

nating in several (about 5) curved subulate teeth; palpus minute, setaceous, 11-jointed, with the second joint the longest, and the third, nearly equalled in length by the penultimate, longer than any of the remaining joints. Laciniaë of maxillæ II. broadly falcate, almost as broad as the subquadrangular lobes of the labium; palpus 13-14-jointed; the first joint much the stoutest and longest, about half as long as the flagellum; the second joint (the first of the flagellum) longer than any of the others. Terminal margins of the fore wings free. Hind leg little longer than the fore leg; tarsus about $\frac{1}{2}$ as long as the tibia, and this about $\frac{2}{3}$ as long as the femur; all the legs are fringed with hair along their upper edges, and have strongly incurved ungues. Setæ defective; the median plumose, the others ciliated within. Length of body 21 mm.

Hab. Chili (Reed, in M^cLach. Mus.).

Part IV. Read December 17th, 1885.

Third Series of Group III. of the Genera of the Ephemeridæ.

Adult.—Anal-axillar interspace of the fore wing curvilinear-trilateral, subtended by the anal angle and a part of the terminal margin. Forceps-basis of ♂ well developed—its form and that of the penis (especially the latter) facilitate distinctions of genera; forceps-limbs either 4-jointed, with the second joint proportionally very long, or 3-jointed (through coalescence of the first with the second joint), with an enlargement at the base of the proximal joint. *Nymph* [those of section 13 unknown]: palpi of maxillæ I. and II. 2-jointed and geniculated; terminal joint of the palpus of maxilla II. peculiarly pouched. Abdominal tracheal branchiæ [excepting the hindermost in some genera] foliaceous and fringeless, furnished at the base each with a fascicle of fibrils or an annexed lamella filiformly dissected at the edges.

Section 13 of the Genera.—Type of *Atopopus*. *Adult.*—In the fore wing the first axillary-nervure (9^1) meets the inner margin at or near the very obtusely rounded anal angle; the second axillary (9^2), subparallel with and adjacent to the first, receives several branchlets [or curved cross veinlets] from the distal portion of the inner margin which comes between its own termination and that of the third axillary nervure (9^3); the almost straight anal nervure (8) meets the terminal margin rather far in advance of the anal angle; the trilateral, somewhat leg-of-mutton-shaped space [the “anal-axillar interspace”], bounded by the anal and first axillary nervures together with the terminal margin, and attenuated towards the wing-roots, contains a variable number of intercalary nervures, incurvate from the terminal margin and commonly grouped together in two couples of unequal length, of which the longer [usually the nearest to the first axillar (9^1)] extends about halfway to the wing-roots. Tarsi of the hinder legs as long as the tibiæ or longer. *Nymph* unknown: perhaps that ranked in section 12.

Absence of requisite materials precludes description of the genera of this section in full detail.

AMETROPUS, Albarda, 1878.

Illustrations. *Adult* (details), Pl. XXII. 38.

Adult.—Fore tarsus of ♂ nearly 5 (about $4\frac{5}{8}$) times as long as the tibia, which is $\frac{3}{4}$ as long as the femur; the tarsal joints in diminishing sequence rank, 1, 3, 2 equal to 4, 5 [the intermediate joints probably vary slightly in their mutual proportions], the first joint about $1\frac{1}{2}$ as long as the second and almost twice as long as the tibia. Fore leg of ♀ about $\frac{3}{7}$ as long as the body; tarsus about $2\frac{2}{3}$ as long as the tibia, and this $\frac{3}{2}$ as long as the femur; the joints in the order of their shortening rank 1, 2, 3 equal to 4, 5, and the first joint is about $1\frac{1}{2}$ as long as the second, and little shorter than the tibia. Ungues mutually dissimilar in every tarsus. In the anal-axillar interspace of the fore wing figured the two intercalary nervures next to the anal nervure are the longest. Hind wings well developed; the dilatation of the marginal area angular in front; the axillar region ample and supplied with abundant neuration, to which the hindermost nervure contributes numerous branchlets. Forceps basis of ♂ deeply and roundly excised, with acute points; forceps-limbs 4-jointed; the proximal joint stout, nearly $\frac{2}{3}$ as long as the second, which is the longest; the other joints short. Ventral segment 9 of ♀ formerly (as was that of *Siphylurus*, erroneously) described as lobeless; but it is just possible that (as in the genus alluded to) a very short obtuse lobe may have been overlooked. Median caudal seta about as long as the others; those in ♀ imago about $1\frac{3}{4}$ as long as the body; in ♀ subimago about as long as the body. ♂ Oculi evenly contoured.

Type. *A. fragilis*, Albarda.

Distribution. Holland.

Etymology. ἀμετρος and πούς, from the excessive length of the ♂ fore tarsus compared with the tibia.

The proportion of the total length of the ♂ fore leg to the body is perhaps only as 11 to 14 approximately; but this estimate rests upon the assumption that the original drawings of the ♂ and ♀ legs were uniform in scale of enlargement, which, though very probable, is not absolutely certain.

AMETROPUS FRAGILIS, Albarda. Plate XXII. 38 (wings, legs, and genitalia).

Ametropus [type] *fragilis*, ! Albarda, Ent. Mo. Mag. xv. 129 (1878); ! Etn. op. cit. xviii. 22 (1881).

Subimago (dried).—Wings uniformly light smoky grey, with light yellowish or testaceous longitudinal nervures. Setæ testaceous.

Imago (dried), ♂.—Notum pitch-brown. Abdomen bistre-brown above, testaceous at the joinings and towards the sides; venter in segments 2–7 yellowish, in 8 and 9 fuscous; forceps testaceous; setæ whitish. Fore leg testaceous, with the tibia, and the femur distally, dull piceous. Hinder legs somewhat of a light brownish ochre. Wings vitreous; longitudinal neuration light amber-colour; cross veinlets colourless, those in the pterostigmatic portion of the marginal area of the fore wing numerous, mostly simple, and gently curved.

♀. Very similar. Fore leg rufo-piceous, with the base of the femur, the joinings, and the terminal joint of the tarsus testaceous. Setæ very light warm-sepia or cologne-earth

grey, rubiginose at the roots. Length of body 13-15; wing, ♂ 14-15, ♀ 16-17; setæ, ♀ im. 22, subim. 12 mm.

Hab. Holland; near Rotterdam (Fransen) and near Arnhem (Van Medenbach de Rooy) in Albarda's Mus. A single *Ametropus* without locality, in Dr. Hagen's collection, was sent to me amongst *Ephemeridæ* collected chiefly in southern Russia, Caucasus, and Armenia. p. 321-322

ATOPOPUS, Etn., 1881.

Illustrations. *Adult* (details), Pl. XXII. 32.

Adult, ♂.—Fore leg about as long as the body; tarsus about $1\frac{2}{5}$ as long as the tibia, and this nearly $1\frac{1}{5}$ as long as the femur; the tarsal joints in order of shortening rank 1, 2, 3, 4, 5, and the first is about $1\frac{1}{3}$ as long as the second, and nearly $\frac{1}{2}$ as long as the tibia. Hind tarsus twice as long as the tibia, and this about $\frac{7}{12}$ as long as the femur; the joints in order of shortening rank 1, 2, 3, 5, 4, and the first is about $3\frac{4}{9}$ as long as the second, and upwards of $1\frac{1}{9}$ as long as the tibia,—the excess is larger in the intermediate leg. Ungues each unlike the other in every tarsus. In the anal-axillar interspace of the fore wing the two intercalary nervures nearest to the anal (8) are shorter than the other couple. Costal dilatation of the hind wing angular in front; axillar region of minimum proportions. Forceps-basis transverse, widely excised behind, with the sides of the excision convergent towards a narrow low prominence at the bottom. Forceps-limbs virtually 3-jointed. Setæ about twice as long as the body; the median aborted.

Type. *A. tarsalis*, Etn.

Distribution. Borneo.

Etymology. ἄτοπος and ποῦς, from the strange proportions of the hinder tarsi.

ATOPOPUS TARSALIS, Etn. Plate XXII. 39 (wings, legs, genitalia ♂).

Atopopus [type] *tarsalis*, ! Etn., Ent. Mo. Mag. xviii. 22 (1881).

Imago (dried), ♂.—Body pitch-black above, with the abdominal pleuræ and terminal segment flavescent; venter and forceps pitch-brown; setæ pitch-black. Fore leg pitch-black; the femur pitch-brown from the base to about the middle; the tarsal joinings whitish beneath. Hinder femora *in opaque view* pitch-brown; tibiæ flavescent; tarsi brownish: *in transmitted light* the femora become translucent brownish, the tibiæ yellow-amber, and the tarsi yellowish with a suffusion of rather deep smoky grey. Wings vitreous, with pitch-brown markings and black neuration; the markings comprise the marginal area of the fore wing beyond the middle and, in part, nearer the base, the submarginal area almost to the base, and a narrow patch on the terminal margin near the anal angle; in the hind wing the apex and terminal margin are likewise narrowly bordered with the same colour. Length of body, ♂, 9-10, wing 11, setæ 20 mm.

Hab. Labuan (M^cLach. Mus.).

THALEROSPHERUS, Etn. 1881.

Illustrations. *Adult* (details), Pl. XXII. 40.

Adult, ♂.—Fore legs defective in the specimens examined. Hind tarsus as long as the

tibia, and this about $\frac{4}{5}$ as long as the femur; the tarsal joints in order of shortening rank 1, 2, 3, 5, 4—the first is about $1\frac{1}{4}$ as long as the second joint, and not quite $\frac{1}{3}$ as long as the tibia; ungues each unlike the other. In the anal-axillar interspace of the fore wing the two intercalar nervures nearest to the anal (8) nervure are shorter than the next two. Hind wing well developed [defective in the illustrations]; the dilatation of the marginal area angular in front. Forceps-basis transverse, with a small subobtusate projection on each side of its distal margin in proximity to the insertions of the limbs. Forceps-limbs 3-jointed, with the terminal joint minute. Median seta aborted; the outer setæ defective in the specimens examined. ♀ unknown.

Type. *Th. determinatus* (in †*Baëtis*), Walker.

Distribution. Java and the Philippines.

Etymology. θαλερός and σφυρόν, from the size of the ankle or proximal joint of the tarsus.

THALEROSPHYRUS DETERMINATUS, Walker. Plate XXII. 40 (wings, legs [part], forceps).

†*Baëtis determinata*, ! Walk., List. of Neuropt. Ins. in Brit. Mus. part iii, 567 (1853).

Heptagenia determinata, ! Etn., Trans. Ent. Soc. London (1871), 157.

Thalerosphyrus [type] *determinatus*, ! Etn., Ent. Mo. Mag. xviii. 22 (1881).

Imago (dried), ♂.—Piceous with a yellowish stripe down the back, including (*vide* Walker) some piceous marks in the abdominal segments. Setæ in ♀ intense warm sepia-brown. Legs flavescent, the femora broadly banded in the middle and distally with fuscous; both extremities of the tibiæ, and the tarsi also fuscous. Wings vitreous, with the neuration mostly fuscous; the costa of the fore wing towards the base bright yellow-ochreous, but in the marginal and submarginal areas somewhat thickened and pitch-brown. Length of body, ♂ (shrunken) 11; wing 12; setæ, ♀ im. 27 mm.

Hab. Java (Brit. Mus. and Leyden Mus.).

THALEROSPHYRUS TORRIDUS, Walker.

†*Baëtis torrida*, ! Walk. List of Neuropt. Ins. in Brit. Mus. part iii. 571 (1853).

Heptagenia torrida, ! Etn., Trans. Ent. Soc. London (1871), 157.

Imago (dried), ♀.—Thorax dark rufo-piceous above. Abdomen discoloured, dark at the hinder borders of the segments. Setæ lost. Fore legs very dark rufo-piceous, darker than the notum; hinder legs with femur and tibia translucent light raw-sienna brown, and with tarsus and the tip of the femur light pitch-brown or rufo-piceous. Wings of a light raw-umbre grey tint, the marginal and submarginal areas of the fore wings darker; neuration pitch-brown. Length of body (shrunken) 8, wing 9.5 mm.

Hab. The Philippine Islands.

Section 14 of the Genera.—Type of *Ecdyurus*. *Adult.*—Wing-neuration conformable in plan to that predominant in Section 13 of the genera, described at p. 230. Hinder tarsi obviously shorter than the tibiæ. *Nymph.*—Palpus of maxilla i. longer than the lacinia. Terminal margins of the fore wings free. Pronotum distinct.

The hind wings of the adult flies are well developed, as a rule, and have the costa sharply elbowed at about the first $\frac{1}{7}$ th of the wing's length; the marginal area, moderately

broad at the base of the wing, becomes linear beyond the elbow, and the axillar region is narrow. In *Bleptus* (Pl. LXV. 1) the hind wing is abnormal. The ♂ oculi are almost contiguous with one another above; and, in ♀, the median ocellus is rather smaller than the hinder ocelli.

The items chiefly relied upon for generical classification in this Section are differences noticeable in the relative lengths of joints of the tarsi, and in the forms of the penis-lobes of adult specimens; and also peculiarities of the nymphs. The style of coloration of the wings of subimagines, and the femoral markings (if any) of the flies are likewise of some critical value. But to arrive at a true decision respecting the genus of an individual representative of this type upon these bases, caution and extreme circumspection are often demanded, in view of the following circumstances.

The relative lengths of the tarsal joints of corresponding legs are not strictly invariable in every species of a genus, nor in all specimens of the same sex of a species. The variations noticeable in the fore tarsi of a large series of examples of one species, like the differences between the tarsi of some species and of other species of one genus, may reasonably be suspected to be due either to circumstances attending the last moult, or (in some instances) to marked diversity in the nature of the habitats of the individual nymphs. But apart from such variations, it should always be remembered that tarsi are very subject to deformity. The deformity of a leg in course of reproduction is conspicuous, and familiar to physiologists; no entomologist would be likely to mistake such a leg for a well-proportioned limb. But it does not appear to have been noticed hitherto, that when a nymph has chanced to sustain the loss of a limb in early life, the remaining leg of that pair, although uninjured, is apt to deviate from its proper proportions in the adult fly, through some of its component parts becoming hypertrophied. In this way one or more of the first two or three joints of either of the hinder tarsi may acquire abnormal extension in so slight a degree as to be appreciable only by specialists, and yet quite sufficient in amount to occasion perplexity should unblemished specimens be unobtainable.

When Plate XXIV. was published, this characteristic defect in adult flies grown up from maimed nymphs had not been discovered. Some of the legs there figured were undoubtedly the fellows of limbs in course of reproduction. I have therefore re-drawn and re-measured the legs of representative species of all the genera of this Section (excepting *Pægniodes* and *Compsoeuria*), and quote the results thus obtained both in the tabulated admeasurements subjoined, and in the descriptive letterpress, in lieu of the older data.

The aspect of the penis in dead specimens is sometimes much altered from that normally presented by it during life by convulsive movements made by the moribund insect. Sometimes these lead to extreme extrusion of the lobes accompanied by excessive lateral divergence; but sometimes the contrary action is set up, and the lobes are withdrawn by a process of intussusception either partially or completely, leaving in the latter case nothing but the stimuli visible.

In the nymphs generical distinctions reside chiefly in the abdominal tracheal-branchiæ, in some of the mouth-parts, and in the structure of the pronotum. In repose their

compressed femora protect the tracheal-branchiæ; but in swimming progression is aided by scrambling movements of the legs.

In the "Aid to the Generical Identification" of adult Mayflies of the *Ecdyurus* type, Roman numerals designating the five joints of each tarsus stand at the head of the columns of Arabic numerals which set forth the proportionate lengths of the corresponding tarsal joints of the species named in the left-hand column. The Arabic numerals, in fact, state the millimetric admeasurements of drawings diverse in scale of enlargement, made with the aid of the camera lucida. The figures of the intermediate and hind tarsi are of uniform scale with one another in the same species, but the scale is varied arbitrarily in the different species inversely with the size of the specimens, so as to reduce the dimensions of the longest joints approximately to a common standard of absolute length. Similarly the figures of the fore tarsi are diversified in scale of enlargement with the size and sex of the specimens, irrespectively of the figures of the hinder tarsi of the same species, so as to facilitate the comparison of the proportions of the tarsal joints of the fore leg in all specimens of either sex.

SHORT TABULATION OF NYMPHS OF SECTION 14 OF THE GENERA.—TYPE OF *Ecdyurus*.

Laminæ of the foremost abdominal tracheal branchiæ convergent, coming into contact beneath the metasternum; branchial fibrils fasciculated.

Median caudal seta present in specimens of advanced age *Rhithrogena*. Pl. LIV.

Median caudal seta entirely absent in aged specimens *Iron*. Pl. LV.

Laminæ of the foremost abdominal tracheal branchiæ widely remote from each other.

- Median caudal seta entirely absent in aged specimens. Branchial fibrils fasciculated *Epeorus*. Pl. LVI.

Median caudal seta present.

Laminæ of the hindermost tracheal branchiæ conspicuously different from the others, being linear-lanceolate instead of broad; branchial fibrils connate for some distance, thus forming a single filiformly multifid membranous appendage to each of the broader laminæ, which are oblique at the base.

Broader branchial laminæ obovate-oblong and cuspidate *Nameless Gen.* Pl. LVII. *Sten*

Broader branchial laminæ sub-quadrilateral, mostly auricled below at the base and rounded off at the other corners *Nameless Gen.* Pl. LVIII. *Sten*

Laminæ of the hindermost tracheal branchiæ very similar in form to the others; branchial fibrils fasciculated.

Branchial laminæ of the intermediate pairs of tracheal branchiæ mostly ovate-triangular and broad *Nameless Gen.* Pl. LIX. *Ecdy*

Branchial laminæ narrowly lanceolate *Heptagenia*. Pl. LX. *caerulea*

Branchial laminæ of the anterior pairs of the series ellipsoidal; those of hinder pairs pass gradually from oblong-oval to obovate. In *junior* specimens the laminæ are narrower and trilateral *Ecdyurus*. Pls. LXI., LXII. *fl*

Heptagenia

Aid to the Generical Identification of Adult Representatives of Section 14.—Type of Ecdyurus.

Tabulation showing the proportionate lengths of the joints of the tarsi; the joints of each tarsus are indicated by Roman numerals, their relative lengths by Arabic,—explained at p. 235.

		Fore tarsus.					Intermediate tarsus.					Hind tarsus.						
		I.	II.	III.	IV.	V.	I.	II.	III.	IV.	V.	I.	II.	III.	IV.	V.		
<i>Epeorus torrentium</i>	♂	14	14	12	10	6	7.5	7	5	4	14	7	6	5	3	14	In the fore leg of the the tarsus is about as long as the tibia.	
" <i>alpicola</i>	♀	15	15	14	10	8										1 1/2		
" <i>torrentium</i>	♀	13	13	9	7	16	8	7	6	4	15	8	6	5	4	15		3/4
" <i>alpicola</i>	♀	12	12	9	7.5	16												1 1/4
<i>Bleptus fasciatus</i>	♂	20.5	18	16	13	6	9	6	5	4	7	8	5.3	4.2	3	7.5		1 1/2
<i>Iron longimanus</i>	♂	21	19	19	15	7	7	7	7	4	12	6	6	6	3.5	12		1 1/2
" <i>nitidus</i>	♀	12	16	16	6	12	..	..	..	..	..	6	6	6	3	11		1 1/2
<i>Cinygma integrum</i>	♂	14	22	23.5	15	7	8	8	8	4	9	8	7	6	3	10		1 1/2
" "	♀	12	14	12	7	12	..	..	..	..	..	..	..	..	..	..		1 1/2
<i>Rhithrogena semicolorata</i>	♂	4	20	20	16	6	5	6	5	3	11	5	5	4	2	11		1 1/2
" <i>aurantiaca</i>	♂	4	20	21	15	7												1 1/2
" "	♂	4	21	22	14	7												1 1/2
" <i>semicolorata</i>	♀	7	14	12	7	12	5	6	5	3	10	5	5	4	2	11		1 1/2
" <i>aurantiaca</i>	♀	6	13	10	6	13												1 1/2
" <i>nivata</i>	♀	7	13	9.5	6	16												1 1/2
<i>Pægniodes cupulatus</i>	♀	6	13	11	5	6	5	7	7	2	5	5	7	7	3	5		1 1/2
<i>Heptagenia gallica</i>	♂	5	20	20	11.5	7	5	7.5	7.5	3.5	12	5	6.5	6.5	3	12		1 1/2
" "	♀	6	18	17	7.5	16	5	8.5	8	4.5	15	6	7.5	7	4	15		1 1/2
" <i>sulphurea</i>	♀	6	15	13	7.5	12	5	9	7	4.5	11	5	7	5.5	3.5	11		1 1/2
<i>Compsoeuria spectabilis</i>	♀	12	15.4	10.7	5.4	8	..	..	..	..	..	8	7.2	4	2.4	8		1
<i>Ecdyurus helveticus</i>	♂	5	16	17	11	6	8	8	6.5	5.7	11	8	7	6	4	11	1	
" <i>venosus</i>	♂	11	21	20	13	8	10	10	9	5	15	8	8	7	4.5	14	2	
" <i>helveticus</i>	♀	12	21.6	16.2	12	19.7	8	8.5	7	5.2	13	9	8	6	5	14	2	
" <i>venosus</i>	♀	12	13.8	12.9	7.3	13.8	..	..	..	..	..	10	7	6.5	5	14	2	
" <i>fluminum</i>	♀	12	14.4	12	7.2	13.2	7	6	5	3.5	9	7	5	4.1	3	10	2	
" <i>italicus</i>	♀	12	18	14.4	8.4	15.9	7.5	7.5	6	4	10	8	7.2	6	4	12	2	

The species described by Walsh under the names of *Heptagenia simplex*, *pulchella*, *terminata*, *maculipennis*, and *cruentata*, are probably not congeneric with any of those in the foregoing tabulation. They probably represent undescribed genera, and possibly some of the three of which the nymphs are figured in Plates LVII., LVIII. and LIX., and are described in the letterpress immediately before the restricted genus *Heptagenia*. The species in question will be dealt with in the Appendix.

EPEORUS, Etn., 1881; restricted [in Pl. XXIV.] 1883.

Illustrations. *Adult* (details), Pl. XXIV. 44 A. *Nymph*, Pl. LVI.

Adult.—First joint of the hind tarsus rather longer than the second; first joint of the fore tarsus commensurate with the second joint; ungues of the ♂ fore tarsus alike and obtuse; penis lobes of moderate breadth, produced outwards a little at their extremities. Fore leg of ♂ about as long as the body: tarsus about $1\frac{1}{6}$ as long as the tibia, and this about $1\frac{1}{4}$ as long as the femur; the tarsal joints in order of shortening rank 1 equal to 2, 3, 4, 5. Fore leg of ♀ about $\frac{7}{10}$ as long as the body; tarsus about $\frac{3}{4}$ as long as the tibia, and this about $1\frac{2}{3}$ as long as the femur; the tarsal joints rank as in the other sex. Hind tarsus of ♂ about $\frac{2}{3}$ as long as the tibia, and this about $\frac{4}{5}$ as long as the femur; joints 1–4 of the tarsus diminish successively in length by small gradations. Ungues of the ♂ fore tarsus alike, broad and obtuse; those of the hinder tarsi and also of the ♀ fore tarsus each unlike the other. Hind wings of ordinary form; the axillar region narrow, but with sufficient neuration. In the ♀ abdomen the relative lengths of the dorsal segments 2–10 may be formulated thus:—7, 9, 12, 12, 12, 10, 10, 5, 5; ventral lobe of the ninth segment retuse. Forceps-basis of the ♂ produced behind into short divergent lobes for the support of the forceps-limbs; the short proximal joints of the limbs combine with the second joints so as to constitute a gibbous enlargement at the base of each limb. The seminal ducts terminate near the extremities of the penis-lobes; stimuli not obvious. Outer caudal setæ of ♂ about thrice, of ♀ $2\frac{1}{2}$ –3 times, the length of the body. Vertex of ♀ head transverse; the edge of the occiput ascends from the middle towards the posterior orbits of the oculi in even curves; median ocellus somewhat isolated, moderately prominent, in dried examples, below the front border of the upper surface of the head. Pronotum of ♀ excised, or sometimes cordately excised in the middle behind; the reflexed lateral lobes rounded below and somewhat straightened behind.

Subimago.—Wings tinted with greyish; the neuration opaque; the bordering of the cross veinlets (when developed) inconspicuous. During repose the insect protracts its fore legs a little apart, and the setæ are only separated to a small extent.

Nymph.—Abdominal tracheal branchiæ obliquely reclinate or decumbent at the sides, with short scanty suberect fasciculate fibrils; laminæ of the foremost pair far apart, each a little longer than broad and obliquely ovate; hinder laminæ nearly uniformly oval, with the outer or inferior margins thickened and ciliate; the fourth lamina on each side is the longest, and those anterior to it diminish successively in size less than the three that follow: branchial tracheæ well defined, laxly and delicately arborescent, distributed chiefly towards the thinner parts of the laminæ. Median caudal seta totally absent; the two little longer than the body, and glabrous. Pronotum well defined, truncate posteriorly; its lateral borders undilated, rounded off at the front corners, but subparallel behind. Fangs of the mandibles unequal, compressed, denticulated at the tips; the exterior fang broad and only moderately acute; the interior fang much shorter and smaller; endopodite absent, represented only on the left mandible by an inconspicuous tuft of hairs. Lacinia of maxilla i. nude externally, and terminated by three subequal subulate fangs; first joint of the palpus stout, enlarged only slightly towards

the base; second joint clavate, obliquely truncate and densely velutinotus at the end, and acute at the tip. Median lobe of the tongue subquadrangular, longer than broad; paraglossæ obliquely truncate, broadest at about the middle. The dark markings of the femora on the coloured side comprise a pair of short opposite longitudinal streaks near the base, separated by a narrow interval from three other longitudinal streaks, of which the two longer extend to the tip, and the shorter is contiguous with the lower edge; these three combine partially to form an irregular submedian fascia; a dot in the interspace between the basal and distal groups of streaks is coalescent with the lower streak of the former group.

Type. *E. torrentium*, Etn.

Distribution. Europe, Armenia, and North America. A Himalayan insect also is ranked provisionally in this genus.

Etymology. ἐπήγορος, soaring on high.

The Armenian and American species, communicated by Dr. Hagen, are undescribed. A single pinned specimen from the former province is in his own cabinet; and from the latter continent three nymphs in alcohol, exhibiting the normal structure, are in Mus. Comp. Zool. Cambridge, Mass., registered 22c, Wenas V., W. T., Taylor's 6, vii. 1882. Before *Iron* and *Cinygma* were recognized as genera, other specimens than those above referred to were returned as species of *Epeorus*, Etn. MS.

The generical identification of the nymph was established by an exhaustive examination of the fauna of sites in a mill-stream frequented by the imago of *E. torrentium* at Tarascon (Ariège). The subimago was observed to take flight at places where the water rippled strongly over submerged stones; the stream was nearly waist-deep, and the strength of the current rendered the employment of a water-net indispensable to the capture of the nymphs lurking beneath the stones. This mill-stream is close to the highway above the town.

In insects of this genus the coloration of the body is often difficult to define, owing to the superficial tissues differing in hue from more deeply situated pigmentary matter visible through them. The pattern of the ventral markings affords an easy means of distinguishing the species of adult specimens.

EPEORUS GEMINUS, sp. nov. *sylvicola*. Ed. Pict. Description - p. 322

Imago, ♂.—(*dried*.) Notum brown-ochreous, darker behind. In each of the ventral segments 3-7 a single narrowly obtuse, or obovate-lanceolate, dark spot contains before the tip of the segment a pair of pale dots. In dorsal segments 2-8 the terminal margin is dark, excepting at the pleuræ, the hinder angles of which are of a light colour; and the dark colouring is continued from the said margin on each side, descending forwards obliquely in a gentle curve to the main trachea, and, running onwards along it, terminates at the place of the branching-off of the dorsal trachea.—(*Living*.) Eyes warm sepia-brown. Notum bistre-brown, darker laterally and posteriorly. Dorsal abdominal segments 2-8, light brownish yellow at the base and sides, bordered broadly with pitch-brown along the greater part of the terminal margin, and striped obliquely with the same colour on each side, the stripes descending from the bordering nearly to the middle of the lateral

margin; the remaining segments darker. Venter traversed lengthwise by a median very light burnt-umber stripe, which in segments 1-7 is dilated more or less broadly, posteriorly, so as to form a series of obovate or obovate-lanceolate spots. Setæ piceous, with the joinings of the more attenuated portions opaque. Fore leg piceous, with the basal $\frac{1}{3}$ of the femur above (like the trochanter) either yellowish brown or rufo-piceous. Hinder femora (*dried*) light raw umber or yellowish brown, with a fine very indistinct dark longitudinal streak in the midst; tibiæ yellower than the femora; tarsi light bistre-brown; in transmitted light the femur becomes brownish amber, and the tibiæ yellowish amber. Wings vitreous, tinged in the pterostigmatic region of the fore wing with bistre-grey; neuration piceous, excepting the proximal extremities of the longitudinal nervures posterior to the radius, the costa of the fore wing at the roots, and that of the hind wing in the vicinage of the salient angle. Length of body 14-15; wing 16; setæ, ♂ im. 40 mm.

Hab. Portugal; common by a stream from the Estrella, S. of Sabugeiro (4200 ft., 10:30 A.M., 7th June, 1880, water 56° F.). In the living insect the tips and median streaks of the hinder femora are blackish. p. 322

EPEORUS ASSIMILIS, sp. nov.

Subimago ? (*dried*).—Wings light bistre-grey, with bistre-brown neuration; the wing-roots lighter and pale yellowish.

Imago ♂ (*dried*).—Notum pitch-black, or pitch-brown in front and pitch-black behind. In each of the ventral segments 3-7 a single broadly obcuneate dark spot contains a pair of ill-defined pale and mostly elongate dots. In dorsal segments 2-8 the terminal margin is dark excepting at the pleuræ, the hinder angles of which are of a light colour; and the dark colouring is produced forwards from the said margin in a curve through the scar of the nymphal tracheal branchia on each side of the segment, terminating thereabouts and not extending to the place of the branching-off of the dorsal segmental trachea. Fore leg piceous, in some lights somewhat rufo-piceous along the upper edge of the femur, but less distinctly so than in *E. geminus*. Hinder femora light bistre-brown, very indistinctly banded with darker in the middle; tibiæ and tarsi in opaque view rather lighter than the femora, but only in a slight degree, with the tarsal joinings brownish and the ungues piceous; in transmitted light the hinder tibiæ are of a yellower amber-colour than the femora. Wings vitreous, tinted slightly, or sometimes strongly, towards the base with light yellowish-green, and tinged with sepia-grey in the pterostigmatic region of the fore wing; neuration pitch-black, with the same exceptions as in *E. geminus*. Length of body 14; wing, ♂ 15-16, ♀ subim. 17; setæ, ♂ im. 35-45 mm.

Hab. France and Belgium; near Pau, in the Nééz, above the Pont d'Oly (600 ft., p. 322 June 4, 1878). Also the Schwarzwald, Baden (M^eLach., end of July 1875), where it occurs at altitudes of 2200-2700 ft.

EPEORUS ALPICOLA, Etn. (restricted).

Heptagenia alpicola, ! Etn., Trans. Ent. Soc. London (1871), 148 [excl. Carinthian examples & pl. vi. 19, detail of *Ecdyurus Zelleri*].

Imago (*dried*).—Notum varying from reddish umber or Vandyke-brown to rufo-

piceous or almost to brown-ochre, and commonly traversed by a darker longitudinal median stripe in front. The ventral markings in segments 1-8 compose a continuous median dark stripe dilated in the middle of each of the segments (although not always distinctly so in some of the hinder segments): the usual pale dots are indistinct or absent. In dorsal segments 1-8 the terminal border is very distinctly edged with dark colouring, which extends almost to the lower margin of the hinder lateral angle, and which, in lieu of running forwards in a curve at the side of the segment, exhibits at most only a short acute projection barely reaching the edge of the scar of the nymphal tracheal branchia. (*Living.*)—♂. Eyes roman sepia-brown. Notum either fusco-luteous, or pitch-brown varied with pitch-black. Superficies of the dorsum light bistre, or greenish grey; the underlying tissues especially in segments 8-10 are often tinged in some measure with orange or yellowish: at the terminal margin segments 1-8 are bordered narrowly and somewhat evenly with piceous, and the bordering almost extends to the lateral margins of the hinder angles of the pleuræ in segments 1-7; but in segment 8 it ceases at the pleuræ so as to leave the hinder angles of the segment wholly of the lighter colour; in segment 9 a triangular streak of a similarly dark colour extends on each side in proximity to the pleura from the terminal margin to the base of the segment. Moreover in every abdominal segment the dorsal vessel is bordered on both sides with light brownish, this colouring forming in segments 4-6 twin triangles, acuminate behind, having the track of the vessel as their common base adjacent to their acute angles. Venter light yellowish olive-grey, tinged in the penultimate segment with brown-ochre, and traversed lengthwise by an extremely light jecinoreous or burnt-umber stripe in segments 1-7, which is dilated angularly in the middle of each segment so as to be resolvable into a continuous series of hexagonal spots, broad in the anterior segments and elongated in the hinder segments; in each of these spots are the usual pair of pale dots beyond the middle, and three longitudinal dark lines (the dark borders of the nerve-trunks visible through the integument) in front. Forceps olivaceous or warm sepia-brown, with the last two joints dusky inside. Setæ warm sepia-brown, becoming more intense towards the roots. Fore femur pitch-brown or rufo-piceous, the tibia and tarsus darker, with the distal edges of the intermediate tarsal joints whitish: *when dried* the femur *in opaque view* becomes bistre-brown, with the lower edge dark for some distance from the base, and with faint indications of a dark broadly diffused streak a little before the middle; the tibia and tarsus become pitch-brown or pitch-black; *in transmitted light* the femur becomes brownish amber-colour, the tibia more opaque than it, and the tarsus subequal in translucency to the femur. Hinder femora pitch-brown, dark at the tips; tibiæ dull reddish pitch-brown; tarsi black or pitch-black: *when dried* the femora *in opaque view* become light bistre-brown, each dark at the tip and with a dark longitudinal streak almost from the base nearly to the middle, tapering at both ends; and the tibiæ and tarsi become pitch-brown. Wings vitreous, tinged with bistre-brown or sometimes bistre-grey in the pterostigmatic region of the fore wing: neuration in opaque view black, in transmitted light pitch-brown, excepting at the bases of the wings, where the colouring of the main nervures becomes deficient or at most light raw-umber brown.

♀ (*dried*).—Notum more of a brown-ochre than in the other sex, whence an approach in general appearance is made to *E. torrentium* ♀; but the ventral markings of *E. alpicola* ♀ conform to those of the ♂ and suffice to distinguish the species. The pterostigmatic region of the fore wing is only slightly tinted with bistre-grey. Length of body, ♂ 12–14, ♀ 13–14; wing, ♂ 14–16, ♀ 15; setæ, ♂ im. 36–44, ♀ im. about 33 mm.

Hab. The Bernese Oberland, and from the Pennine to the Rhætian Alps, at altitudes of about 3000–6000 ft. Switzerland: Meyringen, near the Alpbach (M^oLach.); a torrent between Champéry and Tervin, Valais (4500 ft. 14 August, 6 P.M., water 50° F.); the St. Gothard (M^oLach.). Savoie: les Contamines (about 4000 ft.); Chamounix (M^oLach.). Italy: Macugnaga, Val Anzasca (about 5000 ft., M^oLach.); the Oglio, in Val Mazza, near Ponte di Legno (5800 ft. 29 July, 5 P.M., water 49 F.).

EPEORUS TORRENTIUM, Etn. Plate XXIV. 44 A (legs & penis) & LVI. (nymph).

Epeorus [type] *torrentium*, ! Etn. Ent. Mo. Mag. xviii. 26 (1881).

Subimago (*living*).—Wings cinereous with olivaceous or bistre-brown longitudinal nervures and dark-edged black cross veinlets. Fore legs piceous; hinder legs olive- or bistre-brown with black tarsi. Eyes blackish green. Setæ blackish with opaque joinings. (*Dried*).—Wings light bistre-grey in opaque view, with raw-umber longitudinal nervures, and black cross veinlets narrowly margined with light grey; the wing-roots lighter.

Imago (*dried*).—♂. Notum light brown-ochre, sometimes modified posteriorly with faint traces of light bistre. The ventral markings form a continuous series of spots diminishing in breadth inversely with the lengthening of the segments: in ♂ the spot in segment 5 is narrowly spathulate, those in segments 7 and 8 are sublinear, that in segment 3 broadly pyriform, and that in segment 2 almost semicircular; the usual pairs of pale dots or spots are distinct as well as the three or four fine dark lines alongside of the nerve-trunks. In dorsal segments 2–8 the terminal margin is dark excepting at the pleuræ and in close proximity to them; the dark colouring, leaving the hinder angles of the segment pale, is suddenly produced forwards in a curve from the said margin to the scar of the nymphal tracheal branchia, and, distinctly skirting the upper and the front edges of the scar, either terminates in the pleura at about the middle of the segment, short of the actual edge, or (in some examples) is very faintly traceable beyond that up to the place of the branching-off of the dorsal segmental trachea; in ♀ the edges of the said branchial scars are dark all round. Fore leg in opaque view:—femur pitch-black lengthwise below and either light bistre or dull rufo-piceous above; tibia and tarsus pitch-black or pitch-brown: in transmitted light the femur becomes translucent piceous, the tibia and tarsus or sometimes only the tarsus bistre-brown. Hinder legs in opaque view dull yellowish brown, with the tarsi in some lights dull reddish brown, and with an ill-defined blackish band nearly in the middle of each femur; in transmitted light the prevailing colour is an impure pale brownish amber, the ungues and the distal edges of the tarsal joints, however, remaining opaque and brownish. Wings vitreous; the pterostigmatic region of the fore wing almost imperceptibly tinted with greenish grey:

neuration in some lights pitch-black, in others pitch-brown, the cross veinlets in some positions remaining of the darker colour while the longitudinal nervures become pitch-brown; in both pairs of wings the subcosta is dark throughout, but the other main nervures become more or less deficient in colouring near the wing-roots. Setæ sepia- or warm sepia-brown at the roots, lighter distally, with dark joinings. The living ♂ is described in the publication cited above.

♀ (*living*).—Eyes greenish, intersected by a fusco-piceous line, and exhibiting a moveable black spot. Very similar in colour and markings to ♂. Dorsum of abdomen in segments 2–7 either fusco-luteous or light bistre-brown, with a rounded pale space on each side extending some distance from the base of each; segments 8–10 brown-ochreous: in each of the intermediate segments the recurved stripes from the dark terminal bordering are piceous, and there is a dark median longitudinal streak from which the colouring spreads outwards for a short distance along the basal margin of the segment; the median streak disappears in the process of drying. Length of body, ♂ 11, ♀ 13; wing, ♂ 12, ♀ 15; setæ, ♂ im. 28–29, subim. 17, ♀ im. 22–26, subim. 19 mm.

Hab. Southern France, and perhaps Northern Italy: August and September. Common at Tarascon (Ariège), inhabiting the conduit above the town as well as the main stream (1560 ft., August 25th, afternoon and evening, water 64° F., and Sept. 1st). A ♀ subimago doubtfully referred here was captured between Lovere and Breno in the Val Camonica (770 ft., August 3rd, 3.30 p.m., water 66° F.). This specimen (*dried*) has very light sepia-grey wings, with pitch-black neuration and pale yellowish wing-roots. The Oglio and Ariège in the places specified have apparently a similar water-climate, and are inhabited by *Oligoneuria rhenana*; therefore it is not improbable that the same species of *Epeorus* is common to both. My hesitation as to the identification of the Italian insect proceeds from the slight colour-differences noticeable between the single examples of subimago available for comparison; but these may be due solely to disparity of age.

Care must be taken to distinguish this species from *Ecdyurus fluminum* ♀.

EPEORUS PSI, sp. nov. Plate LXV, 13 (♂ genitalia)

Imago (in spirits).—♂. Body discoloured. The abdomen exhibits black markings upon a lighter ground-colour, viz.:— on the dorsum, in segment 2 a small round median spot; in segments 3 and 4 corresponding single trilobate spots; in segments 5–9 corresponding single tridents or ψ-oid markings, each formed of a median longitudinal line in combination with oblique stripes ascending the sides of the dorsum. The ventral markings in each of segments 2–7 comprise a very fine longitudinal median line produced forwards from the hinder part of the segment, sometimes partially effaced anteriorly, and a pair of fine tapering streaks, one on each side of the median line, mutually convergent towards the base of the segment. Each femur has a neatly defined black spot nearly in the middle, and is darkened towards the knee; ungues each unlike the other.

♀. Ventral lobe of segment 9 very slightly emarginate in the middle. Length of body, ♂ 15, ♀ 18; wing, ♂ 16, ♀ 22–24; setæ, ♂ and ♀ im. 40 mm.

Hab. Kooloo, Himalaya (Rev. M. Carleton, Mus. Comp. Zool. Cambridge, Mass.).

BLEPTUS, gen. nov.

Illustrations. *Adult* (detail) Pl. LXV. 1.

Adult.—First joint of the hind tarsus rather longer than the second; first joint of the ♂ fore tarsus also longer than the second; ungues each unlike the other; penis lobes when dried conformable to those of normal species of *Rhithrogena*; hind wings unusually small, destitute of axillar neuration.—Fore leg of ♂ about $1\frac{1}{2}$ as long as the body; tarsus nearly $1\frac{1}{4}$ as long as the tibia, and this about $1\frac{5}{11}$ as long as the femur; the tarsal joints in the order of their shortening rank 1, 2, 3, 4, 5. Hind tarsus of ♂ about $\frac{1}{3}$ as long as the tibia, and this $1\frac{3}{11}$ as long as the femur; the tarsal joints in order of shortening rank 1 equal to 5, 2 subequal to 3, 4. Ungues in every tarsus each unlike the other. Forceps-basis of ♂ bifid, but only slightly emarginate in the middle of its posterior border, and not produced into projecting lobes at the bases of the limbs; the short proximal joint of each limb is well defined. Penis lobes tubular, curved very slightly outwards, but contiguous at the roots; orifices of the seminal ducts terminal. Outer caudal setæ of ♂ $3\frac{1}{2}$ as long as the body. Only the adult ♂ is known.

Type. *B. fasciatus*, sp. nov.

Distribution. Japan.

Etymology. βλεπτός, worth seeing.

BLEPTUS FASCIATUS, sp. nov. Plate LXV. 1 (hind wing).

Imago (dried) ♂.—Notum dark brown-ochre. Dorsum of abdomen light brown-ochre, with the joinings of the segments and a fine longitudinal median line pitch-brown or intense warm sepia; segments 8–10 rather darker than the others: venter spotless. Setæ warm sepia-brown, dark at the roots. Forceps-limbs slightly brownish; the basis concolorous with the venter. Femora and tibiæ *in opaque view* light raw-umber brown, dark just at the knee, and piceous at the extreme tip of the fore tibia: tarsi dull light yellowish, the fore tarsus approaching the lightest tints of Roman ochre or raw sienna, and having the terminal joint and ungues light raw-umber brown; but the hinder tarsi are lighter and more uniform in tint. *In transmitted light* the general colouring of the femora and tibiæ becomes a rich yellow amber, and that of the tarsi whitish amber, with the joinings of the hinder tarsi slightly opaque. Wings vitreous, with brownish or greyish markings: *in opaque view* of the fore wing the marginal and submarginal areas are of a light raw-umber brown tint, which in the pterostigmatic region acquires a slight degree of opacity; a narrow, irregular fascia, curved outwards a little, and of rather a greyer brown (approaching light bistre) than the said areas, crosses the wing almost directly from the radius to the vicinage of the extremity of the anal nervure, and thereabouts becomes slightly dilated, running inwards a little along the margin of the anal-axillar interspace; a cloud of the same colour as the fascia, concave inwards, occupies the extremity of the wing posterior to the radius, and the same colouring borders more or less narrowly the remainder of the terminal and inner margins: *in transmitted light* very little difference is perceptible between the tint of the marginal and submarginal areas, and that of the markings of the remainder of the fore wing. A broad intense

sepia or brown-black border surrounds the tip of the hind wing, and, narrowing gradually, terminates anteriorly where the costa first comes into proximity to the subcosta, while posteriorly its extremity is nearly coincident with that of the anal (8) nervure. Wing-neruation, in opaque view, for the most part pitch-black; but that of the colourless portion of the hind wing is pale; and in the fore wing the subcosta and radius outside the pterostigmatic region, together with the interjacent cross veinlets and parts near the subcosta of the cross veinlets in the adjoining portion of the marginal area, and also the near extremities of the main nervures posterior to the radius, are light raw-umber. Length of body 10; wing 13; setæ, ♂ im. about 35 mm.

Hab. Japan; Yagohara, 29th July (G. Lewis, in M^cLach. Mus.).

IRON, Etn., 1883 [in Plate XXIV.].

Illustrations. *Adult* (details), Pl. XXIII. 44 [*Epeorus*] and Pl. XXIV. 44 [*Iron*]. *Nymph*, Pl. LV.

Adult.—First joint of the hind tarsus equal to the second and third joints respectively; the corresponding joints of the intermediate tarsus similarly proportioned; first joint of the ♂ fore tarsus longer than the second, which is equal in length to the third joint; first joint of the ♀ fore tarsus shorter than the second, and this equal to the third joint; unguis mutually dissimilar. Penis lobes apparently liable to be deformed through desiccation; in the typical species they are comparable to those of *Thalerosphyrus* (Pl. XXIII. 40), but are not so broad; but in the other species they seem to be tubular and contiguous, somewhat as in *Bleptus* or species of *Rhithrogena*.—Fore leg of ♂ about as long as the body; tarsus about $1\frac{1}{3}$ the length of the tibia, and this about twice as long as the femur; the joints in the order of their shortening rank 1, 2 equal to 3, 4, 5. Fore leg of ♀ about as long as the body; tarsus about $\frac{2}{3}$ the length of the tibia, and this about $1\frac{1}{10}$ as long as the femur; the joints in the order of their shortening rank 2 equal to 3, 1 equal to 5, 4. Hind tarsus of ♂ about $\frac{3}{7}$ as long as the tibia, and this very nearly as long as the femur; its joints in order of their shortening rank 5, 1–3, 4, and the first three joints mutually equal in length are each about half as long as the fifth joint. Unguis in every tarsus each unlike the other. Hind wings of ordinary form; the axillar region narrow, but with sufficient neruation. In the ♀ abdomen the relative lengths of the dorsal segments in dried examples may be formulated thus:—7, 9, 10, 10, 10, 10, 8, 6·5, 6; ventral lobe of the ninth segment slightly emarginate. Forceps-basis of ♂ seldom conformable to that of *Rhithrogena*, but usually tridentate, or saliently curved behind between the insertions of the limbs. Penis lobes either as in *Rhithrogena*, or else narrow and split lengthwise along their inner sides; stimuli well developed in the type, but not obvious in the other species, perhaps retractile. Outer caudal setæ of ♂ about 4 times, those of ♀ about twice, as long as the body. Vertex of the dried ♀ head transverse, convex from side to side: the occipital border when not retuse is scarcely prominent in the middle, and almost even with the posterior orbits of the oculi; median ocellus somewhat isolated, prominent, but rather below the anterior border of the upper

surface of the head. Pronotum of ♀ somewhat cordately excised behind; the reflexed lobes rounded.

Subimago.—Wings yellowish or greyish in tint; neuration opaque, not edged with greyish.

Nymph intermediate in character between *Epeorus* and *Rhithrogena*.—Abdominal tracheal branchiæ disposed as in the latter genus, with short sparse fasciculate fibrils; laminæ of the foremost pair very large, transverse, narrowly subreniform with the sinus eccentric, in mutual contact at their inner extremities beneath the metasternum; laminæ of the intermediate pairs obliquely reclinate at the sides, lessening successively in breadth from the foremost, and also in length (but in both directions) from the third and fourth pairs, each of them oblique, more or less broadly ovate and subacute, with the outer or inferior margin thickened and ciliate; laminæ of the hindermost pair obliquely conduplicate and incurved so as to meet at the tips when deflected beneath the penultimate segment: branchial tracheæ distinct, pinnately branched, but largely deficient towards the thickened portion of the lamina (which part is broader in *Iron* than in *Epeorus*), and both coarser and sparser than in the preceding genus. Pronotum transverse, short: the hind margin uneven; the lateral margins undilated and mutually subparallel. The markings on the coloured side of the femora comprise two groups of longitudinal streaks with a rounded spot interposed between them, somewhat as in *Epeorus*; but in *Iron* this spot is isolated. Caudal setæ and mouth-parts similar to those of *Epeorus*.

Type. *T. longimanus*, sp. nov.

Distribution. North America, and (undescribed species in M^eLach. Mus.) on Irazu in Costa Rica.

Etymology. εἶρων, a dissembler.

The identification of the nymph rests upon specimens from Washington Territory in Mus. Comp. Zool. Cambridge, Mass., communicated by Dr. Hagen, representing subimago and nymph, viz.:—1 ♂ and 1 ♀ subim. registered “Wenas V., W. T., Pressy’s 7. vii. 1882,” and 3 nymphs registered “Klikitat V., W. T., Thorpe’s 10. vii. 1882, S. Henshaw.”

IRON LONGIMANUS, sp. nov. Plates XXIII. & XXIV. 44 (wings and legs), LXV. 2 (genitalia).

Epeorus (Colorado sp.), ! Etn., Ent. Mo. Mag. xviii. 26 (1881).—*E. longimanus*, ! *id.*, in the writing of Pl. XXIII. of this monograph (1883).

Iron longimanus, ! Etn., in the writing of Pl. XXIV. of this monograph (1883).

Imago (*dried*) ♂.—Notum either light yellowish ochre, or a light reddish-brown ochre. Dorsum of abdominal segments 2-9 tinged extensively with light brownish [sometimes light bistre, sometimes Vandyke], and in segments 2-7 exhibiting slightly depressed spaces translucent and deficient in colouring, viz.:—on each side of the segment an elongate ellipsoidal spot near the pleuræ, and a narrow space extending from spot to spot across the base; there is also, as frequently in *Ephemera*, a small obovate or elongate pale spot on each side of the dark tract of the dorsal vessel; segments 9 and 10 are sometimes light-brown ochre, with a dark line down the middle: the pleuræ are of a

light colour, and the dark colouring of the terminal margin of each of the intermediate segments does not enter their hinder lateral angles, but a short bistre-brown streak runs in a curve from the said margin to the scar of the nymphal tracheal branchia on each side of every such segment very near the said angles. Venter of a light colour, translucent, apparently showing the light brownish ganglionic cords, and perhaps a small whitish spot on each side of them in each of the 2nd to 7th segments. Forceps-basis very salient in the middle behind. Setæ light warm sepia-brown. Femora and anterior tibia *in opaque view* translucent raw umber [in some lights rather yellower], the former each with a rounded black spot in the middle, and the latter bistre-brown at the insertion of the tarsus; fore tarsus dull light yellowish brown; hinder tibiæ and tarsi light yellowish brown or brownish yellow, with [in some positions of the specimens only] the terminal joint and the distal edges of the other tarsal joints light brownish. Wings vitreous; neuration of the fore-wing *in opaque view* light pitch-brown, but the great cross vein, the baseward extremity of the subcosta, and those of the nervures posterior to it are somewhat deficient in colour; the neuration of the hind wing also, as a whole, is of a similarly pale colour; *in transmitted light* the stronger nervures of the fore wing become light brownish amber; pterostigmatic cross veinlets simple. Length of body 9-10; wing 11; setæ, ♂ im. about 26-33 mm.

Hab. Colorado (M^cLach. Mus.); Manitou, Col. (Morrison, in Mus. Comp. Zool. Cambridge, Mass.).

IRON NITIDUS, sp. nov. Plate LXV. 3 (genitalia).

Imago (dried).—♂. Notum light brown-ochre. Abdomen above and beneath in segments 2-7 very light bistre-brown (or in small examples very light yellowish ochre) somewhat translucent, with the joinings opaque, the dark colouring filling the hinder lateral angles of the segments; segments 8-10 light brown ochre, sometimes with the dorsal joinings light brown. Forceps-limbs light bistre. Setæ in some lights whitish yellow, tinged towards the roots with brownish; in other lights their predominant colour is light yellowish brown. Fore femur and tibia *in opaque view* light raw-umber brown, the latter bistre-brown at the insertion of the tarsus; fore tarsus whitish brown-ochre, with the joinings, the terminal joint and unguis slightly brownish; *in transmitted light* their predominant colours change to brownish amber and whitish amber respectively. Hinder legs *in opaque view* very pale yellowish, approaching whitish yellow-ochre, with the extreme bases of the tibiæ, the tarsal joinings, terminal joints, and unguis warm sepia-brown. Wings vitreous, strongly iridescent; the pterostigmatic region of the fore wing tinted with extremely light raw-umber; the remainder of the marginal and submarginal areas more faintly so tinted, and the other part of the wing almost imperceptibly so; neuration raw-umber brown; pterostigmatic cross veinlets, almost without exception, simple.

Variation.—*In opaque view* the ♂ fore tibia is lighter than the femur, and the tarsus is uniformly light bistre-brown: *in transmitted light* the tibia and tarsus are almost concolorous.

♀. Wing-membrane transparent, tinged universally with a light brownish yellow approaching the lightest shades of raw-umber. Fore tarsus lighter than the tibia, and with narrow brownish joinings. Notum in one specimen as dark as in the ♂; in another specimen it is of a much lighter brown-ochre. Length of body, ♂ 9-12, ♀ (*shrunk*) 9; wing, ♂ 11-14, ♀ 15; setæ, ♂ im. 28-36, ♀ im. 22 mm.

Hab. Mt. Hood, Oregon, and (Edwards) California (M^cLach. Mus.).

CINYGMA, gen. nov.

Illustrations.—*Adult* (details), Pl. LXV. 4, 5.

Adult.—Very closely related to *Iron*, the proportions of the tarsal joints of the intermediate legs being similar; but in the hind tarsus, joints 1-4 diminish successively in length, and there are differences in the proportions of the joints of the fore tarsus. First joint of the ♂ fore tarsus shorter than the second, and this a very little shorter than the third joint; first joint of the ♀ fore tarsus shorter than the second, but as long as the third joint; ungues each unlike the other. Penis-lobes similar to those of *Rhithrogena*. Fore leg of ♂ $\frac{9}{10}$ as long as the body; tarsus about $1\frac{4}{5}$ the length of the tibia, which is barely longer than the femur; the tarsal joints in the order of their shortening rank 3, 2, 4, 1, 5, and the first is about $\frac{2}{3}$ as long as the second joint. Fore leg of ♀ about $\frac{7}{10}$ as long as the body; tarsus about $\frac{3}{4}$ the length of the tibia, and this about as long as the femur; the tarsal joints in the order of their shortening rank 2, 1 equal to 3 and to 5, 4, and the first $\frac{6}{7}$ as long as the second. Hind tarsus of ♂ $\frac{1}{2}$ the length of the tibia, and this about $\frac{8}{9}$ that of the femur; its joints in the order of their shortening rank 5, 1, 2, 3, 4, the proximal three joints differing (if at all) successively in length by only small gradations. Ungues in every tarsus, each unlike the other. Hind wings of the usual form; the axillar region narrow. In the dried ♀ abdomen the relative lengths of the dorsal segments 2-10 may be formulated thus:—5, 6, 8, 10, 10, 10, 9, 7, 5; ventral lobe of the ninth segment retuse. Forceps-basis either produced into short lobes (as in *Epeorus*) for the support of the limbs, or else saliently toothed near the insertions of the limbs on each side of its posterior border; penis-lobes similar to those of *Rhithrogena*. Outer caudal setæ of ♂ thrice, of ♀ about twice, the length of the body. Median ocellus of ♀ somewhat isolated, and (though prominent) lower than the anterior border of the upper surface of the head; occipital margin almost even with the posterior orbits of the oculi. Pronotum of ♀ emarginate in the middle behind; the reflexed lateral lobes angular.

Subimago. Wings uniformly greyish or yellowish; their neuration opaque, but not bordered.

Type. *C. integrum*, sp. nov.

Distribution. North America.

Etymology: κινύγμα, from the hovering habits of the flies.

CINYGMA INTEGRUM, sp. nov. Plate LXV. 4 (genitalia).

Subimago (dried).—Wings transparent brownish grey, approaching light Cologne-earth; the hind wings lighter than the others, approaching whitish Cologne-earth grey: neuration inconspicuous, subopaque; the costa pale at the roots. Abdomen bistre-brown above, varied in segments 2–7 with very light brown-ochre; the darker colour borders the terminal margins of these segments broadly, excepting at the pleuræ, and in each of them is produced forwards to the base of the segment, both as a narrow stripe along the track of the dorsal vessel, and also as a broad longitudinal stripe through the midst of each side of the back; and conversely an oblong spot of the lighter colour extends from the base some distance along the pleuræ on each side of the back, and a narrower spot saliently curved externally reaches from the base some distance along each side of the dorsal vessel; venter unicolorous, very light brownish ochre.

Imago (dried), ♂.—Notum light pitch-, or Vandyke-brown. Abdomen in segments 2–7 translucent, light Vandyke-brown, opaque at the joinings above the pleuræ, and with three slightly darker longitudinal stripes from the hinder border of each of these segments, viz.:—one coincident with the track of the dorsal vessel, which is intersected lengthwise by a fine pale median line, and is sometimes only very faintly indicated, and another rather broader and darker stripe on each side of that, falling short of the base of the segment and vaguely delimited along its upper side; moreover the tracheæ are dark: in segments 8–10 the prevailing colour becomes modified either with light burnt-umber or with opaque burnt-sienna or brown-ochre, while the median stripe is posteriorly obliterated more or less in every segment, and in segments 8 and 9 the lateral stripes attain the base. Venter spotless, in segments 1–6 light Vandyke-brown, in the hinder segments light burnt-umber, approaching opaque burnt-sienna. Setæ very light bistre or whitish bistre-grey. Fore femur and tibia *in opaque view* light bistre-brown, with the insertion of the tarsus black, and with two broad indistinct obscure bands on the femur (one just before, and the other just beyond the middle); tarsus in some lights whitish brown-ochre, in other lights bistre-grey, or nearly concolorous with the tibia; *in transmitted light* the femur and tibia acquire a light brownish amber tint. Hinder legs lighter than the fore leg, the femora each with a single brown indistinct dark band beyond the middle, the tibiæ *in opaque view* whitish brown-ochre, and the tarsi either concolorous with the tibiæ or in some lights greyish or light brownish: *in transmitted light* the femora become light yellowish amber, and the tibiæ whitish amber-coloured. Wings vitreous; the pterostigmatic region of the fore wing (tinged, like the membrane just at the roots, with extremely light bistre-grey) contains evenly anastomosing cross veinlets: neuration pitch-brown.

♀. Very similar to ♂; but the notum is of a light yellowish brown approaching light brown-ochre, the setæ whitish brown-ochre, the femora of some examples more strongly coloured than in ♂, and the tibiæ *in opaque view* dull light brown-ochre. Length of body, ♂ 11, ♀ shrunken; wing, ♂ 12, ♀ 10–13; setæ, ♂ im. upwards of 25, ♀ im. 15–20 mm.

Hab. Washington Territory, and Mt. Hood, Oregon (M^cLach. Mus.).

CINYGMA PAR, sp. nov. Plate LXV. 5 (genitalia).

Imago (dried), ♂.—Notum light pitch-brown, sometimes approaching light luteopiceous anteriorly at the sides. Dorsum of the abdomen Vandyke-brown and opaque in segments 8–10; the other segments for the most part are lighter and somewhat translucent, the dark colouring at their tips being shaded off anteriorly and encroached upon by dirty-whitish subtransparent spaces, viz. :—a large space on each side of the back in front, a narrow strip extending across from the one space to the other along the anterior margin of the segment, and three longitudinal linear streaks proceeding from the base nearly to the terminal border of the segment, of which the intermediate (coincident with the course of the dorsal vessel) and the others are narrowly edged with dark colouring: in the large subtransparent spaces referred to the tracheæ are visible, and in some lights appear slightly brownish; the hinder angles of the pleuræ are pale. Venter in segments 3–7 translucent, with conspicuous nervous ganglia of a light warm sepia-brown; the hinder segments opaque, and of a very light brownish ochre. Setæ light warm sepia-brown. Legs *in opaque view* bistre-brown, the base of the fore femur and the fore trochanter rather lighter, the insertion of the fore tarsus slightly darker: *in transmitted light* their predominant colour is brown-amber or golden brown. Wings vitreous, tinted with light bistre-grey throughout, but with a stronger tint than elsewhere in the pterostigmatic region of the fore wing and at the wing-roots: neuration *in opaque view* bistre-brown, changing in transmitted light to raw-umber brown: the cross veinlets of the pterostigmatic space in the fore wing are mostly simple and seldom anastomose at all, and then only irregularly and very sparsely. Length of body, ♂ 8; wing 9–10; setæ, ♂ im. 18–20 mm.

Hab. Arizona (M^cLach. Mus.).

CINYGMA MIMUS, sp. nov.

Imago (dried), ♂.—Very similar in aspect to the European *Rhithrogena semicolorata*. Notum either light raw-umber or light chestnut-brown. Abdomen discoloured: in opaque view segments 7–10 are in some specimens of a light brownish colour approaching brown-ochre, and the remaining segments of a light purplish brown; but in other specimens the prevailing colour is more nearly madder-brown: segments 2–7 are each of them colourless and transparent at the extreme base, and the colourless spaces, narrow in the middle, are enlarged a little by the pleuræ, presenting thereabouts a small rounded expansion on each side bounded posteriorly by the anterior tracheæ of the segment: the arrangement of the ventral colouring resembles that of the dorsum. Setæ light raw-umber brown. Legs light yellowish brown, approaching raw-umber or dull bronze-brown in some lights, with the insertion of the fore tarsus and the ungues of that foot light pitch-brown, and the hinder tibiæ and tarsi rather lighter and yellower than the femora; in transmitted light the femora and fore tibiæ become light brownish amber, and the remainder yellowish amber. Wings vitreous with raw-umber brown neuration varying in intensity with change of light: but the subcosta and radius to the middle, and the basal extremities of the hinder longitudinal nervures of the fore wing, and the

costa and the bases of the remaining nervures of the hind wing appear in most positions of a light raw-umber or yellowish brown, and the rest of the neuration intense raw-umber approaching pitch-brown: the wing-membrane is faintly tinted with light raw-umber throughout; but the tint is chiefly noticeable in the hind wing and the basal half of the fore wing, as in the *Rhithrogena* referred to above. Length of body 9; wing 10; setæ, ♂ im. about 20 mm.

Hab. Colorado (M^cLach. Mus.); Manitou, Col. (Mus. Comp. Zool. Cambridge, Mass.).

CINYGMA GEMINATUM, sp. nov.

Subimago (dried).—Very similar in aspect to *Heptagenia sulphurea*. Wings and neuration in ♀ light yellowish ochre throughout; in ♂ the membrane is rather of a yellowish grey, but the neuration is light yellowish ochre, though less strongly coloured than in the other sex. Setæ concolorous with the wings. Notum yellow-ochre varied with lighter. Abdomen faded. Fore femur in ♂ light brownish ochre, in ♀ Mars yellow: tibiæ and tarsi all whitish yellow-ochre, with the tarsal joinings and the joining of the tibia with the tarsus light brownish; in transmitted light the fore femur becomes brownish amber, the hinder femora and fore tibia light yellowish amber, and the tarsi and hinder tibiæ whitish amber.

Imago (dried), ♀.—Almost indistinguishable without inspection from *Heptagenia sulphurea*, ♀ im., and even when closely compared together the differences in colour between the two species are trivial and few. *C. geminatum* has the vertex of the head suffused with light reddish brown, no black spots near the eyes either on the vertex or on the face, nor any at the bases of the coxæ; setæ uniformly whitish; wing-neuration for the most part piceous or bistre-brown instead of black, the stronger longitudinal nervures amber-coloured towards the base; wing-membrane vitreous, uniformly tinted in the faintest degree with pale yellowish. Length of wing, ♂ 8-9.5, ♀ 9-12; setæ, ♀ im. [the smallest specimen] about 18 mm.

Hab. Washington Territory and (Lord Walsingham) California (in M^cLach. Mus.); Arkansas Cañon, Col. (P. R. Uhler, in Mus. Comp. Zool. Cambridge, Mass.). This species and *Rhithrogena elegantula* are almost exactly alike in colour.

RHITHROGENA, Etn., 1881

Illustrations. *Adult* (details) Pls. XXIII. and XXIV. 43, see also citation of Palmén (1884) under *Rh. semicolorata*; (whole figures) refer to citations of Stephens (1835) and Pictet (1843-5) under the same, and of the latter under *Rh. semitincta*. *Nymph*, Pl. LIV.; see also citation of Pictet (1843-5) † *Baëtis* † *lateralis* under *Rh. aurantiaca*.

Adult.—First joint of the hind tarsus equal to the second and a little longer than the third joint; first joint of the intermediate tarsus a little shorter than the second, but equal to the third joint; first joint of the ♂ fore tarsus much shorter than the second, and this equal or subequal to the third joint; first joint of the ♀ fore tarsus much (about $\frac{1}{2}$) shorter than the second, which is longer than the third joint; ungues mutually

dissimilar. Penis-lobes narrow, often extremely so when dried and apt to shrink to mere peg-like projections (compare Pl. XXIV. 43³).—Fore leg of ♂ $1\frac{1}{8}$ – $1\frac{1}{5}$ the length of the body: tarsus about $1\frac{2}{3}$ as long as the tibia, and this $1\frac{1}{4}$ the length of the femur; the joints in order of their shortening rank 3 subequal to 2, 4, 5, 1, and the first is about $\frac{1}{5}$ as long as the second joint. Fore leg of ♀ about as long as the body: tarsus little more than $\frac{1}{2}$ the length of the tibia, and this nearly $1\frac{1}{4}$ that of the femur: the joints, in the order of their shortening, rank variously in different species, the second or the fifth being the longest and sometimes of the same length, the third usually shorter (rarely as long as the fifth), the first usually equal in length to the fourth (rarely a little longer) and about $\frac{1}{2}$ as long as the second joint. Hind tarsus ♂ about $\frac{3}{7}$ the length of the tibia, which is little shorter than the femur; its joints, in order of their shortening, rank 5, 1 equal to 2, 3, 4: those of the intermediate tarsus rank 5, 2, 1 equal to 3, 4. Ungues each unlike the other in every tarsus. Hind wings of the usual form; axillary region narrow. The relative lengths of the dorsal segments of the dried ♀ abdomen may be formulated thus:—5, 9, 12, 14, 13, 10, 9, 5, 4; ventral lobe of the ninth segment either obtusely rounded or slightly retuse at the tip. Forceps-basis of the ♂ usually concave in the middle behind, rarely saliently curved. Penis-lobes divergent from each other during life, often contiguous when dried: inferior stimuli well developed, usually closely appressed to the lobes: apertures of the seminal ducts terminal. Outer caudal setæ of ♂ usually 2– $2\frac{1}{2}$, seldom 3 times, the length of the body, those of ♀ about twice its length. Median ocellus of ♀ prominent, contiguous with the anterior border of the upper surface of the head: the occipital border very slightly (if at all) convex in the middle, almost even with the posterior orbits of the oculi. Pronotum of ♀ somewhat cordately excised behind; the lateral lobes not extensively reflexed.

Subimago.—Wings tinted with grey [yellowish in a single species from Arizona]: neuration not conspicuously darker than the membrane, nor bordered with pigment especially. The ordinary length of this period is 24–36 hours: the insect during repose stands upon all its feet with wings erect and setæ divergent.

Nymph.—In the pose of the laminæ of the abdominal tracheal branchiæ—the foremost pair attaining mutual contact at the tips of the laminæ beneath the metasternum, the intermediate pairs reclining outwards (figs. 1, 2) when not deflected out of sight (fig. 3), and the hindermost pair transversed lengthwise by an eccentric open fold and brought together beneath the penultimate segment—this nymph resembles that of *Iron*. But the laminæ are slightly different in form from those of that nymph: the foremost are very large, transverse, oblong, and curved: the other laminæ exhibit successive gradations in form from subrotund-oblong, through oblong-obovate and obovate to oval: again, although their inferior margins are ciliate they are not thickened. Moreover the fasciculated fibrils are longer in proportion to the laminæ and more lax than in *Iron*; and the branchial tracheæ are invisible, or become obliterated after death. Median caudal setæ subequal to the others, nearly as long as the body, minutely plumose for some distance beyond its basal $\frac{1}{3}$: the other setæ ciliated correspondingly on their inner sides. Pronotum transverse, very short, undilated, and either curved or nearly straight at the sides: its posterior margin well defined, saliently rounded off on each side of a

median sinus. Fangs of the mandibles very unequal and of peculiar construction: *viewed from beneath* (Pl. LIV. 8 and 9) *without compression*, the exterior and much the larger fang, which is set obliquely in relation to the stipes, appears falcate, sharply truncate at its outer base, just opposite the very rudimentary interior fang, and serrulate for some distance before the tip along its outer edge: *viewed from above under pressure* (Pl. LXV. 6) each fang opens out into a concave expansion; the exterior becomes acutely subovate triangular, truncate at the inner basal angle, where it joins the crown of the mandible, and displays fine serrulations along both its lateral margins, while its base is pectinate or ciliated and inflexed; the interior fang [or ? endopodite] partly contained in the concavity of the outer fang, is oblong-cochleariform or like an oblong scoop, slenderly serrulate at its terminal border, finely and densely pectinate along the upturned edge subtended by the concavity of the outer fang, and sparsely ciliate along the opposite edge. The hairs composing the tuft near the inner bases of the fangs appear unilaterally plumose when highly magnified in a favourable light. Lacinia of maxilla 1. beset along the edge of the crown with appressed pectinate teeth: proximal joint of the palpus broadly dilated behind: terminal joint stoutly clavate, oblique at the extremity, and densely scabrid externally from near the base to the acute point. Median lobe of the tongue (as in *Epeorus*) quadrilateral, broader than the paraglossæ, which are narrow and dilated in the middle. Femora marked on the coloured side each with a conspicuous isolated dark spot, in or about the middle, and sometimes clouded with grey between that and the tip.

p. 322 - 323

NORTH AMERICAN SPECIES.

RHITHROGENA JEJUNA (renamed).

‡ *Baetis* || *fusca*, ! Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 568 (1853); Hag., Smithson. Miscell. Coll. (1861) Synop. Neuropt. N. Am. 45.

Heptagenia fusca, ! Etn., Trans. Ent. Soc. London (1871) 138, pl. vi. 13-13 b [detail].

Imago (dried).—♂. Thorax dull rufo-piceous above. Abdomen in segments 2-5 translucent burnt-umber brown, with the apical borders of the dorsal segments darker. Forceps bistre-brown. Legs bistre-brown; the femora each with a black longitudinal streak tapering at both ends and commencing at a short distance from the base; the apical lobe of the fore tibia pitch-black. Wings vitreous, the membrane tinted with very light bistre-grey, scarcely darker or greyish-tinted in the pterostigmatic space; neuration pitch-brown; the marginal area of the fore wing contains about 3 cross veinlets before and 19 beyond the bulla; many of these in the pterostigmatic region divide irregularly and anastomose with one another.

♀. Abdomen bistre-brown, the distal borders of segments 3-8 rather broadly margined with pitch-black. In the marginal area of the fore wing are about 6 cross veinlets before, and 21 beyond the bulla. Length of body 6-7, wing 9-10 mm., in both sexes.

Hab. St. Martin's Falls, Albany River, Hudson's Bay (Brit. Mus.). The specific name of this species should be rendered "uninteresting".

RHITHROGENA MANIFESTA (renamed).

‡ *Baëtis* || *debilis*, ! Walsh, Proc. Acad. Nat. Sc. Philad. (1862) 371; Hag., Proc. Ent. Soc. Philad. ii. 170 (1863) [nec. ‡ *B. debilis* ! Walk. 1853; neque *B.* || *debilis* ! Walk. (*Cl. debilis*) 1860].

‡ *Siphylurus debilis*, Etn., Trans. Ent. Soc. London (1871) 130.

Subimago.—Wings fumose, with fuscous neuration. Setæ cloudy at the tips. Fore tarsi fuscous.

Imago (living), ♂.—Eyes brown above, fuscous in their lowest $\frac{1}{4}$. Notum generally piceous. Dorsum of abdomen ferruginous, with the distal $\frac{1}{3}$ – $\frac{1}{2}$ of each segment more or less piceous. Setæ uniformly whitish; forceps pale. Legs pale greenish; the femora with a narrow median band [? thin longitudinal streak] and generally the knee fuscous; the tip of the fore tibia, the tips of the tarsi, and the incisures of the fore tarsus fuscous. Wings hyaline; neuration pale greenish hyaline, excepting the basal $\frac{1}{3}$ of the costa, subcosta, and radius, and occasionally their tips, which are fuscous in the fore wing.

♀. Paler than ♂; thorax almost yellow. Abdomen ferruginous, usually darker at the tip of every joint. Wing-veins dusky along the costa and at the tip of the fore wing, gradually becoming hyaline as they approach the anal angle. Length of body 4–7; wing 5–7; setæ, ♂ im. 13–14, subim. about 5, ♀ im. 8–11.5 mm.

Hab. Rock Island, Ill. [after Walsh]. Why Walsh should have supposed this insect to be more nearly related to *Siphylurus* than to *Heptagenia* is inexplicable.

RHITHROGENA HAGENI (renamed). Plate XXIV. 43 c (penis dried).

Heptagenia || *brunnea*, ! Hag., Ann. Rep. U. S. Geolog. & Geograph. Survey of the Terr. 1873, part iii. Zool. 581 (1875) [♂ im. only].

Imago (dried), ♂.—Thorax above bright-brown ochreous, the peak of the mesonotum flavescent, a line adjacent to the tegulæ and a streak below it in front of these in a depression brown-black. Abdomen above pitch-brown, the tips of the segments darker; venter rufescenti-lutescent, spotless; setæ sepia-brown, with most of the joinings opaque. Forceps pitch-brown. Wings vitreous, the fore wings almost imperceptibly tinted with light sepia-grey in the pterostigmatic space; their marginal area contains 4 or 5 cross veinlets before the bulla, then 5–7 simple, followed by 11–14 irregular cross veinlets anastomosing with one another nearer the costa than the subcosta; neuration pitch-brown, paler just at the wing-roots. Fore legs fuscous, the tibiæ and tarsi piceo-fuscous; hinder legs luteo-fuscescent, their tarsi slightly browner or warm sepia; every femur in its proximal half is marked with a longitudinal brown-black streak tapering at both ends. Length of body 10; wing 13 mm.

Hab. Nevada, Truckee in the Sierra Nevada, June 10 (G. R. Crotch).

RHITHROGENA ELEGANTULA, sp. nov.

Subimago (dried).—Wings as in *Heptagenia sulphurea*, extremely pale yellowish ochre, with concolorous neuration. Setæ dull whitish, with the joinings narrowly reddish. Tarsi slightly tinged with brownish, approaching bistre-brown; the joinings seem opaque only in transmitted light. The femoral bands are faintly defined.

Imago (dried), ♂.—Similar in general aspect to *Heptagenia sulphurea*. Notum very pale yellowish ochre, traversed lengthwise by a median reddish brown-ochre stripe approaching raw-umber. Dorsum of the abdomen in segments 2–5 and the base of segment 6 transparent whitish shaded with greenish bistre-grey, with the joinings of the segments narrowly subopaque and of a darker shade of the same grey; the remainder of segment 6 and the hinder dorsal segments nearly concolorous with the notum. Venter uniformly pale yellowish ochre. Fore femur in opaque view light bronze-brown approaching raw-umber, darker and light reddish-brown just at the knee, and very indistinctly banded in the middle with the same colour; tibia in some positions concolorous with the femur, but in other positions both it and the tarsus appear lighter, and the tip of the tibia, the last joint and joinings of the tarsus, and the ungues are rufo-piceous or of a dull reddish tint: in transmitted light the prevailing colour of the leg is light yellowish amber, and the markings are reddish amber. Hinder legs rather similar in colour and markings to the fore leg, but lighter, and without any trace of the median femoral band or any spot at the tip of the tibia. Wings vitreous; the fore wing tinted slightly with light greenish- or bistre-grey in the pterostigmatic region, and more faintly still in the remainder of the marginal and submarginal areas: neuration in opaque view piceous or black, excepting the subcosta and radius in the basal half of the fore wing, which are yellow-amber; in some positions the longitudinal neuration appears pitch-brown, and the cross veinlets black: in transmitted light the greater part of the neuration appears brown-amber: the great cross vein of the fore wing is thickened posteriorly and piceous.

♀. Light yellowish ochreous like *Heptagenia sulphurea*. Head marked on each side with a small triangular black spot at the anterior lower angle of the oculi, and with a reddish brown mark close to the orbit in the midst of the vertex. The rugæ at the sides of the thorax between the wing-roots and the legs are edged with black, as in the ♂. Legs rather stronger in colour than in the other sex, the femora being transparent greenish grey and having the median band, though faint, better defined. Length of body (shrunken) 6; wing, ♂ 9, ♀ 10 mm. Setæ defective.

Hab. Arkansas Cañon, Colorado (P. R. Uhler, in Mus. Comp. Zool. Cambridge, Mass.); Arizona (M^cLach. Mus.).

RHITHROGENA VITREA, Walker.

‡ *Palingenia vitrea*, ! Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 555 (1853).

Heptagenia vitrea, ! Etn., Trans. Ent. Soc. London (1871) 143, note.

Subimago (dried), ♀.—Wing-membrane very light smoky grey, the neuration extremely light brown-ochraceous. Body light brown-ochreous; the legs nearly of the same colour, each femur banded in the middle with black-grey, and light brownish at the knee; fore tarsus light warm sepia-brown. In the marginal area of the fore wing are 6–7 cross veinlets before the bulla, and 15–17, simple and straight, beyond it. Length of body 6; wing 6 mm.

Hab. St. Martin's Falls, Albany River, Hudson's Bay (Brit. Mus.).

EUROPEAN SPECIES.

RHITHROGENA BOREALIS, Etn.

Heptagenia borealis, ! Etn., Trans. Ent. Soc. London (1871) 137, pl. vi. 11 [detail]; Palmén, Paar. Ausf.-Gänge d. Geschl. Org. b. Insect. 852 (1884) [anatom.].

Imago (dried), ♂.—Notum piceous. Abdomen ochraceous, translucent, with the tips of the anterior segments, in addition to the last three or four segments, light fuscous above. Setæ fawn-grey with fuscous joinings. Legs light fuscous. Wings vitreous; the longitudinal nervures light fuscous. Length of body or wing, ♂ 10 mm.

Hab. Finmark, between Koutokæino and Karesuando (Walker MS., in Dale Mus.).

RHITHROGENA NIVATA, Etn.

Heptagenia nivata, ! Etn., Trans. Ent. Soc. London (1871) 137, pl. vi. 10 [genitalia].

Subimago (living).—Fore wings dark cinereous; hind wings lighter. Hinder legs olivaceous, with dusky tarsi; fore legs darker. Setæ dull black.

Imago (living), ♂.—Eyes sooty black above, tinged slightly with olivaceous below. Notum jet-black. Dorsum of the abdomen fuscous, rather paler by the joinings; venter olivaceous. Setæ dusky, with the joinings narrowly dark. Fore femur olive-black, the tibia and tarsus black; hinder femora olivaceous, the tibiæ dull whitish-olive-grey or cretaceous, the tarsi tinted with olive. Wings uniformly vitreous; neuration olive-grey.

♀. Fore tibia and tarsus dusky, very dark; hinder tibiæ cretaceous, the tarsi dusky, with pale ungues. Venter olivaceous, with rather darker spots under the ganglia: lobe of the 9th segment slightly emarginate. Length of body 11; wing, ♂ 12, ♀ 17; setæ, ♂ im. 27, subim. 8, ♀ im. 12–15 mm.

Hab. The Barberine in the Val de Trient (about 3700 ft.) and Lac de Combal (5774 ft.).

RHITHROGENA ALPESTRIS, sp. nov. Plate XXIV. 43 a [genitalia, ♂].

Rhithrogena † *semitincta*, Etn. MS. in the writing of Pl. xxiv.

Subimago (dried).—Wings very light brownish grey (Cologne Earth grey) with opaque longitudinal neuration; nearly concolorous with dried examples of *Rh. semicolorata*.

Imago (living), ♂.—Eyes fuscescent, or greenish bistre-brown above, traversed by a broad black band, and bluish grey below that band. Notum fusco-piceous. Abdomen above suffusco-piceous, pale by the joinings at the extreme bases of the intermediate segments; venter fuligineo-fuscous, with pale joinings, tinged in the penultimate segment with burnt-sienna (rubiginous); forceps dusky. Setæ slightly dusky, with subpiceous joinings towards the roots. Fore leg blackish, with the end of the femur and tibia black; hinder legs very light greenish grey, with the tip of the femur fuscous above, and the tarsi dusky, with the terminal margins of the short joints black; trochanters terminated each by a black point; coxæ suffuscous; mesosternum piceous. Wings uniformly vitreous, with subpiceous neuration: tegulæ light yellowish.

♀. Eyes fusco-olivaceous traversed by a moveable black band. Epistoma greyish; vertex of head piceous, varied with yellowish fuscous. Abdomen lighter than in the ♂; segments 2–7, each with a pale dot on each side of the median dorsal line nearly in the

middle: egg-valve darker than the neighbouring parts; lobe of the 9th ventral segment entire. Legs of a greener tint than in the ♂; a dark longitudinal streak nearly in the middle of the inner side of the fore femur; the hinder tibiæ whitish basewards, but distally, like the tarsi, dusky. Pterostigmatic region very faintly tinted with dusky; tegulæ more or less yellowish. Length of body 8.5; wing, ♂ 10, ♀ 11; setæ, ♂ im. 20-25, ♀ im. 17 mm.

Hab. Switzerland, Savoy, and North Italy; July to September. Alpbach, Meyringen (1 subim. 15th August, M^cLach.); common near the Chalets de Pas, Champéry (5760 ft., 5 P.M., 20th August, water 51° F.); very common in the vicinage of Charbonnière, about the head-waters of the Dranse de Biot (4300-4800 ft., 4-5 P.M., 2nd Sept., water 62° to 48° F.); also singly by the Oglio in the Val Mazza above Ponte di Legno (5800 ft., 4.45 P.M., 29th July, water 49° to 56° F.).

RHITHROGENA HYBRIDA, sp. nov.

Imago (dried), ♂.—Notum black. Dorsum of the abdomen pitch-brown. Setæ light warm sepia-brown with slightly opaque joinings. Fore leg pitch-brown or intense bistre-brown: hinder femora *in opaque view* uniformly of a reddish brown, the tibiæ lighter and of a rather yellower brown in some postures, and the tarsi slightly greyish; no femoral markings. The colouring of the wings in its distribution conforms to that of Variation 1. of *Rh. semicolorata*, but is of a duller hue, being light bistre-brown instead of raw-umber. Wing-neuration, in opaque view, entirely pitch-brown, excepting that the sector (4), cubitus, brachial, and anal (8) nervures of the fore wing are deficient in colour at the extreme roots where they meet the raised fold in the membrane. Length of wing 9-10 mm.

Hab. Savoy, in the neighbourhood of Samoëns; common about the head-waters of the Dranse de Biot, near Charbonnière (4780 ft., 10 A.M., 12th August); also near the Chalets de Jouplane (5100 ft., 9.30 A.M., 29th August, water 52° F.). Easily mistaken for the following species; but the absence of femoral markings, and the uniformly dark colour of the subcosta and radius of the fore wing seem to necessitate their separation.

RHITHROGENA SEMICOLORATA, Curtis. Plates XXIII. 43 [& virtually 44] (wings), XXIV. 43 (legs), & 43¹⁻³ (penis). Nymph Plate LIV. 3, 4.

? [*Ephemer*] or *E. stigma* [Zsch. Mus. Lesk. i. 150, no. 20 (1789)]; Gmel. Linn. Syst. Nat. ed. xiii. i. pars v. 2630 (1790); Ol., Encyc. Méth. vi. 422 (1791).—? *E. fuscata*, Schrank, Fn. Boica, ii. 199 (1798).

‡ *Baëtis semicolorata*, Curt., Lond. & Edinb. Philos. Mag. ser. 3 (1834) 121; ! Steph., Ill. Brit. Ent. vi. 64, pl. xxix. 2 (1835); Pict. Hist. Nat. Névropt. ii. Ephém. 178, pl. xxii. 4-9 (1843-5); Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 577 (1853); Hag., Ent. Ann. (1863) 26.—‡ *B. semitincta*, Pict., Hist. Nat. Névropt. ii. Ephém. 180, pl. xxii. 1-3 (1843-5); Walk., List &c. part iii. 558 (1853); Brauer, Neuropt. Austr. 26 (1857); Ausser., Ann. d. Soc. Natur. Modena, An. iv. 133 (1869); Etn., Trans. Ent. Soc. London (1871) 36, note.

Heptagenia semicolorata, ! Etn. Trans. Ent. Soc. London (1871) 136, pl. vi. 9 [detail]; Hag. & Etn., *op. cit.* (1873) 403; Meyer-Dür, Bull. Soc. Ent. Suisse iv. 311 (1874); Rostock, Jahresh. d. Ver. f.

Naturk. Zwickau, 1877, p. 89 (1878) ; Palmén, Paar. Ausf.-Gänge d. Geschl. Org. b. Insect. S. 44 & 52, taf. ii. 30 (1884) [detail & anatom.].—*H. semitincta*, Meyer-Dür, Bull. Soc. Ent. Suisse, iv. 312 (1874).

Rhithrogena [type] *semicolorata*, ! Etn., Ent. Mo. Mag. xviii. 23 (1881); *nec Rh. semitincta*, ! *id.*, in the writing of Pl. xxiv. 43 *a* of this work.

Subimago (*living*).—Fore wings very light grey; hind wings paler. Legs greenish-, or brownish-grey, with a small elongated spot in the middle of the femur, and with the tarsus brown-black or greenish-black. Setæ very pale grey. ♂. Oculi dark olivaceous, crossed by a transverse black line. (*Dried.*)—Fore wings very light brownish-grey; hind wings dull greyish white: femoral spots often indistinct or lost.

Imago (*living*), ♂.—Genital stimuli narrowly ligulate, closely appressed to the lobes of the penis, and acutely bi- or tri-denticulate at the tips. Eyes intense raw-umber or olive-brown above, and either black or pitch-brown below, and sometimes with a bluish grey or greenish grey edging to this darker surface; ocelli piceous. Notum light bistre-brown or pale fuscous, varied on the metanotum with pitch-brown, and sometimes with a small yellowish spot near the peak. Dorsum of the abdomen light bistre-brown or greenish grey, sometimes tinted in segments 8–10 with brown-ochre or raw-umber, and with the joinings of the intermediate segments whitish: venter dull light sepia- or olive-grey in segments 2–7 or 8, and either somewhat dull rubiginose (medium burnt-sienna) or ochreous in the last two or three segments. Setæ light sepia-brown, or dusky, or brown-black. Forceps-basis dull, either rubiginose or greenish grey: the limbs blackish, with the last two joints sepia-grey. Femora light greenish grey, each with a submedian triangular longitudinal black streak, which is acute inwards and acuminate outwards in the hinder legs, but more rounded in the fore leg: fore tibia and tarsus either sepia-grey or dark olive-grey; hinder tibiæ and tarsi sometimes of a lighter sepia-, or greenish-grey than the fore legs, and sometimes of a yellower tint, with the extreme distal edges of the short tarsal joints black, and with the ungues slightly rufescent or greyish. *When dried* the femora in opaque view approach raw-umber brown in their general hue; in transmitted light the femora become strongly yellowish amber, and the hinder tibiæ pale yellowish amber: the femoral streaks sometimes disappear. Wings vitreous, varying considerably in the tint and extent of their coloration.

In the typical *semicolorata*, Curt. [the *semitincta* of Pictet] the membrane in the basal half of the fore wing, and throughout the hind wing, is only faintly tinted with dull rusty yellow: *in opaque view* the neuration of both wings appears pitch-black, excepting the extreme roots of the costa, sector (4), cubitus, præbrachial, pabrachial, and anal (8), the great cross vein, and the part between the roots and the bulla of the subcosta and radius (3) of the fore wing, which are subtestaceous or rusty yellow; *in transmitted light* the whole of the neuration becomes in some positions light brownish, but in most positions light brownish amber.

Variation 1 [the *semicolorata* of Pictet, not of Curt.].—The coloration of the fore wing extends to the tip in the marginal and submarginal areas, and in the disk reaches from the wing-roots to a little beyond the junction of the sector (4) and the fourth sectorial intercalary nervure, the fork of the præbrachial (6), and the anal angle, forming

a distinctly defined cloud of deeper tint than the colouring of the typical specimens—in fact, sometimes a medium raw-umber brown cloud. Legs darker than in the typical race: *when dried* the fore femur becomes raw-umber brown, and the tibia and tarsus light pitch-brown, with the insertion of the latter dark; femoral streak distinct.

Variation 2.—The whole of the membrane of the fore wing is tinted with dull rusty yellow, and the colouring in the basal half is scarcely, if at all, darker than in the remainder, although, when the wings are erect, it may apparently be so where the hind wings underlie the others. Notum brown-ochreous. Legs lighter than in the typical race; femoral streaks distinct but rather small.

♀ (*living*).—Eyes olive-black. Dorsum of the abdomen intermediate in tint between yellow-ochre and raw-sienna, very pale by the joinings; venter very light Mars-yellow; lobe of the ninth ventral segment emarginate. Legs golden-brown or brown-amber; the fore tibia and tarsus, the hinder tarsi, and the bases of the hinder tibiæ tinged with olive-grey; the femoral spots or streaks, the femoral tracheæ, and the points of the trochanters black. Wings vitreous, colourless or almost colourless: *in opaque view* the stronger of the longitudinal nervures appear to be subtestaceous or rusty yellow, the finer nervures piceous, and the cross veinlets black; *in transmitted light* all of the neuration appears subtestaceous.

Variation [the *semicolorata* of Pict., not of Curt.].—The colour of the wings resembles that of Variation 2 of the other sex.

Length of body 7–11; wing 7–12 [usually 10–12]; setæ [of the larger specimens], ♂ im. 23–28, subim. 8–9, ♀ im. 14, subim. 10 mm.

Hab. Europe, from Norway (Wallengren) southwards to the Alps and Pyrenees. The typical race is common in Great Britain from June to September, frequenting trout-streams and the swift parts of rivers ranging in temperature during the summer from about 51° to 58° F. In Cumberland, on Cross Fell, it ascends to about 1500 feet. The same race occurs on the continent in Belgium, France, Saxony, Switzerland, Bavaria, northern Italy, and (Zeller, in M^cLach. Mus.) Carinthia, *e. g.* at the following localities:—the stream at Versoix in June (Pict.) [upwards of 1250 ft., water 58° F. in the afternoon of August 24th]; Morillon near Samoëns [2200 ft., water 50° F., 4–6 P.M. August 30th]; between Partenkirchen and Mittenwald in Bavaria; in the Ortler district, both in the Val Furva above S^{ta} Caterina [6300 ft., water 59° F., July 28th], and in the Val Mazza near Ponte di Legno [5800 ft., water in the Oglio 49° F., but 56° F. in a tributary torrent at the same place, July 29th, in the afternoon]; along the Nééz, above the Pont d'Oly, near Jurançon, Pau [about 600 ft.]; on the road to the Col des Tontes from Eaux Bonnes [3220 ft.]; and at the outlet of the Lac d'Aious [5945 ft.].

Variation 1 is represented in M^cLach. Mus. by specimens from Autun, Gex (Ain), and Neuchatel. According to Pictet it is common in the neighbourhood of Geneva, at streams, and is wont to appear in large numbers before rain or thunder-storms in summer. Variation 2, in the same collection, is ticketed Carinthia, May 27th (Zeller). Pictet makes no mention of the femoral markings.

Rhithrogena aurantiaca, Burmeister.

‡ *Baëtis aurantiaca*, Burm., Handb. d. Ent. Bd. ii. Abth. ii. 801 (1839); Pict., Hist. Nat. Névropt. ii. Ephém. 191 (1843-5); Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 560 (1853); Etn., Trans. Ent. Soc. London (1871), 148 [note to Synon. of *Heptagenia iridana*].—? *B. † lateralis*, Pict., *op. cit.*, pl. xxi. i. [nymph] (1843-5).

Heptagenia aurantiaca, Meyer-Dür, Bull. Soc. Ent. Suisse, iv. 315 (1874); ! Rostock, Jahresb. d. Ver. f. Naturk. Zwickau, 1877, p. 91 (1878).

Rhithrogena [nymph], ! Etn., Ent. Mo. Mag. xviii. 24 (1881).

Subimago (*living*), ♀.—Wings usually griseous, seldom light sepia-grey, the hind wings scarcely, if at all, lighter than the fore wings; wing-roots dull pale brownish-yellow marked with a brown spot, the great cross vein similarly brownish; neuration a little darker. Setæ griseous. Oculi subolivaceous or cæsious, with a black transverse line and a black moveable spot; orbits of ocelli black; a black line or triangular spot extends from the base of the antenna almost to the orbit of the ocellus, and the facial carina has sometimes a small black spot upon it. Pronotum pale, sometimes edged with black; a faint fuscous blotch at the front border of the mesonotum; tegulæ, a stripe in continuation with them, the two longitudinal sutures of the mesonotum nearest to the tegulæ, and one or two lines on the pleuræ in advance of the intermediate coxæ, subpiceous or nigro-piceous; a black spot on the foremost stigma; a dark or black dot or dash upon the outer proximal joining of the intermediate coxa, or in front of it, and a spot upon the meso-pectus behind the coxa (or else a fine subpiceous line between the coxa and the mesopectus in its stead); a black spot at the base of the hind coxa in front, and another beneath at its tip; trochanters black-pointed. Fore femur greenish grey, black at the extreme edge of the knee above, and marked nearly in the middle with a small black V-shaped or triangular spot; fore tibia blackish grey, black at the knee; fore tarsus and ungues black. Hinder legs lighter, but correspondingly marked.

Imago (*living*), ♂.—Oculi commonly intense burnt-umber brown above and greenish grey beneath, divided either by a black transverse line or by a pale space edged with black; sometimes the upper portion is fusco-olivaceous, and the lower cæsious or cærulescenti-griseous; in twilight, or by candle-light, the upper part appears greenish black. Occiput black; face pale, marked, as in subimago, with fuscous or piceous. Thorax above varying from brownish yellow-green (pistazinous), or fuscous, or pitch-brown, or luteo-piceous, to pitch-black [changing to luteous or luteo-piceous in dried examples]; the metanotum black or piceous; sternum concolorous with the mesonotum. Markings of the pleuræ and pectus, coxæ, and femora very similar to the same in subimago; ground-colour of the legs:—fore femur at first pistazinous changing to piceous; tibia and tarsus in some lights darker, in others the tarsus is paler than the tibia, and its insertion is black: hinder femora at first almost greenish white, changing to light olivaceous; tibiæ paler, sometimes piceous at the tip; tarsi smoky, or blackish grey, darker than the fore tarsus, with the incisures very narrowly black. Wings vitreous; neuration either fuscous or colourless, but the subcostal bulla piceous; cross veinlets in the marginal area of the fore wing usually quite simple, 2-6 (3 commonly) before the bulla very

faint, 1 (rarely 2) at or near the bulla, and 10–19 (usually about 16) beyond it better developed. Abdomen above fuscous or pistazinous, the segments narrowly darker immediately before their pale extreme apical edges, their sides paler and concolorous with the venter; in segments 2–7 from the lateral line near the base of the segment on each side of the dorsum a dark fuscous stripe (sometimes black towards its origin) ascends obliquely, growing gradually lighter and less defined, and blends with the dark colouring along the midst of the posterior border of the segment; these stripes are most strongly marked in the hinder segments. Venter in the anterior segments spotless, pale or cinereous, in 7–10 more or less lutescent or orange-tinted; forceps black or greenish black, paler inside distally; penis testaceous. Setæ sepia-grey, becoming whitish distally, sometimes black close to their origin; a few of the joinings near the base black.

♀ (*living*).—Markings similar to those of the subimago. Oculi subglaucous, with their orbits and the line across subpiceous. Ground-colour of thorax light fuscolivaceous; the oblique abdominal stripes are sometimes abbreviated, the stigmata marked with a dark dot. Wings and neuration colourless. Fore tarsus concolorous with the tibia, its joints narrowly edged above at the tips with blackish like those of the hinder tarsi, whose ungues are sometimes slightly rubiginose. Venter pale ochraceous; setæ sometimes greyish white, sometimes greyish; ventral lobe slightly excised. In other respects similar to the ♂.

Dried specimens have the main nervures of the wings pale amber-colour, the great cross vein of the fore wing blackish or piceous, the costa beyond it greyish, and the bulla black; the cross veinlets remain pellucid as a rule. In some specimens the hinder tarsi are a shade darker than the tibiæ. The lateral stripes of the abdomen sometimes are reduced to spots, and sometimes are almost obliterated. Length of body 6·5–9; wing 7–10; setæ, ♂ im. 11–15, subim. 6·5, ♀ im. 9–10, subim. 6·5 mm.

Hab Common on the continent, in rivers and streams, from Holland and Germany southwards to Switzerland, the Pyrenees, and Portugal, *e. g.* at the following places:—Arnhem, Halle, Dresden; Basle, Berne, Versoix; Brive, near Le Puy (Haute Loire), Toulouse, Tarascon (Ariège), Orthéz; and Ponte de Marcellos (Beira Baixa).

Herr Rostock's identification of this species with Burmeister's ‡ *B. aurantiaca* appears compatible with the latitude of interpretation allowed to the descriptions of more than forty years' standing. Burmeister omits to mention the conspicuous dark spots on the femora; but Pictet did just the same thing with respect to those of the preceding species; and therefore no stress need be laid upon the omission.

RHITHROGENA GERMANICA, sp. nov. Plate XXIV. 43 *b* (penis dried).

Imago (dried), ♂.—Notum pitch-brown anteriorly, pitch-black posteriorly. Abdomen fusco-piceous or piceo-fuscous, paler by the dorsal joinings. Setæ fuligineo-piceous. Fore femur piceous; tibia fuligineo-piceous. Hinder femora piceo-lutescent, each with a dark median band, the trochanters rather lighter; tibiæ light yellowish amber; tarsi fuscescent, with piceous ungues. Wings vitreous, tinged slightly with light olive-grey

in the marginal and submarginal areas; costa, subcosta, and radius piceous; the remaining neuration either pitch-black or black. Length of body or wing 14; setæ, δ im. about 28, subim. about 16 mm.

Hab. The Rhine, near Lauffenburg (Berne Mus.).

PÆGNIODES, Etn. 1881.

Illustrations. *Adult* (details), Pls. XXIII. & XXIV. 41.

Adult.—First joint of the hind tarsus shorter than the second, which equals the third joint in length; the corresponding joints of the intermediate tarsus similarly proportioned; first joint of the ♀ fore tarsus much (about $\frac{1}{2}$) shorter than the second, and this rather longer than the third joint; ungues mutually dissimilar. Penis-lobes rather narrow and subcylindrical, with suddenly enlarged patulous tips, in the typical species.—Fore leg of ♂ defective in the specimens examined; but the first tarsal joint is shorter than the second. Fore tarsus of ♀ about $\frac{3}{4}$ the length of the tibia, and this about as long as the femur; the tarsal joints in the order of their shortening rank 2, 3, 5, 1, 4, and the first is nearly $\frac{1}{2}$ as long as the second. Hind tarsus of ♀ nearly $\frac{4}{7}$ the length of the tibia, and this about $\frac{7}{8}$ as long as the femur; its joints in the order of their shortening rank 3 subequal to 5, 2, 1, 4. Ungues each unlike the other in every tarsus. Hind wings of usual form; the axillar region narrow. Penis-lobes at the base subcylindrical, but distally enlarged suddenly to a moderate extent in the typical species; the seminal ducts apparently open into the capacious cavities of the hollow lobes; inferior stimuli well developed. Forceps basis saliently curved to a moderate extent in the middle behind. Ventral lobe of the ninth ♀ abdominal segment entire. Outer caudal setæ in both the sexes about thrice the length of the body.

Type. *P. cupulatus* (in *Heptagenia*), Etn.

Distribution. China and Tibet.

Etymology. $\piαιγνιῶδης$, sportive.

PÆGNIODES CUPULATUS, Etn. Plate XXIII. 41 (part of fore wing, hind wing), XXIV. 41 (legs ♀ & ♂ genitalia).

Heptagenia cupulata, ! Etn., Trans. Ent. Soc. London (1871) 138, pl. vi. 14, 14a [detail]; Palmén, Paar. Ausf.-Gänge d. Geschl. Org. b. Insect. S. 74 [anatom.] (1884).

Pægniodes [type] *cupulatus*, ! Etn., Ent. Mo. Mag. xviii. 23 (1881).

Subimago (dried).—Wings light raw-umber grey, the hind wings very narrowly edged with black-grey along the terminal margin; longitudinal neuration raw-umber brown; cross veinlets mostly pitch-brown or pitch-black.

Imago (dried), ♂ .—Thorax deep brown-ochreous above, the pronotum with a double black spot in the middle, the metapleura with a descending brown-purple stripe. Abdomen light brown-ochreous above, with a median longitudinal streak, the apical borders of the segments, and in each of the segments 2–8 on each side, with a broad

oblique lateral stripe from the hinder border to the spiracular line, and a fine abbreviated streak from the hinder angle of the dorsum along the same line, intense purple-madder-brown, or purple-black; venter unicolorous. Setæ light burnt-umber brown. Legs dull translucent rufo-lutescent, almost rufous, the fore leg with the apical projection of the tibia pitch-brown, and the tarsus light brown-ochreous. Wings vitreous; the fore wing from the base to the pterostigmatic space in the marginal and submarginal areas faintly tinted with light yellowish-green, and from thence to the apex coloured with raw-umber brown; the hind wing in the larger portion of the marginal area tinted with light yellowish-green, and along the terminal margin narrowly bordered with black-grey or brown-black; longitudinal neuration mostly pitch-brown, the costa of the fore wing in some lights seeming darker, and the nervures near the wing-roots, the subcosta and radii for some little distance farther, and the great cross vein, light raw-umber; cross veinlets pitch-black.

♀. Neuration of wings pitch-black, excepting the bases of the costa and subcosta, the great cross vein, and the proximal extremities of the longitudinal nervures posterior to the radius, which are very light raw-umber brown. Legs rufo-lutescent, with the terminal joint of every tarsus intense warm sepia-brown. Egg-valve acute; ventral lobe of the penultimate segment entire, and traversed by a median longitudinal fold. Length of body, ♂ (large example) 18, ♀ 16; wing, ♂ 11-15, ♀ 21; setæ, ♂ im. 48 (or more), ♀ 54 mm.

Hab. China, Hong Kong (Brit. Mus.).

THREE NYMPHS, *generis incerti*, OF THE *Ecdyurus* TYPE.

NYMPH No. I.—Pl. LVII. (whole figure and details).

Six anterior pairs of the abdominal tracheal branchiæ provided with broad, pointed laminae recumbent upon the sides of the dorsum; seventh pair spreading, the laminae linear-lanceolate and minute. Each of the anterior laminae is oblique, somewhat obovate and cuspidate, but is asymmetrical, the lower margin being either truncate obliquely or sinuate, and the opposite side slightly dilated, between the base and the widest part of the lamina, while the cusp is nearer the upper than the lower edge; each contains a strongly defined fruticosely branched trachea, and partially overlies the branchial filaments, which are not fascicled in the usual manner, but explanate, and connected together by their membrane for some distance from the roots, thus constituting a single subrotund lamella, fringed deeply with long branching filaments, annexed to the base of the lamina. The hindermost laminae each contain a pinnately branched trachea, and are pilose at the edges, but apparently lack fibrils. Median caudal seta subequal in length to the others and to the body; their joinings beset with minute spreading hairs. Pronotum transverse, very short, well defined behind; its lateral margins slightly dilated; its posterior margin rounded off obtusely towards the sides, and sinuate in the middle. Ventral segments 2-5, short, the hinder ones successively longer; the lobe of the ninth segment of ♀ elliptical at the tip, and sinuate on each side thereof; pleuræ

shortly and acuminate produced into teeth at the hinder angles of segments 7-9. Fangs of the mandibles slim, compressed and subequal in length; the exterior tridentate at the summit, and serrulate along the superior edge; the interior fangs diversiform, terminated each by a tooth and two denticulations; in the right mandible the tooth is intermediate between the denticulations, is subulate, elongate, and slightly twisted, and the inferior denticulation is preceded by a few short hairs placed in a row along the edge of the fang; in the left mandible the tooth is somewhat conical and is above the denticulations. Lacinia of maxilla I. beset at the edge of the crown with short appressed triangular pectinate teeth, and terminated by two simple pungent spinules; proximal joint of the palpus stout; terminal joint comparatively slender, its inner side nearly straight, the outer side gently curved, pungent at the point and somewhat pilose in proximity to its termination externally. Median lobe of the tongue inflated, subovate, grooved lengthwise in the middle nearly as far as the tip, and then transversely tumescent; paraglossæ broadly dilated, slightly recurved at the tips, and much larger than the median lobe. Femora, on the coloured side, banded with grey in two or three places; the bands confluent below. Length of body 7; setæ about 7 mm.

Hab. Niagara and Trenton Falls, N. Y. (G. H. Hubbard, 20 & 22, v. 1874); Dakota (Coues, 1872 & 1873), common; also N. Illinois (Prof. W. A. Forbes, vi. 1883). Figured and described from specimens communicated by Dr. Hagen (in Mus. Comp. Zool. Cambridge, Mass.).

It is possible that the Swedish insect figured by De Geer, *Mém. pour servir à l'Hist. des Ins.* ii. part ii. pl. xviii. 1-4, may be congeneric with Nymph No. I. The nymph was found by him in May in a ditch by the gardens of Leufsta, near Dannemora, in which grew many species of aquatic plants. Towards the end of May the imago appears, of which the oculi are sea-green. The nymphs climb up the plants to undergo the penultimate moult.

NYPH No. II.—Pl. LVIII. (whole figure and details).

Six anterior pairs of the abdominal tracheal branchiæ provided with broad, obtuse or retuse laminæ recumbent upon the sides of the dorsum; laminæ of the seventh pair linear-lanceolate and spreading. The anterior laminæ are quadrilateral, longer than broad, oblique at the base, pilose at their exposed edges, and pergamentose; all but the foremost are auricled at the base on the lower side, and all are slightly sinuate at the base on the upper side, the foremost being merely dilated instead of auricled correspondingly; distally the first three are truncate and slightly retuse, but the next three are obtusely rounded at the extremities; the hindermost laminæ, linear-lanceolate, acuminate and ciliated, lie outwards and obliquely backwards from the sides, and seemingly are destitute of branchial fibrils. Each of the anterior laminæ contains a strongly defined fruticosely branched trachea, and partially overlies the explanate branchial fibrils which are connected together by membrane as in Nymph No. I., but more extensively and so as to resemble an oval membranous lamella, deeply fringed with branched filaments, and produced into a lacinated auricle at the base on the

upper side (*i. e.* the side farthest from the auricle of the pergamentose lamina). Median caudal seta about $1\frac{3}{7}$ as long as the others, and twice as long as the body; their joinings beset with minute spreading hair. Pronotum transverse, imperfectly delimited, being confluent with the mesonotum at the lateral margins (although well defined elsewhere) and there slightly dilated anteriorly. Ventral segments short, the lobe of the 9th in the ♀ triangular; pleuræ in segments 6-9 produced posteriorly into short acuminate triangular teeth. Fangs of the mandibles slender, compressed, subequal in length; the exterior 2-3 denticulate at the tip, and serrulate at the upper border; the inferior fang bidentate in the right mandible, tridentate in the left, without remarkable differences in the teeth. Maxilla I. and tongue very similar to those of Nymph No. I.; the former more sparsely beset with spinules and ciliæ, in the place of pectinate teeth, at the edge of the crown, and with stronger fangs at the point; its palpus furnished with a compressed acute spine below its pungent point. Femora marked on the coloured side with two broad dark bands, each containing a pale blotch upon the upper margin; the bands are confluent below. Length of body 7.2, setæ 13 mm.

Hab. The Falls of Niagara, N. Y., 3 examples by Mr. H. Hubbard, 22, v. 1874 (Mus. Comp. Zool. Cambridge, Mass.); also 3 or 13 probably from Ithaca, Fall Creek, N. Y., and 6 from Crystal Lake by Prof. S. A. Forbes. Figured and described from specimens communicated by Dr. Hagen.

NYPH, No. III.—Pl. LIX. (whole figure and details).

Abdominal tracheal branchiæ all reclinate at the sides of the body, with moderately long fasciated fibrils; laminæ oblique, the foremost and the hindmost two obtuse and almost semi-obovate, the others subovate, triangular, and broad; branchial tracheæ well developed, arborescently branched, excentric, with their longer branches ascending or directed towards the broader sides of the laminæ. Caudal setæ defective in the specimens examined; the median seta well developed. Pronotum transverse, very short, well defined behind; the lateral margins dilated and rounded off. Ventral segments subequal in length; the lobe of the ninth segment of the ♀ narrowly elliptical at the tip; pleuræ in segments 6-8 produced into minute acuminate teeth. Fangs of the mandibles slender, unequal, stronger in the left than in the right mandible; the exterior fang, bifid, and denticulate along its upper side in the latter, is in the former more compressed, acuminately lanceolate, and serrulate along both edges; the interior fang, slightly bifid, or slenderly bidentate in both of them, is in the right mandible obviously stunted, and in place of an endopodite has three short unilaterally plumose setulæ, while the other mandible has only a single smooth setula in that place. Lacinia of maxilla I. beset at the edge of the crown with numerous flattened pectinate teeth, and with a few bristles at the point instead of spines; proximal joint of the palpus stout; terminal joint slenderly clavate, obliquely truncate, densely pubescent at the end and acute at the tip. Tongue very similar in form to those of the preceding two nymphs. Femora marked on the coloured side with three irregular zigzag grey fasciæ, narrowly confluent in the middle, preceded by a solitary oval spot near the base. Length of body 7 mm.

Hab. Dakota, 1872; 20 examples captured by Mr. Coues (Mus. Comp. Zool. Cambridge, Mass.) communicated by Dr. Hagen.

HEPTAGENIA, Walsh, 1863; restricted, Etn. 1881.

Illustrations. *Adult* (details), Pls. XXIII. & XXIV. 45; see also [anatom.] citations of Palmén (1884) under *H. flavipennis* and *sulphurea*; (whole figures) see citations, under the same species of Sulzer (1776), Panzer (1805), and Pictet (1843-5). *Nymph*, Pl. LX.

p. 323

Adult.—First joint of the hind tarsus shorter than the second, which is either equal to or a little longer than the third joint; the corresponding joints of the intermediate tarsus of like proportions; first joint of the ♂ fore tarsus much shorter than the second, and this equal or subequal in length to the third joint; first joint of the ♀ fore tarsus much shorter than the second, which slightly exceeds the third in length; ungues each unlike the other. Penis-lobes somewhat explanate, oblong, and subtruncate at their divergent extremities.—Fore leg of ♂ about $1\frac{1}{2}$ the length of the body; tarsus about $1\frac{2}{3}$ as long as the tibia, which is very little longer than the femur; the tarsal joints in the order of their shortening rank 2 equal to 3, 4, 5, 1, and the first is about $\frac{1}{4}$ as long as the second joint. Fore leg of ♀ about equal in length to the body; tarsus about $\frac{2}{3}$ as long as the tibia, which is about $\frac{1}{3}$ as long as the femur; the tarsal joints in the order of their shortening rank 2, 3, 5, 4, 1, and the first is $\frac{1}{3}-\frac{2}{5}$ as long as the second joint. Hind tarsus of ♂ about $\frac{2}{5}$ as long as the tibia, which is less than $\frac{5}{8}$ as long as the femur; its joints in the order of their shortening rank in ♂ 5, 2 equal to 3, 1, 4, in ♀ 5, 2, 3, 1, 4. Ungues each unlike the other in every tarsus. Hind wings of ordinary form; the axillar region narrow. In the dried ♀ abdomen the relative lengths of the dorsal segments 2-10 may be formulated thus:—5, 7, 8, 8, 10, 10, 8, 6, 7; ventral lobe of the ninth segment obtusely rounded or retuse. Forceps-basis of ♂ seldom truncate behind, usually slightly prominent between the insertions of the limbs, and retuse in the middle. Penis lobes rather broad, flattened beneath, subtruncate at the tips, and curved outwards to a moderate extent divergently; stimuli well developed, adjacent to the median line. Outer caudal setæ of ♂ $1\frac{1}{2}$ – $2\frac{1}{2}$ (but usually twice) the length of the body; those of ♀ $1\frac{1}{4}$ – $2\frac{1}{2}$ its length. Vertex of ♀ head transverse; the edge of the occiput, transverse in the midst, ascends at the posterior orbits of the oculi usually only in a slight degree; median ocellus prominent, contiguous with the anterior margin of the upper surface of the head. Pronotum of ♀ subcordately excised behind; the reflexed lateral lobes only slightly rounded posteriorly.

Subimago.—Wings tinted with yellowish, very rarely with greyish; neuration opaque, the cross veinlets acquiring a black tint and narrow dark grey borders, the membrane likewise becoming transversely striped in the disk, and the terminal margins bordered with greyish, shortly before the final moult.

Nymph.—Abdominal tracheal branchiæ spreading at the sides; branchial fibrils fascicled and about as long as the narrowly lanceolate laminæ, of which the fifth is the longest, the others shortening successively in a slight degree in both directions therefrom; branchial tracheæ indistinct in the laminæ after death, through the absence of pigment.

Median caudal seta subequal to the others, about $1\frac{2}{7}$ as long as the body, and beset at the joinings on both sides nearly throughout with minute spreading pubescence, while they are similarly beset on the inner side only. Pronotum well defined, sinuate in the middle posteriorly; its lateral borders scarcely at all dilated, nearly straight, but rounded off slightly in front. Fangs of the mandibles strongly developed, subequal, inflected and compressed; the exterior somewhat triangular, acute, serrulate along the upper edge; the interior fang bifid; endopodite absent, represented perhaps by a minute tuft of hair in the left mandible, and a single short hair in the right. Lacinia of maxilla i. beset at the outer edge of the crown with flattened pectinate teeth, and terminated by two contiguous flattened spines at the point; first joint of the palpus stout; terminal joint slender, slightly clavate, oblique and velutinous at the end, and pungent at the point. Median lobe of the tongue obtuse and somewhat hexagonal; paraglossæ broadly expanded, almost oval, not recurved at the tips. Femora marked on the coloured side with a pair of large opposite confluent spots, forming an irregular distal band, and a pair of separate longitudinal opposite streaks near the base, sometimes connected with the band by dark colouring along the edges of the femur.

NORTH AMERICAN SPECIES.

HEPTAGENIA FLAVESCENS, Walsh.

† *Palingenia flavescens*, ! Walsh, Proc. Acad. Nat. Sc. Philad. (1862) 373; Hag., Proc. Ent. Soc. Philad. ii. 177 (1863).

Heptagenia [type] *flavescens*, ! Etn., Ent. Mo. Mag. v. 90 (1868); *id.*, Trans. Ent. Soc. London (1871) 142, pl. vi. 16 [detail ill drawn]; Hag., *op. cit.* (1873) 404; ! Etn., Ent. Mo. Mag. xviii. 24 (1881).

Subimago.—Wings slightly tinged with fuscous in ♂; in ♀ subflavescent, subopaque, with yellowish neuration, "except on the disk and tip," [where doubtless they are fuscous]. Setæ of ♂ dull greenish; of ♀ pale, a little fuscous at the tips.

Imago, ♂.—Yellowish. Eyes bright greenish yellow during life. Notum ferruginous, sometimes verging upon piceous. Dorsum of abdomen ferruginous, darker at the tips of segments 2–7, and with a pair of subobsolete pale vittæ at the base of each of them; venter pale greenish in segments 2–7 or –8. Setæ whitish; the joinings fuscous, and sometimes towards the roots alternately "white" [wide?] and narrow. Forceps pale, at the tips fuscous. Fore leg pale ferruginous, with a median and a terminal band on the femur, the tip of the tibia, and the tarsal joinings and tips fuscous. Hinder legs yellowish, with the tips of the femora fuscous, and the tarsal joinings and tips a little cloudy. Fore wing hyaline, with a pale ferruginous cloud in the pterostigmatic region; neuration fuscous, excepting the basal $\frac{2}{3}$ of the costa, subcosta, and radius, which are yellowish; the thickening at the bulla of the subcosta, about 0.5 mm. long, is more or less obfuscated. ♀ paler than ♂; vertex and notum rather luteous than ferruginous; dorsum of the abdomen pale fuscous or pale ferruginous, without any pale vittæ. Setæ in one specimen uniformly whitish. "The costal cross veins are hyaline on their basal $\frac{2}{3}$." Length of body 9–13; wing 11–15; setæ, ♂ im. 27–38, subim. 17, ♀ im. 27–28, subim. 13 mm.

Hab. Rock Island, Ill. [After Walsh.]

HEPTAGENIA INTERPUNCTATA, Say. (see p.323)

‡ *Baëtis interpunctata*, Say, Journ. Acad. Nat. Sc. Philad. viii. 41 (1839); Pict., Hist. Nat. Névropt. ii., Ephém. 194 (1843-5); Walk., List of Neuropt. in Brit. Mus. part iii. 562 (1853); Le Conte, Complete Writings of T. Say, ii. 411 (1859); Hag., Smithson. Miscell. Coll. (1861) Synop. Neuropt. N. Am. 44.

‡ *Palingenia interpunctata*, Walsh, Proc. Acad. Nat. Sc. Philad. (1862) 374; Hag., Proc. Ent. Soc. Philad. ii. 177 (1863); Walsh, *op. cit.* ii. 190 (1863).

Heptagenia interpunctata, Etn., Trans. Ent. Soc. London (1871) 142.

Subimago.—Wings at first opaque and tinged with yellowish, afterwards becoming fuscous; neuration fuscous, excepting the basal $\frac{2}{3}$ of the costa, subcosta, and radius, which are yellowish, and the neuration of the axillar region of the fore wing, which (like the whole neuration of the hind wing, except at the tip) is light amber-coloured.

Imago, ♂.—Yellowish. Eyes during life pale greenish yellow, bisected horizontally by a black line; near their upper orbits is a black spot on each side, sometimes obscured by the vertex being obfuscated, and again below each of the antennæ is another black spot a little elongated transversely, which appears angular only when viewed obliquely. Prothorax marked with a black triangle at the base and a black line on each side; notum piceous. Abdomen in segments 2-7 or -8 "pale obscure greenish hyaline" [?=transparent and tinged faintly with greenish], with the terminal $\frac{1}{3}$ of each of them, and a median longitudinal line or stripe on the dorsum piceous, which stripe is usually broad, and when broad contains a pale spot on each side: the remaining dorsal segments almost entirely piceous: venter pale, obscure greenish, with the tips of the segments darker; forceps pale, sometimes cloudy at the tips. Setæ pale greenish, narrowly fuscous at the joinings, except in one immature specimen. Fore leg pale greenish yellow, with a median and a terminal band on the femur, the tip of the tibia, and the joinings and tip of the tarsus fuscous. Hinder legs somewhat paler, but similarly marked on the femur and at the extremity of the tibia, excepting in one instance where the median femoral bands were wanting. Wings hyaline; the fore wing clouded with yellowish brown along the costa, especially in the pterostigmatic space, and the hind wing tipped distinctly with brown; behind the bulla, in the midst of the interspace between the radius (3) and the sector (4) of the fore wing is a very coarse black longitudinal streak about 0.5 mm. long: neuration for the most part fuscous; but in their basal two thirds the costa, subcosta, and radius are yellowish; the cross veinlets in the marginal and submarginal areas of the fore wing are very coarse.

♀. Differs from the ♂ in having the black triangle at the base of the prothorax reduced to a dot; meso- and metanotum luteous. Abdomen in segments 2-9 egg-yellow above and beneath, with the piceous markings much narrower than those of the ♂, and with the ventral joinings pale instead of dark; segment 10 whitish. In the fore wing the costal border is uniformly clouded with yellowish, not darker in the pterostigmatic space, and the neuration in proximity to the inner margin, like that of all but the tip of the hind wing, is yellowish hyaline. Length of body 6-10; wing, ♂ 8-11.5, ♀ 8-14; setæ, ♂ im. 20-25, subim. 9-15, ♀ im. 14-24, subim. 7-14 mm.

Hab. Rock Island, Ill. [after Walsh]. Also Indiana (Say); Alleghany Mts., Va., Washington, D.C., Trenton Falls and Chicago (Osten Sacken, *teste* Hag.).

EUROPEAN AND ASIATIC SPECIES.

In Herr Rostock's analysis of the Saxon species of *Heptagenia*, some of the characteristics relied upon are in some degree variable with the individual specimen (*e. g.* the coloration or the partial deficiency in colour of the marginal area of the fore wing).

HEPTAGENIA SULPHUREA, Müller. Plate XXIV. 45 (legs).

Ephemera sulphurea, Müll., Zool. Dan. Prodr. 142 (1776).—*E. helvola*, Subz., Abgek. Gesch. d. Ins. 171, pl. xxiv. 7 (1776).—*E. leucophthalma*, Ström, N. Saml. Kongl. Dansk. Vidensk. Selsk. Skrift. ii. 90 (1783); Wallengren, Christ. Vidensk. Forhandl. No. ii. 21 (1880).—*E. † bioculata*, Römer, Gen. Ins. Lin. & Fabr. icon. illust. 23, pl. xxiv. 7 [after Subz.] (1789).—[*Ephemera*] or *E. ferruginea* [Zsch. Mus. Lesk. i. 150. no. 18 (1789)]; Gmel., Linn. Syst. Nat. ed. xiii. i. pars v. 2630 (1790); Ol., Encycl. Méth. vi. 422 (1791).—*E. † bioculata*, var., Panzer, in Explic. Schæf. Ic. ccxxix. (1804); *id.*, Fn. Ins. Germ. init. Heft xciv. no. 17 (1805).—*E. citrina*, Hummel, Essais Entom. no. iv. 71 (1825).—*E. † lutea*, ! Steph., Ill. Brit. Ent. vi. 55 (1835).

Baëtis elegans, Curt., Lond. & Edinb. Philos. Mag. ser. 3 (1834) 120; ! Steph., Ill. Brit. Ent. vi. 64 (1835); Pict., Hist. Nat. Névropt. ii. Ephém. 193 (1843-5); Walk., List of Neuropt. in Brit. Mus. part iii. 560 (1853); Hag., Ent. Ann. (1863) 25.—*B. costalis*, Curt., Lond. & Edinb. Phil. Mag. ser. 3 (1834) 120; ! Steph., Ill. Brit. Ent. vi. 64 (1835); Pict. Hist. Nat. Névropt. ii. Ephém. 194 (1843-5); Walk., List of Neuropt. in Brit. Mus. part iii. 561 (1853).—*B. straminea*, Curt., Lond. & Edinb. Philos. Mag. ser. 3 (1834) 121.—? *B. marginalis*, Burm., Handb. d. Ent. Bd. ii. Abth. ii. 801 [excl. citations] (1839).—*B. cyanops*, Pict., Hist. Nat. Névropt. ii. Ephém. 171, pl. xx. 2 (1843-5); Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 556 (1853).—*B. sulphurea*, Pict., Hist. Nat. Névropt. ii. Ephém. 185, pl. xxiii. 8 (1843-5); Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 558 (1853); Brau., Neur. Austr. 74 bis (1857); Ausser., Ann. d. Soc. Natur. Modena, An. iv. 134 (1869); Joly, Rev. d. Sc. Nat. Montpellier, v. 323, pls. viii., ix. figs. 36-38 bis & 51, 52 [anatomical details] (1876).—*B. † lutea*, Hag., Ent. Ann. (1863) 23.

Heptagenia elegans, ! Etn., Trans. Ent. Soc. London (1871) 145, pl. iii. 5 [wing] & vi. 18-18 b [details]; Hag., *op. cit.* (1873) 404; Meyer-Dür, Bull. Soc. Ent. Suisse, iv. 312 (1874); Rostock, Jahresb. d. Ver. f. Naturk. Zwickau, 1877, p. 90 (1878); Palmén, Paar. Ausf.-Gänge d. geschl. Org. b. Insect. S. 44, 64, 65, 74, 75, 77, 78, 83, 92, taf. ii. 28, 29, iii. 39-41, & iv. 58 [anatom.] (1884).

Subimago (living).—Eyes pale blue-verditer, or else pale yellow-green with a movable round spot surrounded by about half a dozen little circular specks of less intense grey; orbits of ocelli olivaceous; a small triangular black speck on each side of the face at the lower part of the inner orbit, and sometimes a rhomboid black spot close to the eyes on the vertex; a linear dash on the pleura just behind the fore coxa, and from 1 to 3 dots, also black, near and above the intermediate coxa. On each side of the mesonotum is a pitch-brown streak tapering forwards from the hinder part of the segment and angulated close to the wing-roots. Wings at first unicolorous sulphur-, or lemon-yellow; the membrane afterwards becomes dull greenish yellow, or even yellow-green (like fumes of chlorine); a tapering grey streak is developed transversely from near the inner-terminal angle of the fore wing, and another nearer the tip of the wing from the vicinage of the pterostigmatic space, while simultaneously a grey band of moderate breadth appears along the terminal margin and the cross veinlets together with a dot at the bulla turn

black. Fore femur and base of tibia light yellowish green; the remainder of the tibia lighter in tint; hinder femora and the bases of the tibiæ whitish, with a yellowish green tint; the remainder of the tibiæ smoky white. Tarsi smoky white, or greyish, with black joinings and ungues. Setæ smoky white with rufescent joinings. *When dried* the wings are transparent dull light yellowish, and it depends upon what was the period at which the specimen was killed whether the cross veinlets are also yellowish or else brownish or black.

Imago (dried).—Femora not dark-banded. Dorsum of the abdomen devoid of a longitudinal median dark stripe, but with the terminal margins of the segments narrowly dark-bordered nearly from side to side. Metathorax as pale at the sides as elsewhere.—*♂ (living).* Eyes at first cæsius, with a transverse dark line and movable markings like those of the subimago: sometimes they are tinged with pale yellowish green above, and more deeply so below. At a later period, and when viewed under artificial light, their colour changes to black or greenish black; but later still it is apt to become cæsius again. Head and sides of the thorax marked as in subimago with either black, piceous, or fuscous. Pronotum light greenish bistre, or olive-brown; the remainder of the notum either light pitch-brown or somewhat brown-ochreous: tegulæ, pleuræ, and sternum much paler, and variously coloured with pale greenish yellow, pale greenish brown, &c. Dorsum of abdomen in segments 1–7 or –8 (excepting at the sides) translucent light greenish brown, or olivaceous grey, narrowly darker (often pitch-black) at the terminal margins of the segments; segments 8 or 9–10 opaque, and more or less brown-ochreous varied with yellow ochre. Venter in segments 1–7 or –8, and the sides of the corresponding dorsal segments, very pale transparent olivaceous green; the remaining ventral segments opaque and somewhat yellow-ochreous. Setæ smoke-grey, or greyish white, with black, pitch-brown, or rufescent joinings. Fore legs subolivaceous, sometimes tinged with yellowish brown: tarsus smoky grey; the tip of the femur, both extremities of the tibia, and the tarsal joinings, blackened. Hinder legs yellowish-green or whitish amber-colour, with the tarsus and tip of the tibia smoke-grey, and often with the tarsal joinings blackened. Wings vitreous, with pitch-black neuration, excepting that, towards the roots, the principal nervures are often tinged with greenish- or amber-yellow: in the fore wing the whole of the submarginal area and at least the pterostigmatic portion of the marginal area are of a greenish- or yellowish-amber tint, the pterostigmatic parts being subopaque and often tinged with grey; but frequently the remaining portion of the marginal area is likewise amber-tinted. *In dried specimens* the greater portion of the wing-neuration becomes pitch-brown; the axillar fold of the fore wing is bordered externally with a slight brownish cloud; the legs to a large extent become strongly amber-coloured, and the notum raw-umber brown; while the thoracic pleuræ often lose the dark markings and become almost uniformly pale brownish yellow.

♀ (living).—Eyes either light yellowish green, glaucous, cæsius, or black; on each side of the face and vertex at the orbit of the eye is respectively a triangular black spot and a triangular fuscous spot. Notum laterally of the very lightest shade of brown-ochre, but along the middle fuscous, with the peaks of the meso- and metanota yellow-ochreous; in front of the upper part of the base of the intermediate coxa is usually a fuscous or

black spot or streak. Dorsum of abdomen in segments 2-7 either very light olive-green or light gamboge-yellow, but in segments 8-10 light yellow or yellow-ochre; the terminal borders of the segments narrowly fuscous; venter spotless. Setæ white or greyish white, with dark or rufescent joinings. Legs gamboge- or amber-yellow; the tarsi greyish white, with black joinings. Wings vitreous; the fore wing usually tinged only in the marginal and submarginal areas with lemon-yellow, but sometimes a fainter tint of the same colour suffuses the remainder of the membrane universally; neuration mostly black, but the stronger portions of the longitudinal nervures, the great cross vein, and the axillar fold are gamboge- or amber-yellow. *In dried specimens* the notum becomes light brownish ochre, instead of fuscous, along the middle, and in many positions the longitudinal neuration of the wings becomes amber-yellow, while the cross veinlets remain pitch-black or black; the colouring of the wing-membrane in the marginal and submarginal areas of the fore wing of ordinary specimens becomes brownish amber, and is most apparent only in the submarginal area and in the pterostigmatic portion of the marginal area, though not entirely deficient in the remainder of the former area.

Variation, ♂ im. (dried).—The abdomen is almost uniformly light pitch-brown (excepting, as usual, the terminal edges of the dorsal segments), and the tract of the dorsal vessel is subopaque, but not so dark as to be reckoned as a dark dorsal stripe.

Hab. Ponte de Morcellos (Beira Baixa), Portugal.

Length of body, ♂ 7-10, ♀ 9-11; wing, ♂ 8.5-12, ♀ 11-13; setæ, ♂ im. 16-23, ♀ im. 14-19, subim. ♂ & ♀ 12-15 mm.

Hab. Generally distributed in Europe in streams and the swift parts of rivers from at least Hammerfest to the south of France and northern Portugal, and from Great Britain to southern Russia. May to September. In Brauer's description of the ♂ fore tarsus "dritte" is written for "vierte."

HEPTAGENIA CÆRULANS, Rostock. (= *H. gallica* - see p. 325)

Heptagenia cærulans, ! Rostock, Jahresb. d. Ver. f. Naturk. Zwickau, 1877, p. 89 (1878).

Imago.—"Thorax yellow-brown, darker behind. Abdomen brown above, darker at the tips of the segments, ochreous at the sides and beneath, and tinged with orange in the last three segments. Forceps brownish. Setæ smutty-white, annulated with darker towards the tips. Fore leg of ♂ testaceous-brown, with darker joinings. Fore wings with bluish iridescence, the marginal area either colourless, or, at the most, tinged with yellowish at the apex. Expanse of wing 21; length of setæ, ♂ im. 25 mm." [After Rostock.]

Hab. Weisseritz, near Dretschen, Saxony (Rostock). I have had no recent opportunity of comparing this species with *H. gallica*. As nothing is said by Herr Rostock of any spot at the side of the metanotum, or of any dorsal abdominal stripe in *H. cærulans*, I have supposed them to be distinct species.

HEPTAGENIA FLAVA, Rostock.

Heptagenia flava, ! Rostock, Jahresb. d. Ver. f. Naturk. Zwickau, 1877, p. 90 (1878).

Subimago (dried).—Wings dull light yellowish, less transparent than in *H. sulphurea*; the hind wings broadly bordered with a light greyish cloud along the terminal margin; the fore wing faintly tinged at the pterostigma with very light red-purple, or purple-madder. Neuration at first lutescent, the cross veinlets turning black as in *H. sulphurea*. Setæ lutescent with dark joinings.

Imago (dried).—Femora not dark-banded. Dorsal segments 1–7 ♀ or 1–10 ♂ of the abdomen traversed lengthwise by a dark median stripe, and dark-edged halfway across the terminal border on each side of the stripe. A dark stripe on each side descends obliquely from the first dorsal segment, running close behind the hind wing-roots and the spiracle, and just in front of the insertion of the hind leg.—♂. Thorax brown-ochreous or piceo-luteous above, “with a dark violet-brown spot on each side of the prothorax.” Abdomen bright yellow, with a broad stripe along the middle of the back strongly tinged with purple-madder, darkest above the dorsal vessel and at the joinings for a short distance on each side of that; in some examples the ordinary curved pale translucent line is visible on each side of the dorsal vessel in segments 2–5, and the other markings comprise a median linear black-purple stripe extending from segment 1 to segment 7 or 8, and a purple-madder band extending halfway across the back along the distal margin of each of these segments, and then produced forwards almost at right angles with the margin in a linear stripe to the basal joining of the segment, so as to enclose a light-coloured blotch on each side of the median stripe at the base of the segment. Setæ white or pinkish white, with reddish joinings. Fore femur brown, tinged with madder-purple, chiefly so where in other species the two dark bands are placed; fore tibia and tarsus testaceous, or in transmitted light pale amber-yellow, the extremity of the tibia, the tarsal joinings, and the unguis burnt-umber brown; hinder legs very light testaceous, or else amber-yellow, with an ill-defined purple-brown mark at the end of the femur, best seen in the intermediate leg and at the lower edge of the limb; their tarsal joinings and unguis purple-brown. Wings vitreous; the fore wing tinged with light amber-yellow in the base and pterostigmatic portion of the marginal area, and in the whole of the submarginal area; in the pterostigmatic part of both areas, about halfway between the bulla and the apex, is a faint red-purple cloud; neuration for the most part pitch-black, the costa, subcosta, and the radius to beyond the middle light pitch-brown or yellowish brown, the bulla pitch-black; the axillary nervures and the proximal extremities of the others very light yellowish brown.

♀. Very similar; the inner orbit of each eye with a black line below running inwards towards the carina, and a black triangular streak above tapering backwards obliquely. Pronotum with a curved tapering purple-black streak on each side directed obliquely downwards from the upper posterior angles. The indistinct markings of the legs are similar to those of the male, but the fore femur is less tinged sometimes with madder-purple, and the burnt-umber brown at the tip of the fore tibia is restricted to the joining. Length of body 9–12; wing, ♂ 10–12, ♀ 11–15; setæ, ♂ im. 24, subim. 13, ♀ im. 15–25, subim. (large example) 19 mm.

Hab. Middle Europe; Arnhem in Holland, near the railway bridge, 27th July; near Dretschen, Saxony (Rostock). In M^cLach. Mus. are two examples from Herr Rostock,

and eight (probably from Posen), captured during the second fortnight in June, from Prof. Zeller. The red-purple tint in the pterostigmatic region of the fore wing, the black-purple dorsal stripe, and the faint traces of the almost obliterated purple-brown femoral bands serve to mark off this species from its very similar neighbours.

cærules Rost. (see p. 325)

HEPTAGENIA [GALLICA, sp. nov.] Plate XXIII. 45 (fore wing), XXIV. 45 a (♀ tarsi 1 & 2, penis dried). *Nymph*, Plate LX.

Heptagenia^{p. 325} [nymph], ! Etn., Ent. Mo. Mag. xviii. 25 (1881).—*H. gallica*, ! *id.*, in the writing of the plates cited above (1883).

Imago (dried).—Femora, each more or less faintly marked with a dark median band, which bands in some [possibly newly moulted] specimens are incomplete, the colouring matter extending only part way across from the under edge of the femur. On each side of the metanotum above the insertion of the hind coxa is a dark spot, which is relatively large and rounded in ♂, but quadrangular and smaller in ♀. Tract of the dorsal vessel narrowly bordered with brownish; the terminal edges of the intermediate dorsal segments are entirely dark.—♂ (*living*). Eyes at first black, changing to cæsius with a black transverse line. Thorax raw-sienna above, with the peak of the mesonotum and a large round spot just behind and below the hind wing-roots black. Dorsum of abdomen in the middle of the intermediate segments, and right across their terminal borders, fuscous; segment 10 raw-sienna; the sides of the dorsum in segments 2–7 translucent whitish, with the main trunk of the tracheæ in a large measure black. Setæ whitish, distally with every joining, but near the base with only the alternate joinings piceous. Hinder legs whitish amber or cretaceous, with greyish tarsi and black tarsal joinings: the spine of the trochanter and the median spot at the lower border of the femur blackish, the tip of the femur fuscescent. The fore femur, tinged with raw-sienna, is similarly marked with blackish, and the tip of the fore tibia and the terminal joint of the tarsus are also black; but the other joints of the fore tarsus are concolorous with the tibia with black joinings, excepting the first joint, which is greyish. In front of the basal joining of the hind coxa is a dark dash; the mesosternal ganglion shows as a cordate fuscous blotch. Wings vitreous, with piceous neuration; the great cross vein, towards the costa, and the proximal extremities of the longitudinal nervures of the fore wing are deficient in colour; in some positions the costa, subcosta, and radius of this wing become bistre-brown, and *in transmitted light* the neuration, as a whole, appears brownish amber-colour. The pterostigmatic region is sometimes very faintly tinged with brownish.—*When dried* the notum is brown ochreous, varied behind with pitch-brown; the fore tibia and tarsus become very light brown-ochreous with blackish markings. Hinder legs very pale yellowish amber, with greyish markings; the bands at the tips of the femora become obsolete.

♀ (*dried*).—Before oviposition the insect closely resembles *H. flava* in its colouring; but afterwards it is as follows:—Thorax above pale yellowish ochre, approaching Naples yellow, varied behind, and also below the tegulæ in front, with a whiter ochre. Abdomen in segments 2–7 translucent dull whitish ochre, with the terminal margins of the segments narrowly dark grey across the back, and with a brownish streak from in front, tapering

posteriorly, on each side of the tract of the dorsal vessel, and another very faint triangular cloud of a similar tint from the hind margin of the segment, on the outer side of the streak, tapering forwards, tending to enclose between them a small curved pale space; the main tracheal trunks are greyish in segments 6–8, but hardly perceptibly so in the anterior segments; segments 8–10 opaque, light yellow-ochre, with the vulva brown-ochreous. Setæ white, with dark joinings. Wings vitreous throughout, with the greater part of the neuration picèous, but with the stronger parts of the longitudinal nervures and the great cross vein of the fore wing *in opaque view* light dull yellowish or yellowish grey; in transmitted light the longitudinal neuration acquires amber-tints, while in most positions the cross veinlets remain black. The markings of the hinder femora are more distinct than in the other sex; and just before the extremity of the femur the lower edge of the limb is for a little distance black. Length of body, ♂ 10; wing, ♂ 11, ♀ 12; setæ, ♂ im. 24, ♀ im. 22 mm.

Hab. Netherlands, near Arnhem, end of July. France, at Toulouse, July–September; common near the Pont d'Empalôt, and by St. Michel opposite the island. The newly-moulted nymph is entirely light yellowish; but on immersion in a solution of alcohol the greyish-black markings become developed after death.

HEPTAGENIA FLAVIPENNIS, Dufour.

‡*Ephemera flavipennis*, Dufour, Mém. par divers savans, Instit. de France, viii. 580 note (1841).

‡*Baëtis longicauda*, Steph. Ill. Brit. Ent. vi. 63 (1835) [*nomen ineptum*]; Pict., Hist. Nat. Névropt. ii. Ephém. 193 (1843–5); Walk., List of Neuropt. Ins. in Brit. Mus. part. iii. 560 (1853); Hag., Ent. Ann. (1863) 24.—‡*B. cerea*, Pict., Hist. &c. 183, pl. xxiii. 2 (1843–5); Walk., List. &c. iii. 558 (1853).

Heptagenia flavipennis, ! Etn., Trans. Ent. Soc. London (1871) 144, pl. vi. 17–17 c [details]; Meyer-Dür, Bull. Soc. Ent. Suisse, iv. 312 (1874); Rostock, Jahresb. d. Ver. f. Naturk. Zwickau, 1877, p. 90 (1878); Palmén, Paar. Ausf.-Gänge d. geschl. Org. b. Insect. SS. 68, 74, 77, 78, taf. iv. 55 [anatom.] (1884).—*var. ? H. volitans*, ^{p. 325}! Etn., Trans. Ent. Soc. London (1870) 7; ! *id.*, *op. cit.* (1871) 147, pl. vi. 20 [detail]; Rostock, Jahresb. d. Ver. f. Naturk. Zwickau 1877, p. 89 (1878); Palmén, Paar. Ausf.-Gänge d. geschl. Org. b. Insect. S. 52 [anatom.] (1884).

Subimago (living).—Eyes and wings very similar in colour and in their developed markings to those of *H. sulphurea*; the bullæ of the costa and subcosta, and the cross veinlets of the pterostigmatic region black. Femora of a light dull warm brown-ochre, banded in the middle and at the tip with light reddish; tarsi and tips of tibiae greyish black. Setæ concolorous with the femora, scarcely opaque at the joinings. *When dried* the wing-membrane is brighter than in *H. sulphurea*, approaching in tint a very light shade of Mars-yellow or Italian ochre.

Imago (dried).—Femora (or at least the fore femur), more or less faintly dark-banded in the middle; but the bands often disappear from the hinder femora of dried specimens. On each side of the metanotum, behind the upper part of the insertion of the hind coxa, is a rounded black spot, which is small in both sexes. The tract of the dorsal vessel is not bordered; but the extreme terminal edges of the intermediate dorsal segments are dark almost from side to side.—♂ (*living*), eyes bright or very light olive-green. Notum raw-sienna or furfurosus. Dorsum of abdomen in segments 2–7 either greenish grey or light yellowish green, or light sulphureous, with the terminal margins of the segments

greyish black nearly from side to side; segments 8–10 raw-sienna. Setæ light brownish ochre with dark joinings. Legs as in subimago, but with the fore tarsus sepia-brown, dark at the tips of the joints. Wings vitreous, tinged with greenish yellow, especially towards the fore costa; longitudinal neuration blackish green; cross veinlets, and the bullæ of the subcosta and radius, black. *When dried* the notum becomes light brownish ochre; a small dark spot is visible on each side just above the hinder part of the insertion of the hind coxa. Segments 2–7 of the abdomen are translucent whitish, with a slight yellowish tint posteriorly and in the middle of the back, and are edged with light bistre-brown nearly across their terminal margins; their tracheæ are white. Segments 8–10 are bright brown-ochre. The fore wings are tinged with yellowish amber distinctly throughout the submarginal area, and also in the uttermost extremities of the two following areas; in the marginal area the tint is much fainter. *In opaque view* the finer longitudinal neuration and the cross veinlets appear black or piceous, while the great cross vein and the thicker nervures of the fore wing appear yellowish brown; *in transmitted light* the longitudinal neuration becomes yellowish amber, and the cross veinlets remain black. The bulla of the subcosta is thickened for some distance, and black.

Variation 1. ♂ (dried). The wing-membrane is faintly tinged with yellowish throughout the disk, and the stronger tint in the marginal area is as distinct as that of the submarginal area. The ground-colour of segments 2–7 and 10 of the abdomen is subopaque light yellowish approaching Roman ochre; that of segments 8 and 9 light reddish. *Hab.* Orthéz. ^{p. 325}

?*Variation 2 [volitans].* Eyes of ♂ blackish brown. Notum atro-fuscous. Dorsum of abdomen light bistre-brown, with the tips of the segments darker. Setæ pale greenish grey, with darker joinings. *Hab.* Near Reading, Berks.

♀ (*dried*). Very similar to *H. gallica*; but the dark edging does not extend the whole way across the back along the terminal margins of segments 2–7, and the course of the dorsal vessel is not marked out; the main tracheæ also are whitish or pale. Setæ whitish, with reddish joinings. Wings vitreous, tinged throughout the submarginal area of the fore wing distinctly, and more faintly so in the marginal area with yellowish amber; neuration coloured as in the other sex; the bulla of the subcosta is thickened, and brownish or piceous. The median markings of the hinder femora are hardly perceptible; but close to the knee, very near the under edge of the femur, is a very small black spot or dot. On the head is a black dot on each side of the vertex close to the eyes, and another on each side below the eyes. Length of body 12–14; wing, ♂ 14–15, ♀ 17; setæ, ♂ im. 20–33, subim. 24, ♀ im. 21 mm.

Hab. England, near Reading, on the Kennet and Holybrook. Switzerland, at Basle (M^eLach.) and by the Lake of Geneva (Pict.). France, at Orthéz (Basses Pyrénées). June and July. The subimago emerges chiefly after sunset.

I refer here as a variation the insect described in 1870 as a distinct species,—*H. volitans*, ^{p. 325}—with some hesitation. The difference in the colour of the eyes is immaterial; the coloration of the legs is favourable to their identity. The colouring of the body, however, is a more serious obstacle to their union; but it may not be insurmountable.

COMPSONEURIA, Etn. 1881.

Illustrations. *Adult* (details), Pls. XXIII. & XXIV. 42.

Adult.—Joints 1-4 of the hind tarsus diminish successively in length; first joint of the ♀ fore tarsus rather shorter than the second, but longer than the third joint; ungues each unlike the other. Penis lobes subsimilar to those of *Heptagenia*. Cross veinlets conspicuously few in number in the fore wing.—[Proportions in length of the legs and body not recorded.] Fore tarsus of ♀ almost as long as the tibia, which is $\frac{4}{5}$ the length of the femur; the joints in the order of their shortening rank 2, 1, 3, 5, 4, and the first is about $\frac{4}{5}$ as long as the second. Hind tarsus of ♀ little more than $\frac{1}{3}$ as long as the tibia, which is about $\frac{5}{7}$ as long as the femur; its joints in the order of their shortening rank 5 equal to 1, 2, 3, 4, and the first is about $1\frac{1}{7}$ as long as the second joint. Ungues each unlike the other in every tarsus. Hind wings of the ordinary form; the axillar region narrow. In the disk of the fore wing, posterior to the radius, are four somewhat dislocated transverse series of cross veinlets: of these the innermost, commencing near the junction of the sector (4) and cubitus (5), becomes irregularly dislocated inwards at the anal (8) nervure; the second (the nearest to the bulla), dislocated outwards in the sectorial region, becomes posteriorly, between the cubitus (5) and the hinder branch of the pobrachial (7), more nearly aligned with its commencement, running as a whole subparallel with the first series; the third, receding from a point nearly opposite the commencement of the pterostigmatic region, is interrupted between the fourth sectorial intercalary nervure and the cubitus, and its elements are diverted towards the fourth series between the cubitus and the anterior branch of the pobrachial; the fourth series, intermediate between the third and the extremity of the wing, meets the terminal margin between the cubitus and the præbrachial (6) nervures. Penis-lobes and other genitalia very similar to those of *Heptagenia*. Caudal setæ defective in the specimens examined.

Type. *C. spectabilis*, Etn.

Distribution. Malay Region.

Etymology. κομψός and νεύριον, from the elegance of the cross veinlets in the fore wings of the typical species. Possibly (as in *Callibætis*) they may vary in number and arrangement with the species.

COMPSONEURIA SPECTABILIS, Etn. Pls. XXIII. 42 (wings ♀), XXIV. 42 (♀ fore and hind legs, ♂ genitalia).

Compsoneuria spectabilis, ! Etn., Ent. Mo. Mag. xviii. 23 (1881).

Imago (dried), ♂.—Yellowish ochre approaching light straw-colour. Notum varied with pitch-brown. Segments 2-8 of the abdomen bordered narrowly in the midst of their posterior dorsal margin with black, and marked on each side with a black line recurrent obliquely from that bordering towards the spiracle; segments 3-7 have also each a lanceolate black streak produced from the same bordering along the line of the dorsal vessel; segments 9 and 10 pale. Venter and forceps light yellow-ochreous. Hind

leg pale straw- or amber-yellow; the trochanter, a band in the middle and another at the tip of the femur, the base of the tibia, and the extreme edges of the tarsal joinings pitch-black; the other legs wanting. Wings vitreous; longitudinal neuration pellucid, excepting that the costa, subcosta, and radius are piceous towards the tip of the fore wing; cross veinlets piceous, and narrowly bordered with piceous.

♀. Very similar; but the general colouring of the body is brown-ochre instead of yellow-ochre. In the hind wing there are rather more cross veinlets than in the other sex. Length of body 6; wing, ♂ 7, ♀ 8 mm.

Hab. Lahat (in Leyden Mus.); received from Mr. C. Ritsema.

ECDYURUS, Etn. 1868; revived 1881.

Illustrations. *Adult* (details), Pls. XXIII. & XXIV. 46, see also [anatom.] citations of Palmén (1884) under *E. angustipennis* and *venosus*; (whole figures) see citations of Pictet (1843-5) under *E. helveticus*, *purpurascens*, *angustipennis*, *obscurus*, *lateralis*, & *montanus*, and of Curtis (1834) under *venosus*. *Nymph*, Pls. LXI. [junior] & LXII. (senior); see also Pictet, *op. cit.* (1843-5) pl. 16.

Adult.—In the hind tarsus joints 1-4 usually diminish successively in length, but the first is sometimes equal or subequal in length to the second joint; in the intermediate tarsus the first joint is more commonly as long as the second joint; first joint of the ♂ fore tarsus usually about $\frac{1}{2}$ as long as the second (in *E. helveticus* scarcely $\frac{1}{3}$ as long as the second joint), which is nearly of the same length as the third joint; first joint of the ♀ fore tarsus shorter than the second, which exceeds the third joint in length. Penis-lobes stout, usually broadly trilateral, but sometimes obovate; stimuli well developed, adjacent to the median line. Fore leg of ♂ 1-1 $\frac{1}{2}$ as long as the body; tarsus about twice as long as the tibia, which is almost as long as the femur; the tarsal joints in the order of their shortening usually rank 2, 3, 4, 1, 5 [in *E. helveticus* 2, 3, 4, 5, 1] and the first is usually about $\frac{1}{2}$ [in *E. helveticus* about $\frac{1}{3}$ or $\frac{1}{4}$] as long as the second joint. Fore leg of ♀ subequal in length to the body or about $\frac{5}{7}$ as long as it; tarsus $\frac{3}{4}$ -1 $\frac{1}{2}$ as long as the tibia, which is about $\frac{5}{8}$ as long as the femur; the tarsal joints in the order of their shortening rank usually 2, 5, 3, 1, 4 [in *E. helveticus* 2, 5, 3, 1 equal to 4] and the first varies in proportion to the second joint from about $\frac{6}{7}$ - $\frac{6}{11}$ as long. Hind tarsus of ♂ about $\frac{4}{7}$ as long as the tibia, which is about $\frac{7}{9}$ as long as the femur; the joints in the order of their shortening usually rank 5, 1 equal to 2, 3, 4, but in the ♀ tarsus and in that of *E. helveticus* ♂ they rank 5, 1, 2, 3, 4. Ungues each unlike the other in every tarsus. Hind wings of the usual form; the axillar region narrow. In the dried ♀ abdomen the relative lengths of the dorsal segments 2-10 may be formulated thus:—5, 8, 9, 9, 9, 9, 7, 6, 6; ventral lobe of the ninth segment entire. Forceps-basis of ♂ usually slightly or moderately curved saliently behind between the insertions of the limbs, and sometimes with a small blunt projection or tooth on each side of the curve adjacent to their insertions. Penis-lobes stout, usually expanded broadly outwards at the tips, but sometimes obovate; stimuli well developed, adjacent to the median line. Caudal setæ of ♂ 2 $\frac{1}{2}$ -3 times the length of the body, those of ♀

about $1\frac{1}{2}$ its length. Vertex of ♀ head transverse; posterior orbits of the oculi higher than the interjacent portion of the edge of the occiput; median ocellus prominent, contiguous with the anterior margin of the upper surface of the head. Pronotum of ♀ either retuse only or subcordately excised behind; the reflexed lobes somewhat rounded behind.

Nymph (senior).—Abdominal tracheal branchiæ, when not spread, obliquely reclinate at the sides, with well-developed suberect or ascending fascicled fibrils; the laminae successively increase in size from the first to the fifth pair, and then diminish gradually to the seventh; the fibrils attain their maximum development at the third pair, and decreasing successively from that point in opposite directions, both in density and length, are lacking in the seventh pair; the foremost laminae, narrowly ovate-oblong in form, are (like the next two) small in proportion to the fibrils; those of the second pair are ovate, of the fifth pair ovate-oblong, of the seventh obliquely obovate, and the others exhibit intermediate gradations of form: branchial tracheæ well defined, commonly alternate-pinnately branched, but occasionally (as in Pl. LXII. 20) arborescent. Median caudal seta subequal to the others, minutely plumose, while they are unilaterally so, and about as long as the body. Pronotum completely defined; the lateral borders broadly dilated, rounded off in front, and produced behind into acute angles flanking the anterior portion of the mesonotum. Ventral segments subequal in length; the lobe of 9th segment of ♀ subtriangular; pleuræ narrowly dilated, saliently curved at the outer edge anteriorly, and shortly acuminate behind, so as to form minute teeth. Fangs of the mandibles narrowly subfalcate; the exterior, and stronger, serrulate at the edges; the interior, more slender and shorter, is in the left mandible or tridentate at the point; in the place of the endopodite, in both mandibles, is a short tuft of plumose hair. Lacinia of maxilla i. beset with flattened pectinate teeth along the edge of the crown, and terminated by a pair of contiguous flattened subulate spines at the point: first joint of the palpus moderately stout; terminal joint slender, clavate, obliquely truncate and densely velutinous at the end, pungent at the tip, and pubescent externally. Median lobe of the tongue truncate-subcordate, with the auricles excised; paraglossæ broadly unciform, with the points recurved. Femora marked on the coloured side with two irregular zigzag grey bands composed of confluent spots, and apt to be respectively connected with a spot near the base, and another, or two, near the tip.

The nymphs figured respectively in Pl. LXI. and Pl. LXII. 24, probably are merely junior grades of species of *Ecdyurus*; and the latter is the younger, judging from the completeness of the delimitation of the pronotum at the hinder lateral angles. The somewhat older N. American nymph (Pl. LXI.) differs from that of *E. venosus* of senior grade in the following particulars. The lateral borders of the pronotum are not produced posteriorly, but are intimately blended with the mesonotum; and hence the pronotum wants definition at the hinder lateral angles. The mandibles lack the tufts of hair adjacent to the bases of the interior fangs; and the left mandible has a single slender bristle in their place, like that of those figured in Pls. LVIII., LIX. The median lobe of the tongue resembles somewhat that of the nymph last referred to; but the paraglossæ differ both from those of that nymph and from those of the senior

Ecdyurus, being broader at the base, less recurved and more pointed at the tips: and the tongue as a whole bears some resemblance in outline to an Eagle Ray (*Myliobatis aquila*). Resident in rivers and streams.

Type. *E. venosus* (in *Ephemeris*), Fab.

Distribution. Europe eastwards to Siberia, the Caucasus and the river Euphrates; the Himalaya; North America from Texas northwards.

Etymology. ἐκδύω and οὐρά, in allusion to the abortion of the median caudal seta.

NORTH AMERICAN SPECIES.

ECDYURUS CANADENSIS, Walker.

‡ *Baëtis canadensis*, ! Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 569 (1853); Hag., Smithson. Miscell. Coll. (1861), Synop. Neuropt. N. Am. 47.

Heptagenia canadensis, ! Etn., Trans. Ent. Soc. London (1871), 138, pl. vi. 12, 12 a.

Imago (dried), ♂.—Head and thorax above rufo-piceous or rufo-lutescent, with a large black spot on each side of the face below the antennæ adjacent to the orbits of the eyes: the pleuræ streaked with piceous above the interspaces in advance of the hinder coxæ. Abdomen in segments 2–9, translucent, subochraceous, or very light bistre-grey, the 10th segment rufescent, the apical borders of the previous segments across the middle of the back, and the lateral spots or oblique stripes prolonged forwards from them pitch-black; venter very light whitish ochreous. Setæ pale, with fuscous joinings. Fore femur (as an opaque object) rufo-lutescent or (with transmitted light) translucent bistre-brown, with a broad black band at the base, another in the middle, and with a rufo-piceous knee; fore tibia rufo-lutescent tipped with black; fore tarsus light brown-ochre, with black joinings. Hinder femora (as opaque objects) light olive grey, or (with transmitted light) very light greenish-yellow amber-colour, banded with black-grey in the middle and near their terminations: hinder tibiæ and tarsi light brown-ochreous, their joinings rather dark, and the distal tarsal joint brown. Wings vitreous, with pitch-brown or bistre-brown neuration, excepting the cross veinlets between the costa and sector in the fore wing, which are pitch-black. The fore wing at the roots and in the portion of the submarginal area subtending the pterostigmatic space very light raw-umber, this colour extending further along the margin to just beyond the extremity of the wing; the remainder of the same area of a very much fainter tint: in the area between the radius and the sector, in the vicinage of the bulla, 2 or 3 cross veinlets approximated to one another are intersected by a short intense sepia-brown dash rounded at both its extremities, and 3 or 4 of those nearer the base of the wing are marked each with a rounded spot of the same colour. Terminal margin of the hind wing narrowly bordered with sepia-grey. Length of body, ♀ 7·5, wing 8 mm.

Hab. Canada (Brit. Mus.).

ECDYURUS VERTICIS, Say.

‡ *Baëtis verticis*, Say, Journ. Acad. Nat. Sc. Philad. viii. 42 (1839); Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 562 (1853); Le Conte, Complete Writings of T. Say, ii. 412 (1859); Hag., Smith-

son. *Miscell. Coll.* (1861) *Synop. Neuropt. N. Am.* 46; Walsh, *Proc. Ent. Soc. Philad.* ii. 204 (1863); Etn., *Trans. Ent. Soc. London* (1871), 121.—*B. flaveola*, Pict., *Hist. Nat. Névropt.* ii. Ephém. 186, pl. xxiii. 4 (1843-5); ! Walk., *List of Neuropt. Ins. in Brit. Mus.* part iii. 559 (1853); Hag., *Smithson. Miscell. Coll.* (1861) *Synop. Neuropt. N. Am.* 44.

Heptagenia flaveola, ! Etn., *Trans. Ent. Soc. London* (1871) 149, pl. vi. 22, 22 a [detail].

Subimago (dried).—Wings very light grey; the longitudinal neuration of the fore wing is, in some lights, concolorous with the membrane, in others pitch-brown; the cross veinlets in the ♀, at first dark grey, afterwards become pitch-black; those before the bulla in the marginal and submarginal areas also become bordered with deep warm sepia-brown; the neuration of the hind wing is concolorous with the membrane. Femora banded in the middle, and again distally more narrowly with dark grey. The whole of the body and legs in the female are chiefly very light yellow-ochreous approaching Naples yellow; the abdominal segments 1-9 bordered distally in the midst of the back with black grey, and in segments 4-6 marked with a small black spot on each side of the back just before the distal border, in place perhaps of the usual oblique stripes.

Imago (dried).—♂. Thorax rufo-luteous above. Abdomen in segments 2-7 translucent ochraceous, white with the joinings above bistre-brown; segments 8-10 rufo-luteous above; venter spotless. Setæ whitish-grey, with the joinings scarcely at all darker. Legs sub-stramineous, with dark joinings; every femur with a bistre-brown band in the middle and another distally; the fore tarsus whitish, with dark joinings. Wings vitreous; the fore wing with the neuration mostly black, the costa, subcosta, and radius however, being light translucent testaceous; neuration of the hind wings pellucid.

♀. Head and thorax very light ochraceous; a greyish spot at the lower end of the facial carina, a dark oblique streak at the base of the fore coxa, a black dash in the suture in front of the hind coxa, and another on the hinder surface of the pleura above the coxa. Abdomen (discoloured) of a redder yellow; the segments above narrowly edged with black-grey at the joinings. Setæ whitish-grey, with pitch-brown joinings. Legs extremely light yellow-ochreous; the median and distal bands of the femora dark sepia-brown; the extreme edge of the tibia at its distal termination above, and the terminal joint of the tarsus, and also the ungues, light brown. Wings vitreous; the fore wing tinged very faintly with light dull greenish yellow in the submarginal area as far as the vicinage of the pterostigma from the base of the wing; longitudinal neuration translucent and of a light colour; cross veinlets light bistre-brown, the great cross vein coloured more strongly near the subcosta. The marginal area of the fore wing contains about 4 cross veinlets before, and 11 beyond the bulla; these last are simple. Length of body, ♂ 9, ♀ 8-10; wing, ♂ 10, ♀ 11-13; setæ, ♂ im. 20, ♀ subim. 16 mm.

Hab. St. Martin's Falls, Albany River, Hudson's Bay (Barnston, in *Brit. Mus.*); West Farms, N.Y. (Angus, in M^eLach. *Mus.*); Tennessee (Pœpig), Dalton, Ga. (Osten-Sacken) and Washington (*id.*, in Hag. *Mus.*).

ECDYURUS LURIDIPENNIS, Burmeister.

Ephemer noveboracana, Lichtenstein, *Cat. Mus. Holthusien*, iii. 193 (1796) ?

† *Baëtis luridipennis*, Burm., *Handb. d. Ent. Bd.* ii. Abth. ii. 801 (1839); Pict., *Hist. Nat. Névropt.*

ii. *Ephém.* 192 (1843-5); ! Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 563 (1853); Hag., *Smithson. Miscell. Coll.* (1861) Synop. Neuropt. N. Am. 49.—*B. noveboracana*, *id.*, *op. cit.* 50 (1861)?
Heptagenia luridipennis, ! Etn., *Trans. Ent. Soc. London* (1871) 149, pl. vi. 21, 21 a [detail].

Subimago (*dried*).—Wings transparent, very light bistre-grey; the longitudinal nervures bistre-brown, the cross veinlets pitch-black. Setæ light bistre-brown, with dark joinings.

Imago (*dried*).—♂. Thorax above rufo-testaceous or (in other lights) fusco-lutescent; abdomen in segments 2-7 translucent light burnt-umber brown, opaque at the joinings, and formerly with dark oblique lateral stripes; the hinder segments rather dark bistre-brown. Setæ bistre-grey, with dark joinings. Fore femora and tibiæ subtestaceous, with two dark bands on the femur and the end of the tibia fuscous; fore tarsus light bistre-grey. Hinder legs dull light yellow-ochre, the coxæ, trochanters, and femoral bands, light warm sepia-brown, the apical edges of the tarsal joints, and the ungues brownish. Wings vitreous, slightly discoloured in the pterostigmatic portion of the marginal and submarginal areas; the neuration pitch-brown, excepting the thicker longitudinal nervures near the base, which are there bistre-brown.

♀. Very similar to the ♂. Thorax raw-umber brown above. Legs dull light-yellowish green horn-colour; a band in the middle and at the extremity of the femur, the joinings and the terminal joints of the tarsus, ungues included, warm sepia-brown. The portion of the submarginal area of the fore wing adjacent to the pterostigmatic space is faintly tinted with pale greenish. Length of body 10-11; wing, ♂ 13, ♀ 15; setæ, ♂ 25 (?), ♀ 15 (?) mm.

Hab. St. Martin's Falls, Albany River, Hudson's Bay (Brit. Mus.); the St. Lawrence, Canada (De Selys-Longchamps).

ECDYURUS VICARIUS, Walker.

‡ *Baëtis vicaria*, ! Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 565 (1853); Hag., *Smithson. Miscell. Coll.* (1861) Synop. Neuropt. N. Am. 48.—*B. tessellata*, ! Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 566?

‡ *Ephemera pudica*, ! Hag., *Smithson. Miscell. Col.*, Synop. Neuropt. N. Am. 39 (1861).

Heptagenia vicaria, ! Etn., *Trans. Ent. Soc. London* (1871) 150, pl. vi. 23, 23 a [details]:—*nec H. pudica*, ! Hag., *Ann. Rep. U. S. Geolog. & Geograph. Survey of the Terr. for 1873*, part iii. Zool. 581 (1875). (1875)

Subimago ? (*dried*).—Wings warm sepia-grey; longitudinal neuration yellowish brown; cross veinlets in some parts black-brown, in other parts light-sepia-brown, edged narrowly with light sepia-grey, the black-brown or intense sepia colouring spreading along the longitudinal nervures at their junctions with cross veinlets, and causing the nervures to be banded. Setæ bistre-grey, with darker joinings.

Imago (*dried*), ♂.—Notum brown-ochreous, modified with raw-umber brown; an intense black-brown stripe from the fore wing roots on each side of the mesothorax. Dorsum of the abdomen in segments 2-9 light pitch-brown, in segment 10 brown-ochreous; on the dorsum and venter, by the spiracles, are translucent figure-of-6-shaped marks, and at the base of every intermediate dorsal segment is a pair of short pale longitudinal lines. Setæ bistre-brown with dark joinings. Fore femur, in opaque view, light bistre-brown, banded broadly in the middle and narrowly at the tip with pitch-brown; tibia rather a redder raw-umber than the femur, brown-black at the tip; tarsus light

warm sepia-brown. Hinder femora, in opaque view, testaceous or very light brown-ochreous, banded broadly in the middle and rather broadly at the tip with brown-black; tibiæ brown-ochreous; tarsi brown-black. Wings vitreous, tinged in the pterostigmatic region of the fore wing with light bistre-grey; neuration either pitch-brown or very dark rufo-piceous; the cross veinlets interjacent between the fore costa and the pobra-chial (7) are most of them slightly thickened, and those of the pterostigmatic space are simple and straight.

♀. Similar to ♂. Length of body, ♂ 12; wing, ♂ 13, ♀ 14.5–18; setæ, ♂ 35 mm.

Hab. The St. Lawrence (Walker); Chicago and Washington (Hagen); Savannah (Osten-Sacken). I did not compare the subimagines described respectively by Hagen and Walker; and have only quite lately come to consider them to be of one species.

EUROPEAN AND ASIATIC SPECIES.

* *Penis-lobes broadly expanded outwards at the tips.*

ECDYURUS KRUEPERI, Stein.

‡ *Potamanthus Krueperi*, Stein, Berlin. ent. Zeit. vii. 414 (1863).

? *Leptophlebia Krueperi*, Etn., Trans. Ent. Soc. London (1871) 86.

‡ *Baëtis Krueperi*, Stein MS., Etn., *op. cit.* (1873) 395.

Imago (dried), ♂.—Notum dark pitch-brown, approaching intense burnt-umber. Dorsum of abdomen bright brown-ochre, approaching in some lights Mars-yellow; the joinings of the segments appear slightly opaque, and oblique dark lateral stripes of the ordinary description are faintly indicated in segments 2–7 or –8 [the specimens described are aged and doubtless faded]; the ventral nerve-ganglia are visible. Setæ whitish brown-ochre, browner towards the roots; their joinings light pitch-brown and, in the lighter portion, alternately narrow and broad. Fore leg, in opaque view, pitch-brown. Hinder femora, in opaque view, light raw-umber brown, the tibiæ rather lighter, the tarsi, in some lights, nearly concolorous with the femora. Fore wings vitreous, tinted faintly throughout the disk with whitish raw-umber, but more distinctly tinged with light raw-umber at the roots and in the marginal and submarginal areas, and especially so at the commencement of the pterostigmatic space; the cross veinlets of this space are branched, and anastomose evenly with one another. Hind wing conspicuously tinged with light raw-umber brown, darkest towards the terminal margin. Wing-neuration, in opaque view, for the most part pitch-brown; but the near extremities of the longitudinal nervures posterior to the radius (3) in both wings, the whole of the costa of the hind wing, and the extreme base of the costa in the fore wing are light raw-umber.

♀. Notum dark brown-ochre. Abdomen discoloured; the oblique stripes at the sides of the segments are piceous, and the spaces below them are of a light colour. Setæ defective, piceous at the base, with opaque joinings. Legs similar to those of ♂ in colour, but with the hinder tibiæ darker. Fore wing very similar to that of the ♂, but less distinctly discoloured along the costa. Hind wing as nearly colourless as the fore

wing throughout, excepting only the neurulation. Ventral lobe of segment 9 ellipsoidally rounded off. Length of body 10–11; wing, ♂ 12–14, ♀ 14 mm.; setæ defective.

Hab. Greece (Stein, in Berlin Mus.); Albania (Sir S. Saunders), 2 ♂, 1 ♀ im. (in M^cLach. Mus.).

Part V. Read November 18th, 1886.

I FIND myself unable to decide, from dried specimens, whether *E. helveticus*, *venosus*, and *forcipula* are entitled to rank as species only or as races. It is possible, if specimens were grouped in accordance with their style of coloration, that *E. forcipula* might justly be held to bear the same kind of relationship towards *E. helveticus*, as the var. *quasitor* to *E. venosus*, and that the peculiar shortness of the first joint of the ♂ fore tarsus of *E. helveticus* may be found to be something less than a specific distinction. On the 3rd of June, 1885, I captured two ♂ imagines of *E. venosus* by the river at Eden Lacy in Cumberland, having the tarsal joint in question perceptibly shorter proportionally than that joint is in any other specimens caught elsewhere, or at other times in the same place, during that year. Specimens of *E. venosus* that have been relaxed and set out for the cabinet after they have become dry in the first instance are very apt to lose their markings and to be rendered unserviceable for study; and I have consequently found it difficult to institute comparisons between the unset specimens in my own collection, and a large proportion of those from other collections submitted to me for identification.

ECDYURUS HELVETICUS, sp. nov. Plate XXIV. 46 a (♂ fore tarsus).

‡ *Baëtis* ‡ *venosus*, Pict., Hist. Nat. Névropt. ii. Ephém. 167, pl. xx. [part.] (1843–5).

Subimago (*living*).—Wing-membrane either fumatose or dusky, tinged at the base of the fore costa and again beyond the middle with bright or sulphur-yellow, but elsewhere in the basal half of the same with dull greenish, approaching olive-green; fore wing marked with the usual dark stripes; terminal margin of the hind wing broadly bordered with dark grey. Eyes of ♂ dull yellowish green, traversed by a reddish-brown line, and displaying a movable black spot; those of ♀ dark and dull olivaceous. Fore femur of ♂ pitch-brown; tibia rather lighter; hinder femora dull greenish grey or olivaceous; tarsi black; setæ pitch-black; forceps black.

Imago (*dried*), ♂.—Notum light brownish or pitch-brown. Fore leg of ♂ uniformly piceous, with the first tarsal joint short for an *Ecdyurus*. Pterostigmatic space of the fore wing darkened. Abdomen nearly uniformly brownish above, with the following exceptions:—*in transmitted light* on each side of the base in segments 2–7 a small colourless translucent narrow space or spot, rounded below, extends nearly to the anterior dorsal trachea of the segment; and between the two dorsal tracheæ of the segment, the shallow, oval depression (covered in the nymph by the tracheal branchia) is rather paler than its borders.—(*Living*). Eyes sometimes intense bistre or pitch-brown above, sometimes rich rufo-fuscous, and traversed below by a dark or rusty line edged with light