment and base of claws as dark as tibia. Other legs whitish, last tarsal joint and claws purplish grey.

Wings—Veins dark purple-brown. Tendency for some of cross veins in stigmatic area to fork toward costal margin.

Abdomen—Bronze with dark purplish brown markings. Anterior half of each tergite bronze, posterior half purplish brown. Wide dark brown posterior border on each, except at median line. Median line light colored, creamy bronze in anterior and slightly darker in posterior of each tergite. A dark brown streak on each side of the light median area in anterior half of each tergite, extending slightly beyond center. These streaks are farther apart posteriorly. Pleural fold and posterior

lateral angle of each side darker than remaining parts of tergite. A small dark spot at anterior margin midway between median line and pleural fold.

Sternite 1 very dark purple-brown except for whitish posterior border. Sternites 2-4 same dark color except for cream colored to light bronze anterior lateral angles, posterior margin, a dash on each side of median line, and four small dots arranged transversely across center of each. Sternites 5 and 6 similar, but light on each side of the dark central area, and but two dots near the center, between the short dashes. 7-9 mostly light, only a restricted dark area in the center. Dashes and dots as in 6. On 2-9, a narrow dark bar parallel to pleural fold, in posterior half of sternite; in line with this bar and anterior to it, a dark dot.

Tails—Very dark brown. Distal third slightly lighter brown. Joinings in basal half lighter brown.

Genitalia—As on Pl. 10, Figs. 19 and 22. Of the 'arida' type. Incurved lower portion of the penes bears 7-8 teeth or spines; 'saw-toothed'.

Female imago

Differs from the male only in these respects.

Head—Bronze, purple between ocelli, at posterior lateral angles of the occiput, and along inner margin of compound eyes. Median and lateral carinae edged with red. Dark spot below lateral carina on each side.

Thorax—Pronotum lighter than in male. Mesonotum yellowish bronze.

Legs—Basal half of fore femur whitish. Second and third legs yellowish, last three tarsal joints washed with purplish grey.

Abdomen—Flushed with pinkish orange, probably due to presence of eggs. Tergites as in male, but dark areas more restricted. Dark areas on sternites restricted to center of each. Median line light. Markings as in male. Sternite 9 with no markings except two short lavender streaks at anterior margin. Apical margin of 9th sternite with little or no indentation. See Pl. 10, Fig. 11.

Nymph

Dark red-brown.

Head—Carina, posterior margin of compound eyes, median line caudad of lateral ocelli, and small areas laterad of each lateral ocellus and cephalad of median ocellus, yellowish white. Antenna dark brown at base. Remainder yellowish brown, except for dark brown transverse band one-third from the base, and a whitish tip.

Thorax—Median line yellowish white, slightly widest on pronotum. On each side of pronotum, three indistinct yellowish marks. Faintly mottled with yellowish, anterior to wing roots. Ventrally, greyish brown.

Legs—Yellow bar at each end of tarsus and across center of femur of foreleg. Each end of fore femur and tibia light brown, remainder of each joint very dark brown. Second and third legs similar, but tibia yellowish at each end, and the yellow bar on the femur one-third from the distal end. Tibial spur and flange of femur of foreleg, and claw of third leg, as on Pl. 10, Fig. 13c; and Pl. 11, Fig. 4c.

Abdomen—Median dorsal line yellowish on first three tergites, light red on others. A blackish irregular line borders the median light streak on each side. Posterior margin narrowly black, and a dark brownish red area occupies most of the area on each side of the central streak, except a lighter portion next to the pleural fold. 10th tergite black except anterior fourth, which is yellowish red.

Ventrally, light red-brown. Median line yellowish in anterior third of sternites 1-7. A dark brown spot in anterior lateral angle of sternites 2-4; a dark brown streak in posterior half of sternites 5-9, paralleling pleural fold. Central portion of sternites 3-8 with yellowish dashes and dots, arranged as in imago.

Gills—Dark purple except for dark brown upper margins and narrow greyish white outer edge. Two brown spots in outer margin. Third gill as on Pl. 11, Fig. 14.

Tails—Marked as in *I. albomanicata*, but very dark red-brown, almost black, basally.

Holotype—Male imago. Reared from nymph—Allen's Creek, near Waynesville, N.C., July 21, 1930. No. 1085.1 in Cornell University collection.

Allotype—Female imago. Reared. Same location. July 23, 1929. No. 1085.2 in C. U. collection.

Isonychia aurea, sp. nov.

MEASUREMENTS

| | BODY | TAILS | FOREWING | FORELEG |
|---------------------------------|-------|-------|----------|---------|
| Female nymph (5 specimens)..... | 16-17 | 11 | | |
| Female imago (2 specimens)..... | 16-17 | 22-23 | 13-15½ | 7 |

No males of this species were obtained. Abdomen of female imago light orange, with purplish brown markings. Thorax greenish yellow. Fore tarsus not lighter than other joints of the foreleg. Tails dark brown. Venation purplish brown. Nymph dark reddish bronze, gills greyish, each with two brown spots in outer margin.

Female imago

Head—Greenish yellow. Orange yellow on vertex just caudad of ocelli. Posterior border and posterior lateral angles of occiput purplish. Keel of median carina purplish red. Antenna light purplish grey at base, filament same color but darker.

Thorax—Pronotum, mesonotum and metanotum except posterior portions, and pleura, greenish yellow. Pleura marked with purplish grey at wing roots and above third leg. Meso- and metanotal spines, and lateral boundaries of each, dark reddish brown. Ventrally clear light yellow. Brown spot in center and posterior lateral margins of central mesosternal sclerite. White band behind fore legs, similar bands anterior to legs of second and third pairs.

Legs—Fore femur very light brown basally, distal half dark red-brown. Tibia and tarsus very dark brown, slightly washed with purple. Second and third legs greenish yellow. Claws and last three tarsal joints dark purplish grey, joinings slightly darker. First joint faintly purplish grey distally.

Wings—Venation dark purplish brown, the longitudinal veins of the costal border dark yellowish brown. Many of the cross veins of the stigmatic area are anastomosed. Outer margin of hind wing with numerous intercalary and cross veins.

Abdomen—Light orange, brighter dorsally. Tergites marked with purplish brown. A wide band of this color along the posterior margin of each, broken at the median line except for a slender connecting thread along the upper edge. Posterior lateral angles purplish brown. A somewhat crescentic purplish brown mark on each side of the wide light median line on tergites 3-9, its open side toward the median line. A rectangular blotch occupies a corresponding position in tergite 2. These marks arise from a purplish triangular blotch on each side of the median line at the posterior margin, and extend forward beyond the center of the tergite.

Ventrally, a deep orange triangle, its base on the posterior margin and its apex attaining the anterior margin, occupies the middle of sternites 2-6. Within each triangle the ganglionic area appears as a whitish

blotch. Sternites 7-9 yellowish. Posterior edge of egg valve purplish brown. No distinct streak nor dark dot next to pleural fold, on any sternite. Apical margin of sternite 9 shown on Pl. 10, Fig. 12.

Tails—Very dark reddish brown basally, becoming gradually lighter brown in central portion, and purplish grey in the distal fourth. All joinings slightly darker.

Nymph

Body dark reddish bronze.

Head—Frontal carina brownish except for whitish upper central portion. Whitish areas laterad of each lateral ocellus, cephalad of median ocellus, and on anterior and posterior margins of compound eyes. Antenna dark brown at base, the remainder yellow to yellowish brown, with no distinct dark transverse bar.

Thorax—White median line on pronotum, wider anteriorly. Very narrow light median line on mesonotum. Two white marks on each side of pronotum near the anterior margin. Several small light spots anterior to wing roots on mesonotum. Lighter ventrally.

Legs—Yellow, banded with dark brown. Tarsi yellow at each end, narrowly so on fore leg. Distal half of tibia, narrow streak at its basal end, and three bands on each femur yellow. On third leg, the median band of the femur is confined to the hind margin. Tibial spur and flange of foreleg, and claw of third leg, shown on Pl. 10, Fig. 13d and Pl. 11, Fig. 4a.

Hairs of foreleg orange.

Abdomen—Tergites 2-9 each with a white blotch in the anterior portion of the median line, extending to center of tergite on 2-6, but at margin only, on 7-9. A dark mottled dash, crescentic in the anterior tergites, arises from each side of this white blotch, extending outward and backward, but not reaching the posterior margin. A white dot on each side, above and toward the center from the posterior lateral angle. Tergite 10 yellow in basal third; distal two-thirds very dark brown. Ventrally, the anterior margin of each sternite is dark purplish brown, but with a white space at the median line. Indistinct bars and dots are present—a bar on each side of the median line, and at the posterior ends of the bars, four dots transversely arranged.

Gills—Greyish, faintly marked with lavender basally. Mid-trachea and margins, and two spots in outer margin, brown. See Pl. 11, Fig. 12.

Tails—Dark brown at extreme base, then yellowish brown to first dark transverse bar.

Holotype—Female imago. Reared from nymph. Small tributary of Pigeon River, near Hazelwood, N. C., July 26, 1930. No 1090.1 in C. U. collection.

Paratypes—Female subimago and female imago. Reared. Same locality, July 22 and 25, 1929. No. 1090.2-3 in C. U. collection.

GENUS PSEUDOCLOEON Klap 1905

Pseudocloeon dubium Walsh

Nymphs which fit the description given by Dr. McDunnough (Can. Ent. 63: 85) for this small species were taken from Flat Creek,—a tributary of the Swannanoa River at Black Mt., N. C.—on June 19, 1930; from Bald Creek,—tributary to the Nolichucky River,—July 6, 1930; and from a tributary of the French Broad River at Selica, on July 13, 1930. No adults were obtained.

The mouthparts of this nymph are quite similar to those of *P. carolina*, differing however in these respects: 1) the canines of the mandibles stand rather erect instead of leaning outward (See Pl. 12, Fig. 17); and 2) the labial palp is plainly composed of three segments, the distal of which is separated by a definite notch on the inner margin from the second segment (see Pl. 12, Fig. 14). Femora with fairly long hairs on the inner margin; tibiae and tarsi with but a few short spines on the outer margin, practically no hairs on the inner margin.

Pseudocloeon carolina Bks.

Rather chunky nymphs, tails not barred, which correspond quite well with Ide's description and figures of *P. carolina* (Can. Ent. 62: 221, and pl. 18, figs. 3, 3a and 3b), were collected at several stations in the mountain area. Another species, more slender than this one, was however more in evidence during June in the Black Mt. region, from which locality *P. carolina* was originally described. Nymphs of this species were taken from a tributary of the Pigeon River at Waynesville, July 14, 1929; from near Chimney Rock, June 17, 1929; the Rocky Broad River at Lecky Gap, June 23, 1930; the Ocona Lufty River near Cherokee, July 12, 1930; and at Selica, July 13, 1930.

This species differs from others of the genus found in North Carolina in the possession of very long hairs on the inner margin of both femora and tibiae, and somewhat shorter ones on the inner margin of the tarsi. In the specimens from this state, the labial palp is three-jointed, the short

distal joint seeming to be partially fused with the second. Canines of both mandibles lean strongly outward (see Pl. 12, Fig. 13).

A female imago was reared from a nymph of this species captured in the North Fork of the Swannanoa River on June 14, 1930. This female is somewhat lighter than the one described by McDunnough. The thorax is light tan shading into a somewhat darker tan on the metanotum, which is tinged with pale rose. A smoky streak extends forward from the wing roots. Occiput of head and central portion of pronotum faintly smoky. Abdomen cream-colored to light tan, lighter ventrally. Tergites washed faintly with pale rose, the posterior margin of each being deeper rose. Stigmatic areas marked with purplish black. Fore femur, distal end of tibia and fourth tarsal joint smoky brown.

Slender *Pseudocloeon* nymphs were collected in the vicinity of the Black Mts. These nymphs seem not to be *P. cingulatum* McD. or either of the two preceding species. As no adults were reared, the species cannot be determined at present, but I present the following summary of the characters of the nymphs, referring to them as *Pseudocloeon* sp.?

Pseudocloeon sp?

Size—Body 4-4½ mm.; tails 3 mm.

Body relatively slender, not appreciably widened at the mesothorax, as in *P. carolina*.

Mouthparts. Canines lean outward, but less so than in *P. carolina*. Labial and maxillary palps much as in *P. carolina*. See Pl. 12, Figs. 28 and 32.

Legs—Fairly long hairs on hind margin of femur; a few short spines on tibia and tarsus, longer than in *P. dubium*; no hairs as in *P. carolina*. Olive-brown except at each end and a narrow line on the hind margin of the femur; basal half (in some specimens, oblique band only) of tibia; basal half of tarsus, except narrow dark line at basal joining.

Abdomen dorsally dark reddish brown with definite olive tinge. Tergites 4, 5 and 9 lighter. Dark mark on each side of median line anteriorly on 2-6, ending at center of tergite with a brown dot. Similar dark dots on 7-9. Sternites light tan to yellowish brown, washed with brown laterally. Tails light yellowish brown, not banded.

Taken from the Rocky Broad River on June 23, 1930. Nymphs which appear to be of the same species were also found in the Catawba River above Marion, June 16, 1930.

GENUS CENTROPTILUM Eaton 1869

Centroptilum album McD.?

A single specimen of this genus,—a female imago—was captured at the auto headlights from the North Fork of the Swannanoa River on the evening of July 3, 1930. This specimen is smaller than any species recorded from the United States or Canada. It comes nearest to the description of the female of *C. album* McD. (Can. Ent. 58: 189), although the latter is a somewhat larger species. To this species I doubtfully refer my specimen, and give a description of it, for purposes of comparison.

Size—Body 3 mm.; wings $3\frac{1}{2}$ mm.; tails $3\frac{1}{2}$ mm.

Head light brown. Ocelli ringed at base with purplish black. Basal segments of antenna whitish, the filament purplish in basal half, white distally.

Thorax—Light brown, faintly washed with rose. Rose markings on lateral and postero-lateral margins of pronotum; on mesonotal median line posteriorly; laterad of the base of each middle leg, on the mesosternum; anterior to the wing roots; above and on the third coxa. Mesonotal spine white. Prominent spinous process at center of metanotum. Legs white. Claws and last tarsal segment tinged with brown.

Wings—Hyaline. Intercalaries single, as usual. Hind wing very narrow, two longitudinal veins. Costal angulation not particularly prominent.

Abdomen—White with yellowish tinge, prominently marked with deep wine-red. Tergite 6 mainly wine-red; 7, 9 and 10 yellowish brown with rose tinge. Wine-red patches at center of tergite 2, and occupying most of the lateral areas of 2 and 3. Small triangular lighter red spots on anterior margins of 4 and 5, one on each side. Tiny black mark at spiracular area. Ventrally white, the three posterior sternites washed with yellow. Posterior margin of each sternite with prominent wine-red border, except on median line. Spots of same color near lateral margin of each. On 2 and 6, a dark line parallels the pleural fold.

Tails white.

GENUS BAETIS Leach 1815

Although nymphs of this genus were relatively abundant in all three regions of the state, only a few species were reared. Of these, and of the female imagoes caught in flight or entangled in spiders' webs near the streams, very few could be positively identified.

Baetis rusticans McD.?

Nymphs taken from Flat Creek near Black Mt. transformed on June 15, 1930. The imagoes seem to correspond quite closely to the above species, in which I am placing them tentatively.

Baetis australis, sp. nov.

MEASUREMENTS

| | BODY | TAILS | FOREWING | FORELEG |
|------------------------------------|------|--------|----------|---------|
| Male imago (1 specimen)..... | 4½ | Broken | 4½ | 4 |
| Male subimago (5 specimens)..... | 5 | 8 | 4-4½ | 1½-2 |
| Female imago (1 specimen)..... | 4½ | Broken | 5 | 1¼ |
| Female subimago (3 specimens)..... | 4-5 | 6½ | 4½-5 | 1 |

This species is close to *B. frondalis* McD., differing from it in the following particulars. 1) no spine at the base of the excavation of the posterior margin of the 9th segment; 2) inner apical margin of first segment of forceps with tuberculate process; 3) no short spinous process on outer basal portion of third segment of forceps; and 4) a slight difference in the venation of the hind wing.

Male imago

Head—Turbinate eyes large, orange; oval in outline. Antennae light purplish brown.

Thorax—Dark ruddy brown; intersegmental areas of pleura yellowish. Anterior portion of mesosternum lighter yellowish brown.

Wings—No cross veins before bulla in forewing. 6-8 cross veins beyond the bulla, not anastomosing. Only the most apical two of these touch the subcosta. Stigmatic area somewhat opaque. No marginal intercalaries in first interspace. Hind wing long and narrow, the costal angulation reduced. See Pl. 12, Fig. 4.

Legs—Yellowish white.

Abdomen—Abdominal tergites 1-6 translucent silvery white in central area, the lateral area of each being purplish brown. Posterior margins narrowly purplish brown. Tergites 7-10 opaque reddish brown with purple tinge. Prominent continuous purplish black line on stigmatic areas. Ventrally, translucent greyish white, sternite 1 shaded with brown. Tails missing from the single specimen.

Genitalia as on Pl. 12, Fig. 3.

Male subimago

Very similar to imago, but rather paler. Wings grey.

Female imago

Head—Purplish rose.

Thorax—Yellowish brown. Pronotum marked with rose.

Abdomen—White central area on abdominal tergites 1-6 present, but tinged with rose. Abdomen purplish rose dorsally; black stigmatic marks as in male. Ventrally, silvery with faint rose tinge. Purplish rose streak on each sternite next to the pleural fold, wider on anterior sternites. Tails missing. Apical margin of extension of 9th sternite as on Pl. 12, Fig. 19.

Female sub-imago

Rather similar to imago, but with white markings on head and thorax, and the central light area on abdominal tergites 1-6 entirely obscured by reddish brown tinged with purple.

Holotype—Male imago. Goshen Swamp, N. C. Taken by Prof. Needham, on April 11, 1929. No. 1098.1 in C. U. collection.

Allotype—Female imago. Lenoir Co., same date, same collector. No. 1098.2 in C. U. collection.

Paratypes—4 male subimagoes, 3 female subimagoes. Same as holotype. Burncoat Swamp, same date and collector. No. 1098.3-9 in C. U. collection.

These specimens were secured by Prof. Needham from the coastal plain region in the localities listed above, on April 11, 1929. Along with these were several female imagoes somewhat smaller in size and more definitely tinged with rose, which I am not including in the above species. Likewise several nymphs were collected from the same stations, but it is not known that they are associated with the adults. These nymphs are long and slender, show a black stigmatic line as in the imago of *B. australis*, and the abdomen seems disproportionately long in its relation to head and thorax combined.

Baetis sp? No. 1

A single male imago taken from Flat Creek, near Black Mt., on June 19, 1930, is apparently close to *B. incertans* McD., but differs from it in

the following respects: 1) no ruddy tinge on pleura; 2) abdominal tergites whitish on posterior margin, instead of deeper ruddy brown; 3) abdominal tergites 7-10 deep orange-brown; 4) no smoky apical spot on fore tibia; 5) hind wing with an extra short intercalary between the two strong ones and the second vein. Genitalia as on Pl. 12, Fig. 9.

GENUS CALLIBAETIS Etn. 1881

Callibaetis sp?

Nearly one hundred nymphs of one species of this genus were found in a tiny temporary pool in the vicinity of Greensboro, on March 18, 1930. Although seemingly in good condition, not one of these transformed to the subimago state, although many died in the attempt to do so. By April 6 most of the nymphs had died. As none was reared, no attempt will be made to determine the species, unless a future comparative study of many species of nymphs of this genus can be undertaken.

Only this single species was found in the collecting done in the state.

GENUS ACENTRELLA Bengtsson 1912

Dr. McDunnough prefers to retain in the genus *Baetis* the four species *B. propinquus*, *B. frivolus*, *B. insignificans* and *B. dardanus*, the latter being perhaps synonymous with *B. propinquus* (see *Canad. Ent.* 57: 172 and 175). The lack of a costal projection on the hind wing, which would place these in the genus *Acentrella*, he thinks is not a character of generic value. Since, however, the genitalia of the last three species mentioned likewise differ somewhat from the usual *Baetis* type, I feel that there is sufficient justification for recognizing *Acentrella* as a valid genus. Especially is this true, since the two-tailed nymph of *Acentrella* is readily distinguishable from all species of *Baetis* except the western *B. bicaudatus*. It may be distinguished from the nymph of *Pseudocloeon*, which also has but two tails, by the presence of the second pair of wing buds.

A species of this genus, rather close to *B. frivolus* but differing from it and from all the other three species mentioned above, is present in my collections from Big Alamance Creek in the piedmont area of the state. *Acentrella* nymphs, which appear to be of this same species, were taken also from the outlet of Hamburg Lake and from the Uharie River, but were not reared. One male subimago, one male imago and one female imago were reared from the Alamance nymphs. This species I designate as follows.

Acentrella ampla, sp. nov.

MEASUREMENTS

| | BODY | TAILS | FOREWING | FORELEG |
|---------------------------------|-------|--------|----------|---------|
| Male nymph (2 specimens)..... | 6½-7½ | 5-6 | | |
| Female nymph (6 specimens)..... | 7-8½ | 4½-6 | | |
| Male imago..... | 7 | Broken | 6½ | Broken |
| Female imago..... | 8½ | 12 | 6½ | 3¼ |

Nymph

Mature nymph dark red-brown dorsally, lighter ventrally. Immature nymph very light red-brown. (Mature nymph used for description.)

Head—Brown. Vertex and occiput mottled; median line yellow. Lateral ocelli large, rounded. Median ocellus small, somewhat crescentic. Antennae light brown basally, distal portion yellowish. Mouthparts very similar to those of *Pseudocloeon*.

Thorax—Dark red-brown dorsally, marked and mottled with yellow. Ventrally, dark brown anterior to second and third legs, and brown band laterad of second leg. Remainder yellow.

Legs—Yellow, marked with brown. Greyish brown marks on femur toward distal end. Joinings dark brown. Distal end of tarsus, and claw, very dark brown.

Abdomen—Dorsally, tergites 1-9 dark red-brown, each with a round yellow dot on each side of median line at center. Tergite 10 yellow. Ventrally, light red-brown, the posterior margin of each sternite darker. On 2-8, two light marks, one beneath the other, on each side of median line. Sternite 1 with but one round mark on each side of median line; 9 and 10 unmarked.

Gills—Simple. Very similar to *Baetis*. Opaque white; anterior and inner posterior margin of each narrowly brown.

Tails—Two. Very short unsegmented rudiment of middle tail present. Hairs on inner margin only; tips bare. No dark markings.

Male imago

Head—Turbinate eyes orange. Somewhat rounded in outline as viewed from above. Not contiguous over occiput. Lower portion of eyes, and mark across frons, black. Antennae light brown.

Thorax—Light red-brown. Mesonotum marked with longitudinal

dark brown streaks on median line and on each side of this. Red tinge most prominent on metanotum. Pleura red-brown, sternites light red-brown.

Legs—Foreleg missing. Second and third legs yellowish.

Wings—Hyaline, Veins definitely yellowish brown. 7-8 costal cross veins beyond the bulla; only a slight tendency for these to anastomose. Paired intercalaries absent from first interspace, well developed in others. Hind wing long and narrow; two distinct and well developed longitudinal veins.

Abdomen—Segments 1-5 yellowish brown with tinge of grey. 6-10 light reddish brown. Posterior margin of each widely opaque white. Tergite 1 mostly concealed by wide metanotum.

Genitalia—Distal segment of forceps limb longer proportionately even than in *B. frivulus*, which the genitalia most resemble. See Pl. 12, Fig. 21.

Tails—Missing.

Female imago

Differs from male as indicated.

Head and thorax cream-yellow, the latter marked with dark brown. No dark longitudinal stripes on mesonotum, as in male.

Legs—Yellow, the joinings narrowly brown.

Wings—As in male, but a faint oblique intercalary between the two longitudinal veins of the hind wing. See Pl., 12, Fig. 11.

Abdomen—Much as in male, but segments 1-6 tinged with light orange, due to the presence of eggs, Segments 7-10 olive rather than reddish brown. A rose-colored spot at center of distal margin of tergite 10, and a narrow transverse rose line next to white posterior border on tergites 2-5. Distal margin of sternite 9, and plates of 10th sternite, shown on Pl. 12, Fig. 20.

Tails—Yellowish white.

Holotype—Male imago. Reared. Big Alamance Creek, N. C., March 21, 1929. No. 1099.1 in Cornell University collection.

Allotype—Female imago. Reared. Big Alamance Creek, Feb. 20, 1930. No. 1099.2 in C. U. collection.

Paratypes—Male subimago, and two nymphs. Same location, Feb. 20 and 25, 1930. No. 1099.3-5 in C. U. collection.

SELECTED BIBLIOGRAPHY

ARGO, VIRGIL

- 1927 The North American species of the genus *Potamanthus*, with a description of a new species. *Journ. N. Y. Ent. Soc.* **35**: 319-328. 1 pl.

BANKS, NATHAN

- 1908 A list of Neuropteroid insects from North Carolina. *Proc. Ent. Soc. Washington* **9**, No. 1-4: 149-155.
- 1908 Neuropteroid insects. *Trans. Amer. Ent. Soc.* **34**: 255-266. 3 pls.
- 1914 New Neuropteroid insects, native and exotic. *Proc. Acad. Nat. Sci. Philadelphia* **66**: 612-616.
- 1924 Descriptions of new Neuropteroid insects. *Bull. Mus. Comp. Zool.* **65**: 421-455. 4 pls.

CLEMENS, W. A.

- 1913 New species and new life histories of Ephemeridae or mayflies. *Canadian Entomologist* **45**: 246-262, and 329-338. 2 pls.
- 1915 Rearing experiments and ecology of Georgian Bay Ephemeridae. *Canad. Dept. Marine and Fisheries* **5**, Sessional Paper 39b: 113-128. 2 pls.
- 1915 Mayflies of the *Siphonurus* group. *Canad. Ent.* **47**: 245-260. 3 pls.
- 1917 An ecological study of the mayfly *Chironetes*. *Univ. of Toronto Studies. Biol. Ser.* **17**: 1-41. 5 pls.

EATON, REV. A. E.

- 1871 A monograph on the Ephemeridae. *Trans. Ent. Soc. London*, 1871: 1-158. 6 pls.
- 1883-6 A revisional monograph of recent Ephemeridae or mayflies. *Trans. Linn. Soc. London*, 2nd ser., *Zoology*, **3**: 1-352. 55 pls.

IDE, F. P.

- 1930 Contributions to the biology of Ontario mayflies. *Canad. Ent.* **62**: 204-213, and 218-231. 4 pls.

KENNEDY, C. H.

- 1926 The nymph of *Ephemera guttulata* Pictet with notes on the species. *Canad. Ent.* **59**: 61-63. 7 text figs.

MCDUNNOUGH, J.

- 1924 New Ephemeridae from New England. *Occas. Papers Boston Soc. Nat. Hist.* **5**: 73-76. 1 pl.
- 1924 New Ephemeridae from Illinois. *Canad. Ent.* **56**: 7-9. 1 text fig.
- 1924 New Canadian Ephemeridae with notes, I and II. *Canad. Ent.* **56**: 90-98, 113-122, and 128-133. 2 pls.
- 1924 New North American Ephemeridae. *Canad. Ent.* **56**: 221-226. 1 pl.
- 1925 New Ephemerella species (Ephemeroptera). *Canad. Ent.* **57**: 41-43.
- 1925 New Canadian Ephemeridae with notes, III. *Canad. Eng.* **57**: 169-176, and 185-192. 2 pls.
- 1925 The Ephemeroptera of Covey Hill. *Trans. Royal Soc. Canada, Sect.* **5**: 207-223. 1 pl.
- 1926 New Canadian Ephemeridae with notes, IV. *Canad. Ent.* **58**: 296-303. 1 pl.

- 1927 A new Ephemerella from Illinois (Ephemeroptera). *Canad. Ent.* **59**: 1.
- 1928 Ephemerid notes with description of a new species. *Canad. Ent.* **60**: 238-240.
- 1929 Notes on North American Ephemeroptera with descriptions of new species, II. *Canad. Ent.* **61**: 169-180. 2 pls., 1 fig.
- 1930 The Ephemeroptera of the north shore of the Gulf of St. Lawrence. *Canad. Ent.* **62**: 54-62. 3 pls.
- 1931 The Bicolor group of the genus Ephemerella with particular reference to the nymphal stages (Ephemeroptera). *Canad. Ent.* **63**: 30-42, and 61-68. 4 pls.
- 1931 The genus Isonychia (Ephemeroptera). *Canad. Ent.* **63**: 157-163. 1 pl.
- 1931 The eastern North American species of the genus Ephemerella and their nymphs. *Canad. Ent.* **63**: 187-197. 1 pl.
- MORGAN, ANNE H.
- 1911 Mayflies of Fall Creek. *Ann. Ent. Soc. Amer.* **4**, No. 2: 93-118. 7 pls.
- 1912 Homologies in the wing-veins of mayflies. *Ann. Ent. Soc. Amer.* **5**, No. 2: 89-106. 5 pls.
- MORRISON, EMILY REED
- 1919 The mayfly ovipositor, with notes on Leptophlebia and Hagenulus. *Canad. Ent.* **51**: 139-146. 2 pls.
- NEEDHAM, J. G.
- 1901 (Ephemeridae in) Aquatic insects in the Adirondacks. *N. Y. St. Mus. Bull.* **47**.
- 1905 (Ephemeridae in) Mayflies and midges of New York. *N. Y. St. Mus. Bull.* **86**.
- 1907 Additional data concerning New York mayflies. *N. Y. St. Mus. Bull.* **124**.
- 1918 (Ephemeridae in) Ward and Whipple, *Fresh-Water Biology*. New York.
- 1918 A new mayfly, Caenis, from Oneida Lake, New York. *N. Y. St. Coll. Forestry* **18**: 249.
- 1920 Burrowing mayflies of our larger lakes and streams. *Bull. U. S. Bur. Fisheries* **36**: 269-292. 13 pls.
- NEEDHAM, J. G., AND NEEDHAM, P. R.
- 1927 A guide to the study of freshwater biology. New York and Albany.
- STEGE, A. LOUISE
- 1931 Some preliminary notes on the genus Ephemerella. *Psyche* **38**, No. 1: 27-35. 1 pl.
- TRAYER, J. R.
- 1931 The Ephemerid genus Baetisca. *Journ. N. Y. Ent. Soc.* **39**: 45-64. 2 pls.
- 1931 A new mayfly genus from North Carolina. *Canad. Ent.* **63**: 103-109. 1 pl.
- ULMER, GEORG
- 1920 Key to the genera of Ephemerida. *Stett. Ent. Zeit.* **81**: 97-144. (I used the translation by Dr. L. E. Wolfertz and Dr. Ph. de Vargas, published in *Peking Soc. Nat. Hist. Bull.* **4**, pt. 4: 1-18. 1929).