

TRANSACTIONS

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P.

I. *A Revisional Monograph of Recent Ephemeridæ or Mayflies.* By the Rev. A. E. EATON, M.A. (Communicated by Sir JOHN LUBBOCK, Bart., F.R.S., Pres. Linn. Soc.)

(Plates I.—LXV.)

Part I. Read April 19th, 1883.

INTRODUCTORY REMARKS.

THE present monograph is designed to facilitate the study of the Ephemeridæ. On many accounts these insects are very eligible subjects for scientific research; but so long as they are ill known, and their exact identification a matter difficult of accomplishment, their employment in any branch of zoological learning is surrounded with disadvantages too patent to need indication.

Many points in the classification of the Ephemeridæ formerly doubtful receive elucidation in this work through the kind co-operation of entomologists of various nationality. An unprecedented wealth of material, through their means, has been available for examination, every thing at their disposal likely to be in any way of service to me having been most courteously given or lent by them. The chief contributors of specimens have been Mr. R. M^cLachlan, F.R.S., and Dr. H. A. Hagen, of Cambridge, Mass. I am also under great obligations to Mr. H. Albarda of Leeuwarden, Mr. C. Ritsema of Leyden, the Baron E. de Selys-Longchamps, M. Albert Müller of Berne, M. A. E. Vayssière of Marseilles, and Dr. E. Joly of Toulouse. My thanks are also due respectively to the chief Entomologists or Directors of the British, Oxford, Brussels, Paris (Jardin des Plantes), and other museums, for permitting valuable specimens to be thoroughly examined by me. Many very choice Ephemeridæ in the Museum of Comparative Zoology, Cambridge, Mass., forwarded by Dr. Hagen, and some remarkable species contributed by Mr. O. Salvin, demand particular acknowledgment.

At an initial stage in the preparation of the letterpress, having decided to write in English, the question arose whether or not descriptions of the species should be given, or should the text treat of genera only. The various tints of yellow, brown, grey, and, in a lesser degree, of black, largely prevalent in the coloration of Ephemeridæ, cannot be precisely defined in common English entomological terms so well as in Latin; and

kindred species are often so nearly alike in colour that terms of precision are indispensable in describing the differences between them. When it was settled that the work should be written in its present form, the exigencies of the case were met by having recourse to a trade-colour pattern-book, as a standard of reference, sold by one of the principal artists' colour merchants in London. The samples display three or four gradations of each colour,—intense, medium, light, and sometimes very light. In my descriptions, colours of medium gradation are usually quoted without any qualifying adjective; but in blacks, only the intense gradation is termed black, the medium being designated greyish black, or blackish. The light gradation in blacks and browns, or sometimes the lighter and lightest in a quadruple series of the latter, are referred to as greys of such and such a tint. Very light gradations of red, orange, yellow, green, blue, &c. are denoted as “extremely light,” “the lightest possible tint,” or “whitish,” according to circumstances.

During the interval which will elapse between the issue of the successive parts of this monograph, opportunities will doubtless occur of supplementing the illustrations of species. A list of all additional figures not cited in the text relating to the species represented by them will therefore be given in the final part; and references to them can be made addenda.

STRUCTURE OF THE EPHEMERIDÆ IN GENERAL.—ADULT.

The Ephemeridæ are insects with a long, soft, ten-jointed, sessile abdomen, furnished at its hinder extremity with either two or three many-jointed setaceous or filiform tails (caudal setæ), and whose body is smooth and glabrous.

Head free, with atrophied mouth-organs, carinated epistoma, short subulate antennæ, composed of two short stout joints succeeded by a slender many-jointed setaceous awn, three ocelli, and large oculi (compound eyes).

Thorax robust; mesothorax predominant; sternum well developed; fore wings ample, erect or spreading in repose, plaited lengthwise but not folded up (excepting when a female happens to be ovipositing under water, and then they are reclinate and compactly plicate like a closed fan); legs slender, femora strong, the fore coxæ somewhat distant from the others.

Abdomen armed with a pair of claspers (forceps), in the male placed ventrally at the extremity of the penultimate segment; the vasa deferentia have each of them a separate intromittent organ situated at the ventral joining of the ninth and tenth segments. In the female the oviducts terminate separately in the joining of the seventh and eighth segments; there is no real ovipositor, but in some genera (e. g. *Heptagenia*) the apex of the seventh segment is produced beneath into a short rounded flap, and in one (*Hagenulus*) this projection takes the form of a spout. In many genera there is a similar extension of the ninth segment in one or in both of the sexes. Alimentary canal capacious, straight, filled with gas, and apparently destitute of salivary glands; malpighian tubules in most instances indefinitely numerous, capillary, very long and entangled; but in *Prosopistoma* shorter, stouter in proportion, fewer in number, and combined into one common duct on each side. Tracheæ filamentose or capillary, not sacculated, furnished

with ten pairs of stigmata, two thoracic and eight abdominal. Ventral nervous tract slightly abbreviated, and posteriorly somewhat concentrated, in *Prosopistoma* extremely so.

Peculiarities in structural detail are often noticeable in both or one of the sexes, and are chiefly presented by the ocelli, wings, legs, and caudal setæ, and in the male by the oculi and forceps.

The foremost ocellus is sometimes as large as the others, sometimes much smaller.

The oculi, always much larger in the male than in the other sex, are in him, in some genera, divided each into two parts transversely; the upper portion has larger facets than the lower, and is sometimes coloured differently from it. The division between these segments of the oculus may amount to nothing more than a mere superficial furrow or impressed line traversing the faceted surface horizontally; but when it is deeper, the upper part of the oculus (always much the larger of the two) assumes a short, subcylindrical or turbinate form, faceted only on its summit, and supports on its outer base the smaller division, which is oval, and is faceted all over.

The fore wings, seldom ovate or oblong, are usually trilateral, ample, and rounded off at the extremities. Their margins are unequal in extent, the costal or anterior margin being slightly (sometimes not much) longer than the terminal or outer margin (measured along the curve), and seldom less than double the length of the inner margin. The costal margin is somewhat sinuous as a rule; nearly straight at the base of the wing, it generally presents a shallow sinus midway towards the apex, and then proceeds in a gradual salient curve to its extremity. The terminal margin is arched; its curvature is sometimes stronger towards its extremities than in its midst, where it is occasionally almost straight. In the greater part of its course the inner margin is usually straight or incurved; but there are cases in which it describes a salient curve continuous with that of the terminal margin. The wings are relatively longer in the female than in the male.

The hind wings in some of the genera are not developed; in others they are very minute; at the most they are not particularly large. Their usual form is triangular-ovate, or oblong-ovate, with a salient prominence in front, either close to the wing-roots or midway towards the apex, in which last case the prominence is sometimes (*e. g.* in *Habrophlebia*) followed by a deep sinus; their neuration is fairly plentiful. When they are very minute their nervures are very scanty, and their form is usually oblong or linear-lanceolate.

The inner margin of the fore wing and the anterior margin of the hind wing hitch together automatically to a larger or smaller extent when the wings are spread open.

The wing-membrane is usually glassy and iridescent in the adult. In *Oligoneuria* and some other genera, however, the subimaginal pellicle of the wings is not shed, and these are dim in consequence (viewed as transparencies); their reflection too differs from that of the wings of other Mayflies in being either glossy instead of iridescent, or else (as in *Lachlania* &c.) of uniform azure glow. Pigment is often deposited in the marginal and submarginal areas of the fore wings, and occasionally in all of the wings beside some of the nervures and cross veinlets as well as at the wing-roots; by the confluence of

adjacent deposits blotches and fasciæ are apt to be produced. The wing-membrane is decurrent along the sides of the peak of the mesonotum; in *Oligoneuria* and some allied forms^{p. 328} it is there prolonged into short free subulate tails, figured by Dr. Hagen in 1855. In most of the Ephemeridæ, during the subimaginal stage, the wings are fringed with short ciliæ along the terminal margin. This fringe (excepting in *Cænis*, *Prosopistoma*, and *Trycorythus*) is not retained by the adult fly.

Wing-neuration in the Ephemeridæ is less complicated than it appears to be; and where difficulty is experienced in ascertaining the homologies of nervures, it is more likely to be occasioned by the suppression of some of them than from there being more in the wing than can be reasonably accounted for. Unstable in minutia, so closely is the essential plan of the neuration adhered to by nearly related Mayflies, that the general facies of the wings is an important aid to their classification, affording characteristics as easily recognizable as the style of branching in the case of trees. Its simplest modifications are displayed in Oligoneurians (Pl. III.), its most complex in Pl. VI.

Throughout the whole series of figures illustrative of neuration, the special and serial homologies of the main nervures of the fore wing and hind wing are indicated by numerals (the same number being employed to denote the same nervure in every figure), and these are placed at the distal extremities of the following nervures, excepting the costa and the sutural nervures, whose numbers are not usually appended to them:— 1, the Costa, coincident with the anterior margin of the wing; 2, the Subcosta; 3, the Radius; 4, the Sector; 5, the Cubitus; 6, the Præbrachial; 7, the Pobrachial; 8, the Anal; 9¹, 9² &c. Axillary nervures; 10, the Sutural vein coincident with the inner margin. Between these nervures others of an adventitious nature that issue from the wing-margin in certain regions are often interpolated; in many genera they do not remain free, but annex themselves to the adjacent main nervures, often acquiring the appearance and discharging the functions of branches of these. When necessary or advisable for purposes of elucidation, the numeral of the nervure, dashed, is repeated at the extremity of the hindermost adventitious branch.

At a meeting of the Entomological Society of London, in February 1879, I remarked upon the tendency of the main nervures of the anterior wing in most of the Ephemeridæ to be segregated into three groups, of which the first communicates directly with the thorax, the intermediate is either annexed to the first group, or terminates in the wing-membrane adjacent to it, close to the base of the wing, while the third is associated with the prominent curved or angulated crease in the membrane which forms the boundary of a depression, posterior to the great cross vein and close to the wing-roots. I mentioned, further, that the anterior nervures of the hinder groups had a proneness to secede from their own set, and transfer themselves to the hindermost nervure of the group next in advance of them, so that in other orders of insects they are usually reckoned as branches of the nervures to which they have strayed. An extreme instance of such a transference is shown in the remarkable aberration figured in Pl. VII. 11 *c*, where the sector (4), accompanied by most of the neighbouring adventitious nervures, has usurped the trunk of the radius (3), so that this last nervure is not in direct continuation with its own basis, but simulates a branch.

Nervures of the fore wing. First group.—The costa (1), the subcosta (2), and radius (3), are strong simple nervures, nearly of the same length, and almost parallel with one another. Close to the base of the wing they are all connected by the great cross vein, and still nearer to the wing-roots the hinder two are again bound firmly by another strong cross vein. In *Palingenia* and some other genera the costa and subcosta are liable to be folded back under the radius, so that this last appears to skirt the edge of the membrane for a considerable distance. In *Elassoneuria* (Pl. III. 3) the subcosta is completely suppressed; and in no case is the adventitious mediastinal ever developed in the Ephemeridæ.

Second group.—The sector (4) and cubitus (5), the præbrachial (6) and pobrachial (7), are the main nervures of the second group. The sector and cubitus (excepting in genera allied to *Oligoneuria*, where one or both of them are suppressed) unite before the middle of the wing, and their common trunk joins the præbrachial towards its termination. The sector is usually reckoned as a branch of the cubitus by entomologists; but it constitutes a separate nervure in the hind wings of many Ephemeridæ. Excepting in wings very scantily nerved, the interval between the sector and cubitus is supplied with adventitious nervures, usually five in number, but sometimes three or six. When there are five of them, the fifth from the sector is the longest, the third the shortest of all, and the first is longer than the second. In *Cloëon* and some other genera cross veinlets afford the only communication between these and the main nervures; but very frequently most of them combine with the first or fourth, and that unites with the sector, the fifth usually remaining alone. When the præbrachial nervure is simple (excepting in allies of *Oligoneuria*) two adventitious nervures are always interposed between it and the pobrachial nervure (Pl. XVI. & XVII.); when it is forked, its fork contains a single adventitious nervure, and its hinder branch is followed by the pobrachial nervure immediately without the interpolation of any nervure whatever. The hinder branch of a forked præbrachial nervure is therefore evidently homologous with the second adventitious nervure, and should be accounted a false branch accordingly. The fork is extremely deep in *Campsurus* and *Polymitarcys* (Pl. V. & VI.).

The pobrachial nervure, somewhat deserted by its fellows, is essentially a simple nervure, any branches which it may appear to have being (like those of the præbrachial) virtually adventitious nervures introduced between it and the anal nervure. Because in this as in the last instance referred to, when the pobrachial nervure is obviously simple (Pl. XVI. & XVII.), two adventitious nervures intervene between it and the anal nervure (8), which sometimes annex themselves to the latter (Pl. I. 1 *b*, 1 *c*); and when the second of them simulates a branch of the pobrachial, the fork thus formed contains a single adventitious nervure within it, and is followed immediately by the anal. Sometimes each of them unites with the nervure to which it is nearest (Pl. V. 8 *a*); in short, the combinations into which they enter with themselves and the adjoining nervures are almost as many as are possible. In *Palingenia longicauda* (Pl. I. 1 *a*), provision seems to be made for the origination of several other adventitious nervures.

Third Group.—The anal (8) and the axillary nervures (9¹, 9², &c.) complete the series of main nervures in the disk of the wing. The former, as a rule, subtends the anal

angle directly, receiving some or all of the adventitious nervures that may happen to originate in the interval between itself and the first axillary nervure. But there are many deviations from this rule. In genera related to *Polymitarcys* and in *Palingenia* (Pl. I., II., V. & VI.), from one to five adventitious nervures come between the anal nervure and the anal angle; while in *Bætisca* (Pl. XXI.), where no nervure worthy of mention intervenes before the axillaries, the first and second nervures of this last group extend to the terminal margin between the said angle and the anal nervure. The usual interpolated nervures in other instances are occasionally intercepted by the first axillary instead of by the anal nervure (Pl. XI. 18, &c.). In several genera the last of these adventitious nervures sometimes assumes the aspect of a main branch of the anal nervure (Pl. I.—III. &c.).

The axillary nervures seldom extend beyond the middle of the inner margin; but in *Cloëon* and its allies (Pl. XVI. & XVII.) the first of them reaches to where the anal angle would be in wings of a more distinctly trilateral form, and in *Bætisca* (as has been stated just above) both it and the second axillary nervure terminate beyond this angle. In *Oligoneuria* and kindred genera the axillary nervures are either suppressed, or are represented only by a very few short obsolescent rudiments at the commencement of the inner margin.

By careful inspection of the third group of nervures, observing especially the disposition of the proximal extremities of the main nervures along the prominent curved fold of the membrane, the form of the area contained by the first axillary nervure and the inner margin, or of that enclosed between the first and the second of the axillary nervures, and lastly, the general aspect of the adventitious and other nervures, the approximate affinities of Ephemeridæ to one another can be ascertained very easily.

Cross veinlets, speaking generally, are of very small account in classification, though the contrary was formerly supposed. Their relative abundance or scarcity in the marginal area used to be considered as an item of prime importance; but the sexes of the same species sometimes (*e. g.* certain species of *Cloëon*) differ from one another, in respect of this very particular, more than, in other instances, the species of different genera. They occasionally are serviceable in the distinction of species, more especially the veinlets in the pterostigmatic portion of the marginal area: in some genera these are indifferently simple or branched in individual examples of the same species, and their branches are apt to anastomose with one another. The nature of the series of anastomosing branches is obvious enough in actual specimens of the insects, but in figures of wings it is liable to be mistaken for an adventitious longitudinal nervure, as has recently been done by a distinguished entomologist. Several of the genera related to *Oligoneuria* have a peculiar arrangement of elevated folds and cross veinlets forming communications between the main nervures close to their proximal extremities, to which attention was first directed by Dr. Hagen in 1855. They are indicated in only one of my figures (Pl. III. 2 *a*, ♀).

Nervures of the Hind Wing. First Group.—A noticeable difference is perceptible in the composition of the first group of nervures in the hind wing, compared with the corresponding group in the other wing, because the cubitus (5) is transferred to it from the second group, and is annexed to the radius (3) either near the base (Pl. I. 1 *a*), or

nearer the middle of the wing (Pl. XII.), the sector and the adjacent adventitious nervures either remaining apart from both or forming a union with either of them. When the costa is not rounded off at the extreme base, it almost always describes a salient angle in or before the middle of the anterior margin, after which it becomes approximated to the subcosta (2); and this last, when not straight nor evenly curved, is strongly arched towards its proximal extremity. The radius (3) takes a nearly direct course to the further border of the wing, near the apex, so that a relatively wide space is left between it and the subcosta: in *Bætisca* it is interrupted, or obsolescent. The sector and adventitious nervures (4-4¹) are suppressed in scantily nerved wings, but vary in number and in their combinations in other instances. The sector alone is present in some species of *Campsurus* (Pl. V. 8 b); but in most genera there are at least two adventitious nervures associated with it, the hinder one of which usually unites with the sector, so as to form a fork, including its fellow. Another arrangement occurs sometimes in *Polymitarceys* (Pl. VI. 10 a) where three such nervures are interposed; in *Palingenia* (Pl. I.) and *Bætisca* (Pl. XXI.) there are perhaps five of them, whilst in most of the genera from *Coloburus* onwards, although the number of the adventitious nervures appears at first to be two, it seems reasonable upon closer inspection to recognize four of them, of which the third unites with the cubitus (5) to form a fork enclosing the fourth (4¹), in the same manner as the second and sector enclose the first.

Second Group.—The defection of the cubitus and sector from this group is compensated for by the transference of the anal (8) nervure to it. When adventitious nervures are interposed between the præbrachial and the pobrachial (they are absent in *Habrophlebia*, Pl. XIII.), they are more frequently associated with the former than with the latter nervure; and it sometimes happens that the hindermost adventitious nervure (6¹) in genera related to *Siphilurus*, assumes equality with, or even predominates over, the præbrachial (6). The adventitious neurulation intervening between the pobrachial (7) and anal (8) is of meagre extent when it is not suppressed.

Third Group.—The axillary nervures (9), usually left behind by the anal (8), generally occupy a very limited space in the hind wing; they attain their highest development in *Chirotonetes* and *Oniscigaster* (Pl. XIX. & XXI.).

The legs present great differences in their condition, in the relative lengths of the several pairs, and in the proportions of the component parts of corresponding pairs. Some of these differences are sexual, others are generical. Sometimes all of the legs are functionless,—flaccid, filamentary rudiments of the tibiæ and tarsi, or else atrophied miniatures of the same, definitely shaped, but thoroughly infirm, remaining attached to the femora; in other instances such is the condition of only the two hinder pairs, and then the anterior pair may be either stout and short, or slender and long in either the male only, or in both sexes. The fore legs are always longer in the male than in the female (usually very much so), and are generally longer than either of the hinder pairs; but in the male of *Oligoneuria* the fore leg is shorter than the intermediate. The hind legs are usually as long as, or shorter than, the intermediate; but in *Adenophlebia* the middle pair is the shortest of all. The prolongation of the fore leg is chiefly due to the lengthening either of

the tarsus, or of the tibia, or of both of them ; but in the other legs it is generally brought about by extension of the tibia and femur. The fore tarsus is often as long as the tibia ; indeed in the male it frequently is much longer than it : the hinder tarsi are usually shorter, and only in a very few forms are they longer than it (*e. g.* in *Bætisca*, where the proximal joint of the tarsus by itself is as long as the tibia). The maximum number of tarsal joints is 5 ; the apical projection of the tibia which, in some genera, forms a basis for the insertion of the fore tarsus of the male, resembles at first sight a sixth joint, but it conforms in colour to the tibia and not to the tarsus. All of the tarsi may alike have five joints, or the fore tarsus may be five-jointed, while the others have only four distinct joints, and a very ill-defined trace of the fifth ; or all of them may have only four joints : in atrophied legs, however, the tarsi of the hinder legs may be two-jointed, or even jointless. The ungues of the fore tarsus are sometimes both alike in form and size ; but this is often not the case : the same may be said of the ungues of the hinder tarsi, which further may resemble or differ from the ungues of the fore tarsus in form.

The forceps of the male (specialized legs of the ninth abdominal segment) are seldom jointless (*Cænis*, *Campsurus*, &c.), but are usually two-, three-, or four-jointed, with the basal joint or the next the longest. In some genera they afford good distinctive characters of species.

Much diversity is exhibited in the number and relative proportions of the caudal setæ. They are often all of one length ; but the median seta is occasionally a little longer or a little shorter than the others, sometimes considerably shorter, frequently atrophied to a mere rudiment, and in many instances altogether cast off. The outer setæ are always persistent (in the absence of accident), and either many times exceed, or else equal or fall short of, the body in length, according to sex or genus. The setæ are commonly glabrous, or almost so, seldom pilose or plumose : their component joints, transverse in the basal portion, assume a more elongated form in the distal portion of the seta, where in some cases they attain rather attenuated dimensions.

HABITS OF THE FLIES.

The popular supposition, that Mayflies are strictly ephemeral, is fallacious in most instances. It is true that the adult insect cannot eat, owing to atrophy of its mouth-organs and to the condition of its alimentary canal ; but, provided that the air be not too dry, the imagines of many genera can live without food several days. Tradition states that Curtis kept a female *Cloëon* alive three weeks ; this is an exceptionally long period, for in general an individual in confinement becomes perceptibly shrunken within three days, and is dead by the fourth day, if not before. Apparently there is some correspondence between the length of time spent in the subimago stage and the duration of the life of the imago : when the former amounts to twelve or twenty-four hours and upwards, the latter lasts more than a day ; but when the change into imago takes place within a few minutes of the insect's quitting the nymph skin, its life is fugitive, passing away in the course of the evening or early morning. In some genera of short-lived Ephemeridæ the subimago skin is partially or altogether persistent in one or other of the sexes ; and such

portions of it as may be shed are moulted while the insect is in full flight. Thus the males of *Oligoneuria* retain the pellicle in question upon their wings (the slough that may often be seen still dangling from their tails comprises exuvæ of the body, legs, and setæ only), whilst the females of *Palingenia*, *Campsurus*, and some others, seem to throw off none of it at all. The males of these restless creatures have their hinder legs either atrophied or too feeble to support the body, and in most of the females the fore legs also are equally infirm and functionless. The longer-lived flies issue from the nymph-skin in a rather less matured condition than the others; their legs are always serviceable in both of the sexes; and the subimago skin is always completely cast. The change from nymph to subimago is effected while the insect is floating at the surface of the water, buoyed up by gas which has accumulated within the alimentary canal and between the new and the old integuments of the body. The moult having been transacted in the ordinary manner, the subimago, standing upon the water with the wings erect, awaits a favourable moment for flying to shelter. Fluttering steadily upwards it mounts aloft, sometimes to a considerable elevation, presently making its way to trees, walls, or herbage, &c., likely to afford it a suitable resting-place. There it assumes the posture characteristic of its genus during repose. It may stand either upon all of its feet, or upon only the two hinder pairs; and the fore legs extended in advance, off the ground, may in this last case be held either close together or else apart from each other. The caudal setæ, in most instances divergent, are sometimes placed alongside of one another horizontally, or slanting upwards.

Adult diurnal Ephemeridæ, in hot weather, seek repose during the heat of the day, limiting their flight to the cooler hours of sunlight, or, at most, extending it later in the evening till just after sunset. In cold disagreeable weather they seldom fly at all, but remain under shelter. Many persons are familiar with the mode of flying habitual to some of the more conspicuous Mayflies (especially the males), which, by the intermittent action of the wings, results in a dance-like motion almost vertically up and down,—a fluttering swift ascent, and then a passive leisurely fall, many times repeated. The body during the rise is carried in a position very little out of the perpendicular, with the legs extended upwards in advance, and the setæ trailed behind; and this is the posture maintained by *Heptagenia* and its allies (only their setæ are divergent) whilst hovering head to windward, which has led to their being locally designated in the valley of the Axe (Devon) “Yellow Uprights.” During the descent, the body, less steeply inclined, is steadied by the half-spread motionless wings and the outstretched setæ and legs. The males of *Cænis* sometimes jerk themselves downwards impetuously in their dance, instead of subsiding without effort; and the females of *Ephemerella*, while flying horizontally onwards, have a habit of dipping frequently in their flight. Conspicuous objects near water, such as roads, hedges, and shrubs, as well as the streams inhabited by the nymphs, are favourite rendezvous of the dancers, and therefore good sites for collecting the adult flies. In mountain-glens and wooded ravines prominent light-coloured rocks often serve to attract them; but frequently in such situations their diversions proceed beyond the range of the net. When this is so, it is advisable to watch for subimagines rising from the water, and carry them home alive in bottles, to undergo their moult. The bottles must be kept cool, and neither very dry inside nor visibly damp; and it is sometimes necessary to place

within the bottle a piece of paper, secured from shaking about, to afford foothold to the captives. A woollen wrapper round the bottle, and three or four drops of water upon the paper, meet these requirements; and in very warm weather the bottles can be carried in a mat basket. Subimagines of certain genera issue only at particular times of the day; as a rule, the afternoon and evening are the best periods for collecting them. In the morning specimens harbouring amidst branches of shrubs and trees overhanging streams can be procured by beating into the net. Nocturnal species may advantageously be looked for in spiders' webs, and on lamps, adjacent to rivers; and wherever such lamps happen to be close to white walls or placarded hoardings, numbers of specimens are apt to be attracted by the illuminated surfaces. Subimagines of *Baëtis* and sundry other genera may frequently be found clinging to *Sparganium* and grass at the borders of streams, a few inches above the level of the water.

Many species that fly by night appear on the wing before dark. They are most of them short-lived. The ordinary flight of *Oligoneuria* is rapid, the insects sweeping swiftly to and fro, far up and down the stream, with flurried bustling movements, very similar, indeed, to those of Leptoceridæ, the females for the most part close to the surface, and the males a few feet above it, while now and again a female hurries aloft pursued by a jostling throng of admirers amidst whom she very soon sinks down again encumbered towards the water. Upon occasion, however, they behave differently. During one or two nights only in the course of the season, in favourable weather, innumerable multitudes of these flies issue after sundown from the river, filling the air, like snowflakes in a storm, to a very considerable height (M. Albert Müller observed some at an altitude of 500 feet above the Rhine at Basle), and advancing steadily in one direction. Species of other genera, such as *Palingenia* and *Polymitarcys*, have a similar habit of swarming, and so also have certain kinds of *Ephemera* and *Hexagenia*. *Cænis* has been observed in East Central Africa flying in dense clouds that resembled smoke in the distance.

Most of the Ephemeridæ couple during flight, the male lowermost. Darting at his mate from below, and clasping her prothorax with his elongated fore tarsi (whose articulation with the tibia is so constructed as to admit of supination of the tarsus) he bends the extremity of his body forwards over his back, grasps with his forceps the hinder part of her seventh ventral segment, and with his outer caudal setæ embraces her sixth segment. These two setæ exhibit near their origin a strongly marked articulation, where they can be deflected abruptly so as to lie forwards over the back of the female parallel with one another between her wings. Meanwhile the couple gradually sink, the female not being quite able to support herself and mate; and by the time they reach the ground, if not before, their connexion is usually terminated, although a pair of *Ecdyurus* has been seen by me to maintain union effectively as long as six or seven minutes after they had come to rest. Soon after their disengagement the male flies away to resume his interrupted gambols (being prone to polygamy), and the female after resting awhile repairs to the water to lay her eggs. Many of the females are polyandrous.

The male of *Palingenia* has very short fore legs; and he is mated, not in mid air, but upon the river amidst crowds of rivals, who pile themselves up upon him and his surroundings until he is overwhelmed by a large struggling mass of them floating down the

stream like a heap of foam, whose resting-place (in New Guinea, at least) is generally found in the mouth of a big fish. [See below, under *Palingenia papuana*.]

OVIPOSITION AND THE EGG.

Oviposition is usually performed in fresh water; a Cingalese *Palingenia*, however, inhabits an estuary where the water occasionally must be brackish. Some short-lived species discharge the contents of their ovaries completely *en masse*, and the pair of fusiform or subcylindrical egg-clusters laid upon the water rapidly disintegrate, so as to let the eggs sink broad-cast upon the river-bed. The less perishable species extrude their eggs gradually, part at a time, and deposit them in one or other of the following manners:—either the mother alights upon the water at intervals to wash off the eggs that have issued from the mouths of the oviducts during her flight; or else (Eaton, Trans. Ent. Soc., London, 1873, p. 401) she creeps down into the water—enclosed within a film of air, with her wings collapsed so as to overlie the abdomen in the form of an acute narrowly linear bundle, and with her setæ closed together—to lay her eggs upon the underside of stones, disposing them in rounded patches, in a single layer evenly spread, and in mutual contiguity. This has been witnessed by me several times, and in the case of several species of *Baëtis*. The female on the completion of her labour usually floats up to the surface of the water, ineffectively swimming with her legs, and, on emerging, her wings all at once are suddenly unfolded and erected; she then either flies away, or (as often happens) if her setæ have chanced to become wet and cannot be extricated from the water, she is detained by them until she is drowned. In some instances, however, the female dies under water beside her eggs.

The eggs, indefinitely numerous, are diversiform according to the genus, some being subrotund, others elliptical. An appendage of various relative size is in certain cases present at one end of the egg; for example, in *Cænis* it is narrowly crescentic, but in *Ephemerella* it nearly equals the yolk itself in size, and forms in combination with it a somewhat figure-of-8-shaped mass.

The duration of the egg-stage varies with the temperature to which the eggs are exposed. Some of *Polymitarcys virgo*, kept in Dr. N. Joly's laboratory at Toulouse, were hatched about six or seven months after they were laid.

Professor L. Calori (1848) and Dr. E. Joly (1877) have recorded instances of larvipartition observed by them in *Cloëon dipterum*. Although they supposed that the young were produced from impregnated eggs retained within the mother, perhaps for some weeks, it may be conjectured, with equal if not greater probability, that these were the produce of unfertilized ova advanced to maturity within the nymph and hatched as soon as she became an imago.

In the absence of elaborate contrivances, many Ephemeridæ can be bred in captivity if confined in flower-pot saucers, or other wide vessels, containing very little water, duly protected from extremes of temperature. If the bottom be glazed inside, it should be thoroughly strewn over with sand or fine river-gravel, that the insects need not die of fatigue in struggling to maintain their footing upon it. *Ranunculus* should not be

planted in the pans, because the sap exuding from its broken stems appears to be poisonous to these animals.

THE YOUNG OF THE EPHEMERIDÆ.

The term "nymph" is employed in this work to designate all the subaqueous stages in the development of the young after it is hatched. The old-fashioned usage of "larva" and "pupa," borrowed from the terminology of other Orders to denote respectively the wingless and wing-budding grades of the nymph, seem scarcely worth retention; for they do not indicate precisely any definite epochs of particular importance in the life-history of these animals. Nymphs are young which lead an active life, quitting the egg at a tolerably advanced stage of morphological development, and having the mouth-parts formed after the same main type of construction as those of the adult insect.

Mayfly nymphs mostly feed upon either mud or minute aquatic vegetation, such as covers stones and the larger plants; but (judging by their mandibles and maxillæ) some must be predacious. Many of them live in concealment in the banks or under stones in the bed of streams, rivers, and lakes; others ramble openly amongst water-weeds and swim with celerity. Certain genera are restricted exclusively to large rivers; and one of these (*Palingenia*) is said to remain a nymph three years. *Cloëon* (teste Sir John Lubbock) moults twenty-three times, and is probably bred much more expeditiously than *Palingenia*; it is one of the genera found in streams, ditches, and ponds, or the shallow parts of lakes.

Besides the influence of flood and drought, or constancy of supply, the climate of the water is largely concerned in determining the fitness or unsuitability of a particular site for particular kinds of Ephemeridæ. A knowledge of the water-climate needed by a species renders intelligible the limitations of its geographical and local distribution. The temperature of the ordinary land-springs in a district enables the climate of other water in that neighbourhood to be ascertained readily by comparison with it. If the water of a given site exhibits marked differences in temperature from the standard of the neighbourhood, according to the season or the time of day, its climate is extreme, and the site cannot be inhabited by species which require relatively cold water.

The newly hatched nymphs are destitute of any visible muscular, nervous, circulatory, or reproductive system; their alimentary canal is incomplete; and, being too small to require special breathing-apparatus, they respire through the integument at large. The abdomen is 9-jointed, and the antennæ and caudal setæ have likewise fewer articulations, and are less hairy, than those of more advanced nymphs. *Polymitarcys* possesses the third caudal seta even before it is hatched; but *Cloëon* is born without any trace of it, and develops it gradually at a later period (July and Lubbock).

During the first few days after their birth the young cast their skin several times, the intervals between the moultings lengthening by degrees (Lubbock). Blood-globules and rudiments of the tracheal branchiæ begin to appear simultaneously when the insect is eight or ten days old; the latter bud forth from the hinder lateral angles of some of the abdominal segments, and (like the parts of the mouth) are modified considerably in detail before they acquire their ultimate shapes (July).

Adolescence is evidenced by the advancement towards maturity of the reproductive organs internally, and externally by the outgrowth of rudimentary wings from the hind borders of the proper segments. The forceps of the male also begin to bud forth, and in certain genera an extension of the apical integument of the penultimate ventral segment becomes perceptible in the female.

Characters and Peculiarities of the Nymph.—In their general form most nymphs nearly resemble the adult. *Prosopistoma* is exceptional in having the body oval in outline, convex above and flattened beneath; and it possesses the faculty of adhering firmly by suction, like a limpet, to stones. A N.-American ally of *Ephemerella* (Pl. XXXIX.), longer in the body than *Prosopistoma*, is furnished with concavities on the pectus and venter that are densely pilose, which appear to afford it a similar power. Many other genera have the body of the nymph dilated and flattened beneath more than it is in the imago, but not with any view to its employment as a means of adhesion.

Head diversiform, prominent, usually about as wide as the thorax, vertical or else protense; cranial sutures mostly distinct. Labrum (when present) transverse, emarginate in front, and rounded off at the anterior corners; when it is absent, a velvety fold of the palate-membrane completes the enclosure of the mouth opening immediately above the mandibles at a distance from the edge of the epistoma. Frons usually even, but sometimes (e. g. in *Ephemera*) produced into short projecting points. Ocelli three, small. Oculi moderate, becoming large in the adolescent male. Antennæ slender and tapering (their first two joints the stoutest), usually many-jointed and long, but sometimes few-jointed, very short and subulate; in many genera the joints are nearly bald, whilst in others (e. g. *Ephemera*) they are beset near their tips each with a whorl of long spreading hair. Mandibles strong, with more or less asymmetrical dentition, which comprises usually a molar surface in addition to fang-like lobes; but in some predatory genera (Pls. XLIII. & LIII.) the molar region is wanting. The endopodite is often represented by a slender jointless movable appendage attached to the inner base of the inferior lobe (as in *Siphururus*, Pl. L.), or sometimes by a tuft of hair (*Ecdyurus*, Pl. LXII.). The lobes are remarkably abrupt in *Baëtis* (Pl. XLIV.). The outer lateral region of the mandible in a *Palingenia* from Ceylon (Pl. XXV.) is produced into a massive enlargement continuous with the crown; in *Potamanthus* it is armed with a tooth-like tubercle (Pl. XXXI.); in *Polymitarcys*, *Ephemera*, &c. it is extended into a strong tapering tusk, distinct from the crown, variously furnished outside with tubercles (Pls. XXVIII. & XXX.); this prolongation is more slender in *Euthyplocia* and densely hairy (Pl. XXIX.). First maxilla unaccompanied by a galea, its inner edge generally either hairy or rigidly setulose, but sometimes spinose, the point often pungent, the crown variously armed, sometimes with long fine hair distributed evenly upon it (*Oligoneuria*, *Polymitarcys*, Pls. XXVI.-XXVIII.), sometimes with a dense beard of harsh hair, as in *Habrophlebia* (Pl. XXXVI.), at other times with pectinate spinules, as in *Chirotonetes*, *Rhithrogena*, &c. (Pls. XLIX., LIV., &c.). Palpus of first maxilla usually 2-, 3-, or 4-jointed, according to the affinities of the genus [but in one instance multi-articulate (Pl. LIII.)], and of various relative length,—extremely long in *Euthyplocia* (Pl. XXIX.), very short in *Ephemerella* and its kindred (Pls. XXXVII.-XL.).

Second maxillæ, when present (in *Oligoneuria* they are either suppressed, or else are reduced to the condition of raised folds traversing the upper surface of the labium, Pl. XXVI.), simple and usually flattened; palpus 2-jointed in allies of *Palingenia* and *Ecdyurus* (though in this latter group of genera the last joint may essentially be compounded of two), 3-jointed in most other instances, but in one remarkable case (Pl. LIV.) multiarticulate; it usually tapers towards its extremity, but is sometimes enlarged or expanded, whilst in *Bætisca* (Pl. LII.) it is actually forcipate. Labium in the large majority of genera plane and bipartite, with lobes as large as, or smaller than, the laciniæ of the second maxillæ. In a few cases it is undivided, and is then either plane and creased lengthwise through the middle (*Oligoneuria*, Pl. XXVI.), or else is conduplicate (*Palingenia*, Pl. XXV.; *Polymitarcys*, Pl. XXVIII.). Tongue (glossa) and paraglossæ membranous or pergamentose, the former usually inflated and often concave in the middle, generally broad, and either as long as or shorter than the paraglossæ. The following are their leading modifications:—paraglossæ broad; tongue ovate (Pls. XXV. & XXVI., *Palingenia* and *Oligoneuria*), subrotund (Pl. XXVII. *Jolia*), oblong and entire (Pl. XXXIII. *Blasturus*), emarginate (Pls. XXIX. & XXX., *Euthyplocia* and *Ephemerella*), obcordate (Pl. XXXI. *Potamanthus*), retuse, with claw-like lateral projections (Pls. XXXIV. & XXXV., *Choroaterpes* and *Thraululus*), mucronate, and in combination with the paraglossæ rather like a mitre or a biretta seen broad-wise (Pls. XLV.–XLVII., *Baëtis* and allies):—paraglossæ narrow and recurved, tongue broad and bifid (Pl. XXXVI., *Habrophlebia*). In some genera both glossa and paraglossæ appear to be absent; *Prosopistoma* seems to have none.

Thorax compact or subcompact, rigid; pectus rather broad; prothorax usually well developed and more distinct than the metathorax from the mesothorax; but in *Bætisca* and some few other genera (Pls. XLIII., LII.) the pronotum is intimately blended with the mesonotum. *Ecdyurus* and many of its kindred have the head and pronotum bordered at the sides with a membranous expansion seemingly subservient to the oxygenation of intratracheal air. The winglets of advanced nymphs are united by their inner margins to the apical borders of their proper segments, and overlies the base of the abdomen. In nearly mature nymphs of *Oligoneuria* (Pl. XXVI.), and in even less aged specimens of genera related to *Ephemerella* (Pls. XXXVII.–XL.), the space included between the terminal margins of the fore wings and the peak of the mesonotum becomes closed over by a membrane in continuity with the same, extending almost up to the extremities of the wings. This membrane is produced backwards still farther in *Prosopistoma* and *Bætisca* (Pls. XLIII. & LII.), so as to form in combination with the wings a hood which completely roofs over the tracheal branchiæ and the segments that bear them. Formerly the construction of this shield was not quite understood, the whole of it being attributed to hypertrophy of the mesonotum; but one of Dr. Hagen's gifts of specimens furnished the means of explaining its composition rightly. Coxæ usually prominent, but not so in *Prosopistoma* (*l. c.*). Trochanter short and strong. Femora moderately or very stout, sometimes much compressed. Tibiæ spurless, though in a few instances terminating in a point or spine; often apparently compound owing to the distinctness of an oblique line of muscular insertion perceptible below the knee. Tarsi

2-jointed, the terminal joint claw-shaped. The legs, as a whole, are modified to suit the habits of the nymph: the hinder pairs of burrowing nymphs are often short and weak, whilst their fore legs are strong (e. g. *Polymitarcys*, Pl. XXVIII.); the fore tibiæ and femora of many such nymphs also are often strongly bearded with long stiff hair. In *Prosopistoma* the corresponding armature is a row of minute pectinate spinules. Different nymphs have different manners of disposing their legs whilst swimming, according to their kindred; those which swim laboriously and slowly keep theirs at work as if they were running, without much effect. *Heptagenia* and its allies employ their flattened femora to some advantage; others, such as *Cloëon* and its associates, trail their legs at length through the water, darting swiftly about, propelled solely by their caudal setæ; but the legs of *Prosopistoma* (which is just as nimble as the nymphs last referred to) are folded up closely beneath the thorax, which is grooved for their reception. The legs of dead specimens in fluid are often set out in the postures appropriate to them during natation.

Abdomen sessile, differing considerably in length relatively to the head and thorax, according as the anterior segments are or are not abbreviated in comparison with the hinder ones; in cross-section it is either subcircular, or arched above and flattened beneath. The hinder lateral angles of some of the segments are in many genera prolonged backwards into acute teeth of diverse dimensions. From the last segment just below the tergum issue two or three many-jointed caudal setæ of various lengths in proportion to the body; sometimes they are much longer than it (*Heptagenia* &c.), at others unequal to it, while in a *Palingenia* from Ceylon and a few other genera they are many times shorter than it. The median seta is in some instances the shortest or even abortive, and in many more is eventually deciduous at the penultimate moult through atrophy. Throughout more or less of their extent, on one or on both sides, their hair is usually lengthened so as to feather them and render them fit to serve as organs of propulsion. The outer tails can be moved at will towards or away from the median tail; and the amount of their natural divergence from it during repose is an item of importance in classification. In *Prosopistoma* the setæ can be simultaneously retracted into the abdomen so as to be entirely hidden.

Tracheal branchiæ are movable, membranaceous, or filamentose appendages to the integuments, enclosing branching tracheæ, which are deciduous with the epidermis, and are media for the oxygenation of the systemic air distributed throughout the body. It is usual to assert that the insect employs them as fins; but however rapidly it may agitate them to and fro, they do not seem to increase its rate of progression. They are principally outgrowths of some or all of the first seven abdominal segments, and arise from only one region of the same segment at a time; but the point of origin need not be the same in consecutive segments. In the large majority of genera their places of attachment are latero-dorsal, and then either well in advance of the posterior angle of the segment (*Palingenia*, *Leptophlebia*, &c.), or at the apex of the angle, or else at the hinder border of the segment, within a sinus at the base of the lateral tooth-like prolongation of the same. The first abdominal pair in *Oligoneuria* and *Rhithrogena* is latero-ventral instead of dorsal; and in the former genus, as well as in *Jolia*, one pair is

cephalic, issuing from the basal joinings of the upper maxillæ. *Jolia*, in addition, has a branchial tuft at the insertion of each of the fore legs. The abdominal pairs are usually all exposed, and are carried diversely in different genera; their form, proportions, and substance likewise vary more or less, not only with their serial position in the same insect, but also with the genus. In *Bætisca* and *Prosopistoma* all of them are concealed by the shield already described in connexion with the thorax; in other cases one pair is enlarged and thickened so as to resemble elytra covering the pairs posterior to it (Pls. XL.-XLII.). Several fossorial nymphs dispose their tracheal branchiæ in an arch over their backs; in other kinds they are decumbent upon the dorsum; in others they are directed outwards and backwards from, or are held at right angles with, the sides of the body; in *Rhithrogena* some are deflected, and two pairs underlie the venter. As to their forms, when foliaceous they may be subquadrangular, subrotund, oval, ovate, spatulate, lanceolate, or linear, with their margin entire or fringed, or in part eroso-crenate; they may be digitate, pinnatisect, laciniate, or dissecto-fimbriate; and in many of these alternatives they may be single or binate, plane or conduplicate. Sometimes they are compounded of dissimilar elements, as when a tracheal branchia consists of a foliaceous membrane, furnished at its base with an explanate or fasciculated tuft of simple or branched filaments (Pls. LIV.-LXII.); or as in *Ephemerella* and its kindred, where each is composed of a coriaceous lamina sheltering a binate appendage of imbricate lamellæ disposed in the form of the letter V; or again, as in what may be *Tricorythus* (Pl. XLI.). In the matter of proportional size, the tracheal branchiæ of the first abdominal segment (when they are developed at all) are frequently minute (*e. g.* in *Cænis* and *Ephemerella*); the last pair is usually small; the second pair is the largest in *Cænis*, the third or the fourth pair in many others; but very often all of them are much alike in size. The substance of tracheal branchiæ with the margin entire is stronger than that of others whose form is less simple, being usually more or less coriaceous or corneous. When they are unusually stout their hinder or under surface is lined with delicate membrane, upon which the tracheæ are distributed. Most of the tracheal branchiæ are kept in rapid agitation; but the first and the last pairs, and in *Cænis* the elytroid pair, are usually held almost motionless.

The branchial tracheæ branch in a manner very similar to that of the ribs and veins of dicotyledonous leaves of like form. They should be examined (when this is possible) while the insect is yet alive, because very soon after death endosmosis drives the air out of their ultimate subdivisions, which cannot then be seen. More than one skilled anatomist, trusting to inspection of cabinet examples placed in preservative fluid, has denied the existence of tracheæ within filamentose tracheal branchiæ, being unaware of the rapidity and completeness of their obliteration in the dead insect under ordinary circumstances.

Tracheal respiration is apparently carried on to some little extent by means of other organs than the regular tracheal branchiæ in certain instances. The rectum, the expanded borders of the head and front portion of the thorax in *Ecdyurus* and its allies, the hinder surface of the femur in these and some other genera, and perhaps the caudal setæ, may be taken as examples of such accessory organs.

In some genera the body and limbs are partially clothed with hair. This is generally simple; but *Ephemerella* and some kindred nymphs have clavate hairs in certain regions, closely resembling in their spinulose structure the thickened hairs of sundry Trombidinæ; and some of the pubescence on the head of a Cingalese *Palingenia* is microscopically plumose. The figure of the mandible of *Prosopistoma* (Pl. XLIII.) is not on a scale of enlargement sufficient to show the plumose structure of the bristles adjacent to the endopodite.

The term 'Subimago' is used to denote the penultimate stage in the life of such of the Ephemeridæ (the large majority of them) as moult once after direct respiration through the stigmata has been established, and their wings have become fully expanded. The chief points whereby insects in this condition can generally be distinguished from adult examples are—the dulness of the integuments, especially that of the wings; the ciliolate terminal margin of the wings in many genera; the brevity of the fore legs; the greater hairiness and shortness of the caudal setæ; the less protuberant and less brightly coloured oculi; and, in the male, the marked shortness and stoutness of the limbs of the forceps. Where (as in *Cænis* and *Tricorythus*) the wings are ciliolate both in the subimago and in the adult, and where (as in *Polymitarcys*) the wings are opaque in both stages, account has to be taken of the remaining criteria. In some genera the thorax of the subimago differs in its markings from that of the adult fly, and the wings undergo changes in their coloration before the last moult. When the subimaginal slough is retained upon the wings of the adult fly (as in *Oligoneuria*) they remain dull and subopaque during life.

The term 'Pseudimago,' employed by a few authors instead of Subimago, is an etymological solecism derived from two words belonging to different languages. 'Pseud-idolum,' or 'Proidolum,' would be the Latinized Greek equivalent of the Latin Subimago, if any were needed.

CHARACTERS WHICH HAVE BEEN USED AS BASES OF CLASSIFICATION, BUT WHICH
ARE NOT FUNDAMENTAL.

Many of the characters upon which the classification of the Ephemeridæ was formerly based have proved to be unsuitable for the purpose. Originally the *number of the caudal setæ* was deemed a matter of primary importance; and when forms were discovered with the median seta abbreviated, they were ranked between those with three long equal setæ and those with two only. Subsequently, in addition to the setæ, *the number of the wings* was employed as a leading clue to the arrangement of the genera. But it is now well known that these criteria are serviceable at the most for nothing more than the distinguishing of genera very intimately related to each other, belonging to various subordinate alliances comprised within the family; while one of them (the number of the setæ) is not always available for even this purpose, varying as it does in some forms with the sex (*Polymitarcys*), or with the individual (*Atalophlebia australasica*). In more modern times *the comparative scarcity or abundance of cross veinlets* in the wings, and especially in the *marginal area of the anterior wing before the nodus*, has been supposed to furnish a trust-

worthy guide to the succession of the genera ; but it is unequal to the actual requirements of the case ; compare, for example, the fore wing of *Baëtis Salvini* (Pl. XVI. 29 a) with that of *Cosmetogenia* (Pl. XXIII. 42). The most recent suggestion as to the classification of the genera was to group them according to *the structure of the tracheal branches of the nymphs*. According to this scheme *Habrophlebia* (Pl. XXXVI.) and *Thraulius* (Pl. XXXV.) would fail to come into the same group as *Choroterpes* (Pl. XXXIV.) and *Blasturus* (Pl. XXXIII.). Indeed if dependence be placed implicitly upon the modifications to which this organ or that is subjected in the adult, or in the junior conditions of the insect, the scheme of classification arrived at can hardly fail to be unnatural and arbitrary. It is only by taking cognisance of points of difference and agreement in many details, in the anatomy and the mode of development and the habit, of leading representatives of the various alliances of genera, at different periods of their lives, before and after their exclusion from the egg, that the mutual affinities of the several associations of genera to one another can be demonstrated adequately. Until such comparisons can be and shall have been carried out, the whole question of their arrangement can only be dealt with in a tentative and experimental manner ; and it will be fortunate if error be avoided in the necessary grouping of the genera into provisional alliances of apparently kindred forms, preparatory to the study of their affinities. It is far more easy to demonstrate defects in proposed methods of classification than to devise a trustworthy system in their stead ; and possibly extended observation in the future may eventually show that some of the bases of arrangement adopted in this present work are mere temporary expedients worthy of mention in this paragraph.

HISTORY OF THE CLASSIFICATION OF THE EPHEMERIDÆ.

The species of Ephemeridæ known to Linné were arranged by him in two sections of one genus *Ephemera*, according to the number of their caudal setæ—species with three, and with two setæ, respectively.

No further subdivision of the family was attempted until the year 1815, when Leach separated the latter of Linné's sections into two genera, *Baëtis* with four wings, and *Cloëon* with two. In the hands of subsequent entomologists these two genera became obscured by the interpolation of extraneous forms. To *Baëtis*, Say referred sundry species of *Hexagenia* and *Heptagenia*, as well as a *Bætisca* ; and eventually this name was diverted altogether from the original type, and was misapplied by general consent to species of *Heptagenia* and *Siphylurus*.

Curtis, in 1834, proposed another genus named *Brachycercus*, like *Cloëon* deficient in hind wings, but distinguishable from it by its having three setæ. This name was suitable for the female insect only, with which sex alone he was acquainted.

Stephens, in 1835–6, possessing males of *Brachycercus*, finding them differ in very obvious particulars from Curtis's definition of the genus, and failing to perceive that their points of difference were of merely sexual character, established a genus *Cænix* with two sections, species with three long setæ, and species with three short setæ, a section for each sex. He also transferred the genus from the position after *Cloëon* previously assigned to it, to the end of the section of Ephemeridæ with three setæ.

Burmeister, in 1839, based his arrangement of the genera primarily upon the comparative scarcity or abundance of cross veinlets in the wings, and employed as secondary characters the conditions of the oculi, ocelli, tarsi, and setæ. He, too, renamed the genus *Brachycercus* of Curtis, calling it *Oxycypha*. Merging Leach's *Cloëon* and *Baëtis* together under the shorter form of the first name (*Cloë*) he regarded them as mere sections of this. The appellation *Baëtis* was misapplied by him, the first of the two series of species designated by it being equivalent to the unrestricted *Potamanthus* of Pictet (probably his materials were dried specimens defective in setæ), the second series (with one exception) to *Heptagenia*. He founded a new genus (*Palingenia*) for the reception of some species of the comprehensive *Ephemera* of early authors, distinguished by their possessing a distinct median ocellus and four-jointed tarsi, in lieu of an obsolescent median ocellus and tarsi almost five-jointed (the fifth or basal joint being intimately adnate to the tibia and ill-defined). These genera were arranged by him in the same sequence as that in which they are mentioned in this paragraph.

Professor Westwood, in 1840, established a genus *Leptophlebia* for some small species of the "Ephemera caudâ trisetâ" series of early authors, and unknowingly revived the real genus *Baëtis* of Leach, under the name *Brachyphlebia*. From allusions to Burmeister's genera in the Addenda to the Generical Synopsis, he appears to have become acquainted with the 'Handbuch' while the 'Introduction' was in the press, too late for a place to be assigned to *Palingenia*. From consideration of the number of the wings and setæ, and the structure of the nymph, he drew up the following arrangement of the genera:—*Ephemera*, *Leptophlebia*, † *Baëtis* (= *Heptagenia*), *Cænis*, *Cloëon*, and *Brachyphlebia*.

The scheme propounded by Pictet (1843-5) was constructed to a large extent with reference to the abundance or the paucity of cross veinlets in the anterior wings, the condition of the oculi in the male, and the number or the relative proportions of the caudal setæ. In the main the order of succession deduced from these data agrees with that which is arrived at when the genera are grouped according to the general habit of their nymphs (so far, at least, as he had been able to ascertain this), viz. :—Burrowing nymphs, creeping nymphs, and nymphs that swim with agility. The sequence of the genera is :—*Ephemera*, *Palingenia* (= *Polymitarcys*, *Hexagenia*, *Campsurus*, and the restricted *Palingenia*), † *Baëtis* (= *Heptagenia*, and a species of *Atalophlebia*), *Potamanthus* (= the restricted *Potamanthus*, *Leptophlebia*, *Habrophlebia*, and *Ephemerella*), *Cloë* (= *Baëtis*, *Centroptilum*, *Callibætis*, and *Cloëon*), *Cænis*, and *Oligoneuria*. Pictet foresaw that some of the species referred by him to the genera *Palingenia* and *Potamanthus* would probably prove to be incongruous, but was precluded by lack of materials from verifying his suspicions. He also surmised correctly that the neuration of the anterior wings in detail would furnish characters towards their discrimination, adding:—"Mais j'ai répugné à entrer pour cela dans une analyse aride, longue et minutieuse; j'ai craint de rendre plus difficile encore l'intelligence des descriptions;" but he did not attach much importance to the tarsal characters. If he had known of the name of *Leptophlebia* in time he would have used it instead of *Potamanthus*, although, as he remarks, this last is more comprehensive in its application than the former.

In 1862 an account of some Illinois species of Ephemeridæ was published by the late

Mr. B. D. Walsh. The classification of the genera was determined by an application of almost the same principles as were adopted by Burmeister, and is as follows:—‡ *Baëtis*, comprising three sections (Sect. A = *Siphururus*; Sect. B = *Chirotonetes*; Sect. C = *Rhithrogena*); *Potamanthus* (= *Blasturus*); *Palingenia* with three sections (named by him in the following year: A, *Pentagenia*; B, *Hexagenia*; C, *Heptagenia*); *Ephemera*, *Ephemerella*, *Bætisca*; *Cloë* containing three sections (A = *Callibætis*; B = species of *Callibætis* and *Baëtis*; C = *Cloëon*); and *Cænis*.

Dr. Hagen, in 1863, used Pictet's genera in a revised order, alluding only incidentally to forms foreign to Great Britain:—*Oligoneuria*, *Cænis*, *Palingenia*, *Ephemera*, *Potamanthus*, ‡ *Baëtis*, and *Cloëon* (= *Cloë*).

In 1868 a systematic catalogue of genera with named types, and with notes on their geographical distribution, was published by me in the 'Entomologist's Monthly Magazine.' My attempts to describe the wings in an intelligible manner, in the absence of illustrations, were, to say the least, abortive. The genera stood thus:—*Cænis*, *Tricorythus*, *Oligoneuria* (with three sections), *Campsurus* (with two unreal sections), *Polymitarcys*, *Palingenia*, *Pentagenia*, *Hexagenia*, *Ephemera*, *Potamanthus*, *Leptophlebia* (with two sections), ^{p. 210} *Bætisca*, *Coloburus*, *Siphururus*, and *Heptagenia* (with two sections).

In the same year, while describing the nymph of *Cænis*, I adduced reasons for transferring this genus from the position near *Baëtis* and *Cloëon*, assigned to it by Pictet (on account of the simplicity of its wing-neuration), to the neighbourhood of *Leptophlebia*, series 2 (= *Habrophlebia*), and likewise for the removal of *Oligoneuria*, ranked next after *Cænis* by Pictet, to the vicinage of *Palingenia*, changes that were carried out in my work on the Ephemeridæ in 1871, when a few minor alterations involving no principle in the succession of genera were also made.

The structure of the tracheal branchiæ of the nymph was taken as the basis of classification of Ephemeridæ by Dr. A. Vayssière in his 'Thesis' presented to the Faculté des Sciences de Paris, and published in the 'Annales des Sciences Naturelles' in 1882. He arranged the genera in five groups:—1, those having fringed branchial laminæ, *Leptophlebia* (= *Habrophlebia*), *Ephemera*, *Potamanthus*, and *Polymitarcys*; 2, those with laminæ devoid of fringes, *Oniscigaster*, *Cloëopsis* (= *Cloëon*), ‡ *Cloëon* (= —?), ‡ *Centroptilum* (= *Baëtis*); 3, those with simple laminæ furnished at the base with either a tuft of fibrils, *Heptagenia* (= *Ecdyurus*), *Oligoneuria*, *Jolia*, or a bifid appendage bearing very delicate imbricated lamellæ, *Ephemerella*; 4, those whose second pair of branchia afford protection to the following pairs, *Tricorythus* and *Cænis*; 5, "les larves dont l'appareil respiratoire est complètement caché et protégé par des prolongements mésothoraciques dans l'épaisseur desquels naîtront plus tard les ailes supérieures," *Bætisca* and *Prosopistoma*. I examined and named the type specimens of this Thesis at Avignon in August 1880; but the indications affixed to the phials appear to have become confused. To the best of my recollection the specimens representing ‡ *Cloëon* were junior examples of something which I suspected might be *Centroptilum* or *Baëtis*; but I did not ascertain which.

The additional knowledge of Ephemeridæ gained since 1871 has not yet necessitated any material departure from the sequence of the genera which I adopted. A few minor

alterations have been made (such as the establishment of genera in place of provisional sections) and a rearranging of the members of certain alliances; and besides this, some genera, then isolated, have become rallying-points of new alliances; but these changes have not disturbed the scheme as a whole. The plan upon which it has been drawn up may be described as based upon conclusions derived from comparisons of adult insects checked and modified by others deduced from the study of younger specimens. The general effect of this plan has been to bring into the middle of the series genera of hardy habit, that moult completely at the last ecdysis, that have functional legs with four distinct tarsal joints, and have the oculi of the adult male either bipartite or ascalaphoid. The ends of the series are occupied by genera that have the oculi of the ♂ furrowless and undivided, those having weak or functionalless hinder legs with at most four distinct joints to the tarsus, whose eggs are discharged in bulk, and whose life is truly ephemeral, commencing the series; and those whose legs are all efficient with five distinct joints to the tarsus, whose oviposition is gradual, whose life in the adult condition is measured by days, if it attain its full natural term, and whose last moult is complete, bringing the series to its close. The scheme is open to objections attendant upon all linear arrangements in zoology, individual genera here and there having to be ranked in groups with whose formulated definitions they are largely at variance during some portion of their existence. The subjoined Table exhibits the system of classification; generical details of the adult flies are illustrated in the first 24 plates, and the numbering of the genera quoted in the Table accords with the numerals assigned to them in the writing of those plates.

TABLE OF THE CLASSIFICATION OF GENERA OF THE EPHEMERIDÆ
NUMBERED AS IN PLATES I.-XXIV.

Family EPHEMERIDÆ.

GROUP I.

Series I.

Section	1 of <i>Palingenia</i>	Genera	1-6.
„	2 of <i>Polymitarcys</i>	„	7-10.

Series II.

Section	3 of <i>Ephemera</i>	Genera	11-13.
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GROUP II.

Series I.

Section	4 of <i>Potamanthus</i>	Genera	14-15.
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Series II.

Section	5 of <i>Leptophlebia</i>	Genera	16-23.
„	6 of <i>Ephemerella</i>	„	24, 24 bis &c.

Series III.

Section	7 of <i>Cenis</i>	Genera	25, 25 bis, 26.
„	8 of <i>Prosopistoma</i>	„	27.

Series IV.

Section	9 of <i>Baëtis</i>	Genera	28-31.
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GROUP III.

Series I.

Section 10 of <i>Siphururus</i>	Genera 32-36.
„ 11 of <i>Betisca</i>	„ 37.

Series II. (provisional).

Section 12 (provisional)	Genus Plate LII.
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Series III.

Section 13 of <i>Atopopus</i>	Genera 38-40.
„ 14 of <i>Ecdyurus</i>	„ 41-46.

It may be noted of the foregoing Table that the composition of the section of *Polymitarcys* is not altogether homogeneous. Genus 7, *Euthyplocia*, may eventually have to rank as a separate section, on account of its triarticulate palpi.

Section 8 is associated in the same series as section 7, because the adult *Prosopistoma* ♀, in the construction of its head and thorax, is, according to M. Vayssière's representation, very similar to *Cænis*. This last genus, in some particulars, resembles insects of the *Polymitarcys* section; but, on account of the formation of the nymph, it appears to be more nearly related to the section of *Ephemerella* than to the genera of section 2.

The provisional section 12 is classed in Group III. on account of the nymph having some resemblance to genera of section 10 in the form of the lacinia of its lower maxilla and the lobes of the labium. On the other hand, its hinder tracheal-branchia are constructed after the same plan as those of the genera in section 14. As a matter of pure conjecture, it may be suspected of belonging to section 13, of which no nymphs have hitherto been seen; only if such were the case, it is probable that the tibiae would be somewhat shorter than they are in comparison with the tarsi.

SYSTEMATIC DESCRIPTION.

GROUP I. OF THE GENERA.

Adult.—At the fore-wing roots the anal nervure (8) meets the pabrachial nervure (7); the hinder tarsi, when not atrophied, have four distinct joints, and sometimes an ill-defined fifth joint intimately concrete with the tibia; ♂ oculi evenly contoured. *Nymph*.—Palpi of the 2nd maxilla (“labial palpi”) 2-jointed (except *Euthyplocia*, 3-jointed).

First Series of Group I.

Legs of the adult ♀ short in proportion to the body, and feeble, when not functionless, through atrophy of the tibia and tarsus; the fore legs in both sexes of the subimago extremely short, and transversely rugose; hind legs of adult ♀ the longest pair. *Nymph*. Palpi of 1st maxilla very stout, 2-jointed (except *Euthyplocia* 3-jointed) and curved.

Section 1 of the Genera.—Type of *Palingenia*.—Subcosta of the fore wing, when developed, retired within a fold of the membrane somewhat beneath the radius. In many genera the subimaginal pellicle of the wings is not shed at the last moult. Nymph fossorial or predatory; in those that are known the median lobe of the tongue is pointed.

Subsection A. Wing-neuration complete and plentiful; anal nervure (8) of the fore wing either sinuous, or else from the wing-roots to its fork nearly straight, and afterwards gently arched; axillary nervures short but strong; the first (9¹) annexed to the anal

nervure (8) at the wing-roots, the second (9²) ending apart from it in the regular raised axillary fold or vessel; wing-membrane translucent and dull. Pronotum large, transverse, broader than the head, tumescent, arched behind. Setæ pubescent or minutely pilose, short in ♀, very long and divaricate in ♂. Forceps borne upon a deflexible laminar lobe prolonged from the distal ventral margin of the 9th segment, which is not represented in the ♀, the proximal joints of the limbs the longest. Lobes of the penis unarmed; orifice of the seminal duct subapical, and on the inner side of the lobe. Eyes of the ♂ large, oval, narrowly separated from each other; anterior ocellus much smaller than the hinder two. Fore tibia and tarsus densely rugose transversely; ungues in each tarsus unequal, and not quite alike. Nymph fossorial; the labium concave, its sides approximated to each other above; the tracheal branchiæ borne upon protuberances armed with single minute spinules, situated in or near the middle of the sides of their respective segments, and arched upwards over the dorsum; the hinder lateral angles of the segments not produced backwards. Fore legs stout, densely bearded with long hair on the femur and tibia; the tibia and tarsus compressed, the former oblique at the tip. Terminal margin of the fore wings free.

The single genus contained in this subsection is a composite one; but further materials are needed to enable the incongruous species to be completely dissociated from the type. They may be referred provisionally to three subgenera:—*Palingenia* (typical), Burmeister, containing European and Western Asiatic species; *Anagenesia*, containing Indo-Malay, and a Siberian species; and a nameless subgenus containing Brazilian species.

PALINGENIA, Burm. 1839; restricted Eaton, 1868.

Illustrations. *Adult* (details) Pl. I. & III. 1 *a*–1 *f* (whole figures), see citations under *P. longicauda*. *Nymph* Pl. XXV., see also citations of Swam., Gorové, and especially Corn. (1848) under *P. longicauda* (whole figures and details).

Subgenus PALINGENIA (TYPICAL).

Adult.—Præbrachial nervure (6) of the fore wing forked beyond the middle; two conspicuous sets of longitudinal nervures proceed in pairs to the terminal margin (at 4¹, and at 5 & 6). Fore tarsus of ♂ about twice and a half (2 $\frac{3}{7}$) as long as the femur. Setæ 2, in the ♂ upwards of three times as long as the body, in ♀ about the same length as the body. Anterior thoracic spiracle gaping, large; aperture bivalvular, the lower valve the smaller, with concave margin; the upper valve sinuous, having a large salient obtusely rounded lobe projecting inwards in front of the tegulæ. Orifice of the posterior thoracic spiracle gaping, irregularly reniform with the sinus in front.

Nymph [after Cornelius].—Six pairs of abdominal tracheal branchiæ, each lamina fringed with short simple fibrils, and perhaps folded together lengthwise. Setæ about $\frac{1}{3}$ as long as the body in the female.

Distribution. Eastern N. temperate region.

Type. *P. longicauda* (in *Ephemera*), Ol.

Etymology. παλιγγενα, in allusion to its annual swarming.

PALINGENIA LONGICAUDA, Oliv. Plate I. 1 *a* (wings, legs, ♂ ♀, head and forceps, ♂ adult).

Hemerobius, Clutius, Opusc. 2, cap. viii. (frontispiece), p. 100 (1634).

Ephemerum, Swam., Ephem. vita (1675); idem, ed. Tyson, p. 44, pls. i.-iv. and v. 2 (young); pl. v. 1, 3, &c., viii. [adult] (1681); Schæffer, Ic. iii. tab. cciv. 3 (1776). Ladislaus Gorové, alias Stefan Gosevé, in Tudományos gyűjtemény, viii. [Egy különös tüneménynek, az úgynevezett Tisza viragzás nach leiraza], pp. 22, tab. I, a-c (young), e (last moult), f (slough), g ♂, d ♀ im. [A very full account] (1819). Reprinted by Mocsáry, in Rev. d. Inhaltes der Termeszeträzje Furzetek, ii. 124-5, and (German-text) natur. historische, Heft ii. Bd. ii. u. iii. 181-2) (1878).

Ephemer longicauda, Oliv., Enc. Méth. vi. 418 (1791); Latreille, H. N. xiii. 96 (1805); Lamarck, H. N. ed. i. iv. 221 (1817); ! Ramb., Névropt. 295 (1842). *E. flos-aquæ*, Illiger, Mag. f. Ins. i. 187-8, no. 17 (1802); Treipke, Stet. ent. Zeit. i. 54-8 (1840). *E. Swammerdiana*, ! Lat., H. N. xiii. 96 (1805); idem, Gen. iii. 184 (1807); Cuvier, R. A. ed. I. iii. 430 (1817); ditto, ed. II. v. 244 (1829); Lamarck, H. N. ed. I. iv. 221 (1817); Blanchard, H. N. Ins. iii. 54 (1840); idem, in Cuv., R. A., ed. Crochard, xiii. 91 (1848). *E. Swammerdamiana*, Shaw, Gen. Zool. vi. part 2, pl. lxxxii. (1806).

‡ *Semblis marginata*, Panzer, in Explic. Schæf. Ic. cciv. (1804).

Palingenia longicauda, Burmeister, Handb. ii. 803 (1839); H.-Schæf., Fn. Ratisb. 346 (1840); Pictet. Nat. Hist. Névropt. ii. Ephém. 155, pls. xiv. xiv bis, xvi. (1843-45); Cornelius, Beitr. z. Kenntn. d. *P. longicauda*, pp. 38, pls. i.-iv. (1848); Walker, Cat. 549 (1853); Hagen, Stet. ent. Zeit. xv. 316-19 (1854); Perty, Die Zool., Th. ii. 344-45 (1855); Hag., Stet. ent. Zeit. xx. 431 (1859); Loew, Verh. zool.-bot. Ges. Wien, xi. 409-10 (1861); Corn., Stet. ent. Zeit. xxiii. 465-66 (1862); Gerstäcker, Handb. d. Zoologie, ii. 59-61 (1863); Karsch, Die Insectenwelt, v. 400-2 (1863); Eaton, Trans. Ent. Soc. Lond. 1871, p. 62, pls. 17-17 a (1871); Joly, Mém. Soc. d. Sc. Nat. Cherbourg. xvi. pl. i. 2 [after Swammerd.] (1872); Hag., Trans. Ent. Soc. Lond. 1873, pp. 385-86 and 392 (1873); N. & E. Joly, Rev. Sc. Nat. v. 10, and pp. 324-26, pls. vi. 2, ix. 39-41 (1876); Mocsáry [vide *Ephemerum*, Swam. &c. supra] (1878); Rostock, Jahresb. d. Ver. f. Naturk. Zwickau, 1877, p. 82 (1878).

Adult (dried) ♂.—Wings dull translucent brownish, of a tint intermediate between medium sepia and medium Cologne-earth, with opaque neuration and slightly yellowish wing-roots. The first of the subsidiary nervures contained within the fork of the anal nervure (8) is rather unstable in its arrangement. Setæ, venter, legs, and underside of the thorax light bright yellow, excepting the tibiæ and tarsi, which are very light brownish; the pronotum dull light waxy-yellow, the mesonotum slightly browner. Head pitch-black. Dorsum of abdomen intense sepia.

♀. Wings very slightly lighter than in the ♂. Pronotum, meso- and metanotum of a medium Cologne-earth brown, which colour borders the occipital margin of the vertex. Setæ light brownish yellow. Length of body, ♂ 23-25, ♀ 27.5-29; wing, ♂ 24-26, ♀ 31; setæ, ♂ 70-74 & 1.5, ♀ 26-27.5 mm.

Hab. The large rivers of middle Europe from Rotterdam to Hungary, also near Cette. This last locality is quoted on account of a nymph in the Museum of Comparative Zoology, Cambridge, Mass. According to Mr. Snellen of Rotterdam, Swammerdam's statement that this species appears in vast multitudes during one or two evenings only every year, "on or about the Feast of St. John," is generally correct, but the date of the swarm is liable to be earlier in warm seasons, sometimes as early as the 10th of June.

PALINGENIA FULIGINOSA, Georgi.

Ephemera fuliginosa, Georgi, Geogr.-physik. u. naturhist. Beschr. d. russischen Reichs, Th. iii. vi. p. 324 (1802).

Palingenia fuliginosa, ! Hag., Trans. Ent. Soc. London (1873), p. 392.

Adult (dried) ♂.—Wings deep raw-umber brown, translucent, dull. Compared with *P. longicauda*, the sinuous first axillary nervure (9¹) of the fore wing is more strongly arched towards the inner margin; and the first of the subsidiary nervures enclosed by the fork of the anal nervure (8), instead of being diffuse, imitates on a small scale with its branches the same main nervure and its branches in an appreciable manner. Prothorax above somewhat pale ochreous, the remainder of the thorax chiefly brown-ochre. Abdomen above rather darker than the wings; the pleura and venter, forceps and setæ, pale yellow-ochre. Sides and underside of thorax and the femora slightly deeper in tint than the venter, the tibiæ and tarsi tinged with ashy-grey; vertex of head brown-ochre, with the orbits of the ocelli blackened. Approximate admeasurements:—length of body 25, wing 25, setæ upwards of 55 mm.

Hab. The Caucasus.

Subgenus ANAGENESIA.

Adult.—Præbrachial nervure (6) of the fore wing forked before the middle; three conspicuous sets of longitudinal nervures proceed in pairs to the terminal margin (at 4¹, 5 & 6, and 6¹). Fore tarsus of ♂ shorter than the femur. Setæ 2, in ♂ upwards of three times as long as the body, in ♀ about half as long as it.

Nymph.—Divisions of the abdominal tracheal branchiæ, of uniform shape, unequal; each division is a narrow membranous lamina folded length-wise, fringed with short simple fibrils, to which are distributed colourless air-vessels from a dark median trunk. In a nymph from Ceylon the clypeus has a globular tubercle in the middle of its front edge; there is a triangular tubercle above the insertion of the antenna, and one in a line with the eye on each side of the prothorax. The bearding of the fore femur is restricted to a rounded patch at the base beneath, and is almost erect; that of the tibia is spreading, and clothes the sides and the front, and in the latter position a scanty series of long tactile hairs stands erect. In the hinder legs the femoral patches are insignificant, the tibia and tarsus are ciliated outside, and the tibia is shortly and densely pilose on its distal border, and towards its extremity beneath. Antennæ setaceous, shorter than the head; the first three joints longer than any of the others, which are almost nude; the second joint furnished with a dense patch of hair outside. Labrum small. Mandibles short and stout, distally pilose, and with a curved patch of long spreading hair near the base on the outside; the crown, somewhat wedge-shaped and irregularly dentate, is remote from the molar protuberance. Lacinia of the upper maxilla flattened and obliquely truncate, pungent, and crowned with a dense beard, also bearded within below the point, the last line of hair shortly and obliquely decurrent upon the outside; first joint of the palpus nude; second joint much the longer, slightly incurved towards its acute extremity, and densely pilose nearly all over. Labium and

lower maxillæ as in the typical form. Lingua acutely ovate; the paraglossæ rather narrow, connivent. Setæ about $\frac{1}{4}$ as long as the body.

Distribution. Indo-Malay region and Irkutzk.

Type. *P. lata*, Walker.

Etymology. ἀναγενεσία, regeneration.

PALINGENIA SIBIRICA, M^cLach.

Palingenia sibirica,! M^cLach., Ann. Soc. Ent. Belg. xv. 50, pl. i. 1-1a (1872).

Adult ♂ (*dried*).—Fore wings pale yellowish-brown, darkening gradually towards the tip; neuration for the most part pale, but some of the veinlets in the marginal and submarginal areas are blackish. Hinder tarsi with one claw each; legs whitish. Head pale yellowish; a black spot at the base of each antenna, a subtriangular blackish spot contiguous with the oculus on each side of the vertex, the sutures of the cranium blackish, and two brownish occipital clouds. Notum blackish; the borders and median stripe of the pronotum pale. Abdomen above blackish; the segments pale at the sides, and very narrowly so at the tips; venter pale. Setæ pale, with fine short pubescence. Length of body 21 mm.

Hab. Irkutzk, 20th of May (M^cLach. Mus.). There is a specimen in Baron de Selys-Longchamps's collection.

PALINGENIA LATA, Walk. Plate I. 1 b (wing).

Palingenia lata,! Walk., List Neuropt. Brit. Mus. iii. 550 (1853); Etn., Trans. Ent. Soc. Lond. (1871), p. 63, pl. iii. 18-18 b (1871). *P. ampla*, M^cLach., Ann. Soc. Ent. Belg. xv. 50 (1872) [nominal reference—part].

Adult (*dried*) ♂.—Wings and thorax light Vandyke-brown; the longitudinal neuration of the former, the cross veinlets in the basal half of the disk of the fore wing, and also those contained within the narrow interspaces of the nervures, distributed in pairs to the terminal margin, opaque and dark Vandyke-brown; the fork of the anal nervure (8) encloses a single longitudinal nervure. Femora nearly concolorous with the wings; the fore femur dark above, the hinder tibiæ and tarsi greyer, and transversely rugose. In dried examples the unguis of the hinder tarsi appear to be single. Abdomen faded, fuscous above. Setæ very light dull brownish yellow, pilose with uniform hair. Length of body, ♂, 22, wing 23, setæ about 70 mm.

Hab. Silhet.

PALINGENIA AMPLA, sp. nov. Plate I. 1c (wing).

Adult (*dried*) ♂.—Wings (as opaque objects) uniformly deep warm sepia-grey, modified in transmitted light with light sepia-brown, their neuration for the most part opaque; in the fore wing, the fork of the anal nervure (8) encloses a single longitudinal nervure. Venter very light bistre-grey modified with equally light Vandyke-grey; hinder femora nearly of the same colour beneath as the venter, but Vandyke-brown above; fore femora faded; all the tibiæ and tarsi (probably faded) extremely light Vandyke-grey, transversely rugose; the hinder unguis darker and single. Setæ light

warm sepia-brown, with opaque joinings, and pubescent, with a few hairs at the joinings longer than the others. Length of body, ♀, 17, wing 18 mm.

Hab. Sarawak.

PALINGENIA JAVANICA, sp. nov. Plates I. & II. 1*d* (forceps, ♂, legs, fore wing, and parts of setæ).

Adult (dried) ♂.—Wings dark subtestaceo-cervinous, with opaque neuration; the veinlets along the terminal margin of the fore wing less sparse and better defined than in the wing of *P. tenera*. Body faded above; venter and setæ subtestaceous, the genitalia luteo-testaceous; the setæ for some distance in the middle portion of their length are furnished at the joinings with a few spreading hairs, longer and stronger than the hairs of the universal pubescence. The fore legs and the hinder tibiæ and tarsi opaque whitish; hinder femora testaceo-lutescent; fore tibia on the inner side at the tip armed with a small more or less acute tubercle; intermediate legs the shortest pair, hind legs the longest, and more than half as long as the abdomen; unguis of the hinder tarsi very unequal, the lesser hardly visible; those of the fore tarsus more nearly alike, and well developed. The last two joints of each forceps-limb are together very nearly half as long as the antepenultimate joint. Length of body, ♂, 19, wing 22–23·5, setæ about 60–70 mm.

Hab. Orawang (Java occid.). Five examples in Leyden Mus. communicated to me in 1876 by Mhr. C. Ritsema. The MS. name by Van Vollenhoven attached to one of them (No. 50), being preoccupied in Ephemeridæ, is not adopted.

PALINGENIA TENERA, sp. nov. Plate II. 1*e* (wing and part of setæ).

Adult (dried) ♂.—Wings dark cinereous, with the longitudinal nervures and the coarser of the cross veinlets subpiceous or fuscous, and with the finer of these whitish or edged with whitish when viewed obliquely so as to reflect light. Body discoloured, genitalia pale testaceous, setæ almost concolorous with the wings. Legs very short in comparison with those of *P. javanica*, the posterior femur not extending to beyond the second abdominal segment; fore legs faded (whitish?), posterior femur subochraceous. Pubescence of setæ composed of uniform hairs. Length of body 17, setæ circ. 55 mm.

Hab. Ardjoëno (Java orient.). One example in the Leyden Museum. A smaller insect than *P. javanica*, having wings free from the least tint of testaceous, and with more delicate neuration.

PALINGENIA PAPUANA, Etn. Plate II. 1*f* (wing and forceps, ♂ adult).

Palingenia papuana,! Etn., Annal. Mus. Civ. di Stor. Nat. di Genova, xiv. 398, woodcut *a-f* (1879).

Adult (dried and in spirits).—Wings in the ♂ white with light yellowish neuration, the membrane during life somewhat creamy-white; in the ♀ the wings are spotted with black. The fork of the anal nervure of the fore wing contains a single longitudinal nervure. Setæ pubescent with uniform hair. Fore femur in the ♂ not much shorter than the fore tibia; intermediate tarsus about as long as the intermediate tibia; hinder

tarsi biunguiculate, the ungues very unequal (*l. c.* woodcut *b, c*). Forceps short and stout, their last two joints very short. Length of body, ♂ 36, ♀ (after oviposition) 32; wing, ♂ and ♀, 27; setæ, ♂ 50, ♀ 17 mm.

Hab. Near the island of Ellangowan, in December 1875, in insignificant numbers; and on Fly river, New Guinea, on the 2nd of July, 1876, in extreme profusion (Signor L. M. d'Albertis). Specimens in fluid are in Mus. Civ. di Stor. Nat. di Genova, and in M^cLach. Mus., and some remnants of a pinned ♂ example in Brit. Mus.

The 'Annali' above cited, after my diagnosis of the species, quote a passage from Signor d'Albertis's travels relating to this insect, whose purport may be thus freely summarized. On the 2nd of July, 1876, a few hours before sunset, we witnessed a strange and magnificent sight produced by an abundance of a species of Mayfly, actively pursued by the following birds:—*Calornis metallica*, *Artamus cucopygialis*, a *Graculus*, a *Eurystomus*, and the commonest Whiteheaded Osprey, *Haliastur girrenera*. Simultaneously the insects were being preyed upon by thousands of fishes, who rushed up to seize them whenever they touched the water with their delicate wings. But so profuse was the abundance of the flies, that the ravages of all their destroyers caused no appreciable diminution in their numbers. Mile after mile, from bank to bank, the river seemed covered with them, when all at once, as if by signal, the whole of them rose up confusedly, flying aloft in a thousand different directions, producing an effect in the air like that of a heavy fall of snow; then they descended again, and the snow seemed to cover the river with a white layer. The males very largely outnumbered the females.

Subgenus —.

? *PALINGENIA ATROSTOMA*, Weber.

Ephemera atrostoma, Weber, Obs. Ent. 99 (1801).

Palingenia atrostoma, Pict., Hist. Nat. Névropt. ii. Ephém. 157 (1843-5); Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 550 (1853).

? *Hexagenia atrostoma*, Etn., Trans. Ent. Soc. London (1871), 65.

Wings fuscous. Body yellow; mouth black; dorsum of abdomen fuscous; setæ fuscous.

Hab. Brazil. In 1871 I ranked this species conjecturally with *Hexagenia*. At that time the genus *Palingenia* was not positively known to be represented in America; but now that a species of this group (represented by the nymph in the Museum of Comparative Zoology, Cambridge (Mass.), figured in Pl. XXV. of the present work) has been ascertained to occur in the Amazons, Weber's description of the species *atrostoma* as "Gigas in hoc genere; thorax marginatus canaliculatusque; cauda biseta, setis longissimis," taken in connexion with the colours of the wings and body, lends probability to the supposition of its being a *Palingenia*. Pictet was disposed to refer it to what is now known as *Campsurus*. The furrows of the thorax are adverse to its being considered to be a *Euthyplocia*.

Subsection B of Section 1.—Wing-neuration scanty; anal nervure (8) of the fore wing curved; axillary nervures either rudimentary or obsolete, or represented by a branch of the anal nervure (8) that meets the terminal margin; wing-membrane transparent;

recurrent membrane at the fore-wing roots often prolonged into a narrow free-pointed appendage beyond the peak of the mesonotum; hind wing traversed lengthwise by a contracted fold. Pronotum compact, transverse, arched behind. Setæ in ♀ short, smooth, and usually glabrous; in ♂ very long, and more or less pilose. Forceps—limbs inserted upon the sides of a laminar lobe extending from the distal ventral margin of the 9th segment, which lobe is probably not deflexible, but is sometimes represented in the ♀; their proximal joints the longest. Penis exposed, the lobes unarmed (excepting perhaps in *Lachlania*); but stimuli capable of extrusion are in some genera concealed in the 9th segment. Proportions of eyes and ocelli vary with the genus. Fore legs of ♂ short and slender; the tibia and tarsus often transversely rugose, the femur nearly as long as the tibia, the ungues usually alike, the tarsus shorter than the femur; hind legs usually the longest pair, the ungues subequal, broad, sometimes dissimilar, commonly flaccid.

Nymph (*Oligoneuria* only).—Labium flat; abdominal tracheal branchiæ inserted in the axils of notches in the posterior margins of the segments close to the lateral angles, which angles are prolonged backwards. Fore legs strong, the femur and tibia densely bearded beneath or behind with long hair, the tibia and tarsus slender in comparison with the femur. The terminal margins of the fore wings are united by membrane forming a hood. [I believe these characteristics are common to all the nymphs of this alliance, judging from the structure of the adult flies.]

(a.) Wing-membrane dull or satin-like; fore wing with the anal nervure (8) forked, and with a free epinotal appendage; 3 caudal setæ.

OLIGONEURIA, Pict. 1845.

Illustrations. *Adult* (details) Pl. III. 2 *a-b*; (whole figures,) see citations of Costa, Pictet, and Hagen (1855), under *O. rhenana* and *O. anomala*. *Nymph*, Pl. XXVI.; see also citations of Joly and Vayssière (*O. garumnica*), under *O. rhenana*.

Adult.—Fore wing with 5 longitudinal nervures, beside the costa and subcosta (this last concealed), and with several series of cross veinlets in the fore part of the wing. Setæ subequal in length to one another; in ♂ about $1\frac{1}{2}$ as long as the body, and pilose at the joinings; in ♀ at most $\frac{2}{3}$, and at least $\frac{1}{4}$, as long as it. Eyes in ♂ somewhat reniform, and approximated to each other above; in ♀ oval and remote; anterior ocellus not much smaller than the others. Spinose prolongations of the posterior lateral angles of the abdominal segments slender, those of the 8th and 9th segments the strongest. Thoracic spiracles open in the dried insect; aperture of the anterior triangular, that of the posterior ovate, narrowed below.

Nymph (*O. rhenana*).—Six dorsal pairs of tracheal branchiæ, borne upon segments 2-7, and a ventral pair on segment 1, all alike composed of a small, thick, coriaceous, subrotund lamina, with a tuft of fibrils at its point of attachment. Divisions of the labium intimately coherent: 1st maxillæ furnished with a tuft of fibrillose tracheal branchiæ at the outer base of the palpus.—In the nymph of *O. rhenana*, the bearding of the fore leg is restricted to well-defined patches on the inner (or hinder) side of the tibia and femur, the rest of the legs being almost quite glabrous; the intermediate

tarsus is minutely spinulose beneath; the hind tibia is similarly spinulose behind distally; the tibia and tarsi are all slender, and the femora distally somewhat enlarged; the tracheal laminae are spinulose also. Head semielliptical, arched above from side to side, and shelving from behind, so as to be wedge-like in vertical section, the underside being flattened. Antennæ glabrous, setaceous, the first two joints the largest. Labrum slightly retuse in front, and diffusely pilose along its anterior border. Mandibles distally enlarged, the molar tuberosity continuous with the crown, compact, and relatively large; the three fangs slender and small, the innermost appendiculated. Lacinia of 1st maxillæ small, ovate lanceolate, pungent, densely bearded inside, pubescent outside; the palpus very large and stout, the first joint minute, pubescent outside; the second joint relatively enormous, finger-like, curved, tapering distally, within and without at the tip densely hairy above, more sparsely pubescent beneath; the stipes closely associated with the fan-like branchial tuft of fibrils, which passes backwards above and beyond the hinder border of the labium, and underlies the prosternum. Lacinia of the 2nd maxillæ (if developed at all) adherent to the labium in the form of two elevated folds of membrane; palpus strong and finger-like, the first joint short, pilose; second joint pubescent, long, and stout. Lingua somewhat broadly cordate; the paraglossæ well developed and somewhat rounded. Outer setæ less than half as long as the body.

Distribution. Europe, middle and south, and Brazil.

Type. *O. anomala*, Pict.

Etymology. ὀλιγός and νεγίον, from the paucity of cross veinlets in the wings.

The following differences between the adult European and Brazilian species may here be noted, because they may be accompanied by unconformity in the nymphs, and be of more than specific value. *O. anomala*, ♀, has the setæ equal to each other in length, and sparingly pilose. The ♂ has the fore tibia relatively shorter in proportion to the femur than *O. rhenana*, and the proximal joint in all the tarsi longer than the second joint. In *O. rhenana*, ♀, the intermediate seta is slightly shorter than the outer setæ, and all are glabrous. The ♂ fore tibia is about $1\frac{1}{2}$ (instead of only $1\frac{1}{3}$) as long as the femur, and the proximal joint in all the tarsi is shorter than the second joint.

OLIGONEURIA ANOMALA, Pict. Plate III. 2 b (♂, wings, legs, and forceps, ♀, legs).

Oligoneuria [type] *anomala*, Pict., Hist. Nat. Névropt. ii. Ephém. 290, pl. xlvii. (1843-5); Walk., List Neuropt. in Brit. Mus. part iii. 585 (1853); Hag., Stet. ent. Zeit. xvi. 269, pl. i. (1855); Etn., Ent. Mo. Mag. v. 83 (1868); id., Trans. Ent. Soc. London (1871), 55.

Adult (dried) ♂.—Wings transparent light sepia-grey, with opaque light pitch-brown longitudinal neuration, the membrane giving a dull light purple-grey reflection. Thorax pitch-brown. Abdomen in segments 8-10 and in the distal halves of segments 2-7 pitch-brown, the anterior halves of these being pellucid white. Setæ warm sepia-grey, with alternately wide and narrow light pitch-brown annulations at the joinings. Legs subpiceous, the hinder tarsi with their terminal joint white, and ungues piceous.

♀ (after Hagen). Body fuscous or brown. Wings light grey, the fore wings with about six cross veinlets [in the space behind nervure no. 3]. Length of body, ♂, about 7, ♀ (Hagen) 13; wing, ♂ 8, ♀ 15; setæ, ♀ 8 mm.

Hab. Brazil (*Pict.*), Rio Mauhes, "at light," 5th May, 1874, and Rio Jutahi, "at light," 1st to 5th February, 1875 (*Trail*); both sexes in M^cLach. Mus. The cross veinlets in the marginal area of the fore wing are not easily discovered in a dried wing; and those in the space behind the nervure numbered 3 in my figure vary within two or three of the number (six) quoted. The dimensions of the ♀ in M^cLach. Mus. are identical with those stated by Hagen.

OLIGONEURIA RHENANA, *Pict.* Plate III. 2*a* (wings, ♂ and ♀, head, ♂, 3 views, legs, ♂, and forceps, tip of a forceps-limb and penis). *Nymph*, Pl. XXVI. (whole figure and details).

[*Nameless*], Costa, Fn. di Aspromonte, pl. i. 2.

Oligoneuria † *anomala* (part), *Pict.*, Nat. Hist. Névropt. ii. Ephém. pl. xlvi. (143-5); Kirschb., Jahresb. Vereins f. Naturk. Nassau, Heft ix. 44-5 (1853). *O. rhenana*, Imh., Bericht über Verhandl. d. naturf. Gesellsch. Basel. x. 177-180 (1852); Hag., Stet. ent. Zeit. xvi. 267, pl. i. (1855); Brau., Neur. Aust. 25. (1857); Rogenhofer, Verh. zool.-bot. Ver. Wien, vii. 130 (1857); Müll., Ent. Mo. Mag. i. 262 (1865), and ii. 182 (1866); Etn., *op. cit.* v. 83 (1868), and Trans. Ent. Soc. London (1871), p. 55, pls. i. 2, and iii. 7-7*a*; Hag., *op. cit.* (1873), p. 390-1; Meyer-Dür, Bull. Soc. Ent. Suisse, iv. 307 (1874); translation of Imhoff, 1852, by Joly, Bull. Soc. d'Etud. Sc. Angers, Ann. 4-5^{me}, pp. 37-40 (1876). *O. pal-lida* (*O. rhenana*, var. ?), ! Hag., Stet. ent. Zeit. xvi. 268, pl. i. (1855); ! Etn., Trans. Ent. Soc. London (1871), p. 56. *Nymph*.—*O. Garumnica*, ! Joly, Zoologist (1873, Aug.) 36555-7, figs. A, B; *idem*, Proc. Ent. Soc. London (1873), p. xx. figs. A, B; ditto, Bull. Soc. d'Etud. &c. Angers, pp. 37-9 & 46, figs. A, B (1876); ditto, Rev. d. Sc. Nat. Montpellier, v. 9 (1876, Dec.); ditto, Bull. Soc. d'Et. des Sc. Nat. Nimes, Ann. 6^e, no. 4 (separate pgs. 8), figs. A, B [inferior to the earlier figures] (1878, April); *idem*, Compt. Rend. Soc. d'Et. des Sc. Nat. Nimes, 1878, pp. 64-9; Vayssière!, Ann. Sc. Nat. (6) Zool. xiii. 54, figs. 52, 58-65 [whole figure and details] (1882). *O. rhenana*, ! Müll., Mitth. schweiz. ent. Gesellsch. v. 384-6 (1878).

Subimago.—Body much browner than that of the adult fly.

Imago, living, ♂.—Head and thorax brown-ochreous, eyes black. Abdomen white, the segments pellucid in their basal halves and opaque behind, their distal dorsal borders narrowly edged with greyish; in the dried insect the opaque portions of the segments become lutescent or ochreous; in the 9th ventral segment (prior to their extrusion) are visible through the integument the light yellowish chitinous mandibuliform appendages to the penis. Setæ and forceps white. Fore legs from the coxa to the base of the femur whitish, and from thence sepia-brown; hinder legs white, with yellowish white femora and dark unguis: when dried, the fore legs and hinder femora become light yellowish brown. Wings greyish with opaque neuration, the stronger nervures sepia-grey.

♀. Abdomen previous to the extrusion of the eggs bistre-brown, and opaque when dried, afterwards very light brownish-ochreous; eggs lutescent. Thorax brown-ochreous, head rather browner in front, legs when dried light bistre-brown or brown-ochreous. Length of body, ♂ 9-13, ♀ 12-15; wing, ♂ 11-14, ♀ 14-16; setæ, ♂ im. 12-13, subim. (slough) 4; ♀ im. 3-4, subim. 2.5-3 mm.

Hab. The Rhine, Cologne to Basel; the mill-stream at Versoix, Geneva; France, Brive (Haute Loire), Toulouse (Haute Garonne), and Tarascon (Ariège); Portugal,

Ponte de Morcellos (Beira Baixa); Italy, Turin, and Breno (Val Camonica, Brescia to the Neapolitan territory (locality —? *fide* Costa); Hungary (var.? *pallida*, Hag.); Galicia, Stry (*fide* F. Brauer). The terminal small joints of the forceps-limbs appear to be variable in number, and the specimens from France, Geneva, and Italy are much lighter in colour than some of older date from the Rhine with which I have compared them. This difference in colour may be due to my specimens having been killed with fumes of prussic acid (Potassium-cyanide bottle); and the variation in number of the forceps-joints is probably of common occurrence. In the absence of examples in spirits, I failed to arrive at any decision as to the rank of *O. pallida*, Hag., as a var. of *O. rhenana* or a separate species.

ELASSONEURIA, Etn. 1881.

Illustrations. *Adult* (details) Pl. III. 3; also Trans. Ent. Soc. London (1871), p. iii. 9, 9 a.

Adult ♀.—Fore wing with only three longitudinal nervures, besides the costa and concealed subcosta, of which the hinder two are forked; cross veinlets more restricted in their range than those in the fore wing of *Oligoneuria*. Pronotum transverse, prolonged on each side into a deflected oblong lobe. Aperture of the anterior thoracic spiracle triangular, its upper edge straight, that of the posterior spiracle oval. Setæ nearly coequal in length, about $\frac{1}{3}$ as long as the body, the intermediate seta rather slender, all of them glabrous excepting towards their tips, where for a short distance they are sparingly pilose. Eyes oval and remote; anterior ocellus not much smaller than the others. In other points very like *Oligoneuria*.

Distribution. Natal.

Type. *E. Trimeniana* (in *Oligoneuria*), M^cLach.

Etymology. ἐλάσσων and νεγρίον, from the greater paucity of the neuration in comparison with that of *Oligoneuria*.

ELASSONEURIA TRIMENIANA, M^cLach. Plate III. 3 (wings, ♀).

Oligoneuria Trimeniana,! M^cLach., Ent. Mo. Mag. iv. 177–8 (1868); ! Etn., *op. cit.* v. 83 (1868); *id.*, Trans. Ent. Soc. London (1871), 56, pl. iii. 9–9 a [penult. ventr. process ♀]; Joly, Sur une Nouv. Esp. d. Gen. d'Ephém. Oligoneuria &c. Nimes (1877), 6 figs. 8vo. [transl. of M^cLachl. 1868].

Elassoneuria [type] *Trimeniana*,! Etn., Ent. Mo. Mag. xvii. 191 (1881).

Adult (*dried*) ♀.—Head and thorax brown-ochreous above, lighter beneath. Abdomen discoloured; eggs formerly green, now brown-ochreous. Setæ opaque-whitish. Wings transparent, very slightly tinted with light smoke-grey, giving a faint very light cobalt or ultra ash-blue glance, soft as the gloss of satin; neuration opaque, light smoky-grey. Length of body, ♀, 12, wing 22.5, setæ 4 mm.

Hab. Mapumulo Mission Station, Umvoti District, Natal. Captured “at light” on 3rd of March, 1867 (M^cLach. Mus.).

(b.) Wing-membrane “shot” with blue or purple; the free epinotal appendage of the membrane decurrent from the wing-roots is easily broken off, but may be regarded as probably absent in *Lachlania* and *Homœoneuria*.

SPANIOPHLEBIA, Etn. 1881.

Illustrations. *Adult* (details), Pl. III. 4.

Adult.—Anal nervure of the fore wing forked; the membrane decurrent from the wing-roots terminated by a free epinotal appendage; cross veinlets comparatively numerous in the anterior portion of the wing; the nervure next in advance to the anal (8) deeply forked. Aperture of the anterior thoracic spiracle fissure-like and gaping in front (in the dried insect), closed by a single, large, arched, dorsal valve rounded at the edge; the anterior and lower margins of the orifice meeting in front at an angle, without valves; that of the posterior spiracle is large, roundly subtriangular, and valveless, with a small salient lobule projecting from its front edge. Setæ 2. Hinder lateral angles of the intermediate abdominal segments shortly prolonged into slender projections that are easily broken off. Fore tibia of ♂ about as long as the femur; the proximal joint in every tarsus longer than the second joint. Eyes of ♂ hemispherical, relatively small, remote from each other above; the foremost ocellus rather smaller than the others.

Distribution. Tropical South America.

Type. *S. Trailiæ*.

Etymology. σπάνιος and φλέβιον, from the scanty cross neuration.

Differences in the neuration of the fore wings of the two species provisionally placed in this genus are specified in the descriptions. There are other incongruities between them. The ♂ Brazilian species has pilose setæ about as long as the body; those of the Ecuador ♂ are pubescent, and about $2\frac{1}{2}$ as long as the body. The latter certainly possesses the epinotal appendages mentioned above; but these are not so surely present in the Brazilian.

SPANIOPHLEBIA TRAILLÆ, Etn. Plate III. 4 (wings, legs, and forceps, ♂).

Spaniophlebia [type] *Trailiæ*, ! Etn., Ent. Mo. Mag. xvii. 191 (1881).

Imago (dried and in alcohol), ♂.—Body pitch-brown, the thorax darker than the abdomen; the latter with the tenth dorsal segment, and the lateral borders of the other segments above the spiracular margin as dark as the thorax, but with the joinings of the segments pale. Setæ, in the dried specimen pitch-black, with testaceous pilosity; but in the specimen in fluid both are testaceous; forceps whitish. Legs pitch-black, the ungues of the hinder tarsi whitish: in alcohol the legs from the coxa to the knee are light pitch-brown, and the rest of the tibia with the tarsus dirty white. Wings transparent, tinted throughout, very faintly indeed, with smoky-grey, so as scarcely to diminish their limpidity, and giving a light blue-purple or (in other positions) a mauve reflection; neuration piceous, the quasi-subcosta (no. 3) of the fore wing, distally, and the cross veinlets that join it, margined for some distance with intense warm sepia-brown, which colouring occupies the pterostigmatic space, and imparts a slight tint to the rest of the marginal area. The nervure (pobrachial?) in front of the anal (8) of the fore wing, is forked before the middle, at about the same distance from the wing-roots as the anal nervure, and is met nearer the base of the wing by one of two simple nervures interposed

between it and the quasi-subcosta (3). This simple nervure (præbrachial?) forms the posterior limit of the region provided with cross veinlets; of these there are about 25 in the marginal area, from 2 to 5 in the next area, and one or two in the area next to that. Length of body 9, wing 10, setæ 8 mm.

Hab. São Paulo, Rio Solimões, October 13, 14, and November 26th, 1874 (*Trail*, M^cLach. Mus.), "at light."

SPANIOPHLEBIA PALLIPES, sp. nov.

Adult (dried), ♂.—Pronotum, sides and underside of the thorax, the hinder border of the mesonotum, and the metanotum, light Vandyke-brown; the mesonotum in advance of the peak, darker or dull black. Abdomen discoloured, lighter beneath than above; the dorsum nearly concolorous with the metanotum. Setæ white, pubescent throughout. Fore femur in opaque view very light dull brownish-yellow, changing in transmitted light to light yellowish-amber; the tibia in opaque view nearly of the same colour as the femur, but light brown at the tip; the short joints, the ungues and the tip of the terminal joint of the tarsus light brown, the rest of the terminal joint whitish brown. Hinder legs very similar but a little lighter. Wings transparent, tinted, very faintly indeed, with extremely light Vandyke- or sepia-grey, changing in some positions to a like shade of Roman sepia-grey, and "shot" with a rather dull intense blue; their neuration in a large extent light pitch-brown, growing paler towards the wing-roots, changing in some lights to light Vandyke- or warm sepia-brown. The nervure in front of the anal (8) of the fore wing is joined by a weak and flexuous branch nearly in the middle of the wing, at a point further from the wing-roots than the fork of the anal nervure, and shortly before the great cross vein, is joined also by the longer of the two nervures interposed between it and the radius (3); the shorter of these interposed nervures meets the radius a little beyond the middle; the subcosta is visible at the bottom of a deep fold of the membrane when the wing is viewed edgewise from in front, but is concealed by the radius when the wing is viewed from above; the anal nervure bounds posteriorly the portion of the wing traversed by cross veinlets; the number of these in the marginal and submarginal areas (if any exist there) cannot be ascertained; but in the area between the radius (3) and the shorter of the interposed nervures are 6–8, which are thickened towards their junction with the radius; in the next area are 5 or 6 cross veinlets; within the fork of the next nervure 2 or 3; and between this nervure and the anal, from 2 to 4 cross veinlets. Length of body, ♂, about 11 (not allowing for shrinkage); wing 16–17; setæ 40 (or more) mm.

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

LACHLANIA, Hag. 1868.

Illustrations. *Adult* (details), Pl. III. 5 (whole figures), see citations of Hagen and Packard under *L. abnormis*.

Adult.—Anal nervure of the fore wing forked; no epinotal free appendage to the membrane decurrent from the wing-roots; cross veinlets, as a rule (with rare individual

exceptions), uniserial in a transverse row extending to the nervure next in advance of the anal; that nervure is forked shortly, or beyond the middle. Aperture of the anterior thoracic spiracle triangular, with a salient angular valve above, its lower lip straight; that of the posterior spiracle small and round. Setæ 2, in ♂ (pilose?) about $2\frac{1}{2}$ as long as the body, in ♀ glabrous, about $\frac{1}{2}$ as long as it. Proportion of ♂ legs not observed. Eyes of ♀ large for the sex; the anterior ocellus rather smaller than the others. Slender projections, easily lost, are prolonged shortly from the hinder lateral angles of the intermediate abdominal segments; 9th ventral segment of ♀ hardly produced behind into a lobe, but cleft in the middle.

Distribution. Cuba and Central America.

Type. *L. abnormis*, Hag.

Etymology. R. M^cLachlan, the British neuropterist.

LACHLANIA ABNORMIS, Hag. Plate III. 5 (wings, ♀).

Lachlania abnormis! Hag., Proc. Boston Soc. Nat. Hist. (1868), 372-4, fig.; Packard, Guide to Study of Ins. ed. i. 596, fig. 578 [after Hag.] (1870); Etn., Trans. Ent. Soc. London (1871), 54, pl. i. 1 [after Hag.].

Adult (dried), ♀.—Body above warm sepia-brown, beneath lighter; head, prothorax, femora, and the spiracular border of the abdominal segment, piceous; tibiæ and tarsi lighter, especially the ungues; setæ whitish. Wings transparent sepia-grey, with an intense blue-purple reflection, and light (Vandyke) brown neuration; the finer of the cross veinlets much lighter than the others. In the fore wing, a single series of cross veinlets extends in a slight curve from the (functional) subcosta (no. 3) to the anterior branch of the forked longitudinal nervure (pobrachial?) next in advance of the anal (8); the series is sometimes continuous, and sometimes broken by a slight displacement of the second or third veinlet; the posterior branch of the pobrachial is weak, and very similar in colour and calibre to hindermost cross veinlet. Length of body, ♀, 6-7; wing 9-10; setæ 5 mm.

Hab. Cuba (Hag. & M^cLach. Mus.).

LACHLANIA LUCIDA, sp. nov. Plate III. 5 (forceps).

Imago (dried), ♂.—Thorax piceo-fuscous; abdomen fuscous, broadly annulated with white near the joinings; forceps and setæ whitish. Fore legs and posterior femora fuscous, tarsi and posterior tibiæ white, with dark ungues. Wing-neuration subfuscous.

♀. Thorax luteo-piceous; abdomen darker than in the ♂; in other details very like the ♂. Wings tinted as in *L. abnormis*, the membrane reflecting bright (medium small) blue. Length of body 11-12; wing, ♂ 12, ♀ 14; setæ, ♂ circ. 30, ♀ 7 mm.

Hab. Guatemala (♂ ♀, Paris Mus. Jardin des Plantes); Central America (2 ♀, M^cLach. Mus.).

HOMONEURIA, Etn. 1881.

Illustrations. *Adult* (detail). Pl. III. 6.

Adult.—All of the nervures of the fore wing simple; membrane decurrent from the wing-roots, apparently destitute of any free epinotal appendage; no cross veinlets.

Aperture of the anterior thoracic spiracle oblong, with a salient rounded drooping valve at its upper border; that of the posterior spiracle round. Setæ 3, in ♀ subequal, glabrous, about $\frac{1}{4}$ as long as the body. Hinder lateral angles of the intermediate abdominal segments acute, but seemingly not prolonged into projections; 9th ventral segment not prolonged into a lobe behind, nor cleft, but entire.

Distribution. Central America.

Type. *H. Salvinia*.

Etymology, ὁμοιος and νευρίον, from the mutual likeness of the wing-nervures.

HOMÆONEURIA SALVINIÆ, Etn. Pl. III. 6 (wings, ♀).

Homæoneuria [type] *Salvinia*! Etn., Ent. Mo. Mag. xvii. 192 (1881).

Imago (dried), ♀.—Head and thorax pitch-black above; abdomen dark warm sepia-brown above, with the joinings either transparently whitish or opaque sepia-brown, according as this region is distended or not; belly warm sepia-grey, with the hindermost 3 or 4 segments warm sepia-brown; setæ pitch-black. Legs concolorous with the venter; the fore legs darker than the hinder. Wings transparent, faintly smoky, with a glowing purplish French ultra-blue reflection, changing (in a very oblique front view) to very light purple-madder bronze; neuration opaque, coloured and bordered narrowly with very light bistre-brown. Length of body, ♀, 8–11; wing 8–12; setæ 2·5–3·5 mm.

Hab. Guatemala; Dueñas, 4950 ft., and Aceytuno, 5100 ft. alt. (Salvin, in M'Lach. Mus.). The specimens were secured early in the morning while floating dead upon the surface of the stream, when the flash of the wings was very conspicuous. In some examples, the thinner portions of the integument in the hinder parts of the notum are whitish.

Section 2 of the Genus^{era.} Type of *Polymitarcys*. *Adult.*—Subcosta of the fore wing displayed (except in dried *Campsurus*, ♀). Posterior margin of 9th ventral segment in ♀ not extended into a lobe. Pronotum tumid; its hinder border straight (excepting perhaps in *Jolia*, ♂, it may be sinuous behind).

Nymph fossorial or predatory; in those that are known, the median lobe of the tongue is obtuse.

EUTHYPLOCIA, Etn. 1871.

Illustrations. *Adult* (details), Pl. IV. *Nymph* (whole figure and details), Pl. XXIX., see also Pict., Hist. Nat. Névropt. ii. Ephém. Pl. XV. 2–4 [with circumspection].

Adult.—Disqual cellules of the fore wing large, and in the vicinage of the terminal and inner margins transversely elongated, especially those posterior to the sinuous anal nervure, which are themselves sinuous. ♂, fore leg about as long as the head and body together: the tarsus longer than the femur, which is about $\frac{2}{3}$ as long as the tibia. Tarsal ungues equal and nearly alike. Aperture of the anterior thoracic spiracle elongate, or oval, in the dried insect, with an arched upper valve; that of the posterior spiracle narrow, elongate and gaping. Setæ 3, subequal, about $3\frac{2}{3}$ as long as the body in the ♂; in ♀ glabrous, but in ♂ sparsely pubescent beyond the middle. ♂, eyes of moderate proportions, mutually remote; anterior ocellus the smallest. Forceps-limbs inserted at

the sides of a short deflexible lobe prolonged from the hind margin of the ninth segment; their proximal joint very short, the second much the longest. Penis extruded and rather similar to that of *Campsurus 4-dentatus* (Pl. V. 8 e), without apparent stimuli. No projections at the hinder lateral angles of the abdominal segment.

Nymph.—Raptorial, furtive; mandibles tusked; fore tibia spurred; 6 pairs of abdominal tracheal branchiæ, inserted at the sides of segments 2–7, a little in front of the hinder angles, and arched upwards over the back, each composed of a pair of narrow uniform and subequal lanceolate membranous laminæ, folded lengthwise, and fringed with simple fibrils. Setæ rather shorter than the body, pilose to beyond the middle, and then tail-pointed. Palpi of both maxillæ 3-jointed.—Head relatively small, narrower than the thorax: pronotum subquadrate, the lateral borders narrowly dilated; terminal margins of the fore wings free; body slender. Antennæ setaceous, longer than the head. Labrum emarginate, pubescent. Mandibles prolonged into a tusk on the outer side, about twice as long as the head, densely hirsute outside and above with slightly spreading hair, and half encircled at its junction with the crown of the mandible by an interrupted verticil of widely spreading hair; the fangs are rather distant from the molar protuberance, and are set almost at right angles with the tusk, which is curved gently and regularly inwards, and tapers to a slightly oblique point; stipes very short. First maxillæ weak; the lacinia small, pubescent externally, ciliated internally, crowned with a dense tuft of short hair and terminated by a few (3 or 4) slender spines; palpus upwards of four times as long as the lacinia, rather slender, 3-jointed (exclusive of the pedicel); the first joint pubescent, the others pilose; the third joint nearly as long as the other two together. Second maxillæ almost in the form of quadrants, densely pubescent; palpus 3-jointed, geniculated at the penultimate joining, and pilose outside; the distal moiety clavate and truncate, the terminal disk hispid; the proximal joint pubescent within. Labium small, the lobes narrow and acute. Tongue perhaps distorted; medium lobe obcordate; paraglossæ moderate in size and rounded. Legs pilose above and below, the tibiæ obliquely truncate, the fore tibia spurred with a long, slender, but strong apical spine; the fore tarsus very long. (Figured and described from a dried slough in the Mus. Roy. de Bruxelles, measuring,—body (exclusive of mandibles) 30; setæ 19 mm.)

Distribution. Tropical America.

Type. *E. Hecuba* (in *Palingenia*), Hagen.

Etymology. εὐθροπλοκία, from the evenness of the cross veinlets.

EUTHYPLOCIA HECUBA, Hag. Plate IV. 7 a (wings ♀).

Palingenia Hecuba! Hag., Smithson. Miscell. Coll. (1861), Synop. Neuropt. N. Am. 40.

Euthyplocia [type] *Hecuba*! Etn., Trans. Ent. Soc. London (1871), 67; Hag. & Etn., *op. cit.* (1873), 392.

Imago (dried), ♀.—Head blackish fuscous, antennæ pale at the tip; prothorax glossy, fuscous; the rest of the thorax with the coxæ and trochanters luteous, the femora &c. deficient. Abdomen above blackish fuscous, luteous beneath, the setæ whitish sepia-grey, with lighter joinings. Wings dull, transparent, tinted faintly with very light warm sepia-grey (“grayish-rosy,” Hag.), but rather darker along the anterior margin of

the fore wing, from the costa to the radius; neuration opaque ("gray," Hag.), light warm sepia-brown. Length of body, ♀ 20-22; wing, 35-38 mm.

Hab. Vera Cruz (Sallé in De Selys-Longchamps Mus.), Veragua (M^cLach. Mus.).

EUTHYPLOCIA ANCEPS, sp. nov. Plate IV. 7 c (wings, legs, forceps from above).

Imago (dried), ♂.—Head and prothorax above light pitch-brown, the remainder of the notum light testaceous or pale lutescent. Dorsum dark purplish grey; venter whitish ochreous: setæ, near their insertion, tinged faintly with light purplish grey and then becoming transparent white; forceps white. Fore leg (as an opaque object) with the femur pitch-black as well as the tibia, the tarsus greyish white; in transmitted light the tibia is purple-grey, the tarsus purplish white. Hinder legs whitish yellow at the knee, light pitch-brown or fuscous. Wings transparent, in the disk slightly smoky; the fore wing tinted more distinctly with purplish- or light Roman sepia-grey in the marginal and submarginal areas, especially towards the base: neuration in great measure Roman sepia- or pitch-brown, becoming lighter and translucent in its more attenuated portions. Length of body, ♂, about 12; wing 13; setæ about 26 mm.

Hab. Rio Mauhes, Brazil (Trail, in M^cLach. Mus.).

CAMPSURUS, Etn. 1868.

Illustrations. *Adult*, Pl. V. 8 a-8 f (details); (whole figures) see citations of Percheron and Pictet under *C. albicans* & *dorsalis*.

Adult.—Discal cellules of the fore wing large, nearly as wide as long; the intercalated nervures, constituting branches of the cubital (5), præbrachial (6), and often of the anal (8) nervures, are convergent mutually into fascicles towards the base of the fore wing; the anal nervure is somewhat sinuous, and its course from the wing-roots is at first close alongside of the first anal nervure. Fore leg of ♂ shorter than the head and body together; the tarsus longer than the femur, which is about $\frac{4}{5}$ as long as the tibia; the ungues unequal, dissimilar, ligulate and flaccid, are unusually long. Aperture of the anterior thoracic spiracle patulous, subtriangular, with the angles obtusely rounded, and with the anterior border roundly salient; that of the posterior spiracle very large, exceeding the anterior in its dimensions, widely patulous, ovate, narrowed below. Setæ two; in ♂ about $3\frac{1}{2}$ as long as the body, divaricate in dried examples, and glabrous with the exception of a very few scattered hairs near the tips; in ♀ about as long as the body, smooth, and glabrous. ♂, eyes small, oval, mutually remote; foremost ocellus much smaller than the others. Forceps-limbs inserted each upon a separate basis, above and distinct from the posterior ventral margin of the 9th segment, and not upon a deflexible lobe prolonged from the margin; unless these bases be taken to represent proximal joints, the limbs are jointless. Penis extruded, commonly decurved, sometimes provided with well-developed stimuli. No projections usually at the hinder lateral angles of the abdominal segments.

Nymph unknown.

Distribution. Texas to Brazil.

Type. *C. latipennis* (in *Palingenia*), Walker.

Etymology, κάμπτω and οὐρά, from the divarication of the ♂ setæ, after death.

CAMPSURUS LATIPENNIS, Walk. Plate V. 8 *c* (wings & forceps).

Palingenia latipennis! Walk., List of Neuropt. Inst. in Brit. Mus. part iii. 554 [excl. var.] (1853).

Campsurus [type] *latipennis*! Etn., Ent. Mo. Mag. v. 83 (1868); *id.*, Trans. Ent. Soc. London (1871), 57, pls. i. 4, & iii. 10, 10 *a* [details].

Imago (*dried*), ♂.—Thorax fusco-luteous (eaten out by *Psocidæ*); abdomen above very light umber-grey, more distinctly so in segments 4–10 than in the others, with the joinings of the segments and the line of the dorsal vessel darker; venter testaceous; setæ pellucid white. Fore legs sepia-brown, with white unguis. In the fore wing the costa, subcosta, and radius, from the wing-roots to a little beyond the middle, are warm sepia-grey; the adjacent part of the marginal area is tinged with the same colour, or fuscous.

Subimago.—Body very light brown-ochreous, with the setæ white or yellowish white.

♀. Pronotum bistre-grey; mesonotum brown-ochreous. Abdomen discoloured (largely denuded by *Psocidæ*) very light brown-ochreous beneath; dorsum carinated lengthwise and perhaps bistre-grey in segments 2–9. About nineteen fine, simple, almost straight cross veinlets in the marginal area of the fore wing. Length of body, ♂ ♀, 7; wings 8; setæ, ♂ im. 22, subim. 15 mm.

Hab. Pará; Toncantine (Wallace in Brit. Mus.); Santarem (Bates in M^cLach. Mus.).

CAMPSURUS ALBIFILUM, Walk. Plate V. 8 *a* (adult ♂, head, wing, forceps, fore leg; subim. ♂, fore leg).

Palingenia albifilum! Walk., List of Neuropt. Inst. in Brit. Mus. part iii. 554 [excl. var.] (1853).

Campsurus albifilum! Etn., Trans. Ent. Soc. London (1871), 57, pl. iii. 11 [details].

Imago (*dried*), ♂.—Pronotum very nearly light bistre-brown; mesonotum in the type discoloured by gum. Abdomen beneath light Roman-ochraceous; dorsum lighter, marked in segments 1–6 with light grey, but in segments 7–10 with light bistre-brown; the markings are:—in segment 1 a spot on each side; in segments 2 & 3 a streak from the base on each side of the middle curved outwards near the hind margin; in segments 4–7 two marks, one on each side of the middle line resembling square vincula] [placed back to back, whose extremities in the hinder segments tend to be conjoined by a narrow band of the same colour; in segments 8 & 9 a large oblong blotch on each side of the pale median dorsal line; segment 10 is light brown-ochreous with a small spot on each side. Setæ white, faintly tinged at the base with pale ochreous. Forceps and penis pale yellowish. Coxæ testaceous; fore femur and tibia deep sepia-brown, the tarsus and unguis light sepia-grey. Costa, subcosta, and radius of the fore wing light brown-ochreous at the wing-roots, and then light sepia-grey. Length of body, ♂, 12; wing 13; setæ 40 mm.

Hab. Pará (Brit. Mus.).

CAMPSURUS ALBICANS, Perch.

Ephemera albicans, Perch., in Guér. & Perch. Gen. d. Ins. &c. livr. vi. pl. iv. 1 (1838).

Palingenia albicans, Burm., Handb. d. Ent. Bd. ii. Abth. ii. 803 (1839); Pict., Hist. Nat. Névropt. ii.

Ephém. 149, pl. xiii. 1-3 (1843-5); Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 548 [excl. exemplar] (1853).

Campsurus albicans, Etn., Trans. Ent. Soc. London (1871), 58.

Imago (dried), ♂.—Prothorax yellowish, violet-grey at the sides of the notum; meso- and metathorax brown-ochreous. Abdomen pale yellowish or brown ochreous towards its hinder extremity. Legs whitish, the fore femur and tibia violet-grey. Wings whitish, tinged towards the base with violet-grey, the stronger nervures of this same colour. Length of body 10, exp. of wings 30 mm.

Hab. Brazil (*Perch.*). The description is probably insufficient in the absence of definite information of the precise locality where the type was captured. The details figured by Pictet appear to have been drawn from the dried insect, and to be misrepresented; Percheron's illustrations may have been delineated from an example in spirits. The ♀, doubtfully referred to this species by Walker (Brazil, J. P. G. Smith, in Brit. Mus.), seems rather too small to be identical with it, but may possibly be *C. curtus*, ♀. It is well, however, not to attach much weight to mere possibilities in matters of this nature.

CAMPSURUS CUSPIDATUS, Etn. Plate V. 8 d (forceps).

Campsurus cuspidatus, ! Etn., Trans. Ent. Soc. London (1871), 58, pl. iii. 12 [details].

Imago (dried), ♂.—Pronotum mouse-grey, tinged slightly with greenish. Abdomen smoky-white above, yellowish-white beneath. Wings transparent, whitish throughout. Length of body 10.5, wing 11 mm.

Hab. Guatemala (De Selys-Longchamps Mus.). This species is easily recognizable by the cuspidate outline of the subgenital plate.

CAMPSURUS QUADRIDENTATUS, Etn. Plate V. 8 e (forceps).

Campsurus quadridentatus, ! Etn., Trans. Ent. Soc. London (1871), 58, pl. iii. 13 [details].

Imago (dried), ♂.—Thorax and legs pale testaceous. Abdomen light yellow-ochreous, shaded with black-grey, especially posteriorly; the foremost six segments traversed lengthwise by a median black line. Wings dull translucent whitish; subcosta and radius of the fore wing black-grey or sepia-grey. Length of body 12, wing 13 mm.

Hab. Santarem, Brazil, June (Bates, in Dale Mus.). The subgenital plate of the ♂ is angularly excised behind on both sides of a large deep central subcircular sinus. The name has reference to the tooth-like projections adjacent to the excisions.

CAMPSURUS CURTUS, Hag. MS. Plate V. 8 f.

Palingenia † *albifilum*, var. ! Walk., List of Neuropt. Ins. Brit. Mus. part iii. 554 (1853).—*P. curta*, Hag. MS. (1861).

Campsurus [B] *curtus*, ! Etn., Ent. Mo. Mag. v. 84 (1868).

Asthenopus [type] *curtus*, ! Etn., Trans. Ent. Soc. London (1871), 59, pls. i. 3, and iii. 14-14 b [details].

Imago (dried), ♂.—Pronotum piceous, the remainder of the notum (perhaps modified by gum) luteous. Abdomen beneath and at the sides of the back light yellow-ochreous,

becoming darker in segments 8-10; the remainder (midst) of the back chiefly blackish-grey, having joinings 1-3, and a small elongated spot on each side in segments 4-8 pale; joinings 4-7 darker grey. The dark colour projects obliquely downwards as a line from the hind border in segments 1 and 2, and as a short stripe bounded in front by a pale line ascending from the spicular border in segments 3-5 or -6; the same dark colour, in segments 6- or 7-10, occupies nearly the whole dorsal surface, but the same pale lines from the spicular border project upwards into it in segments 7-9. Setæ white, tinged very faintly with light grey near the base. Fore legs blackish-grey, with pale joinings; hinder legs luteous. Wings transparent, their neuration pale distally, but nearer the base (the costa, subcosta, and radius especially) tinged with violet-grey; the same colour imparts a light tint in the fore wing to the proximal portion of the marginal and sub-marginal areas, and also to the space enclosed by the first axillary and the inner margin. Length of body 8, wing 10, setæ 35 mm.

Hab. Pará (Brit. Mus.).

CAMPSURUS DECOLORATUS, Hag.

Palingenia decolorata,! Hag., Smithson. Miscell. Coll. (1861), Synop. Neuropt. N. Am. 43.

Hexagenia decolorata, Etn., Trans. Ent. Soc. London (1871), 65.

Imago (in alcohol).—Luteous; antennæ pale; mesothorax yellowish-fuscous; abdomen striped at the sides with obscure fuscous; setæ luteous. Fore legs blackish; hinder legs luteous. Wings transparent, yellowish; neuration luteous, excepting the fuscous subcosta of the fore wing. Length of body 16, exp. of wings 30, setæ about 30 mm.

Hab. Mexico; Matamoras, Tamaulipas, common (Mus. Comp. Zool. Cambridge, Mass.). [After Hagen.] The specimen seen by me was a female. Specimens from the same localities could be readily identified by the colour of the fore legs, and by the dimensions &c. quoted. In M^cLach. Mus. are several ♀ examples of a *Campsurus* taken by Belfrage in Bosque Co., Texas, which has the fore legs yellowish like the hinder legs.

The fore wing of this Texan species is figured by me in Trans. Ent. Soc. London (1871), pl. i. 3, the hind wing in the present work (Pl. V. 8 b). In the absence of the ♂ it is well to leave it undescribed and nameless.

CAMPSURUS DORSALIS, Burm.

Palingenia dorsalis, Burm., Handb. d. Ent. Bd. ii. Abth. ii. 803, 1015 (1839); Pict., Hist. Nat. Névropt. ii. Ephém. 153, pl. xiii. 5 (1843-5); Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 549 (1853).

Asthenopus dorsalis, Etn., Trans. Ent. Soc. London (1871), 59.

Imago, ♀ [after Pict.].—Pronotum yellowish, with a violet line or spot in the middle; the rest of the thorax yellow-ochreous at the sides, violet above, with a pair of lutescent lines in the middle. Abdomen ochraceous grey, with a median fuscous streak tapering behind. Setæ whitish. Fore legs black-grey. Wings almost colourless; costal region

of the fore wing violet-fuscos, the nervures in other parts of the wing light fuscous; neuration whitish in the hind wings. Length of body 11, exp. of wings 38 mm.

Hab. Brazil (Burm.; Pict. in Vienna Mus.).

JOLIA, Etn. 1881.

Illustrations. Alleged *Adult*, Pl. II. 9 (details). *Nymph*, Pl. XXVII. (whole figure and details): see also citations of figures by Joly and Vayssière under *J. Ræseli*.

Adult.—Discal cellules of the fore wing moderately small, subquadrate; neuration, as a whole, very similar to that of *Polymitarcys*. ♂, fore leg about as long as the head and body together, the tarsus shorter than the femur, which is more than $\frac{1}{2}$ as long as the tibia; tarsal unguis unequal, dissimilar, narrow, long and flaccid (probably subim.). Spiracles mutilated in the types. Setæ 2; in ♀ about $\frac{1}{2}$ or $\frac{1}{3}$ as long as the body, glabrous, excepting near the tips, and there minutely puberulous; in ♂ (subim.?), nearly as in *Campsurus* subim. Eyes of ♂ (subim.?) large, mutually approximated above, rounded, excepting at the inner orbit, and there somewhat flattened or straight; anterior ocellus rather smaller than the others. Forceps-limbs sessile upon the distal border of the 9th ventral segment; the proximal joint (subim.?) short and largely dilated (perhaps = a divided ventral lobe), the 2nd joint the longest; integument transversely rugose and puberulose. Penis exposed, without apparent stimuli. Lateral margins of the abdominal segments somewhat flattened out in a small degree; the hinder lateral angles of the 9th segment of the ♂ produced into a short tooth-like spine, those of the other segments acute or subrectangular, not produced. Duration of subimago stage (*fide* Joly) about 30 minutes; last moult complete. *Nymph* predatory, agile; mandibles tuskless; fore tibia spurred, and strongly setose behind; 7 pairs of abdominal tracheal branchiæ inserted in notches in the hind margins of the segments near their lateral angles on the dorsum, all made alike but unequal in size, each one formed of a single obovate membranous lamina, intersected obliquely by a fine crease or strengthening rib, containing a pinnately branched trachea, and furnished at its hinder base with a fascicle of filaments; margin of the lamina minutely serrated. Setæ about $\frac{7}{10}$ as long as the body, the median plumose and the outer ciliated on their inner sides for upwards of half their length, and then tail-pointed. Palpi of both maxillæ 2-jointed.—Head relatively small, narrower than the thorax. Antennæ long and slender, setaceous and multiarticulate, the first two joints the stoutest. Labrum ciliate in front, hispid on the outer surface. Mandibles broad, their two fangs slender and acute, the innermost appendaged, and distant from the molar protuberance. Lacinia of 1st maxilla rounded and pilose externally, subtruncate and ciliate within, acutely pungent; stipes furnished with a small fascicle of tracheo-branchial filaments at the base outside; palpus stout, the second joint enlarged and densely pilose, the first joint glabrous. Lacinia of second maxilla semiovate, densely pilose, excepting towards the pubescent apex; palpus stout, the second joint enlarged, densely pilose, and about thrice as long as the first joint. Lobes of the labium well defined, but seemingly coherent, smaller than the lacinia of the maxillæ. Median lobe of the tongue, subrotund; paraglossæ rounded, pilose. Body proportioned

as in *Cloëon* or *Siphylurus*; the legs slender, trailed in the act of natation, which is effected by the setæ only. Fore femur and tibia bearded behind with long stiff hairs, which on the tibia are disposed in two rows longitudinally, and spread divergently; the tibial spur nearly as long as the tarsus, the shin or front of the tibia spinulose; the tarsus slender, bearded beneath. Prosternum at the joining of the head furnished on each side with a tuft of fibrillose tracheal branchiæ.

Distribution. South of France, the Garonne at Toulouse; also N. America, at Niagara.

Type. *J. Ræselii* (in *Palingenia*), Joly MS.

Etymology. Dr. E. Joly of Toulouse, who first discovered the animal.

JOLIA RÆSELII, Joly. Plate II. 9 (♂, wings [part], legs, forceps [subim. ?]).

Palingenia tolosana, Joly, MS. (1870). *P. Ræselii*, ! Joly, Mém. Soc. d. Sc. Nat. Cherbourg, xvi. 67, pl. i. 1 [excl. citations] (1872); idem, Bull. Soc. d'Etud. Sc. d'Angers, ann. 4-5°, p. 42, Note C [cited as *P. longicauda*, var.] (1876); idem, Rev. Sc. Nat. Montpellier, v. 309, 314, pl. vi. 3 (1876).

Jolia [type] *Ræselii*, Etn., Ent. Mo. Mag. xvii. 192 (1881). *J. Ræselii*, ! Vayssière, Ann. Sc. Nat. (6), Zool. xiii. 59, figs. 69-73 [nymph details] (1882).

Imago undescribed.—The ♂ specimen given me by Dr. E. Joly, for the British Museum, is in pieces preserved in alcohol. He considers it to be an imago; but the condition of the legs, forceps, and setæ is so nearly identical with that of the corresponding parts in subimagines of *Campsurus* and *Polymitarcys*, that I am not yet convinced of its being the adult fly.

Nymph.—Length of body about 11, setæ 6 and 4 mm.

Hab. The Garonne near Toulouse. The nymph harbours under large stones in swift parts of the river: I have obtained it just below the railway-bridge (pont d'Empalot) above the town. The fly was reared by Dr. E. Joly on 1st September, 1868, who named the nymph *Palingenia tolosana* in a paper read at a meeting of the Soc. d'Hist. Nat. de Toulouse, on the 15th July, 1870, and who altered the name to *P. Ræselii* the next year in another paper communicated to the Cherbourg society, cited above. In the plate illustrative of this later paper Dr. Joly reproduced four figures from older authors, which he tabulated as nymphs congeneric with *Jolia*, and in one instance identical with the French nymph. These are respectively, fig. 2 (after Swammerdam), *Palingenia longicauda*; fig. 3 (after Réaumur), *Cloëon rufulum*; fig. 4 (after Ræsel), a *Siphylurus*; and fig. 5 (after De Geer), a *Siphylurus*. Of these figures, nos. 3-5 had never before been supposed to represent any thing akin to *Palingenia*, and their citation as illustrative of species near of kin to *Jolia* is not only misleading, but also very depreciatory of the novelty of Dr. Joly's discovery. Réaumur's figure of the *Cloëon* and Ræsel's of the *Siphylurus* are not quite accurate, so far as they go; but their general effect is characteristic, and the accompanying letter-press affords additional means of ascertaining what were the subjects intended to be represented by them. De Geer's description is also conclusive.

POLYMITARCYS, Etn. 1868.

Illustrations. *Adult* (details), Pl. VI. 10 a-c; (whole figures) see citations under *P. virgo* and the other species, especially *Palingenia virgo*, Pict., Hist. Nat. Névropt. ii.

Ephém. pl. xi. *Nymph*, Pl. XXVIII. (whole figure and details); see also citations under *P. virgo*, especially of Réaumur (1742), Joly (Sept. 1876 and 1878), and Vayssière (1882).

Adult.—Discal cellules of the fore wing small and subquadrate; in the vicinage of the terminal margin the axillary nervures and the proximal branch of the anal nervure are strong, but in the neighbourhood of the fork of the anal nervure the neuration often assumes a feebler and rather closely reticulated texture; the nervures interposed between the anal (8) and pabrachial (7), or some of them, are liable to lose themselves in this reticulation on approaching the basis of the anal nervure, and nowhere in the wing are the nervures especially fasciculated. Fore leg of ♂ about as long as the head and body together, the tarsus much (3–5 times) longer than the femur, which is not $\frac{1}{4}$ as long as the tibia; the unguis nearly coequal, narrow, long, and flaccid. Aperture of the anterior thoracic spiracle ovate, narrowed below; that of the posterior spiracle ovate, narrow and elongate. Setæ in ♂ 2, in ♀ 3, equal; in the former sex about three times as long as the body, glabrous from the base nearly to the tip, and divaricate in the dried insect; in ♀ about $\frac{3}{4}$ as long as the body, and pubescent. Eyes of ♂ relatively small, oval, mutually remote; anterior ocellus much smaller than the others, which are unusually large in comparison with the eyes. Forceps-limbs sessile upon the border of the segment; the proximal joint short, somewhat compressed; second joint the longest. Penis exposed, the lobes straight, unarmed. Hinder lateral angles of the abdominal segments subrectangular. *Nymph* fossorial; mandibles tusked; fore tibia strongly bearded and minutely tuberculated behind, spurless; seven pairs of abdominal tracheal branchiæ inserted each on a lateral protuberance, armed with a minute tooth-like tubercle, situated a little in advance of the hinder lateral angle of the segment, arched upwards over the back; the first of the series different from the rest, being single, spatulate, and fringeless; the others mutually alike, double, with uniform unequal divisions,—each moiety a rather narrow, blunt, membranous lamina, folded together lengthwise once, and fringed with short simple fibrils. Setæ about $\frac{1}{2}$ as long as the body, plumose in the greater part of their length, and then tail-pointed. Palpi of both maxillæ 2-jointed.—Head hard, about as broad as the thorax; pronotum quadrangular; terminal margins of the fore wings free; body soft and tender. Antennæ setaceous, many-jointed, the first 2 joints stouter than the others. Labrum well developed, subquadrangular, rounded in front. Tusks of mandibles about twice as long as the head, echinate upon the upper surface, slightly connivent distally, each with a well-defined ensheathing beard of long spreading hair inserted in a curve on the outer base, also with a dense patch of shorter hair just at the commencement of the tubercles, and with some sparse pilosity over the rest of the upper side; the crown and lobes (or fangs) nearly at right angles with the tusk. Lacinia of first maxilla subquadrangular, widened from the base to the obliquely truncate crown, acutely pungent, ciliate at the inner margin, and crowned with a dense long beard: palpus stout and long; the first joint nude, and about $\frac{1}{2}$ as long as the second; second joint externally pilose, on the inner side strongly bearded, tapering from the middle to a point, and slightly curved. Lacinia of second maxilla broadly ovate, oblique, densely pilose: palpus stout; first joint nearly $\frac{2}{3}$ as long as the other, pilose outside in the

middle; second joint compressed, dilated distally, pilose outside, and on the inner side strongly bearded before the tip. Lobes of labium small, approximated to each other above. Tongue small, the median lobe subquadrate, obtusely prominent in the middle of its front edge; paraglossæ rounded, pilose. Fore leg short and strong, bearded and minutely tuberculated beneath the femur at the base, and at the back of the tibia; the tibia with a strongly circumscribed line of oblique spreading beard near its base outside, two rows of tubercles behind, and a single series of erect tactile hairs in front. Hinder legs slightly pubescent, but shortly pilose at the upper extremity of the femur, in front of the tibia, and on the dorsum of the tarsus. The nymph sometimes divaricates the outer setæ, and then their tips are bent so as to point behind. When the subimago alights to moult, the slough is cast off completely in about $\frac{3}{4}$ of a minute, the insect standing upon its four hinder legs, holding its fore legs apart off the ground, and its setæ a little apart from one another.

Distribution. Middle continental Europe southwards to N. Africa; Indo-Malay Region; S. Africa; N. America, from Canada (Niagara) to New Orleans.

Type. *P. virgo* (in *Ephemera*), Ol.

Etymology. πολύμιτος and ἄρκυς, from the closeness of the reticulation of the wings.

POLYMITARCYS VIRGO, Ol. Plate VI. 10 a (♂, head, legs, forceps, wings adult; fore leg subim.).

Hemerobius, Ephemera, &c.; Clut., Opusc. ii. title-page (woodcut) and pp. 61, 87, 90 (1634); Mey., in Gödard's *Metamorph. et Hist. Nat. Ins. i. Append.* pp. 193-200 (1662); Blégny, *Temple d'Esculape, An. 2^e*, p. 188 (1680); Targ.-Tozz., *Let. sopr. una numeros. sp. dei Farfalle vedut. in Firenze sulla metà di Luglio*, pp. 32, frontisp. figs. 1-5 (1741); Réaum., *Mém. pour serv. à l'hist. des Ins. vi.* 457-522, pls. xlii.-xliv. (1742); Schæf., 'Das fliegende Uferaa oder der Haft,' &c., p. 34 (1757); idem, reprinted in *Abhandl. von Ins. iii.* 30, pl. i. (1779); idem, *Ic. Ins. Ratisb. ii.* pl. clxxv. 1-3 (1776).

Ephemera virgo, Ol., *Enc. Méth. vi.* 419 (1791); Lat., *H. N. xiii.* 98 (1805); idem, *Nouv. Dict. H. N. x.* pl. xix. 5 (1847).—? *E. marocana*, Fab., *Ent. Syst. emend. iii. pars i.* 69 (1793).—† *E. lutea*, Seetzen, in Meyer's *Magaz. f. d. Thiergesch. i.* 41-3 (1794); Pz. in *Explic. Schæf. Ic. clxxv.* (1804).—† *E. albipennis*, Voigt, *Lehrbuch d. Zool. v.* 309-11 (1840); Blanch., *H. N. Ins. iii.* 54, pl. iii. 1 (1840); Ramb., *Névrop.* 296 (1842).

Palingenia †horaria, Burm., *Handb. Bd. ii. Abth. ii.* 802 (1839); idem, in D'Alton. *Zeit. f. Zool. &c. i. xiv.* pp. 109-12, t. i. 1-12 (1848); Hag., *Stet. ent. Zeit. xxvi.* 229 (1865); Leunis, *Synop. d. Naturgesch. d. Thierreichs &c. ed. ii.* p. 635 (1860); Loew, *Verh. zool.-bot. Gesellsch. Wien, xvi.* 947 (1866).—*P. virgo*, Pict., *Nat. Hist. Névropt. ii. Ephém.* 141, pl. ix.-xi. 3 (1843-5); A. & G. B. Villa, in *Economista*, p. 1-6, illustrat. (1847, November); Walk., *List of Neuropt. Ins. in Brit. Mus. part iii.* 547 (1853); Letzner, in *Arbeit. schles. Gesellsch.* p. 101 (1854); Brau., *Neuropt. Aust.* 25 (1857); Karsch, *Die Insectenwelt, v.* 400-1 (1863); Oulian., *Neuropt. &c. of Moscow*, p. 26 (1867); Ausserer, *Annuaire d. Soc. Natur. Modena, An. iv.* 132 (1869); N. Joly, *Mém. Acad. Sc. Inscript. Belles-Let. Toulouse (7), iii.* 379-386 [development] (1871, Sept.); ditto, *Ann. Sc. Nat. (5), xv. Art. x.* pgs. 5 (1871-2); ditto, *Compt. Rend. lxxxi.* 809 (1875); ditto, *Robin's Journ. Anat. and Physiol. xii.* 486-95, pls. i.-ii. (1876, Sept.); ditto, *Rev. Sc. Nat. Montpellier, v.* 305-330 (1876, Dec.); ditto, *Bull. Soc. d'Et. Sc. d'Angers, 1874-5*, p. 40, note A (1876); idem, *Compt. Rend. lxxxiii.* 809 (1877); ditto (translated), *Ann. & Mag. Nat. Hist. (4), xix.* 193-5 (1877); idem, *Mém. Acad. Sc. Inscript. & Belles-Let. Toulouse (separate)*, 10 pgs. pls. i.-ii. [development] (1878); idem, *Bull. Soc. d'Et. Sc. d'Angers, 1878-9*, p. 171 (1880).

Polymitarcys [type] *virgo*, Etn., Ent. Mo. Mag. v. 84 (1868, Aug.); Trans. Ent. Soc. Lond. (1871), 60, pl. i. 5 & iii. 15–15 *b* [details]; Palmén, d. Morphol. d. Tracheensyst. sect. i. pp. 1–21, taf. i. 1–7 (1877); Mocsary [vide *Ephemerum* under citations for *Palingenia longicauda* (1878)]; Rostock, Jahresber. d. Ver. f. Naturk. Zwickau, 1877, p. 81 (1878); Vayssière, Ann. Sc. Nat. (6), Zool. xiii. 43, figs. 9–12, & 80–80 bis [nymph] (1882).

Adult (in life), ♂.—Head whitish, tinged with grey above, the oculi and bases of the ocelli black, the hinder ocelli met interiorly by a fine curved fuscous line. Pronotum whitish, clouded more or less with grey, and on its front edge in two places on each side tinged with sepia-grey. Meso- and metathorax pale brown-ochreous or lutescent, their peaks and the decurrent membranes of the wing-roots whitish. Abdomen whitish, the dorsum clouded more or less with grey, especially at the tips of the segments, the last two ventral segments and the penis somewhat ochroleucous. Setæ and forceps white, the former pellucid, with opaque joinings. Wings white, the costa, subcosta, and radius of the fore wings grey. Legs white, the fore legs with a longitudinal streak from the base outside the coxa, the femur (all but the back of the knee) and the tibia blackish. The body of the ♀ is more completely pale brown-ochreous, before the eggs are discharged; afterwards the emptied abdomen is of a pale warm sepia-grey. Length of body, ♂ 10–11, ♀ 16–17; wing, ♂ 11–12, ♀ 16; setæ, ♂ im. 30–33, subim. 16, ♀ adult 13 mm.

Hab. In Europe, from Madrid, France, and the Netherlands, eastwards, inhabiting the chief rivers (*e. g.* the Seine at Paris, the Rhône at Lyons and Avignon, and the Garonne at Toulouse); perhaps in Morocco as well. During the last and the first quarters of the moon at the end of August and the early part of September, “la manne” occasionally swarms late in the evening over the water. Dr. E. Joly narrates the invasion of a milliner’s shop by them at Toulouse,—the flies thronging to the gas-burners and actually quenching the flames. Pictet’s figure of the ♂ fore leg is incorrect; he has given a fifth joint to the tarsus (seemingly by dividing the first joint) and has exaggerated the inequality of the unguis. Doubtless his subjects were dried.

POLYMITARCYS SAVIGNYI, Pict.

Ephemer, Sav., Descript. de l’Egypt. Hist. Nat. i. 194 [explic. ic.], ii. Névropt. 5 (1817).

Palingenia Savignyi, Pict., Hist. Nat. Névropt. ii. Ephém. 157 [undescribed] (1843–5); Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 550 [undescr.] (1853).

Polymitarcys Savignyi, ! Etn., Trans. Ent. Soc. London (1871), 61, pl. iii. 16, 16 *a* [details].

Imago (dried), ♂.—Pronotum warm sepia-grey, with a longitudinal median line and the front and lateral edges black; meso- and metathorax light brown-ochreous, probably varied above with warm sepia-grey (the specimen is eroded). Abdomen beneath and at the sides of the palest yellow ochre, becoming light brown-ochreous in segments 8–10; above, segments 1–7 are broadly shaded with light Vandyke-grey, with the edges of the dorsal vessel darker, and the joinings broadly whitish; in segments 8–10 the grey gives place to light Vandyke-brown, which in certain positions changes to violet-grey, and the sides of the segments are concolorous with the venter. Setæ and forceps white. Fore femur above, and the tibia, viewed in certain directions, violet-grey; the tarsus whitish; hinder legs with very pale yellow-ochreous femora, and the remaining parts whitish.

Wings transparent white, with opaque neuration; the costa, subcosta, and radius of the fore wing, up to the commencement of the pterostigmatic space, tinged with light purplish or violet-grey; a faint tint of the same colour is perceptible in the contiguous areas. Length of body 10, wing 11 mm.

Hab. The Nile, Egypt (Pictet & M^cLachlan, Mus.). The only example in this last collection was given to me by M. Pictet.

POLYMITARCYS INDICUS, Pict.

Palingenia indica, Pict., Hist. Nat. Névropt. ii. Ephem. 151, pl. xiii. 4 (1843-5); Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 549 (1853).

Polymitarcys indicus, Etn., Trans. Ent. Soc. London (1871), 61.

Subimago (dried), ♀.—Body in great measure ochreous, with a fuscous spot in the midst of the pronotum, three longitudinal fuscous lines (coincident with the sutures?) on the mesonotum,—one in the middle, the others directed towards the wing-roots,—and a broad violet dorsal stripe along the abdomen. Setæ ochraceous. Fore legs ochraceous, the tibia and a streak on the femur blackish; hinder legs white. Wing-neuration white; the fore wing tinted slightly with violet along the costa. Length of body 12, exp. of wings 30 mm. (After *Pictet*.)

Hab. East Indies (Vienna Mus.).

POLYMITARCYS ALBUS, Say.

Ephoron leukon, Will., Trans. Am. Soc. Philad. v. 71-3 (1802); Etn., Trans. Ent. Soc. London (1871), 124.

†*Baetis alba*, Say, West. Quart. Rept. ii. 305 (1823); Le Conte, Complete Writings of T. Say, i. 204 (1859); Hag., Proc. Ent. Soc. Philad. ii. 170 (1863); Walsh, op. cit. ii. 193, note 12 [in *Cloë A*] (1863).—*B. albus*, Etn., Trans. Ent. Soc. London (1871), 124; Hag., op. cit. (1873), 390.

? *Palingenia puella*, Pict., Hist. Nat. Névropt. ii. Ephém. 145, pl. xi. 4, 5 (1843-5); Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 548 (1853); Hag., Smithson. Miscell. Coll. (1861), Synop. Neuropt. N. Am. 40.—*P. alba*, id., op. cit. 40 (1861); id., Trans. Ent. Soc. London (1873), 391.

? *Campsurus puella*, Etn., op. cit. (1871), 58.

Imago.—Milk-white; pronotum yellowish white; fore legs greyish fuscous; hinder legs white; wings whitish, the fore wing greyish along the costa. Length of body 11-12; exp. of wing 22 mm.

Hab. Passaic river, Belville, New Jersey (*Williamson*); Winnipeg river (*Say*); North Red River and N. York (*Hagen*).

Second Series of Group I. of the Genera.

Adult.—Legs all functional, the hinder pairs rather short, the fore legs the longest pair in the ♂, and in the ♀ at least as long as the hind legs, but usually a little longer than these; femora shorter than the tibiæ; ungues efficient, unequal, those of the hinder tarsi mutually dissimilar. Valves of the thoracic spiracles straight-edged, usually closed in dried specimens. Proximal joint of ♂ forceps-limbs short, the second joint the longest. *Subimago* quiescent during many hours; the fore legs smooth; the last moult complete. *Nymph*.—Palpus of first maxilla long and slender, curved and 3-jointed. The 2-jointed palpus of second maxilla, dilated terminally and geniculated.

Section 3 of the Genera.—Type of *Ephemera*. *Adult.*—Wing-neuration complete and plentiful; in the fore wing the subcosta is displayed, the anal (8) is unequally sinuous, and, together with the second axillary nervure (9²) and the inner margin, encloses an almost semi-sagittate space; the first axillary nervure (9¹) is strongly arched towards its extremity; the second is essentially simple and very gently curved. Hind wings well developed, their membrane devoid of a contracted longitudinal fold. Setæ of moderate length in ♀, very long in ♂; in dried examples the outer setæ of ♂ are divergent from the median setæ (when there are three) or divaricate (when the median is aborted). Forceps-limbs inserted at the sides of the terminal border of a short transverse laminar lobe prolonged from the segment, which lamina is undeveloped in the ♀, their proximal joint shorter than the second, which is the longest joint. *Nymph* [*Pentagenia* (13) unknown] fossorial, with tracheal branchiæ inserted upon the sides of the respective segments in advance of the unprolonged hinder lateral angles, and arched upwards over the back with the tips turned posteriorly; median lobe of tongue emarginate. Legs short and strong; the fore tibia and femur pilose, the former compressed and obliquely truncate distally.

HEXAGENIA, Walsh, 1863.

Illustrations. *Adult*, Pl. VII. 11 *a*–11 *c* (details); (whole figures,) see citations of Guérin (1829–31), Gray (1832), and Rambur (1842), under *H. bilineata*; also of Pict. (1843–5) under *H. variabilis*. *Nymph* Pl. XXIX. (whole figure and some details) and Pl. LXIII. (other details); also Walsh, ‘American Entomologist,’ i. 6, woodcut (1868).

Adult.—Pronotum in ♀ longer than broad, enlarged posteriorly, inflated medially, slightly constricted at its anterior $\frac{1}{3}$ at the sides; its arched and curved hinder border rather prominent just in the middle, and somewhat retuse when dried. Fore leg of ♂ nearly as long as the body, the tibia about $1\frac{1}{3}$, the tarsus about $1\frac{2}{3}$ as long as the femur; ♀ fore femur but little shorter than the tibia, which is about as long as the tarsus. Thoracic spiracles elongate, their lips straight-edged or nearly so, usually closed in dried specimens; but sometimes the anterior gapes narrowly in front; its upper valve is much the larger and is strongly concave within. Median seta extremely rudimentary in both sexes; outer setæ generally upwards of $2\frac{1}{2}$ times as long as (in subimago about the same length as) the body, in ♀ about $\frac{2}{3}$ as long as it; when magnified their surface is minutely pubescent throughout, and their joinings are well defined. Terminal joints of forceps-limbs small. Lobes of penis strongly hooked, and without apparent stimuli. Abdominal segments of ♀ :—1 and 2 very short, the first thoracoid; 3–6 rather short, 7–9 longer, 10 short; 8 is the longest, and 9 about as long as 7. Anterior ocellus much smaller than the others. Eyes of ♂ suboval, curved, large, moderately distant from each other above. *Nymph* in the construction of its tracheal branchiæ, legs, and mouth-parts very similar to *Ephemera*; but the tusks of the mandibles are connivent, and the frons is armed with a single obtuse median protuberance. Abdominal segments 1–7 branchiferous; the gills all double, those of the anterior segments arising each from the upper surface of the pleural region of the segment in the hinder part of the same, but the gills of the seventh segment issuing from it near the base; the gill-roots armed (as

in several other burrowing nymphs) each with a minute tubercle; the divisions of the minute gills of the first segment are linear and fringeless; those of the gills of the other segments are larger, and are flat, ovate-lanceolate, acuminate, fringed, membranous laminae. Wings adnate to the notum along their inner margins only. Pronotum large, quadrangular, ciliated at the sides, which are nearly straight; its border in front and behind slightly thickened, and armed at the fore corners with single triangular points projecting forwards. Setæ acuminately plumose, a little more than half as long as the body. Ventral segments 7-10 of the abdomen, taken together, are about $1\frac{1}{3}$ as long as the rest put together.

Type. *H. bilineata* (in † *Baëtis*), Say.

Distribution. America, from Canada to Brazil; also India.

Etymology. ξξ and γενεά, on account of its being the sixth of the Sections of *Palingenia auctororum* defined by Hagen in 1863, and named by Walsh in that year.

The species of this genus and of *Ephemerella* might be described concisely from living specimens.

HEXAGENIA ALBIVITTATA, Walk.

† *Baëtis albivitta*, ! Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 566 (1853).

Palingenia continua, ! id., Trans. Ent. Soc. London, n. s. v. 199 (1860).—*P. dorsigera*, ! Hag. MS. (1861).

Hexagenia albivitta, ! Etn., *op. cit.* (1871), 64, pl. iv. 2, 2a [details]; Hag., *op. cit.* (1873), 392.

Subimago (dried).—Wings transparent pale smoke-grey with opaque black neuration; but the main nervures are pale near the base of the wings and in the hinder portion of the disk of the hind wings, with the exception of the subcosta of the hind wing, which is black up to the wing-roots.

Imago (dried).—Body above snow-white varied with black; the black forms a broad longitudinal stripe on each side of the pronotum, and encloses a large somewhat mitriform blotch on the meso- and metanotum; white predominates upon the dorsum of the abdomen, leaving a serrated black stripe above the spiracular line on each side (composed of a series of triangular spots, each with its hypotenuse descending obliquely from the hinder margin towards the lower anterior angle of the dorsum of the segment) and enclosing some small black intermediate markings in the anterior portion of some of the segments, viz. :—in both sexes a short longitudinal linear streak adjacent to the dorsal vessel in the last few segments, and in the ♀ in each of the segments 3-6 a pair of similarly situated triangular streaks, whose apices coalesce somewhat with the tips of the serratures of the lateral stripes; venter pale dull reddish sepia-brown with a longitudinal median testaceous streak, and with darker tips to the segments, or, in very faded specimens, pale dull lutescent with the overlapping borders of the segments paler. Setæ either fawn-colour banded with brown, or brownish with irregular dull yellow-ochreous bands. Wings in ♂ perspicuous, faintly tinted with very pale sepia-grey, paler in the ♀; neuration pitch-black. Legs in ♀ lutescent, the hinder tarsi with the terminal joint and ungues, and the extreme apical borders of the paler other joints reddish sepia-brown: the fore legs in ♂ fuscous, with all of the tarsal joints but the last black. Length of body 15; wing, ♂ 15, ♀ 17; setæ, ♂ im. 35, subim. 23 mm.

Hab. Buenos Ayres (*Hag.*); the Amazons Region (*Walk.*); Espirito Santo (M^cLach. Mus.).

HEXAGENIA MEXICANA, sp. nov.

Imago, ♂ (*dried*).—Wing-membrane transparent pitch-brown throughout, with black neuration, the hind wings rather the darker pair; most of the longitudinal nervures and cross veinlets are narrowly bordered with blackish, and this edging is widened along the cross veinlets in the midst of the wings; but the costa, subcosta, and radius, with their interjacent cross veinlets are not bordered in the fore wings. Thorax opaque pitch-brown; the pronotum with a broad longitudinal black stripe on each side. Abdomen discoloured; setæ brown-black; forceps pale, blackened towards their extremities. Fore legs with pitch-brown femur and tibia, the tarsus pitch-black; hinder legs flavescent, the femora towards their distal extremities, the borders of the extremities of the tibia and tarsal joints, the plantar surface, the last tarsal joint and the ungues, tinged more or less with pitch-brown. Length of wing 13 mm.

Hab. Mexico (Hagen Mus.), captured by Sallé; formerly represented in Baron de Selys-Longchamps's collection.

HEXAGENIA BILINEATA, Say. Plate VII. 11 *b*, 11 *b'* & 11 *b* ? (wings [part] and forceps).

‡ *Baëtis bilineata*, Say, Godman's West. Quart. Rep. ii. 303 (1824); Le Conte, Complete Writings of T. Say, i. 203 (1859).—*B. angulata*, ! Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 564 (1853).

Ephemera limbata, Serville MS., Guér. Iconograph. Règ. Anim. ii. part 1, pl. lx. 7-9, texte, iii. 384 (1829-31); Gray, Grif. Cl. Ins. ii. pl. xciv. 7 (1832); ! Ramb., Hist. Nat. d. Ins. Névropt. 295, pl. viii. 2 (1842).

Palingenia viridescens, ! Walk., *op. cit.* iii. 550 (1853).—*P. occulta*, ! id., *op. cit.* iii. 551 (1853); Hag., Smithson. Miscell. Coll. (1861), Synop. Neuropt. N. Am. 43.—*P. limbata*, id., *op. cit.* 43 (1861); Provancher, Natural. Canad. viii. 265 (1876); id., Fn. Ent. d. Canad. ii. fasc. i. 82 (1877).—*P. bilineata*, Walsh, Proc. Acad. Nat. Sc. Philad. (1862), 373; Hag., Proc. Ent. Soc. Philad. ii. 174-5 (1863); Walsh, *op. cit.* 189 & 199 (1863).

Hexagenia bilineata, Walsh, *op. cit.* ii. 199 (1863); ! Etn., Trans. Ent. Soc. London (1871), 66, pl. iv. 4 [detail]; ? Hag. MS., ! Lintar in 10th Ann. Rep. N. Y. State Commission of Fisheries, p. 3, pl. ii. 6 (1878).

Subimago (*dried*).—Wings transparent grey, with pitch-black neuration, the longitudinal nervures occasionally tinged with brown-ochre or bistre-brown close to the wing-roots; hind wings, as a rule, from just before the tip to the commencement of the inner margin bordered with dark grey in ♀, or black in the ♂, and sometimes with several of their cross veinlets near the midst of the wing edged with a like colour.

Imago (*dried*), ♂.—Pronotum bistre-brown, or sometimes pitch-brown, with a broad longitudinal dark bistre-sepia-brown, or sometimes pitch-black stripe on each side, which is extended upon the mesonotum to at least the wing-roots; mesonotum for the most part rufo-luteous or rufo-piceous, with the peak often pitch-black, and sometimes less rufescent on its hinder slopes, rarely of a uniform pitch-brown throughout; metanotum, as a rule, pitch-brown, but sometimes rufo-lutescent or even light brown-ochreous with the peak pitch-brown. Abdomen variable in depth of colour and definition of markings,

the ground-colour ranging from very light yellow-ochreous, or very light Mars-yellow, to light yellowish raw-umber; and the markings from pitch-black and intense burnt-umber brown to a slightly yellowish modification of intense Roman sepia-brown, approaching raw umber. The dominant pattern of the darker markings is, on the dorsum, a median longitudinal stripe and a diagonal lateral stripe extending from the stigma to the hind margin of every intermediate segment; that on the venter, in nearly every segment, is a pair of stripes extending, one on each side, from the hinder angles of the segment (or thereabouts) to the base of the segment, convergent towards each other, and in indirect continuity with the oblique dorsal stripes of the following segment. Some examples simply display this dominant pattern, and in them the light ground-colour in segments 2 to 8 is shown on each side of the median stripe in the form of two right-angled triangular spots occupying the upper anterior and the lower posterior halves of the space diagonally intersected by the lateral stripe; in segment 9 the lower posterior compartment is obscured; segment 10 has a small dark spot at the base in the middle, and no lateral stripes; the midribs of the subanal lobes are pitch-black. This dominant pattern undergoes the following modifications in individual specimens. The median stripe in segments 2-5 is dilated posteriorly so as to form a triangular spot in every segment; the triangular compartments of the quadrangular areas on each side of the median stripe have the angles adjacent to the diagonal stripes filled up with the dark colouring, so as to restrict the lighter ground-colour to oval spots above and ovate or linear spots below the diagonals, or to quadrangular spots in the anterior segments, and semiovate spots in the hinder segments above the diagonals, and a narrow bordering along the spiracular margin below the diagonals; in some examples the pale colouring below the diagonals is restricted almost completely to the hinder lateral angles of the dorsum; the additional colouring is apt to convert the latero-dorsal markings on each side into a broad zig-zag or serrated stripe. On the venter, the spaces included by the two convergent stripes, and the hinder border of nearly every segment are sometimes suffused with the darker colouring, leaving a light-coloured triangular space on each side of the segment external to the stripes; when this is not so, the stripes are sometimes dilated behind. There are often dark spots at the ganglia. Setæ variable in colour, their joints either uniformly or in a large measure bistre-, burnt-umber, or warm sepia-brown, often pale or light-ochraceous anteriorly, sometimes lighter at the joinings only, rarely dark and opaque at the joinings; all of the joints in the same individual specimen are much alike in coloration. Fore leg from trochanter to ungues usually in opaque view dark burnt-umber, changing with transmitted light to madder-brown, the first tarsal joint, the ends of the other tarsal joints and that of the tibia opaque; sometimes they are pitch-brown, or even bistre-brown, with the whole of the tarsus lighter and changing with transmitted light to warm sepia-grey; sometimes the basal portions of the intermediate tarsal joints are in a large measure whitish ochraceous, or the tarsus is nearly uniformly sepia-grey; one example has the tibia pitch-brown, black at the tip, the trochanter and femur intense bistre-brown, lighter above towards the base of the femur, and the tarsus light bistre-brown, with the first and terminal joints and the extremities of the intermediate joints pitch-black, the bistre changing in transmitted light to raw umber. Hinder legs in opaque view, flavescant

or light yellowish ochraceous; changing in transmitted light to light yellowish amber; the ungues, the terminal joint and the distal borders of the other joints of the tarsus, warm sepia, burnt-umber brown, or pitch-black, the dark colouring in the intermediate joints of the tarsus sometimes predominating almost to the exclusion of the light ground-colouring, at other times narrowly restricted to their terminal borders. Wing-membrane usually quite clear in the disk, bistre- or raw-umber brown in the marginal and submarginal areas of the fore wing, and narrowly grey or intense sepia along the terminal margin of the hind wing; but sometimes even those areas in the fore wing from the wing-roots to the pterostigmatic space are colourless, and the bordering of the terminal margin of the hind wing is either limited to a faint spot at the apex of the wing or is entirely deficient. The cross veinlets, which are liable to be bordered with black or grey in the subimago, are apt to exhibit corresponding greyish markings in the imago. Individual specimens occasionally have the greater portion of the wing-membrane tinted almost imperceptibly with greyish. Neuration of similar colour to that of the subimago.

The ♀ has the thorax nearly of the same colours as the ♂; the abdomen very light brownish ochraceous or burnt-umber grey, or vandyke-brown, marked with burnt-umber brown in the opaque portion, but with bistre in the empty terminal segments; the median dorsal stripe corresponds in variety of form with that of the ♂, the latero-dorsal stripes are of the broad serrated type, the ventral markings vary as in the ♂. Fore legs usually piceous, either entirely, or with the tarsal joints whitish at their bases; one example has the fore leg bistre-brown, with the terminal tarsal joint and the extreme edges of the others black. Hinder legs, in opaque view, light bistre-brown, sometimes with the tibia and tarsus darker than the femur; the terminal joint of the tarsus and sometimes the terminal borders of the other joints intense burnt-umber or piceous. Setæ light warm sepia-brown with opaque joinings, or sepia-grey with dark sepia joinings. Wings with transparent membrane and pitch-black or pitch-brown neuration, the longitudinal nervures becoming lighter close to the wing-roots; hind-wings commonly, but not invariably, bordered narrowly with dark sepia along the terminal margin and at the adjacent angles, the bordering uneven in its definition along its inner edge; fore wings often almost imperceptibly and narrowly tinted with very light sepia-grey along the corresponding margin, and more distinctly tinted with sepia-grey in the pterostigmatic region; in many examples the marginal and submarginal areas of the fore-wing, anterior to the bulla, are more lightly tinted with the same colour. Cross veinlets in the fore wing between the costa and the pabrachial (7) nervures, and those in the hind wing from the subcosta to the first axillary nervure (9), generally (but not in every specimen) bordered with light or dark sepia-grey; this bordering is usually lighter in colour and narrower in the fore wing than in the hind wing, and frequently forms irregular blots upon the stem of the sector (4), the end of the longest adventitious nervure contained within its fork, and upon the end of the corresponding nervure included within the fork of the præbrachial (6). Length of body, ♂ ♀ 16-23; wing, ♂ 14-21, ♀ 18-22; setæ, ♂ 44-65, subim. 21-25, ♀ 35-40 and 1, subim. 17 mm.

Hab. Generally distributed in North America, in lakes and rivers, from Louisiana

and Texas northwards, and from the Atlantic to the Pacific. June (or May in the South) to September.

HEXAGENIA MUNDA, sp. nov.

Imago (dried), ♂.—Thorax above light raw-umber, with a broad pitch-brown or intense sepia longitudinal stripe on each side of the pronotum, narrowly and less distinctly produced backwards nearly to the peak of the mesonotum; the tegulæ of the fore wings and the pectus and sides of the prothorax, together with the fore coxæ, yellow ochreous; metanotum partly piceous; intermediate coxæ in front and the fore part of the mesosternum piceous, or intense warm sepia; a lighter spot of the same colour occupies the joining of the meso-, and metasternum. Abdomen very light yellow ochraceous, marked with pitch-black above, and light burnt-umber beneath: the dorsal markings in segments 1-7 are a pair of broad stripes rising obliquely upwards from the base of the dorsum near the anterior lateral angles, one on each side of the back, rounded off posteriorly just before the distal border of the segment, and joined to each other in front and behind by a streak (in the anterior segments), or narrow band (in the hinder segments), of the same colour as the stripes, running respectively parallel with and adjacent to the joining and the apical border of the segment,—in short, a mark like the letter U closed by a line across the top, with arms of equal thickness; in segment 7 a broad longitudinal stripe occupies the middle of the space thus enclosed, whereas in the preceding segments only the dorsal vessel is there visible as a greyish line: segments 8 and 9 differ from segment 7 in their markings failing towards the anterior lateral angles of the segments. Ventrally, in segments 1-7, a light burnt-umber spot semielliptical in the hinder, but in the form of a small segment of a circle in other segments, extends almost across the whole of the apical border of each somite, and thence forwards no farther than the midst of the segment at the utmost, and that only in the anterior segments: in segments 8-10 the predominant colour is bright light brown-ochreous; the ganglionic track is blackened at the base of every segment. Setæ intense bistre-brown, lighter close to their insertion, their joinings very light, and some of their joints lighter anteriorly than at their distal extremities. Fore legs from the trochanter to the first tarsal joint pitch-brown, the trochanter and base of the femur lighter on their inner side; the intermediate tarsal joints pitch-brown distally, but warm sepia-grey in their proximal halves. Hinder legs light yellow-ochreous in opaque view, changing to very light yellow amber in transmitted light; the ungues, terminal joint, and the distal border of the penultimate joint of the tarsus warm sepia-brown or intense burnt-umber. Wings transparent, almost uniformly tinted with extremely light bistre-grey; the marginal and submarginal areas of the fore wing distinctly bistre-grey; the terminal margin of the hind wing very narrowly tinged with light greyish: longitudinal neuration bronzy raw umber-brown, becoming light yellowish at the wing-roots, and in part appearing black in certain lights; cross veinlets black, bordered narrowly with blackish in the same parts of the wings as in *H. bilineata*. Length of body 18; wings 14; setæ 35 mm.

Hab. Morganton N. C. (Mus. Comp. Zool., Cambridge, Mass.).

HEXAGENIA VENUSTA, sp. nov.

Subimago (dried), ♀.—Wings dull light brown-ochreous, with black, usually immarginate cross veinlets. Setæ uniformly light brown-ochreous. Legs brown ochreous, with tarsi and the extremity of the fore tibia intense burnt-umber brown.—*Variation*. Tarsi in a large measure concolorous with the rest of the legs; but the ungues, terminal joint, and the extreme distal edges of the other joints of the tarsi, and also a broad band at the extremity of the fore tibia, dark burnt-umber.

Imago (dried), ♂.—Thorax either very light yellowish bistre-brown, or light brown-ochreous, varied on the meso- and metanotum with light yellow-ochreous, and with a light purple-madder stripe on each side from the edge of the occiput to the fore wing-roots. Abdomen translucent whitish chrome-yellow in segments 2–8, and then posteriorly darker, marked in light purple-madder with the same pattern as the ♀; but in segments 7–9 the dorsal vessel is edged to a greater or less extent with purple-madder: again, the ventral median stripe is prolonged to the prosternum, and in every abdominal segment but the last two contains a pair of pale dots placed transversely in, or a little behind, the middle of the segment; also at the bases of the respective ventral segments, close to the joinings 2–8 and the spiracular borders, in the extreme anterior lateral angles of the segments, are small triangular light purple-madder spots, one spot in each angle. Setæ marked with nearly the same colours as the abdomen, the purple-madder coinciding in certain cases with the joinings, in others with the distal terminations of the joints, in others with the whole of every fourth joint as well so as to form bands of colour each about a joint and a half in breadth in addition to rings; in one example the bands are nearly two and a half joints broad. Fore legs madder-brown, or purple-madder, with the tibia brighter than the femur, and the tarsus dull, uniformly dark in joints 1 and 5, but whitish towards the bases of joints 2–4. Hind legs translucent whitish chrome-yellow, like the abdomen; the terminal joint and the lower point of the penultimate joint of the tarsus, light purple-madder. Wings transparent, and in a large extent tinted almost imperceptibly with light yellowish, but coloured distinctly with raw-umber in the marginal and submarginal areas of the fore wing (this colour receding slightly from the costa between the cross veinlets in the proximal half of the marginal area so as to leave the membrane clear thereabouts, and not extending nearer to the wing-roots than the great cross vein), and sometimes with a more or less narrow blackish-grey bordering along the terminal margin of the hind wing: neuration of diverse colours, the costa, subcosta, and radius outside the great cross vein of the fore wing dark pitch-brown, the remainder of the longitudinal nervures light yellowish (inclusive of the bases of those three); cross veinlets black, sometimes narrowly edged with blackish in the customary parts of the wings, but not so as to form spots.

♀. Body yellow-ochreous marked with violet-grey, viz. :—with a stripe on each side of the pronotum reaching to the wing-roots; on the dorsum of the abdomen, in segments 1–8 a series of oblique triangular spots, on each side one in every segment, the triangles truncate posteriorly, and in segments 1–4 reaching from base to joining, but in the others not starting from the base of the segment; in segment 9 the corresponding spots are

reversed; also in segments 8 and 9 a broad median longitudinal streak from the base, vanishing beyond the middle of the segment before the joining; also a large spot occupying almost the whole of segment 10: beneath, a ventral stripe, dilated in the metasternum, but linear in the abdomen, and somewhat blackened at the joinings, extends backwards to the ninth abdominal segment; the midribs of the perinæal lobes are of the same dark colour. Setæ uniformly very light yellow-ochraceous. Fore leg light brown-ochreous, the tibia and tarsus rather lighter than the femur; unguës, terminal and first joints, and narrowly the distal margins of the other joints of the tarsus, also the distal extremity and the joining at the knee of the tibia, dark Roman-, or warm sepia-brown. Hinder femora yellow-ochreous or light Mars-yellow, changing in transmitted light to dull yellowish-amber colour; tibiæ and tarsi lighter; the terminal joint and lower distal borders of the next two joints of the tarsus very light purple-madder, the larger of the unguës much darker. Wings more of a dull light-yellowish amber than those of the subimago; their longitudinal neuration light-yellowish ochraceous, or sometimes light Mars-yellow, the cross veinlets, and the great cross vein of the fore wing black, as also are the bullæ of the subcosta and radius. Length of body, ♂ 15-18, ♀ 22-23; wing, ♂ 15, ♀ 17-23; setæ, im. ♂ 44, ♀ 27-28 mm.

Hab. Texas, Dallas, Waco, and W. Texas (*Belfrage*), in May; Utah Lake (in M^oLach. Mus. and Mus. Comp. Zool. Cambridge, Mass.). In 1871, having no ♂ im., I failed to distinguish this species from *H. variabilis*.

HEXAGENIA VARIABILIS (renamed). Plate VII. 11 *c* (wings, legs and ♂ forceps)
[*H. limbata*].

Palingenia † *limbata*, Pict., Hist. Nat. Névropt. ii. Ephém. 146, pl. xii. (1843-5); Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 548 (1853); ! Walsh, Proc. Acad. Nat. Sc. Philad. (1862), 373; Hag., Proc. Ent. Soc. Philad. ii. 176 (1863); Walsh, *op. cit.* p. 199 (1863),—*P.* † *bilineata*, ! Hag., Smithson. Miscell. Coll. (1861), Synop. Neuropt. N. Am. 41.

Hexagenia [type] † *limbata*, ! Walsh, Proc. Ent. Soc. Philad. ii. 197 (1863); ! Etn., Ent. Mo. Mag. v. 85 (1868); ! id., Trans. Ent. Soc. London (1871), 65, pl. i. 7 & iv. 3, 3 *a* [details].

Subimago (dried).—Wings of ♂ somewhat greyish, of ♀ dull light yellowish, the marginal and submarginal areas of the fore wing coloured more or less intensely with light bistre-brown or brown-ochreous, and the hind wings in the ♂ along the terminal margin from just round the apex of the wing to the commencement of the inner margin bordered with warm sepia-grey: longitudinal neuration yellowish or very light bistre-grey; cross veinlets black, commonly with dark borders in the usual parts of the wings, these borders narrow and blackish in the fore wing, and rather wider as well as more nearly warm-, or Roman-sepia brown in the hind wings. In some specimens the markings are extensively blurred in the hind wings, imparting a warm sepia-grey cloud to the whole of the membrane excepting at the base of the wing, where the light yellowish tint is stronger than in the fore wing.

Variation, ♀.—Wings free from markings; the membrane uniformly light bistre-grey, very faintly tinted with yellowish in the hind wings; cross veinlets in most of the disk of the fore wings, and those in the hind wings less decidedly blackened than in the ♂;

in certain positions, while the subcosta, radius, and præbrachial nervures of the fore wing remain yellowish, other finer longitudinal nervures appear greyish (Galena).

Imago, ♂ (living).—Eyes bright greenish yellow above, black below (*Walsh*).—(*Dried.*) Pronotum translucent, sometimes tinged with bistre-grey overlying yellow-ochre, traversed lengthwise on each side by a light burnt-umber or pitch-brown streak reaching from the occiput to the fore-wing roots. Meso- and metanotum of a colour intermediate between light brown-ochre and Mars-yellow, varied posteriorly with the former colour. Abdomen varying from light yellowish-ochre, or light raw-sienna, to light brown-ochre, marked on the dorsum with dark madder-brown, and on the venter with intense burnt-umber, the form and extent of the markings presenting much variation. In strongly marked specimens the dorsal pattern consists of a median stripe the whole length of the back, with a jagged stripe on each side of it: the median stripe may maintain a nearly even width in every segment; sometimes in segments 1 and 2 the whole of the dorsum (excepting at the joinings) is dark, in segments 3–6 (whose joinings are also pale) the median stripe is narrowed in every segment from behind forwards so as to be resolved into a series of triangular blotches, while in segments 7–9 its breadth is more equal, and it terminates in a spot at the base of segment 10; but in ill-marked specimens both median triangles and stripe are either deficient, or reduced to a linear streak along the dorsal vessel in segments 7–10. The lateral stripes of the dorsum in strongly-marked specimens are each composed of a series of diagonal triangles or of diagonal stripes extended forwards from the hinder borders, nearly in the middle, to the anterior angles of the segments, which stripes in segments 7–9 are sometimes confluent posteriorly with the median stripe; in some specimens the triangles, instead of tapering forwards, are reversed; in ill-marked specimens the stripes are almost linear. Pectus and ganglionic track intense burnt-umber, the latter sometimes ill-defined; in segments 2–9 at each anterior lateral angle is a small triangular spot of the same colour. Setæ light Roman-sepia brown, many of their joints becoming whitish yellow-ochreous anteriorly in varying extent; sometimes the lighter colour is predominant, and, in the midst of the seta, only every fourth joint and more or less narrow annulations at the distal extremities of the other joints remain of the darker colour. Fore leg as an opaque object madder-brown from the trochanter to the end of the tibia, but slightly blackened at the extreme distal border of the femur and at the base of the tibia; tarsus lighter; the terminal and proximal joints of the tarsus, the tips of its intermediate joints, the ungues, and the distal extremity of the tibia, blackish, or intense burnt-umber; viewed with transmitted light the femur and tibia appear fuscous. Hinder legs as opaque objects very light brown-ochreous, but as transparencies light amber-yellow; the ungues, terminal joint, and the tips of the other joints of the tarsus intense burnt-umber brown. Wings transparent, the fore wings very slightly tinted, the hind wings tinted, sometimes as slightly, sometimes more strongly, with light greenish yellow; the marginal and submarginal areas of the fore wing exterior to the great cross vein, and the longitudinal neuration raw-umber brown, the colouring sometimes receding from the costa towards the subcosta; cross veinlets of the fore wing black, and those in the basal two thirds of the wing between the costa and pabrachial nervure (7)

bordered narrowly with blackish. Hind wing with similarly pale longitudinal and dark transverse neuration, and with nearly all the cross veinlets bordered with blackish; the terminal margin not perceptibly bordered with colour darker than that of the disk. (Texas.)

Variation.—In the fore wing the dark borders to the cross veinlets are obsolete, and those in the hind wing are much reduced in width. Both wings are quite free from all tint of discoloration in the disk; the marginal and submarginal areas of the fore wing are greenish grey or light umber-grey; the terminal margin of the hind wing not bordered with dark colouring. (Washington, D. C.)

Variation.—Both wings are tinted alike throughout in the disk; the marginal and submarginal areas of the fore wing are tinted with umber-brown; the hind wings are bordered with black-grey along the terminal margin: the edgings of the cross veinlets, mostly linear in the hind wing, are obsolete in the disk of the fore wing, but between the great cross vein and the pterostigmatic region of this wing exist as a small rounded spot on every cross veinlet, the roundness of the spots diminishing towards the pterostigma. (Utah Lake.)

Variation.—Wing membrane faintly and uniformly tinted in both wings; no dark bordering along the terminal margin of the hind wing; no bordering perceptible along the cross veinlets of the marginal and submarginal areas, next to none along those in the disk of the fore wing, and hardly any along those of the hind wing. (New England.)

Variation.—Very similar to the foregoing; but some faint indications (as spots) of bordering in the marginal and submarginal areas of the fore wing, narrow sharply defined edging to the other usually bordered cross veinlets, and a grey-black bordering along the terminal margin of the hind wing. Hind legs in their general colouring duller than usual. (Detroit, Mich.)

♀ *imago* (*dried*).—Integument of pronotum translucent very light bistre-grey overlying yellowish-ochre; the rest of the notum, ranging in colour from dark yellow-ochre or dull Italian-ochre to light brown-ochre, is varied with Roman-sepia at the projecting peaks; the light Roman-sepia streak extending backwards on each side of the notum from the occiput is broadest at the hinder part of the pronotum, is much narrowed in front, and is not clearly traceable (though sometimes faintly indicated) on the mesonotum. Dorsum of the abdomen marked longitudinally with a median sepia or warm-sepia stripe, extending from the first segment to very nearly the hind margin of the tenth: in segments 1-5 this stripe is dilated posteriorly so as to form an acutely triangular blotch in each of them; in segment 6 the corresponding triangle is more slender and truncate; in segments 7-9 the stripe in each segment maintains more nearly an evenness of width; but it tapers to a point behind in segment 10. From the median stripe in every segment but the last, on each side of the dorsum, in the vicinage of the hinder border, a tapering streak of a like colour extends obliquely forwards and downwards, either diagonally (as in segments 1-6) or (as in the longer segments 7-9) towards the spiracular border, gradually further and further away from the anterior angle of the dorsum in successive segments. Venter traversed lengthwise, or at least in segments 8 and 9, by a median linear stripe similar in colour to the dorsal markings. Setæ very light yellowish ochraceous. Fore femur

and both extremities of the tibia madder-brown; the rest of the tibia and most of the tarsus in opaque view light brown-ochreous, or in transmitted light yellowish amber-colour, but the ungues, terminal joint, distal borders of the intermediate joints, and the whole of the proximal joint of the tarsus blackish or intense burnt-umber. Hinder legs and wings nearly as in the lighter variations of the σ , the cross veinlets being immarginate: marginal and submarginal areas of the fore wing uniformly tinted with very light amber-yellow. Length of body, σ 14–16, ♀ 18–24; wings, σ 13–15, ♀ 17–24; setæ, σ im. 36–46, subim. 23, ♀ im. 26, subim. 23–25 mm.

Hab. Widely distributed in the United States: Utah Lake; Texas; Lake Harney, Fla.; St. Louis, Miss.; Galena and Rock Island, Ill.; New Red River; Detroit, Mich.; New England; Philadelphia, Penn.; and Washington, D. C. (Mus. Com. Zool. Cambridge, Mass.; Hag. Mus.; M^eLach. Mus.).

EPHEMERA, Linn. 1746; restricted, Leach, 1815.

Illustrations. *Adult*, Pl. VIII. 12 a–d (details); (whole figures) see citations under *E. vulgata*, *danica*, *lineata*, and *glaucops*, especially those referring to Pictet (1843–5), Curtis (1838), and Stephens (1835). *Nymph*, Pl. XXX.; see also citations under *E. vulgata* of Guérin (1829–43), Gray (1832), Blanchard (1868), and Vayssière (1882); also under *E. danica*, of Pictet [pls. 1 & 2] (1843–5).

Adult.—Pronotum in ♀ somewhat transverse, tumescent above, about as wide as the head behind but narrower in front; the anteriorly convergent lateral borders slightly constricted at about their first $\frac{1}{3}$, and suddenly rounded off at the angles in front and behind; the arched and sinuous hind margin slightly retuse in the middle, and a little everted at the lateral angles. Fore leg of σ about $\frac{4}{5}$ as long as the body, tibia $2\frac{1}{2}$ or 3 times as long as the femur, the tarsus about 4 times as long as the femur; ♀ fore femur about $\frac{3}{4}$ as long as the tibia, and subequal in length to the tarsus. Thoracic spiracles straight lipped, relatively smaller than in *Hexagenia*, usually closed in dried specimens, but sometimes the anterior gapes narrowly. Median seta about as long as the others in both sexes; outer setæ in σ about twice as long as the body, in σ subim. and in ♀ im. nearly of the same length as the body: under a lens they appear pubescent throughout, and their joinings are well marked. Last two joints of forceps limbs well developed. Lobes of the penis usually flattened, and oblique at the ends through prolongation of the thickened outer lateral border, but deviating from this European type in some exotic species; stimuli, when present, inferior, subulate and slender. Abdominal segments of ♀ :—1–4 relatively short, the first thoracoid, 5 rather longer, 6–9 long, 10 short; segment 8 is subequal to 7, and rather longer than 9; segment 7 is a little longer than 6; segments 6–10 together constitute about $\frac{2}{3}$ of the abdomen. Anterior ocellus much smaller than the others. Eyes of σ oval, their inner orbits curved, mutually remote above. *Subimago* quiescent for about 24–36 hours, standing with erect connivent wings upon its hinder legs, the fore legs prorect off the ground, and the setæ placed close together, the outer either above or below the median seta. *Nymph*.—Head narrowed anteriorly, and armed in front with two conical projections; mandibles tusked, the tusks

subulate, curved slightly upwards and towards their extremities outwards, their tips interlocking when the jaws are closed. Antennæ setaceous; the first two joints the stoutest, the former minutely pubescent, the latter more strongly so; flagellum pilose near the base, with spreading hair disposed in whorls diminishing successively in length, and becoming very short and minute beyond the middle. Wings and gills as in *Hexagenia*. Pronotum slightly narrowed in front and behind, evenly curved at the sides, and armed in front with a strong triangular projection behind each of the eyes. Setæ in a great measure plumose, and then shortly tail-pointed with whorls of minute spreading hair; their length is nearly $\frac{2}{3}$ that of the body. Ventral segments 7-10 together are almost $\frac{1}{2}$ as long as the abdomen.—Labrum quadrangular, rounded at the fore corners, emarginate in front, and pubescent. Lobes (or fangs) of the mandibles adjacent to the molar tuberosity, and set at right angles with the tusk, which is minutely spinulose above for some distance from the base, and partially pilose. Lacinia of 1st maxilla small, narrow, and incurved, terminated by a few spines, strongly ciliated internally, and partially pubescent outside from the middle to the point; the 3-jointed palpus about three times as long as the lacinia, slender; its nude first joint nearly $\frac{1}{2}$ as long as the remainder, the second almost as long as the third, and similarly pilose with spreading hair. Labium and 2nd maxillæ deplanate, the former small, its lobes narrowly ovate and close together. Lacinia of 2nd maxillæ large and oval; the palpi robust, their first joint flattened, tapering from a wide base, and ciliated within; the second joint incurved, dilated distally, obliquely truncate at the extremity, the truncated surface hispid, the outer surface pilose. Median lobe of tongue semitrifid; paraglossæ rounded, well developed and distally ciliated. Legs pilose along the edges of the femur, the front of the tibia, and the dorsum of the tarsus, and densely hirsute at the back of the tibia; the sole of the tarsus pubescent; the anterior tibia minutely spinulose behind; the femora are compressed, the tibiæ distally dilated and oblique at the ends, where the hind tibia is produced into a spine.

Type. *E. vulgata*, Linn.

Distribution. Northern temperate and Indian regions; also (undescribed sp.) New Zealand.

Etymology. ἐφήμερος (ἐπι and ἡμέρα), from the supposed shortness of life of the imago. Ancient authors in southern Europe probably wrote of *Polymitarcys* under this name, if not of *Oligoneuria*.

I have seen nymphs of *E. vulgata*, *danica*, and *lineata* alive, and of *E. glaucops* and *japonica* in alcohol. In swimming they labour with their legs and progress rather slowly, propelled chiefly by undulations of the body and setæ.

EPHEMERA VULGATA, Linn. Plate VIII. 12 b (wing [part] and penis).

[*Ephemera*] or *Ephemera vulgata* [Linn., Fn. Suec. ed. i. no. 750 (1746); De G., Mém. Sav. Etr. Acad. Paris, ii. 461-9, pl. xvii. 1-2 (1755)]; Linn., S. N. ed. x. i. 546 (1758); idem, Fn. Suec. ed. ii. no. 1472 (1761); Sulzer, Die Keutz. d. Ins. 43, pl. xvii. 103 (1761); [Geof., Hist. Abr. Ins. Paris, ii. 238, no. 1 (1764)]; Müll., Fn. Ins. Fried. 63 (1764); Pontop., Naturh. Dan. 223, pl. xvii. (1765); Schæf., Elem. Ent. tab. lxii. 1-3 (1766); Linn., S. N. ed. xii. pars ii. 906 (1767); Houttyn, Nat. Besch. d. Ins.

(1766-9); De G., Mém. d. Ins. ii. pars ii. 621, pls. xvi. and xvii. 1-10 (1771); Berkenhout, Outl. Nat. Hist. Gt. Brit. and Ireland (1769-72); Fab., Syst. Ent. 303 (1775); [Schäf., Ic. Ins. Ratisbon. i. pl. ix. 5-6 (1776)]; Müll., Zool. Dan. Prodr. 142 (1776); Schr., Enumer. Ins. Austr. indig. 602 (1781); Fab., Sp. Ins. i. 383 (1782); Fourc., Ent. Paris, ii. 351 (1785); Fab., Mant. Ins. i. 243 (1787); Berkenhout, Outl. Nat. Hist. Gt. Brit. &c. ed. ii. i. 150 (1789); Vill., C. Linn. Ent. iii. 16 (1789); [Zsch., Mus. Lesk. i. 150, no. 13 (1789)]; Gmél., Linn. Syst. Nat. ed. xiii. i. pars v. 2628 (1790); Ros., Fn. Etrusc. ii. 7 (1790); Ol., Encyc. Méth. vi. 417 (1791); Fischer, Versuch e. Naturgesch. v. Livland, 337, no. 564 (1791); Fab., Ent. Syst. emend. iii. pars i. 68 (1793); Schr., Fn. Boica, ii. pars ii. 196 (1798); Cederhjelm, Fn., Ingric. Prodr. 134 (1798); Walck., Fn. Paris, ii. 8 (1802); Lat., Hist. Nat. Crust. & Ins. xiii. 94 (1805); Panzer, in Explic. Schäf. Ic. ix. 5-6 (1804); idem, Fn. Ins. Germ. initia, Heft xciv. 16 (1805); Shaw, Gen. Zool. vi. part ii. pl. lxxxii. (1806); Lat., Gen. Crust. & Ins. iii. 184 (1807); Leach, Brewster's Edin. Encyc. ix. 137 (1815); Cuv., Règn. Anim. ed. i. iii. 430 (1817); Lamarek, Hist. Nat. d. Anim. s. Vertèb. ed. i. iv. 221 (1817); Stewart, Elem. Nat. Hist. ed. ii. ii. 225 (1817); Cuv., Règn. Anim. ed. ii. v. 244 (1829); Guér.-Mén., Iconogr. Règn. Anim. ii. pars i. t. lx. 8 [aquat.] (1829-43); Gray in Griffith's Anim. Kingd. ii. pl. xciv. 8 [aquat.] (1832); ! Steph., Ill. Brit. Ent. vi. 55 (1835); [! Ronald's Fly-fish. Ent. ed. i. pl. xiv. 30-31 (1836)]; Dahlbom, Kort. Underättel. om Skandin. Ins. 228 (1837); Perch., in Guér., & Perch. Gen. d. Ins. &c. livr. vi. pl. iv. 1 m. (1838); Burm., Handb. d. Ent., Bd. ii. Abth. ii. 804 (1839); Zet., Ins. Lap. 1044 (1840); Voigt, Lehrb. d. Zool. v. 311 (1840); Blanch., Hist. Nat. d. Ins. iii. 53 (1840); Duf., Mém. par divers Savans, Institut. d. France, viii. 580, note (1841); Lat., Nouv. Dict. d'Hist. Nat. x. 348 (1847); ! Walker, List of Neuropt. in Brit. Mus. part iii. 354 (1853); Leunis, Synop. d. Naturgesch. d. Thierr. ed. ii. 635 (1860); Karsch, Die Insectenwelt, v. 400 (1863); Hag., Ent. Ann. (1863), 14; Stein, Berlin. ent. Zeit. vii. 414 (1864); Hag., Stet. ent. Zeit. xxvi. 229 (1865); Blanchard, Metamorph &c. des Ins. 594 pl. [nec p. 127] (1868); Rostock, Berlin. ent. Zeit. xii. 225 (1868); ! Etn., Trans. Ent. Lond. (1871), 68, pl. i. 9 & iv. 5 (details); Girard, Traité Elem. d'Ent. part ii. fasc. i. (1876); Boulytchhoff, Bull. Soc. Oural. Sc. Nat. Ekaterinb. iv. 37 (1878); Rostock, Jahresb. d. Ver. f. Naturk. Zwickau, 1877, p. 83 (1878); Vayssière, Ann. Sc. Nat. (6), Zool. xiii. 38, figs. 3-7 & 53 [nymph and details] (1882).—*E. maculata*, Linn., Syst. Nat. ed. v. p. 62 (1747).—*E. communis*, Retz, C. de G. Gen. and Sp. Ins. 56, no. 180 (1783).—! *E. † danica*, Ronald's Fly-fish. Ent. ed. v. no. 31 (1856).

Subimago (living).—Wings at first yellowish green or greenish grey, changing to cinereous, broadly tinged with black-grey along the anterior and terminal margins, the discal spots fuscous or piceous, the cross veinlets edged with ivory-black in the male, the neuration dark. Notum ultimately black, but at first varied with luteous, when the pronotum has a black longitudinal stripe on each side, the mesonotum a large rhomboidal luteous spot prolonged at each end into pair of curved streaks, and the luteous metanotum has a pair of L-shaped black marks. Setæ brown-black.

Imago (living).—♂. Head black-brown, the antennæ paler at the base; eyes deep sepia-brown with a pale equator. Pronotum dull greyish olivaceous, with a faint trace of the lateral stripes of the subimago: the joining of the head and prothorax and the pleura of this last, as well as the tegulæ, greenish yellow. Meso- and metanota jet-black. Abdomen very pale olivaceous, with pitch-brown markings, sometimes tinged with luteous or yellow-ochre at the tips, joinings, and in the middle line of some of the hinder segments; the dorsal markings are a pair of curvilinear triangles, broadest at the base of the segment, and ending abruptly at its thickened hinder margin, and a pair of fine curved longitudinal lines interposed between them, which are often effaced; ventral markings, a pair of subparallel fine longitudinal abbreviated black lines, and between them, near the base of the segment, two shorter lines convergent forwards towards one another;

the last segment greenish black above, olivaceous at the sides; eighth and ninth segments often lutescent or ochraceous beneath. Wings pale greenish grey-tinted or yellowish green-tinted with black neuration; many of the cross veinlets away from the terminal margin bordered with pitch-brown, their bordering forming (through confluence) spots in the midst of the fore wing, and a blotch nearer the base of the wing, and also confluent in the submarginal area near the base; hind wings broadly grey-tinted along the terminal margin. Legs olivaceous or olive-brown; fore femur pitch-black, tarsus brownish; hinder tibiæ and tarsi more or less deeply tinged with brown-ochre or lutescent, with the extremity of the last tarsal joint and the ungues dark. Forceps and setæ pitch-brown or lutescent, the former with the apices, the latter at the joinings black-tinted.

♀. Very like the ♂, but with the upper half of the oculi pale olivaceous, and the under half dark sepia-brown. Pronotum jet-black. Fore femora olive-brown, the tibia and tarsus tinged with brown-ochre or lutescent, with the tips of the tarsal joints and the ungues darker. Wings paler than in the ♂; there is sometimes a spot in the midst of the hind wing.

In ill-marked examples of either sex curved lines take the places of the triangular abdominal streaks.

Length of body 14–22; wing, ♂ 16–17, ♀ 18–24; setæ, ♂ im. 33 & 34–32 & 36, subim. 16 & 17–19.5 & 21; ♀ im. 22 & 24–26 & 26, subim. 17 & 16–18 & 19.

Hab. In Europe, from Bavaria, Switzerland, and the middle of France, northwards to Lappmark; May, June, and part of July. Dr. Hagen forwarded an *Ephemera* obtained in Eastern Siberia, very similar to, if not identical with, *E. vulgata*, but having the hinder legs much lighter in colour than the normal European insect. Some specimens from Saxony and Posen (in M^eLach. Mus.) have the wings more strongly tinted, and the bordering of the cross veinlets rather broader than is customary in English examples.

EPHEMERA DANICA, Müll. Plate VIII. 12 *a* (wings, legs, forceps).

Ephemera danica, Müll., Fn. Ins. Fried. 63 (1764); id., Zool. Dan. Prodr. 142 (1776); Vill., C. Linn. Ent. iii. 18 (1789); [*Ephemera*, ! Ronald's Fly-fish. Ent. ed. i. pl. xiii. 28–29 (1836);] Walk., List of Neuropt. in Brit. Mus. 535 (1853); Hag., Ent. Ann. (1863), 15; ! Etn., Trans. Ent. Soc. Lond. (1871), 72, pl. iv. 8, 8 a [details]; Rostock, Jahresb. d. Ver. f. Naturk. Zwickau, 1877, p. 82 (1878); Meyer-Dür, Bull. Soc. Ent. Suisse, iv. 306 (1874).—*E. † maculata*, Vill., C. Linn. Ent. iii. 22 (1789).—*E. † vulgata*, Scop., Ent. Carn. 263 (1763); Don., Nat. Hist. Brit. Ins. iv. 53, pl. cxxviii. (1795); Sam., Ent. Comp. 260, pl. vii. 2 (1819); Wood, Ill. Linn. Gen. Ins. ii. 21–23, pl. xlvii. (1821); Duméril, Cons. Gen. s. la Cl. des Ins. 204, pl. xxviii. 4–5 (1823); Newport, Todd, Cyclop. f. Anat. & Physiol. ii. 864, fig. 345 (1839); Westw., Introd. ii. fig. 61, 1 [the abdominal spots hind before] (1840); Blanch., Hist. Nat. des Ins. iii. 53 (1840); ! Ramb., Hist. Nat. des Ins. Névropt. 293 (1842); Pict., Hist. Nat. Névropt. ii. Ephém. 126, pls. i.–vi. (1843–5); Blanch., Cuv. Règ. An., éd. Crochard, xiii. 91, xiv. pl. cii. 1–1 c (1848); Ronald's Fly-fish. Ent. ed. v. no. 28, pl. xiii. (1856); Brauer, Neuropt. Austr. 25 (1857); Gerstäcker, Handb. d. Zool. ii. 59 (1863); E. Pict., Névropt. d'Esp. 22 (1865); Oulianine, Neuropt. & Orthopt. of Prov. of Moscow, 25 (1867); Ausser., Ann. d. Soc. Natur. Modena, An. iv. 131 (1869); Meyer-Dür, Bull. Soc. Ent. Suisse, iv. 306 (1874); Joly, Rev. d. Sc. Nat. Montpellier, v. pl. vi. 1 [after Pict.] (1876).—*E. cognata*, ! Steph.,

Ill. Brit. Ent. vi. 56 (1835); Curt., Brit. Ent. xv. no. & pl. 708 (1838). *E. hispanica*, ! Ramb., Hist. Nat. d. Ins. Névropt. 294 (1842); Walk., List of Neuropt. Ins. in Brit. Mus. 535 (1853); E. Pict., Névropt. d'Esp. 23 (1865).

Subimago (living).—Wings at first yellowish green or greenish grey, becoming greyer, very narrowly edged with grey-black along the extreme terminal margin, the discal spots and, in the fore wings, most of the cross veinlets black, the rest of the neuration concolorous with the wing-membrane, or yellowish green. Head in ♀ dull pale ochreous tinged with green, the vertex somewhat lutescent, and between the ocelli blackened or pitch-brown; oculi deep sepia-brown. Notum at first blackened, with lutescent markings; the pronotum grey-black, tinged with greenish along the middle, and with a large similarly coloured pale blotch on each side; mesonotum lutescent, with a mitriform blotch in front bisected longitudinally by a fine line, from whose base on each side a curved black streak recedes inside the wing to the hind border of the segment, gradually expanding towards its termination, where it is flanked inside by an acutely triangular spot; tegulæ pale yellowish green; metanotum grey-black with pale sutures. Setæ black.

Imago (living).—♂. Head and thorax above deep blue-black, polished; the pronotum at the edges, and the joining of the head and thorax, also a fine line on each side of the mesonotum in advance of the tegulæ very pale ochraceous; oculi deep sepia-brown above, brown-black beneath; third joint and awn of antennæ black-brown; face and prosternum pale greenish yellow. Abdomen with the foremost four or five dorsal segments ivory-white, with a pale cinereous broad triangular blotch at their base on each side, pointing backwards; the hinder segments varied with pitch-brown or very deep brown-ochre instead of with cinereous, their markings sometimes confluent (leaving in the middle an ivory-white triangle upon the hind margin of the segment pointing forwards), sometimes differentiated into an abbreviated thin streak on each side of the dorsal vessel at the base of the segment, flanked by a longer and broader tapering streak which falls short of the hind margin of the segment and does not extend to the side. The larger of these streaks are represented sometimes by triangular spots in some of the more forward segments; last segment altogether dark above. The spiracular region is edged with an irregular dark line above, and an abbreviated line from the base below, in every segment. Venter somewhat tinged with brown-ochre, especially in the hinder segments, and marked in segments 2-8 or 9 with a pair of subparallel linear brown-black streaks, some of which are slightly connivent in front and abruptly pointed behind. Wings faintly grey-tinted, most distinctly so towards the anterior and terminal margins and in contiguity with their black neuration; the spots pitch-brown, placed somewhat as in *E. vulgata*, but less strongly marked. Legs pitch-black, the hinder pairs tinged with olivaceous, and with their joinings darkened. Forceps intense sepia-brown. Setæ black.

♀ very like the ♂, but with the dorsal markings of the pale ochraceous abdomen better defined. Fore legs with piceous femora, and olive-grey tibiæ and tarsi; the tibiæ at both extremities, and the apices of the tarsal joints darkened; hind legs olive-grey, the coxa, trochanter, unguis, and tarsal joinings, the base and extreme tip of the tibia,

and a spot at the tip of the femur black. Setæ brownish black, darkened at the tips of the joints. Wing-membrane colourless; hence the narrow grey bordering of the cross veinlets is better shown than in the ♂; spots grey. Length of body, ♂ 16–17, ♀ 16–23; wing, ♂ 16–17, ♀ 14–22; setæ, ♂ 35 & 30–41 & 36, ♀ im. 14–25, subim. 17 mm.

Hab. From Madrid (*Rbr.*), France, Switzerland, and Bavaria, northwards to Lapland (*Pict.*). This species usually inhabits colder and swifter waters than *E. vulgata*, and is the Mayfly of anglers. The ♀ subim. and ♂ subim. are respectively designated by them “Green Drake” and “Bastard Drake.”

EPHEMERA LINEATA, Etn.

Ephemera † *danica*, Pict., Hist. Nat. Névropt. ii. Ephém. 130, pl. vii. (1843 5); Oulianine, Neuropt. & Orthopt. of the Prov. of Moscow, 26 (1867).—*E.* † *vulgata*, part, Blanch., Métamorph. &c. des Ins. 127 (1868). [nec p. 594, pl.].—*E. lineata*, ! Etn., Trans. Ent. Soc. London (1870), 1; id., op. cit. (1871), 71, pl. iv. 7–7 b [details]; Hag., op. cit. (1873), 393; Meyer-Dür, Bull. Soc. Ent. Suisse, iv. 306 (1874).

Subimago (*living*).—Wings greenish grey, broadly tinged with light grey along the terminal margins; cross veinlets black, some of them in the midst of the fore wing bordered with black-brown so as to give rise to a series of spots.

Imago (*living*).—♂. Eyes dark sepia-brown above. Thorax pitch-brown above. Abdomen above in the anterior segments greenish grey modified with bistre-brown, but in the hinder segments becoming lutescent; the segments marked with longitudinal curved or slightly sinuous black streaks tapering at the ends, the anterior segments having each two long streaks on each side of the middle of the back, and the posterior segments two short lines from the base between the two pairs of streaks; venter bilineated lengthwise with black. Forceps lutescent. Setæ fuscous with black joinings. Fore legs with the femur piceous, the tibia and tarsus black: hinder legs greenish grey; the coxa, a spot on each side of the end of the femur, the tip and the joinings of the tarsus black. Wings vitreous, the fore wing in the marginal and sub-marginal areas, and broadly along the terminal margin tinted with blackish grey.

♀. Head yellowish ochreous, about the ocelli brown-ochreous, the eyes intermediate in colour between bistre and sepia-brown. Pronotum greenish grey, with a black longitudinal stripe on each side; meso- and metanotum brown-ochreous, with two dark longitudinal streaks between the wings. Fore legs warm sepia-brown, the end of the femur, both extremities of the tibia, and the terminations of the tarsal joints black. Wings vitreous, the anterior tinged in the marginal and submarginal areas with greenish grey; longitudinal nervures greenish grey, cross veinlets black. Length of body, ♂ 15–20, ♀ 21–25; wing, ♂ 16, ♀ 20–21; setæ, ♂ im. 30 & 35–36; ♀ im. 24 & 26 to 25 & 24, subim. 15 mm.

Hab. England, near Reading, on the Thames and Holybrook; France, near Paris; Switzerland, at Genthod, near Geneva. June and July. Dr. Hagen has sent me the two ♀ specimens cited as English examples of *E. glaucops* in his ‘British Synopsis (1863). My conjecture in 1871 that they were in reality *E. lineata* was correct.

EPHEMERA GLAUCOPS, Pict. Plate VIII. (*d* head ♂).

Ephemera †*lutea*, Sulz., Abgek. Gesch. d. Ins. 171, pl. xxiv. 6 (1776); Röm., Gen. Ins. Lin. & Fab. Icon. Illust. pl. xxiv. 6 [after Sulz.], Explic. 23 (1789); Burm., Handb. d. Ent. Bd. ii. Abth. ii. 804 (1839); † Ramb., Hist. Nat. des Ins. Névropt. 294 (1842).—*E. glaucops*, † Pict., Hist. Nat. Névropt. ii. Ephém. 132, pl. viii. 1–3 (1843–5); Walk., List of Neuropt. Ins. in Brit. Mus. 536 (1853); Brau., Neur. Austr. 25 (1857); Hag., Ent. Ann. (1863), 16; Karsch, Die Insectenwelt, v. 400 (1863); Meyer-Dür, Mitth. schw. ent. Gesch. i. 221 (1864); Oulianine, Neuropt. & Orthopt. of the Prov. of Moscow, 26 (1867); Ausser., Ann. d. Soc. Natur. Modena, Ann. iv. 132 (1869); † Etn., Trans. Ent. Soc. London (1871), 73, pl. iv. 9 (details); Hag. & Etn., *op. cit.* (1873), 393; Meyer-Dür, Bull. Soc. Ent. Suisse, iv. 306 (1874); Rostock, Jahresb. d. Ver. f. Naturk. Zwickau, 1877, 82 (1878).

Subimago (*living*).—Wings very light warm sepia-grey, the cross veinlets black, edged with darker warm sepia-grey, their edging forming spots in the usual places about the middle and near the base of the wing, the terminal borders of the wings broadly margined with light grey or warm-sepia. Eyes cæsious, or extremely light verdigris or blue verditer.

Imago (*living*).—♂. Eyes above either light brownish-olivaceous or rusty yellowish, beneath either dark brownish-olivaceous or rusty purple-madder; face light yellowish.—(*Dried.*) Thorax above polished light reddish brown, the pronotum on each side slightly fuscous (with a black streak there during life). Abdomen very light brownish ochre above, lighter beneath and marked with black; the dorsal markings are in segments 2–6 a single grey or black spot or longitudinal streak on each side of the segment about midway between the dorsal vessel and the lateral margin, gradually lengthening in the more hindward segments, and originating near the base of each segment, but terminating at some distance from the hinder border; in segments 7–9 two such curved linear streaks placed close together on each side in a corresponding position; in segment 10 a similarly placed black spot on each side; also in every segment but the last a black spot on each side at the base upon the prominent lateral joining, followed in segments 4–5 by a curved line, but in segments 6–7 by a fine slightly sinuous longitudinal black line, and in segments 8–9 a fine straight line situated a little higher up the side towards the hinder margin; ventral markings variable, consisting in well-marked specimens of a single discontinuous longitudinal series of linear stripes on each side of the middle tract, dilated a little at both ends in segments 4–7; but sometimes the stripes are interrupted in every segment between these dilatations, so as to leave a streak pointing backwards near the base, and another pointing forwards near the distal border, or (in some of the anterior segments) only small spots instead of streaks; and sometimes the hinder of these streaks or spots is obsolete in every segment. Setæ light rusty brown with dark-brown joinings. Forceps partly concolorous with the abdomen, and either black or piceous at the joinings only, or else with the basal and last two joints dark brown. Wings transparent, with rufescent or light Mars-yellow longitudinal nervures, and black cross veinlets, the former in transmitted light becoming rufous-amber colour; in the fore wing the submarginal area, the pterostigmatic portion of the marginal area, the narrow edging of most of the cross veinlets in front of the anal nervure (8), and the usual spots are very light raw-umber, and an almost imperceptible cloud of the same colour lies along the terminal margin; in the hind wing the corresponding bordering of the terminal margin is slightly darker

(during life it is light sepia-grey); the base of the subcosta and the anterior extremities of the cross veinlets anastomosing with it from behind are dark brown; the other cross veinlets posterior to the radius (3) are bordered with light raw-umber, but their bordering hardly gives rise to spots; in certain lights the colour described as raw-umber changes in both wings to light pitch-brown. Fore legs in opaque view dull obscure brownish ochreous, or sometimes rather redder, the tarsus darker and duller, the tip of the femur, both ends of the tibia, and the tips of the tarsal joints dull blackish; hinder legs testaceous, or dull light yellowish, the tarsi tinged somewhat with warm-sepia.

♀ similar, but the wings more faintly marked, the pronotum light bistre-grey, the abdomen of a very pale yellowish green-grey ground-colour, and the fore tarsus concolorous with the tibia. Length of body 11–17; wing, ♂ 10–15, ♀ 10–16; setæ, ♂ 15–23, subim. 17, ♀ im. 11–14 mm.

Hab. Extensively distributed on the continent; southern Sweden, Moscow, Germany, Switzerland, N. Italy; France, Paris district (M^cLach.), Toulouse; Algarve, Saõ Marcos da Serra (Etn.); and Algeria (M^cLach.). It inhabits lakes and gentle rivers. At Geneva and Lucerne the subimago abounds at street-lamps in favourable situations; and spiders lie in wait for them on the neighbouring walls in considerable numbers. Some nymphs of this species in Dr. Joly's collection were labelled *E. vulgata*, and therefore it is very possible that *E. glaucops* was the subject of both his and M. Vayssière's anatomical studies, and not the one quoted.

EPHEMERA COMPAR, Hag. Plate LXIII. 12 *e* (forceps).

Ephemera compar, ! Hag., Ann. Rep. U. S. Geol. & Geograph. Survey of the Territ. 1873, part iii. Zool. 578 (1875).

Imago (dried), ♂.—Brown-ochreous, marked with black and rufo-piceous. Head pitch-black, antennæ somewhat ochraceous. Pronotum striped on each side lengthwise with pitch-black; the stripes lanceolate, broadest behind; mesonotum light rufo-piceous with a light translucent brown-ochreous stripe down the middle; tegulæ of a light ground-colour, the notum marked in front of them with an abbreviated wedge-shaped pitch-black streak on each side. Dorsal abdominal markings:—in segments 3–8, on both sides of the disk, a pair of longitudinal subparallel black linear stripes, gently curved outwards, and every stripe at its proximal extremity slightly enlarged on the inner side; between these stripes, in segs. 6–8, is interposed a single pair of divergent black streaks from the base, longest in the hindmost; in seg. 9 the corresponding markings are confluent across the back; in seg. 2 the stripes on each side coalesce with one another and so form two quadrangular blotches; in seg. 1 the corresponding spots are small and indistinct; seg. 10 is pale (of the ground-colour) with a triangular greyish cloud on each side behind in place of the stripes; every segment has an abbreviated black streak from the base at the side close to the spiracular line, and segs. 5–7 have another from the tip; the joinings of the segments in some lights are opaque. Ventral abdominal markings:—in segs. 2–8 a longitudinal black line on each side of the middle, slightly curved inwards; in seg. 9, a quadrangular black blotch in the midst of the disk, narrowed somewhat anteriorly; in seg. 10 a large rounded black spot on each side at the base. Setæ

light fuscous, the joinings subopaque. Forceps brown-ochreous. Trochanters each with a small black dot outside; fore femur rufo-piceous, greyish towards the base above; fore tibia and tarsus piceous; hinder femora somewhat brown-ochreous, the tibiæ and tarsi lighter, the unguis fuscous. Wings transparent, tinted with very light dull yellowish; fore wing with the costa, subcosta, and radius rufo-piceous, the other longitudinal nervures light yellowish, the cross veinlets black; the pterostigmatic portion of the submarginal area, and the adjacent (outer) half of the corresponding part of the marginal area, together with the extreme apex of the third area from the costa, burnt-umber brown; the same colour occupies the basal portion of the submarginal area to a little beyond the great cross vein, and extends onwards from thence for some distance along the subcosta and radius, and more or less distinctly borders the cross veinlets, besides giving rise to the usual spotting of the wing; the spots are small and distinct. Hind wings with the longitudinal nervures pale yellowish excepting the subcosta towards the base, which is fuscous; cross veinlets mostly black, several of them faintly bordered with burnt-umber grey, and a few marked with minute burnt-umber brown spots; the outer margin broadly edged with brownish grey. Length of wing 15 mm.

Hab. Foot Hills, Colorado (Lieut. W. L. Carpenter), in Mus. Comp. Zool. Cambridge, Mass.

EPHEMERA GUTTULATA, Pict. Plate LXIII. 12*f* (forceps).

Ephemera guttulata, Pict., Hist. Nat. Névropt. ii. Ephém. 135, pl. viii. 4 (1843-5); Walk., List of Neuropt. Ins. in Brit. Mus. 536 (1853); ! Hag., Ann. Rep. U. S. Geol. & Geograph. Survey of the Terr. 1873, part iii. Zool. 579 (1875).—*Ephemera*, sp. nov., ♀, ! Hag., Proc. Ent. Soc. Philad. ii. 177 (1863).—*E. † myops*, var. ? Etn., Trans. Ent. Soc. London (1871), 71; Hag., *op. cit.* (1873), 393.—*E. † simulans*, ! Provancher, Nat. Canad. viii. no. ix. 265 (1876); id., Fn. Ent. d. Canad. ii. fasc. i. 81 (1877).

Imago (dried), ♂.—Thorax above rufo-piceous, varied with piceous, inclining towards intense bistre-brown on the pronotum. Abdomen above, in segments 1-8, spotless whitish Naples-yellow; segment 9 of the same colour, excepting along the spiracular border, where it is narrowly margined with raw-umber brown; segment 10 raw-umber brown, with a longitudinal whitish yellow stripe in the midst of each side. Venter from the tip of segments 1-8 of the same colour as the dorsum, segment 9 ditto, with a triangular spot on each side as long as the segment tinged with raw-umber brown; segment 10 raw-umber, but the thinner portions of the perinæal lobes whitish yellow. Forceps raw-umber, the second joint lighter. Setæ, in opaque view light Vandyke-brown, with blackish joinings. Fore legs lost, excepting the coxæ and trochanters, which resemble the hinder. Hinder legs, in opaque view, light yellowish, with a blackish spot at the end of the tibia, the unguis (if not the whole tarsus) light reddish brown, the trochanter light bistre-brown, and the coxa outside in front rufo-piceous. Wings imperfectly transparent, marked in opaque view with dark bistre- or pitch-brown, changing in transmitted light to light sepia-brown, the markings consisting of a broad, slightly mottled cloud extending from the anal angle to the apex of the fore wing along the terminal margin, the pterostigmatic region, broad bordering to all the cross veinlets in the rest of the fore wing anterior to the anal nervure (8), and narrower bordering to those posterior to it, as

well as to the proximal ends of the nervures from the terminal margin that join it as branches, the bordering confluent irregularly in transverse bands (in lieu of the customary spots) in addition to the median band; in the hind wing, a broad cloud tapering behind runs backwards along the terminal margin from the distal portion of the costal margin, the edging of the cross veinlets in the submarginal area is confluent near the subcosta towards the base of the wing, but tapers rapidly towards the radius (3) beyond the limits of the confluence, a narrow irregular blotch extends from about the proximal extremity of the cubitus (4) to about the second series of the cross veinlets included within its fork (doubtless an instable character), and the edging of the cross veinlets in the remaining parts of the disk constitutes numerous small spots. Neuration piceous, but lighter in a large portion of the hind wings and in part of the axillary region of the fore wings.

♀ very similar to the ♂, the thorax rather lighter; the 9th abdominal segment as well as the foregoing segments Naples-yellow, the 10th light brownish. Setæ light raw-umber grey with black joinings. Fore femur intense Vandyke-brown or piceous, blackish lengthwise through the middle; tibia and tarsus light olive-brown, the extremities of the former, and the first joint together with the distal extremities of the intermediate joints of the latter, blackish brown, the terminal joints and ungues reddish brown; hinder legs nearly as in the ♂. Wings more transparent than in the ♂, the clouds along the terminal margins obsolescent and greatly restricted; the usual median fascia of the fore wing is broad and very distinct, but the edging of the cross veinlets elsewhere does not coalesce into blotches, excepting to a very limited extent in the places of the usual spots; the branches of the anal nervure (8) are marked each with a round spot close to their anterior extremities. In the hind wing the spot at the end of the cubitus (4) is separate from that at the fork; but otherwise the wing is very like the ♂ hind wing. Length of body, ♂ 13, ♀ 18.5; wing, ♂ 13.5, ♀ 19; setæ, ♂ about 30 mm.

Hab. New York (Osten Sacken), 9th June; Quebec (Provancher), in Mus. Comp. Zool. Cambridge, Mass.

EPHEMERA SIMULANS, Walk. Plate LXIII. 12 g (forceps).

Ephemera simulans, ! Walk., List of Neuropt. Ins. in Brit. Mus. part iii. 536 (1853); Hag., Smithson. Miscell. Coll. (1861), Synop. Neuropt. N. Am. 38.—*E. decora*, ! Walk., List *supra cit.* part iii. 537 (1853); Walsh, Proc. Acad. Nat. Sc. Philad. (1862), 376; *id.*, Proc. Ent. Soc. Philad. ii. 177 (1863).—*E. natata*, ! Hag., Smithson. Miscell. Coll. *supra cit.* 39 [after Walker]; *id.*, Proc. Ent. Soc. Philad. ii. 177 (1863); *id.*, Trans. Ent. Soc. London (1873), 393; † *id.*, Ann. Rep. U. S. Geol. and Geograph. Survey of the Terr. 1873, part iii. Zool. 580 (1875).—*E. † guttulata*, ! Etn., Trans. Ent. Soc. London (1871), 69, pl. iv. 6-6b [details].
† *Palingenia natata*, ! Walk., List *supra cit.* part iii. 551 (1853).

Subimago (dried).—Wings translucent, dull light sepia-grey, the wing-roots and longitudinal nervures in opaque light bistre-brown, the disk and black cross veinlets marked as in the imago. Setæ pitch- or intense raw-umber brown, with opaque joinings. Tibiæ lighter than the femora and tarsi; fore femur pitch-brown, hinder femora dark bistre-brown: tarsi sometimes blackish, sometimes Vandyke-brown.

Imago (dried), ♂.—Thorax above deep rufo-piceous, the pronotum in some positions

marked on each side with a rather darker longitudinal stripe: in the living insect the pronotum doubtless is translucent light sepia-brown with a pitch-black stripe on each side. Abdomen discoloured when dry, dark pitch-brown with blackish markings: in specimens preserved in spirits it is light translucent bistre with opaque intense bistre-brown (? pitch-black in life) markings, viz.—a blotch of irregular form on each side of segments 1–9 reaching from the base of the segment nearly to the edge of the terminal border (resembling a quadrangular figure emarginate at the sides and summit, composed of a pair of subtriangular longitudinal streaks, curved slightly in opposite directions, standing apart back to back and united to each other by a broad band in the greater part of their length anteriorly), constituting a single series of blotches on each side of the back; also in segments 7–9, between the blotches and adjacent to the dorsal vessel, a narrow longitudinal streak on each side from the base of the segment; also in segments 1–8, on each side of the venter, a single series of discontinuous longitudinal sublinear stripes, some of them dilated a little at the tips. Setæ medium raw-umber brown with piceous joinings. Fore legs dark raw-umber or dark bistre-brown, the tarsus more translucent, the knees, end of tibia, first tarsal joint and unguis more opaque. Hinder legs, with the femur light bistre-brown, coxa and trochanter varied with pitch-brown, the tibia and tarsus lighter than the femur and perhaps rather yellower, the unguis rufopiceous or dark burnt-umber-brown, and sometimes the terminal borders of the tarsal joints of this colour, the whole leg from the femur onwards changing in transmitted light to brownish or greyish amber: sometimes a depression outside the femur close to the extremity, and also the tip of the tibia is dark. Wings transparent, tinged at the wing-roots with intense bistre-brown, and marked elsewhere with ivory-black in opaque view, or with intense sepia in transmitted light; the hind wings usually bordered rather broadly along the terminal margin with a faint tint of light greyish: neuration uniformly piceous. The markings of the wings present considerable diversity in the size of the spots and the edging of the cross veinlets. In strongly marked examples nearly every cross veinlet in the disk of the fore wing (excepting those near the terminal margin) situated between the costa and the anal nervure (8) is dark-bordered, the bordering of many being dilated and generally somewhat guttulate in certain areas, especially in the marginal and submarginal areas, in the distal part of the next area, and occasionally in the two areas adjacent to the first accessory nervure after the pabrachial (7). In addition to the customary fascia extending from the costa to the fork of the præbrachial (6), spots of irregular shape are apt to be formed at the proximal terminations of many of the interpolated nervures, or, near them, viz.—Three spots within the space bounded by the sector (3) and the cubitus (5), two of them beyond the fascia, and one in the axil of the main nervures; also three spots in the interspace between the pabrachial (7) and the anal (8) nervures, one of them at the termination of the foremost of the long interpolated nervures, another at the head of the much shorter nervure in front of that, confluent sometimes with the fascia, but often only extended forwards to the hinder branch of the præbrachial (6¹), and a third spot at the head of the other short nervures interposed between the two long interpolated nervures. In the hind wing the dark bordering of

the cross veinlets is generally narrow, but in the midst of the wing the edging of about half a dozen veinlets or more is enlarged into small spots.

Variation.—In the fore wing the fascia is virtually resolved into its component spots, the other spots are reduced in size, the bordering of the cross veinlets is much restricted and scarcely anywhere guttulate; in the hind wing the terminal margin is not bordered with the faint greyish cloud, the spots are rudimentary or reduced to two or three in the midst of the disk, and many of the cross veinlets are not dark bordered.

♀ (*dried and in spirits*).—Very similar to the ♂, but with the latero-dorsal blotches more nearly resolved into a pair of separate triangular streaks on each side of segments 3–6, the blending of those in the other segments corresponding with what is usual in the other sex. The wings are rather clearer than is customary in the ♂, especially in the pterostigmatic region, and the edging of the cross veinlets is rather less distinct. Fore legs light rufo-piceous with the femur and tip of the tibia darker; the tarsal joints lighter towards their bases. Hinder legs as in the ♂, but the tibia and tarsus slightly redder than the femur than yellower. Setæ light burnt-umber brown, with pitch-brown joinings.

Variation (probably killed before attaining maturity of colouring).—Thorax brown-ochreous: fore femur light bistre-brown, the tibia and tarsus rather lighter, but with the ungues, the tips of the intermediate and first tarsal joints and also of the tibia dark burnt-umber brown. Hinder legs in opaque view with the femur light greenish bistre-grey, and the rest lighter, changing in transmitted light to greenish amber and light yellow amber. Abdominal markings as in the ♂.

Variation.—Colour of legs, thorax, and wings, normal; but differing in the dorsal markings of the abdomen. In segments 3–6 only the upper triangular streak of every latero-dorsal blotch is present on each side, the lower is absent (perhaps owing to the ravages of *Anthrenus*): a short linear black streak is produced forwards along the spiracular margin from the posterior lateral angle of the dorsum of each of these segments. This is the variation simulating *E. vulgata* mentioned by Hagen. Length of body, ♂ 11–13, ♀ 13–15; wing, ♂ 12–14, ♀ 15–19; setæ, ♂ im. 25–32, subim. 14, ♀ im. 16, subim. 15 mm.

Hab. North America, from Akhurst, Virginia, to St. Martin's Falls, river Albany, Hudson's Bay, and from West Beach, Maine, to Saskatchewan. This species swarms yearly at Chicago, Ill., at street lamps, about the third week in July. A tube full of specimens collected at an island in Lake Erie, near the mouth of Detroit river, by Mr. Scudder, is dated 24th July.

EPHEMERA VARIA (renamed). Plate LXIII. 12 *h* (forceps).

Ephemera † *decora*, ! Hag., Smithson. Miscell. Coll. (1861), Synop. Neuropt. N. Am. 38; *idem*, ! Ann. Rep. U. S. Geol. and Geograph. Survey of the Territ. 1873, part iii. Zool. 578 (1875).

Subimago (*dried*), ♂.—Wings translucent, very light grey or whitish grey, the submarginal area of the fore wing before the pterostigmatic space slightly yellowish: neuration partly light and partly dark, the longitudinal nervures of the fore wing to a great

extent in the disk, and the whole of the neuration in the vicinagè of the terminal and inner margins, light yellowish, but the subcosta and parts of the other nervures adjacent to spots, as well as the cross veinlets in the disk are black; these cross veinlets also are bordered with black-grey, and the bordering is enlarged here and there into spots as in the imago. Neuration of the hind wing mainly light yellowish, but a few cross veinlets in the basal $\frac{1}{3}$ of the disk are blackish, though not bordered.

Imago (dried), ♂.—Thorax above light reddish brown, approaching brown-ochreous, with a longitudinal pitch-brown stripe on each side of the pronotum. Abdomen above largely suffused with violet-grey, leaving at the sides of the segments a narrowly limited space of a light yellowish colour; the usual dorsal streaks are situated within the violet-grey spaces; their pattern, best seen in segments 6–9, comprises,—a pair of longitudinal linear streaks, one on each side of the dorsal vessel, approximated to each other at the base and blended together posteriorly; also a large triangular spot as long as the segment on each side, close to the streak and tapering distally, from whose hypotenuse in segments 5–7 a curved streak is prolonged obliquely backwards and downwards; in addition, the spiracular border of the dorsum in segments 8–9 is narrowly blackish throughout, but in the preceding segments it is blackish only for a short distance from the anterior angle apart from the terminations of the curved streaks described above. Venter very light translucent yellowish, shading into light yellow-ochraceous in the hinder segments and brown-ochre at the base of the forceps, marked lengthwise with three interrupted narrow pitch-black streaks,—one along the ganglionic track, and another on each side of it almost exactly intermediate between that and the spiracular border, posteriorly dilated in segment 9. Setæ light bistre-, or raw-umber grey with pitch-black joinings. In opaque view, the fore coxa and trochanter are light yellowish, the femur light bistre-brown, the tibia and tarsus much lighter, but with both extremities of the tibia, the first tarsal joint, the base of the second and the extremities of the other joints as well as the ungues pitch-black; the hinder femora are very light-yellowish, the tibiæ and tarsi yellowish white, and the ungues light brownish; in transmitted light the fore legs are rich brownish-yellow amber, marked with pitch-brown in the places enumerated above, and the hind legs have the femur very light yellow amber, the tibia and tarsus whitish. Wings transparent; the hind wings, and the fore wings in the immediate vicinagè of the inner margin colourless, these anteriorly becoming gradually tinted more and more with light raw-umber, this tint attaining its greatest depth in the pterostigmatic portion of the marginal area and the whole of the sub-marginal area. Longitudinal nervures and the great cross vein from the costa to the subcosta, in opaque view, light raw-umber or light bistre-brown, changing with light transmitted to brownish-yellow amber, or golden brown; cross veinlets, great cross vein from the subcosta to the radius, and the anterior curves of the branches of the anal (8) nervure of the fore wing black, the veinlets in general edged more or less faintly and narrowly with greyish or with dark bistre-brown, many of those in the disk anterior to the anal nervure having the edging dilated roundly, and others (more broadly margined) establishing through the confluence of their bordering a dark bistre-brown band and spots in the usual situations, viz. :—a transverse curved or angulated stripe from the costa to the

fork of the præbrachial (6) nervure; a spot more distant from the wing-roots, beyond the termination of the stripe, outside that fork; and a spot nearer the wing-roots, placed at the proximal extremities of the accessory nervures interjacent between the pabrachial (7) and anal (8) nervures.

♀ (*dried*).—Meso- and metanotum light brown-ochreous; pronotum lighter, marked on each side with a broad longitudinal pitch-black stripe, which is preceded by a quadrangular spot on the cervical membrane, and is narrowly incurrent along the hinder edge of the segment; below the peak of the metanotum the prominent border is dark. Abdominal markings seemingly similar to those of the ♂, but largely effaced by Psocidæ in the specimens examined. Setæ greenish grey, with pitch-black joinings. Fore coxa and trochanter light yellow-ochreous; femur and tibia very light bistre- or raw-umber grey, blackened distally; tarsus nearly concolorous with the tibia, but duller; a small triangular spot at the outer extremity of the coxa, both ends of the tibia, the first tarsal joint and the extreme base of the second, pitch-black; the apical borders of the other intermediate joints, the terminal joint and the ungues, light burnt-umber brown. Hinder legs coloured as in the ♂. Wings transparent, colourless generally, but in the submarginal area of the fore wing tinged very faintly with greenish yellow; the spots, less blended than in the ♂, are greyish black, and the lighter edging of the cross veinlets is more restricted; wing-roots and near ends of longitudinal nervures light yellowish; the costa, subcosta, and radius external to the great cross vein of the fore wing light brownish- or greenish grey, changing in transmitted light to amber-brown; cross veinlets, and the great cross vein from the subcosta to the radius of the fore wing, black; neuration of hind wings uniformly light yellowish, membrane colourless. Length of body, ♂ 11, ♀ 15; wing, ♂ 12, ♀ 14; setæ, ♂ 25–27 mm.

Hab. New England; Norway, Maine; New Haven, Conn. (Mus. Comp. Zool., Cambridge, Mass.).

EPHEMERA FLAVEOLA, Walsh.

Ephemera flaveola, Walsh, Proc. Acad. Nat. Sc. Philad. (1862), 377; Hag., Proc. Ent. Soc. Philad. ii. 178 (1863); Etn., Trans. Ent. Soc. London (1871), 70.

Subimago.—Wings subopaque, the membrane slightly dusky, and, in a single ♂, with slightly dusky neuration. Setæ dull pale greenish.

Imago, ♂.—Head ferruginous above, the orbits of the ocelli and basal joints of the antennæ a little dusky. Thorax pale ferruginous. Abdomen yellowish, joints 3–7 with a lateral pale fuscous vitta, interrupted at the sutures; setæ whitish with fuscous joinings. Legs yellowish; the terminal half of the fore femur ferruginous, the fore tibia and first tarsal joint, the other joints at the joinings and the last joint at the tip, fuscous; the tips of the hinder tarsi fuscous. Wings hyaline, the fore wing slightly yellowish along the costa, the neuration colourless, excepting the costa, subcosta, radius, and great cross vein, which are yellowish.

♀ similar to the ♂, but having the abdomen egg-yellow in the parts full of eggs, and having fuscous cross veinlets in the wings, excepting in the tips and along the terminal borders. Length of body, ♂ 7·5–9·5, ♀ 9–10·5; exp. of wing, ♂ 17–19, ♀ 19–

20; setæ, ♂ im. 20 & 14, subim. 9-12, ♀ im. 12 & 10, subim. 12 mm. (after Walsh).

Hab. Rock Island, Ill. (Walsh). A fragment of a ♀ subim. apparently of this species is in Mr. M^cLachlan's collection.

EPHEMERA MYOPS, Walsh.

Ephemera myops, Walsh, Proc. Ent. Soc. Philad. ii. 207, note 20 (1863); Etn., Trans. Ent. Soc. London (1871), 71.

This species was described by Mr. Walsh from two ♂ examples, one of them reared from the subimago, which differed in colour from one another. The description is diagnostic only. Eyes smaller and wider apart than in *E. flaveola*; abdomen either yellowish throughout, or in segments 1-5 ferruginous, in segment 6 and segment 9 paler, and in segments 7 and 8 yellowish. Length of body 12-13; exp. of wings 26-27; setæ 27 & 19-29 & 21 mm.

Hab. Rock Island, Ill. (Walsh).

EPHEMERA IMMACULATA, Etn.

Ephemera immaculata, ! Etn., Trans. Ent. Soc. London (1871), 74. pl. iv. 10 [detail].

Imago (dried), ♂.—Thorax brunneo-luteous above. Abdomen fuscous, the tips of the segments and the spiracular lines darker. Setæ light bistre-brown. Wings spotless, vitreous; the fore wing in the submarginal area, and the hind wing at the terminal margin tinged with sepia-grey; neuration dark. Fore legs piceous, the bases of the femora lighter; hinder legs brunneo-testaceous. Length of body, ♂, 10.5, wing 11 mm.

Hab. Cuna, Hindostan (Hope Mus., Oxford).

EPHEMERA EXPECTANS, Walk.

‡ *Potamanthus expectans*, ! Walk., Trans. Ent. Soc. London, N. S. v. 198 (1860).

Ephemera expectans, ! Etn., Trans. Ent. Soc. London (1871), 74.

Subimago (dried).—Fore wings very pale raw-sienna, with dull light brown-ochreous longitudinal neuration, and intense violet-carmine (approaching black-purple) cross veinlets; hind wings rather greyer, with black-purple cross veinlets. Setæ raw-umber grey, with pitch-black joinings. Thorax brown-ochreous above, with a broad pitch-brown stripe on each side of the pronotum, followed by a line on each side of the mesonotum, extending to the area above the wing-roots. Abdomen (discoloured) dark orange-brown, with four slender longitudinal black lines in segments 2-8, and two lines along the venter. Fore legs dark brown-ochreous, the termination of the tibia pitch-black, the distal edges of the nearer tarsal joints and the whole of the terminal joint and ungues pitch-brown; hinder legs lighter, with the broader ungues pitch-brown. Length of body, ♀ 11, wing 14 mm.

Hab. Hindostan (Walker, in Brit. Mus.).

EPHEMERA SUPPOSITA (renamed). Plate VIII. 12 c (forceps).

‡ *Potamanthus fasciatus*, ! Hag., Verh. zool.-bot. Gesells. Wien, viii. 476 (1858) [part].

Ephemera fasciata, ! Etn., Trans. Ent. Soc. London (1871), 74, pl. iv. 11, 11 a [details]; idem, *op. cit.* (1873), 393.

Subimago (dried), ♀.—Wings fawn-colour, the stronger of the longitudinal nervures yellowish, the cross veinlets of the fore wings black; the submarginal area of the fore wings is tinged with yellowish, and some of the cross veinlets in the marginal area are edged with darker towards the subcosta.

Imago (dried).—Thorax testaceous above. Abdomen eroded by Psocidæ, but it appears to have been light bistre-brown on the dorsum, with two darker streaks projecting forwards on each side from the darker hinder borders of segments 1-9, subparallel with each other in segments 9-7, but curved slightly away from each other towards their anterior extremities in the other segments; also in at least segments 9-7 the dorsal vessel appears as a black line; on the venter are visible traces of the usual two longitudinal series of discontinuous linear black stripes. Setæ medium Mars-yellow, with many of the joinings reddish brown. Forceps dull yellowish, with the terminal two joints black. Wings transparent, slightly tinted with greyish, with reddish brown longitudinal nervures and piceous cross veinlets; the fore wing in the submarginal area, and the pterostigmatic portion of the marginal area, tinged with madder-brown, and having small spots of a similar colour in the usual places in the midst of the wing—one at the fork of the præbrachial nervure (6), one close to it on the cubitus (5), another on the first sector (4), and a dot more distant from the wing-roots than these on the pabrachial nervure (7); hind wings similar in the colours of their neuration, but spotless, and rather faintly clouded very narrowly with reddish grey along the terminal margin. Fore tibia madder-brown, the tarsus rather obscurer, the femur somewhat rufescent; hinder legs light yellow-amber, the tarsus more opaque with red-brown unguis. Length of body, ♂, 13, wing 11, setæ about 21 & 23 mm.

Hab. Ceylon (Hag. & M^cLach. Mus.). The ♀ im. from Masuri, northern India, mentioned by me in 1871, is very similar in the pattern of its markings, but perhaps is another species.

EPHEMERA SERICA, Etn.

Ephemera serica, ! Etn., Trans. Ent. Soc. London (1871), 75, pl. iv. 12, 12 a [details].

Subimago (dried), ♀.—Wings very light yellowish grey, with dull light yellowish neuration; in the fore wing most of the cross veinlets between the costa and the sector, and many of those posterior to this last nervure in the proximal third of the disk of the wing are black, a few are also bordered with black, and in the area posterior to the submarginal area 3-5 cross veinlets beyond the bulla are marked each in the middle with a round black spot.

Imago (dried), ♂.—Head light brown-ochreous, reddish brown in the vicinage of the ocelli. Thorax brown-ochreous, with an elongated black spot on each side of the pronotum. Abdomen pale yellow-ochreous, marked with black lines, shown best in the ♀ examples. Setæ ochraceous, the two outer annulated irregularly with black. Wings vitreous, the fore wing with the neuration in a larger measure golden brown, but with the cross veinlets in advance of the sector, and those behind it in the basal $\frac{1}{3}$ of the disk pitch-black, some of them spotted with warm-sepia-brown in correspondence with the markings of the subimago; hind wings spotless. Fore femur deep raw-umber brown,

pitch-black at the knee; fore tibia and tarsus light brown-ochre, the femur pitch-black at both extremities; fore coxa and hinder legs very light yellow-ochraceous, all with a black spot on the coxa.

♀ (*dried*).—Very like the male; the pronotal spots smaller, the wing-spots very indistinct, almost effaced. Abdomen above in segments 3–9 marked with a pair of sub-parallel fine black lines along the middle of the back, interrupted only at the overlapping apical borders of the segments, also with an abbreviated black line on each side along the spiracular border from the posterior angle of the dorsum extending to half the length of the segment, and perhaps with the hinder border of the dorsum black in the middle; venter in segments 3–7 marked along the middle with two slightly sinuous black lines, and with a greatly abbreviated longitudinal black line from the base on each side at the spiracular border. Legs very light yellow-ochraceous; the fore femur slightly darker; its tip, both extremities of the fore tibia, and the proximal joint of the fore tarsus pitch-black; the flat claw blackish in every tarsus. Length of body, ♂ 11, ♀ 14; wing, ♂ 13, ♀ 18; setæ, ♀ subim. 17 mm.

Hab. China, Hongkong (Brit. Mus.). The subimago in the Museum has no spots on the pronotum.

EPHEMERA ORIENTALIS, M^cLach.

Ephemera orientalis, ! M^cLach., Trans. Ent. Soc. London (1875), 168.

Imago (*dried*; after M^cLachlan), ♂.—Body pale greyish yellow, with a black longitudinal streak on each side of the mesonotum, and some blackish markings on the abdomen, viz.—with the posterior borders of the dorsal segments narrowly blackish, also, in segments 4–8, with a black line from the base of each segment extending some distance along the course of the dorsal vessel and flanked on each side of the dorsum with a pair of slightly curved black linear streaks; venter marked in the intermediate segments with a longitudinal straight black line on each side. Setæ at the base universally yellowish, afterwards narrowly blackish at the joinings. Forceps rather short, their last two joints short. Legs pale yellow; the tibiæ and tarsi of the fore legs fuscous. Wings vitreous, with a faint yellowish tint, the hinder spotless, and along the terminal margin rather broadly bordered with pale greyish; neuration blackish, the cross veinlets of the marginal area incassate and deep black, the bullæ black, and the cross veinlets adjacent to that of the subcosta distinctly bordered with black. Length of wing 15 mm.

Hab. Japan; Von Siebold (Leyden Mus.).

EPHEMERA JAPONICA, M^cLach.

Ephemera japonica, ! M^cLach., Trans. Ent. Soc. London (1875), 169.

Subimago (*dried*), ♀.—Wings transparent light greenish grey, spotless in one example, the submarginal area of the fore wing clear yellowish green, the terminal margin of the hind wing narrowly edged with greyish, that of the fore wing hardly perceptibly so; neuration mostly pitch-black, but just at the wing-roots brown-ochreous. Setæ deep sepia-brown at the base, becoming lighter distally, the joinings not conspicuously darker.

Imago (dried), ♂.—Head above very light Mars-yellow ochreous, in ♀ pitch-brown. Pronotum light raw-umber brown, with a linear pitch-brown longitudinal stripe on each side; the remainder of the notum in ♂ slightly yellower, in ♀ brown-ochreous, varied in the metanotum with light yellow-ochre. Abdomen above in ♂, and after oviposition in ♀, very pale translucent raw-umber, the hinder segments (7- or 8-9 or 8-10) light yellow-ochraceous, the tenth sometimes very light brown-ochre; segments 2-9, each with a pair of warm sepia-brown dorsal stripes, divergent and gradually tapering from behind forwards, descending obliquely one on each side from the hinder border to the spiracular border close to the base of the segment, and approximated to one another at the hinder border more closely in the more forward than in the hinder segments; these stripes in segments 4-8 are connected each with the other by an extension of the same colouring along the intervening portion of the hind margin; and the bands thus connecting them together are intersected in the ♂, but not in the ♀, by a fine longitudinal black line along the dorsal vessel in segments 6- or 7-9; this line in the ♀ does not attain the hinder borders of the segments. Venter rather lighter than the dorsum in segments 1-7, and thence posteriorly becoming bright brown-ochreous; a fine pitch-black streak on each side of segments 7-2, subcontinuous with the dorsal stripe of the following segment, runs from the hinder angle of the segment obliquely inwards to the anterior margin, subparallel with the immediately superjacent dorsal stripe; viewed laterally, the ventral streak of one segment in combination with the dorsal stripe of the following segment appears slightly sinuous; in segment 8 of the ♂ the corresponding ventral streaks taper at both ends, and do not reach the hinder lateral angles; those in the same segment of the ♀ meet one another close to the opening of the oviducts; in segment 9 they are subparallel with one another, almost perpendicular to the hinder border of the segment, linear in the ♀, but in the ♂ broader, deep burnt-umber brown, and sometimes ill-defined posteriorly. Setæ deep warm sepia-brown, the joinings pitch-black. Forceps light brown-ochreous, darker distally. Fore femur (as an opaque object) light reddish-brown, or (in transmitted light) bistre-amber colour, the tibiæ pitch-brown, the tarsus rather lighter; hinder legs extremely light yellowish ochre with brownish unguis; the femora in transmitted light very pale yellow amber-colour. Wings vitreous, faintly tinted with light greenish yellow; submarginal area of the fore wing more strongly so tinted; terminal margin of the fore wing very narrowly and faintly, that of the hind wing more distinctly and to a moderate depth, bordered with warm sepia-grey; neuration pitch-brown, the subcosta, or subcosta and radius, of the fore wing pitch-black, the nervures becoming lighter towards the wing-roots, the bulla of the subcosta and that of the first sector, together with a minute spot, nearly in a line with them, on the cubitus of the fore wing slightly greyish. Length of body, ♀, 14-16, wing 18-19, setæ, ♀ im. 25·5, subim. 16 mm.

Hab. Yokohama (Pryer, M^eLach. Mus.).

PENTAGENIA, Walsh, 1863.

Illustrations. *Adult.* Pl. VIII. 13 (details).

Adult.—Pronotum in ♀ transverse, enlarged posteriorly, subtumescens above, broader

and higher than the head behind, but narrowed and sloping downwards anteriorly; its lateral borders, posteriorly, suddenly everted to a slight extent so as to originate a strongly defined sinus or rounded depression on each side of the back; its hind margin curved; in ♂ the pronotum appears to be more appressed to the mesonotum, so that in front view the hind margin seems almost retuse in the middle. Fore leg of ♂ about half as long as the body, the tibia about $1\frac{2}{3}$ as long as the femur, the tarsus scarcely as long as the femur; ♀ fore femur little shorter than the tibia, the tarsus scarcely $\frac{2}{3}$ as long as the tibia. Median setæ in ♂ extremely rudimentary, in ♀ not much shorter than the others; outer setæ in ♂ about $2\frac{1}{2}$ as long as the body, in ♀ im. and ♂ subim. subequal in length with it; under a lens their surface appears minutely pubescent throughout, and their joinings are inconspicuous. Last two joints of forceps-limbs rather small. Lobes of penis nearly straight, subtubular, and somewhat tapering distally; the orifice of the seminal duct terminal; no apparent stimuli. Abdominal segments of ♀:—1 short and thoracoid, 2–6 gradually and successively longer, 7–9 nearly equal to one another, but 8 perhaps a little the longest, and 9 a little longer than 7, which is only a little longer than 6; segments 6–10 together constitute $\frac{1}{2}$ of the abdomen. Anterior ocellus rather smaller than the others. Eyes of ♂ nearly approximated if not mutually contiguous above.

Nymph unknown.

Type. *P. vittigera*, Walsh.

Distribution. Illinois and Texas.

Etymology. πέντε and γεννά, from its being the fifth of the sections of *Palingenia auctorum*, defined by Hagen in 1863, and named by Walsh in that year.

PENTAGENIA VITTIGERA, Walsh. Plate VIII. 13 (wings, legs, ♂ & ♀, forceps).

Palingenia vittigera, ! Walsh, Proc. Acad. Nat. Sc. Philad. (1862), 373; Hag., Proc. Ent. Soc. Philad. ii. 174 (1863).

Pentagenia [type] *vittigera*, ! Walsh, *op. cit.* ii. 197 (1863); ! Etn., Ent. Mo. Mag. v. 85 (1868); ! *id.*, Trans. Ent. Soc. London (1871), 63, pls. i. 6 and iv. 1 [details].

Subimago.—"Wings dull opaque yellowish" (Walsh).

Imago.—Eyes of the living ♂ (*teste* Walsh) yellowish above, their lower $\frac{1}{4}$ ferruginous. (*Dried*) ♂.—Body traversed from head to tail along the middle of the back by a deep warm sepia stripe, containing in segments 1–9 of the abdomen the usual pair of short divergent yellowish lines at the base of every segment; sides and under parts of the body chiefly light yellowish ochreous or Naples-yellow, but segments 8–10 of the abdomen are of a brighter yellow beneath, and on each side of the mesothorax a warm sepia stripe descends from the roots of the fore wing obliquely. Legs, viewed opaquely, very light yellowish ochraceous, but in transmitted light of a yellowish amber-colour; fore tibia light brown-ochreous, the tarsus rather darker, the end of the tibia and the extremity of the broader of the tarsal ungues warm sepia or burnt-umber brown; hinder tarsi with the ungues and the tips of the terminal joints tinged with bistre-brown. Wing-venuration translucent, mostly colourless; in the fore wing the great cross vein between the subcosta and the radius, and a short linear spot at the bullæ of the subcosta and the

sector are pitch-black; but the costa, subcosta, and radius, together with the cross veinlets of the marginal and submarginal areas, are in opaque view bistre-grey, and in transmitted light pale golden brown, or brownish amber-colour. Setæ dull light yellowish white.

♀ (*dried*) very similar. The wings towards the base, especially in the marginal area of the fore wing, tinted with lurid.

Length of body, ♂ 17–19, ♀ 17–20; wing 18–19; setæ, ♂ 40–50 & 5, subim. 18 & 4·5, ♀ 13 & 10·5–20 & 15 mm.

Hab. Near Rock Island, Illinois, and in Texas (Walsh & M^cLach. Mus.). The part of the dorsal stripe in each segment of the abdomen is quadrangular, nearly straight at the sides, and only a little broader in front than behind.

PENTAGENIA QUADRI-PUNCTATA, Walsh.

Pentagenia quadripunctata, Walsh, Proc. Ent. Soc. Philad. ii. 198 (1863); Etn., Trans. Ent. Soc. London (1871), 64.

This species is diagnosed by Walsh as differing from *P. vittigera* in the following details. The part of the dorsal stripe in each segment of the abdomen is angulated at the sides and hexagonal in form. In the fore wing a series of four distinct fuscous dots, surrounded each by a slight cloud, is extended transversely in a slight curve from the middle of the costa to the midst of the wing (the dots presumably corresponding with bullæ), marking the subcosta and the 4th, 6th, and 9th longitudinal nervures from the costa. Wings of subimago opaque whitish. Length of body, ♂ 19, ♀ 19·5–22; wing, ♂ 15; ♀ 18–19·5; setæ, ♀ im. 22·5 & 19·5, subim. 17 & 14, ♂ subim. 15 & 3 mm.

Hab. Rock Island, Illinois.

PART II. Read February 7th, 1884.

GROUP II. OF THE GENERA.

Adult.—At the fore-wing roots the anal nervure (8) communicates with the pabrachial (7) only by means of an obsolete channel of circulation permeating the membrane in proximity to the prominent curved or angulated fold that meets the basis of the radius (3) [excepting perhaps in *Tricorythus* and *Cænis* (Pl. XV. 25 and 26). *N.B.* In Pl. IX. the figure of part of the wing of *Rhoënanthus*, 15, is defective thereabouts]. Legs all functional; hinder tarsi with 4 distinct joints, and sometimes with colour-indications of a fifth joint intimately concrete with the tibia (*i. e.* not definitely limited by suture); ungues rather small. Contour of ♂ oculi various in different sections. *Nymph.*—Palpi of both pairs of maxillæ 3-jointed. [Exceptions: palpus of maxilla I. 4-jointed in *Prosopistoma*, 2-jointed in *Callibætis*; palpus of maxilla II. with joint 3 ill defined in *Baëtis*.]

First Series of Group II.

Adult.—The anal (8) and bifid 2nd axillary nervures, together with the inner margin of the fore wing, enclose a semisagittate space; the 1st axillary nervure (9¹) connivent