AN

INTRODUCTION

TO

THE MODERN CLASSIFICATION

OF

INSECTS;

FOUNDED ON

THE NATURAL HABITS AND CORRESPONDING ORGANISATION

OF

THE DIFFERENT FAMILIES.

By J. O. WESTWOOD, F.L.S.

HON. MEM. LIT. HIST. SOC. QUEBEC; MEM. SOC. CÆS. NAT. MOSCOW; PHYSIOGR. SOC. LUND;
SOC. ROY. SCIENC. LILLE; SOC. HIST. NAT. MAURITIUS; SOC. CUVIER. PARIS;
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MEM. SOC. ENTOMOL. DE FRANCE; SECRETARY ENT. SOC. LONDON, ETC.

"**Empirici,** *formicæ* **more, congerunt tantum et utuntur: rationales,** *aranearum* **more, telas ex se conficiunt:** *apis* **vero ratio media est, quæ materiam ex floribus horti et agri elicit; sed tamen eam propria facultate vertit et digerit."**—BACON, *Nov. Org.* **lib. i. aph. 95.**

IN TWO VOLUMES.

VOL. II.

LONDON:

LONGMAN, ORME, BROWN, GREEN, AND LONGMANS,

PATERNOSTER-ROW.

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Page 407. Since the publication of the sheets relative to the Orthoptera, two works especially devoted to that order have been published; namely, the second part of the second volume of Burmeister's *Handbuch der Entomologie*, 1838, and *Histoire Naturelle des Insectes Orthoptères*, 1839, by M. Serville. In these works numerous new genera are proposed, chiefly founded upon exotic species, under distinct names. Burmeister has subsequently reviewed their synonymy in the third part of Germar's *Zeitschrift fur d. Entomologie.*

428. note *, line 2. for " Blattidæ " read " Mantidæ."

451. *fig.* 55. 16. The short transverse lines at the tips of the antennæ indicate the extremities of these organs to have been cut off.

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Page 5. add as note: * Bibliogr. Refer. to the Neuroptera.

Say, in Goodman's Western Quarterly Reporter, vol. 2. 8vo. 1823. (13 sp. Neuropt. collected in the Expedition to the Rocky Mountains.) — Ditto, Descriptions of new North American Neuroptera (not yet published. See his Life).

Burmeister. Hand. d. Entomologie, vol. ii. part 2. p. 2. (Neuroptera) 1839.

Stephens, Curtis, Latreille, &c.

15. M. Lacordaire has published some original observations on the different kinds of individuals composing the species of Termitidæ in his *Introduction to the Natural History of Insects.*

17. line 18. I have recently discovered an apterous species of this family, possessing more than twenty-five joints in the antennæ, and 3-jointed tarsi.

25. note *, The existence of the anomalous character of an additional pair of eyes, placed on pillars, is not confined to the males of a single species, or even subgenus of Ephemeridæ. I have this day (May 14. 1840) taken both sexes of the two-winged species, figured by Mr. Stephens under the name of Cloeon dipterum, and find that the males possess this character, and are, in colour, quite unlike the females. Neither Leach nor Stephens have noticed the sexual characters of Cloeon. The species figured by Réaumur, possessing two similar additional pedunculated eyes (tom. iv. pl. 19. fig. 3.), evidently belongs, from his accurate description of the very minute hind wings, to my subgenus Brachyphlebia. Burmeister (*Handb.* vol. ii. p. 798.) gives E. bioculata *L.*, as the male of E. diptera *L.*

45. Mr. Swainson has published a figure of the larva of Ascalaphus MacLeayanus *Guild.* in his volume on the *Habits and Instincts of Animals*, p. 29. It differs from my *fig.* 63. 20. and *from Guilding's description*, in having only nine filamentous processes on each side.

51. Dr. Buckland has described a remarkable fossil insect, of which

intermediate between Isogenus and Nemoura), the larvæ are destitute of these external organs of respiration.

In Nemoura cinerea *Pictet, Oliv.*, the under surface of the prothorax is furnished with six elongated filamentous sacs (*fig.* 60. 14.), similar to the sacs observed on the abdomen of the larvæ of Phryganeæ. These organs do not exist in the five other species of the genus, of which M. Pictet has described the larvæ, thus proving the slight importance of these modifications of the respiratory apparatus in the Annulosa. The rudiments of the wing-cases are perceived in the enlarged posterior angles of the meso and metathorax of the larva, and the pupa state is only to be known by the increased size of these wing-cases, which "se développent peu-à-peu dans la nymphe." In the genus Perla, as now restricted, these wing-cases are much less distinct than in the P. microcephala *Pict.* (which is, I apprehend, an Isogenus *), Chloroperlæ (P. virescens *Pict.*), P. nigra, and the Nemouræ; in all which the wing-cases in the pupæ are detached, and considerably elongated (*fig.* 60. 13.). The resemblance between the larvæ of the smaller species of caudated Perlidæ, and the Nemoura is so complete, that M. Pictet could not discover any "caractère constant pour les distinguer," although in the perfect state the latter are destitute of the pair of anal filaments which exist in their larvæ. A species of this family, Semblis viridis (Chloroperla ?) has been made one of the subjects of Dr. Carus's observations on the circulation of the blood in insects. (See Spence, in *Mag. Nat. Hist.* Jan. 1830, p. 49. and Carus, *Entdeck. einfach. Herzen besch. Blutkreis, &c.*)

The family EPHEMERIDÆ * *Leach*, comprises the well-known tribe of insects, ordinarily known under the name of May-flies, distinguished

* M. Pictet informs me that he considers the Isogenus Nubecula *Newm.* to be the Perla bicaudata *Linn.*; but this is doubtful, as the Linnæan description is too vague, and the Linnæan collection affords no decisive information.

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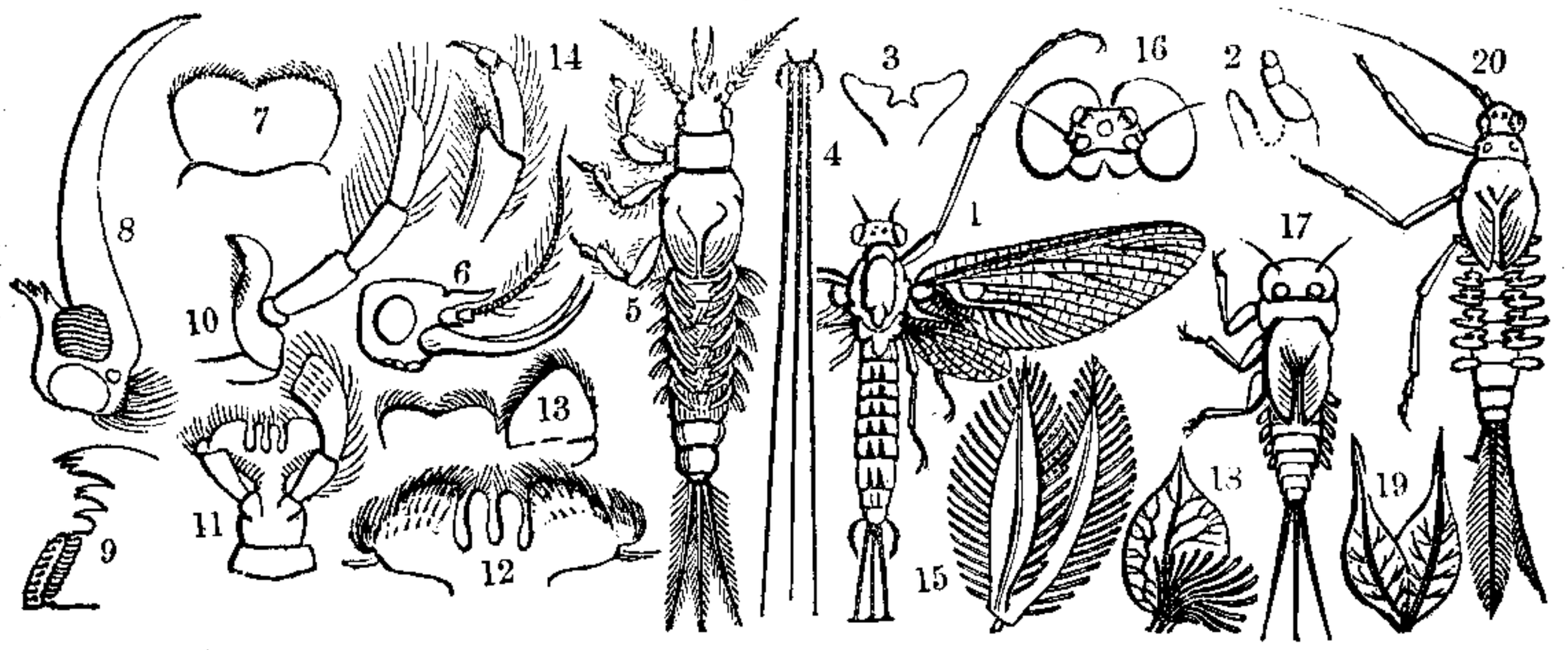
* BIBLIOG. REFER. TO THE EPHEMERIDÆ.

Clutius. Opusculum de Hemerobio. 4to. Amsterd. 1634.
Swammerdam. Historie väd het haft (Ephem.) Amsterd. 1675. — Ditto, in Book of Nature, pl. 13, 14, 15.
De Geer. Obs. sur les Ephem. in Mém. Acad. Sc. Paris, tom. ii. Sav. Etr.
Schäffer. Das fligende Uferaas. 4to. Regensb. 1757, and in Abh. von. Ins. 3 b.
Williamson, on Ephemeron Leukon, in Trans. Soc. Philadelphia, vol. v. 1802.
Collinson, in Phil. Trans. 1746. (Eph. vulgata.)

Fig. 61.



by the minute size of the antennæ; the unequal size of the wings; the membranous and almost obsolete mouth; and the elongated articulated setæ at the extremity of the body. The body is long, slender, and soft (*fig.* 61. 1. Ephem. vulgata ♂, with the tails cut partly off); the head small, transverse-trigonate; the eyes large, nearly oval, and lateral, in the males of some species very large, and meeting on the crown of the head *; the ocelli are three in number, and placed in a triangle between the eyes; the anterior ocellus being often small, and the two lateral ones placed on peduncles (*fig.* 61. 16. head of Baetis): the antennæ are small, and 3-jointed; the two basal joints thick; the third forming a long slender seta: the clypeus in some species (Baetis, *fig.* 61. 16.) is large, fleshy, and shutting over the mouth with

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Curtis, in Taylor's Philos. Mag. 1834. — Ditto, Brit. Ent.
Dryander. Libr. Banks. sub Ephemera.
Stephens, *Savigny* (Egypt), *Fabricius*, *&c.*

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* The males of Ephemera bioculata *L.*, in addition to the ordinary eyes, have the head furnished with two short, thick, erect pillars, on the top of which another pair of large eyes are fixed. Mr. Curtis doubts whether this insect has four wings; and the figure given by De Geer, vol. ii. tab. 18. f. 9., represents an insect with only two wings, although it has its head represented with pillared eyes. Geoffroy's figure, vol. ii. tab. 13. f. 4., has four wings, two anal setæ, and two very large eyes. The insects which appear to me to accord with the Linnæan description, have four wings; but the posterior pair are very minute, with only two longitudinal nerves. The nerves of the anterior wings are exceedingly delicate; and between each pair of the longitudinal nerves, at the tip of the wing, there are two very short nerves unconnected with any transverse nerve. These characters will be sufficient for the formation of this species into a separate genus, which may be named Brachyphlebia. It is perhaps equivalent to Stephens's section B of Baetis. The Linnæan specimens are destroyed.

a thickened rib half way down the centre, and slit through the frontal half. As the life of these insects ordinarily extends but for a few hours, the parts of the mouth are almost obsolete, being minute, fleshy, and filled with fluid, so that their structure is not easily discernible. Latreille describes them doubtingly, as consisting of four short multi-articulate palpi, more slender at the tip. Mr. Curtis having examined living specimens, says that the parts of the mouth seem to consist of two large triarticulate? palpi, with two compressed elongated sublinear lobes between them (maxillæ, *fig.* 61. 2.), and a dilated labrum with two large divaricating fin-like lobes (palpi? *fig.* 61. 3.). Reaumur's figure of the under side of the head (tom. vi. pl. 43. f. 11.), represents a space "où devroit être la bouche et d'où on ne fait sortir qu'une vessie, au dessous on voit quatre languettes charnues, dirigées vers la partie postérieure;" and Savigny has represented the parts of the mouth of a Baetis, in the great work on Egypt; but it is impossible satisfactorily to make out their analogies. The thorax is oval and convex; the prothorax small, narrowed in front, the mesothorax large; the abdomen is elongate, narrow, of nine segments in both sexes, the terminal segments being longest, and gradually narrowed; it is furnished at the apex, in both sexes, with two or three long, slender, multiarticulated filaments * (*fig.* 61. 4. ♂.), and in the males with four, two short setaceous articulated appendages, and two shorter straight ones, which are sometimes not exserted †; the wings are of unequal size, the anterior being much larger than the posterior, and elongate-trigonate, considerably reticulated; at rest they are generally carried erect; the posterior pair are wanting in some species (Cloeon, Ephemera diptera *Linn.*). The legs are slender and simple; the anterior pair, in the males being porrected, and greatly elongated, with the tibiæ and tarsi appearing soldered together; the basal tarsal joint being very minute; the tarsi are 5-jointed, simple, and terminated in the fore legs of the males by two oval pulvilli; in the four posterior legs the tarsi are short, 5-jointed; the basal joint (in the males of E. vulgata), being shortest, and soldered to the tibia (so

* Latreille (*Hist. Nat. Ins.* vol. xiii. p. 80.) states that the males differ from the females in having the middle anal filament very short, whereas it is as long as the others in the females. This is the case in a species observed by Reaumur; but in the true Ephemeræ, the middle seta is nearly, but not quite, as long as the lateral ones

† In Eph. vulgata ♂, they have been overlooked by Curtis, but the extremities are distinctly exserted in my specimens. I have seen no species with three of these short appendages as described by Latreille, *Gen. Cr.* vol. iii. p. 184.

as to make the tarsi appear 4-jointed, as, indeed, they have been described by some authors), and terminated by a large oval pulvillus, and a single broad notched claw.

Dr. Leach formed these insects, in his MSS. (quoted by Stephens, *Syst. Cat.* p. 305.), into a separate order, named Anisoptera, from the unequal size of the wings.

Cuvier, followed by Duméril, united them together with the Phryganeæ, into a distinct section of the order, termed Agnathes, from the rudimental structure of the mouth, destitute of jaws; whilst Brullé united them with Libellula and Termes into a separate order, which he named Dictyoptera.

These insects have obtained their name Ephemera, from the Greek Εφημερος, diurnal, in allusion to the extremely short space of time* which they occupy as perfect insects. Their elegant flight in swarms (composed, as in the gnats, almost entirely of male insects) in fine afternoons, over or near water, alternately rising and falling, must have attracted the attention of the most incurious: in this operation the upward flight is produced by the repeated action of the wings; but in descending, the wings are widely extended, as well as the tails. A few hours previously, they had been the inhabitants of the water, from which, in the pupa state, they had crawled to the surface, where they cast off their pupa skin, appearing at first sight to be fully developed, with the wings extended to their full size (which state is termed by Mr. Curtis the pseudimago); they then make their way, flying with difficulty, to the shore, where they affix themselves to the trunks of trees, stems of rushes, walls, or even upon persons standing upon the bank, when they again cast off a very delicate pellicle, in which they had been entirely encased, and which remains, unchanged in form, attached to the objects on which they had stationed themselves: the skin, however, in which the wings had been enclosed, shrivels and curls up into a mass, hanging down at the sides of the thorax; after this process, the wings, disengaged from the outer covering, assume a brighter appearance, and the tails grow to twice their previous length.

* De Geer kept Ephemera vespertina alive for eight days; and Mr. Stephens mentions having kept specimens of Cloeon dipterum alive above three weeks. Had these individuals, however, been at large, and capable of pursuing their natural habits, I doubt not that their existence would have been as short as that of their companions. Dr. Franklin's beautiful address, supposed to have been delivered by an "ancient Ephemera," which had lived four hundred and twenty minutes, is one of the most profound lessons to humanity ever published.

In some specimens which I have reared, I have invariably found that the casting off of this pellicle takes place during the night. In some species, the operation of shedding this pellicle takes place immediately after flight, and is so quickly performed, that the whole operation does not exceed three minutes; immediately after which the insect again takes wing. (Davis, in *Ent. Mag.* vol. ii. p. 322.) I have observed in one instance, at least, that the insect remained in the pseudimago state upwards of twenty-four hours. In consequence of this peculiarity, these insects have been described as undergoing a quadruple metamorphosis.* After coupling has taken place, the females deposit their eggs in a mass, and which they drop into the water. This being the only operation which the perfect insects are able to perform, they die as soon as it is accomplished.

Notwithstanding the dangers to which the eggs, larvæ, and pupæ are constantly exposed, from the attacks of fishes and predaceous aquatic insects, the number of specimens which arrive at the per-

* Swammerdam asserts of the species which he observed, that the males only undergo this second moulting. I can affirm that in E. vulgata both sexes are subject to it.

This power of flight by the insect, previous to attaining its final form, is perfectly anomalous; and if we were to adopt the opinion expressed by Mr. Newman (*Ent. Mag.* vol. iii. p. 19.), that the pseudimago state of the May fly is analogous to the pupa of the bee, or the chrysalis of the butterfly, it would necessarily follow that the state in which rudimental wing-covers are developed, preceding the pseudimago state of the former, is analogous to the last stage of the *larva* of the latter insects. But Mr. Newman has shown that he is aware of the fact, not only that the dragon fly, on becoming a perfect insect, quits a double skin, the interior of which is analogous to the external pellicle of the pseudimago, but also that butterflies, moths, and gnats, "which do not retain the skin of the previous state, on entering the quiescent state, retain two distinct coverings;" the interior being a soft pellicle, which must have been observed by all who have paid any attention to the rearing of Lepidoptera. But Mr. Newman further contends that the pupa of a bee or beetle is enveloped in only a single skin; whilst the flesh fly, &c. (or the insects which undergo the true coarctate metamorphosis, that is, "on assuming the quiescent state they retain the last cuticle of the previous state,") cast off two skins on becoming perfect insects. Now, both those assumptions are contrary to fact as well as to analogy, since it is certain that the beetles, after quitting the pupa skin, are at first enveloped in a thin pellicle, like the May-fly, and which I doubt not is general, and to be found in the bee, as well as the beetle, if sufficient careful researches were made for it; whilst, at the same time, we are warranted in considering that the real pupa of the flesh fly is likewise inclosed in a similar membrane, so that the latter insect, on arriving at the perfect state, casts three, and not two, skins; namely, the hardened ultimate larva skin, the real pupa skin, and the pellicle analogous to the pseudimago skin of the May fly, which, from its firmer consistence is retained longer by the last-mentioned insect. If this be a correct view of the real nature of the pseudimago state, there will be no grounds for rejecting the Linnæan definitions of metamorphosis.

fect state is sometimes so immense, that the swarms of one species with white wings (E. albipennis) has been compared to a fall of snow; whilst, in some parts of Europe where they abound, it is the custom to collect their dead bodies into heaps, and use them for manure. The fishes at such time eagerly wait for them; and so great are the numbers which fall into the water, that the fishermen call them manna.* They are well known to the angler as excellent baits for trout.† They are also a favourite food of the smaller dragon flies. If, however, the life of these insects in their perfect state is so short, it is of much greater duration in the preparatory states, extending at least, in some species, to two or three years. During this period, they are inhabitants of the water, in which they ordinarily hide themselves, during the day, in the earth, under stones, or in horizontal burrows, divided internally into two canals, each having a separate opening externally, and uniting internally at the extremity, so that the insect can crawl in at one hole and out of the other, without being obliged to make the awkward turn it would have to do, if in a straight hole: these burrows are formed in the earth of the sides of the stream, or standing water, and which circulates freely in them. It is affirmed by some authors, that the larva feeds upon the mud at the sides of its retreat (*Hist. of Insects*, p. 106.). Swammerdam, who dissected these larvæ, always found mud within the stomach and the great and small intestines. It is most probable, therefore, that when the larva has assimilated the decaying vegetable matter therein contained, the earthy particles are discharged. The larvæ bear a considerable resemblance to the imago in their general form, but are easily distinguished by their long multiarticulate antennæ; the want of ocelli; the presence, in some species, of two corneous appendages in front of the head, considered as mandibles, and more

* I must refer to Kirby and Spence's Introduction for various particulars relative to the almost incredible appearance of the swarms of these insects upon certain occasions.

† Out of forty-four species of insects given by Mr. Ronald in his *Fly Fisher's Entomology*, eighteen belong to the present family. Amongst the smaller species, the pseudimago and imago are known under different names. The various kinds of duns are all in the pseudimago state, the name evidently applying to their duller colour. The green drake is the pseudimago, and the grey drake the imago of E. vulgata ♀. See further Sir H. Davy's *Salmonia*, and the late editions of *Isaac Walton*. The females, filled with eggs, are most eagerly seized by the fish; the males, inflated with air, offer them but little nourishment, and are called bastard May flies by the Oxfordshire fishermen. It is rarely that the females are found in the swarms hovering on the water.

particularly by the possession of a row of thin plates on each side of the abdomen, ordinarily united in pairs by their bases, and which are a species of external false branchiæ or gills, in which the tracheæ are extended, and ramify; thus serving as organs of respiration, as well as assisting in locomotion by their constant undulatory motion: the abdomen in the larva is terminated by three setæ, which is the case, not only in those species which have three filaments in the imago, but also in those with only two tails. I have observed that these setæ acquire a greater length at each moulting.

Those species which reside in burrows seldom quit their retreats; whilst the smaller species, which live at large in the water, are much more active, and have the body of a firmer consistence than the others. The pupa differs only from the larva in having the rudimental wing-covers more conspicuous at the sides of the meso- and meta-thorax.

The investigation of the preparatory stages of the different species of these insects, will be sufficient to prove the necessity of their separation into even more genera than have hitherto been proposed for them. The pupæ of several species are represented by De Geer and some other authors: the larvæ, however, are not figured, but we may consider them as similar in character to the pupæ, from which they differ only in the absence of rudimental wing-covers. In the species to which the generic name has been restricted by recent authors (E. vulgata, &c.), the pupa (my *fig.* 61. 5., and De Geer, tom. xxi. tab. 16.), is distinguished by a transverse-quadrate prothorax as broad as the head, a very gibbous meso-thorax, a head of rather small size, with two short horns in front, and two long, acute, slightly recurved mandibles, originating at the sides of the mouth, and being as long as the head (*fig.* 61. 6. head sideways). Considering the rudimental nature of the mouth of the imago, it is surprising that no one has hitherto described the real structure of the mouth, in the preparatory states. Reaumur has attempted it, but his figures are so rude and insufficient, that no idea can be gleaned as to their true structure; Swammerdam, also, passes them over undescribed. In the pupa of E. vulgata, the upper lip is of moderate size, with the anterior angles rounded off, and ciliated; it is flat, and quite membranous (*fig.* 61. 7.); the mandibles (*fig.* 61. 8.) are horny, armed with several teeth within, near the base (*fig.* 61. 9.), which is dilated into a flattened molary plate; whilst the upper angle of the mandible

is produced into the long curved horn above described. The maxillæ (*fig.* 61. 10.) are small, membranous, curved, pointed at the tip, and internally setose; the maxillary palpi do not extend beyond the front of the head; they are 4-jointed, the basal joint being very short; the lower lip (*fig.* 61. 11.) is very large and membranous, covering the underside of the mouth; it is quadrilobed (*fig.* 61. 12.), and furnished within with a broad tongue (*fig.* 61. 13.), of which the anterior angles are produced and pilose; the labial palpi are broad and 3-jointed; the antennæ are about twice the length of the head, multiarticulate, and ciliated; the eyes are large and rounded; the legs are short, broad, and very much compressed; the tarsi 2-jointed, with a terminal hook (*fig.* 61. 14.); the abdomen is 9-jointed, the terminal segments being the longest: of these segments, the six basal ones are furnished on each side with a pair of elongated rather narrow gills, the edges of which are furnished with long, narrow filaments (*fig* 61. 15.), through each of which an air-tube extends to the tip; the air-tubes from each contiguous pair of filaments uniting near the base, and then running to the large tube which traverses the centre of each gill. Each of these pairs of gills are united together at the base, so that in the whole the insect has twenty-four gills. The insect, of which the history is figured by Schäffer (*Abhandl.* vol. iii. pl. 1.), appears to be an Ephemera, with four wings, and three tails, the larva of which forms burrows in the earth; but it is impossible, from his figures, to ascertain either the species or the real characters of the preparatory states.

In a small species figured by De Geer (*Mém.* tom. ii. tab. 17. f. 11—16), having four wings and three tails, the eyes of the male being very large and much elevated, and which is regarded as the E. vespertina (which Mr. Stephens introduces into his second section of the genus Ephemera), the head of the pupa is unarmed; the antennæ longer; the legs and anal setæ longer and more slender; the seven basal abdominal segments are furnished on each side with a pair of oval, flat, membranous gills, each terminating in a long point, and not provided with long marginal filaments (*fig.* 61. 19.). The insect figured by Rösel (*Ins. Belust.* tom. ii. tab. 12. f. 1, 2.) is evidently identical, in the structure of the pupa and imago, with these figures of De Geer. This and the allied species may, perhaps, from the consideration of the variation of their preparatory states, be advantageously separated as a distinct genus, to which the name of Leptophlebia may

be applied, in allusion to the delicacy of the veins of the wings, which are moreover destitute of the numerous transverse veins near the posterior base of the fore wing, so conspicuous in E. vulgata.

The pupa of another species, belonging to the genus Baetis, is figured by De Geer (vol. ii. t. 18. f. 1—4.), and is remarkable for the broad flat head, with short antennæ, and large eyes; the prothorax is very broad and flat; the legs short, with the femora greatly dilated and compressed; and the seven basal abdominal segments furnished on each side with a broadly oval gill, terminating in a point; the six basal ones on each side being further furnished with numerous long floating filaments, representing the other gill (*fig.* 61. 18.); the tails are very long, and not fringed. My specimens (*fig.* 61. 17.) have the head and prothorax considerably broader than they are figured by De Geer, but in all other respects they correspond: in one of these which I dissected, I found the labium very large, completely covering the other parts of the mouth; the mandibles being small, but furnished at the base with a molary plate, as in the pupa of E. vulgata.

Messrs. Goring and Pritchard (*Nat. Hist. Obj. for Microscope*, 1829, pl. 1.) have figured the pupa of a species which they named E. marginata; but their figure of the imago represents it as 2-winged and 2-tailed, thus belonging to the genus Cloeon. The head of the pupa (*fig.* 61. 20.) is small, scarcely more than half the breadth of the mesothorax; the antennæ as long as the body, about 24-jointed; the terminal joints being gradually elongated; the legs long and slender, with 2-jointed tarsi; the five basal abdominal segments furnished on each side with a pair of flattened membranous gills, each being very short (especially the basal one in each pair), the posterior one in each pair being of an elongated oval transverse form: the sixth abdominal segment has on each side a single larger gill; the three apical setæ are long, multiarticulate, and finely setose; the central setæ (as the period for assuming the perfect state approaches) becomes more transparent; whereas the two exterior ones exhibit the two tails of the perfect insect inclosed in them. This pupa feeds on minute aquatic larvæ, as well as on vegetables; the rapidity of its motions is astonishing, employing the six double paddle-like gills as oars, and for the purpose of balancing itself, and the posterior pair as paddles; it likewise possesses the power of leaping or springing in the water to a considerable distance. I have observed these pupæ to possess the power of darting both forwards and backwards with equal rapidity. This insect in its earlier larva state (in which the thoracic and basal

abdominal segments are of equal size) has formed the subject of a valuable paper upon the circulation of the blood, by Mr. Bowerbank. (*Ent. Mag.* vol. i. p. 239.)

The larvæ and pupæ figured by Rösel (*Ins. Belust.* tom. ii. tab. 12. f. 3, 4.) seem, at least so far as they can be determined from the figures, to be similarly constructed to the pupa figured by Goring and Pritchard; the head being of moderate size, and the anal filaments deeply fringed; but the imago (fig. 6.) is represented as possessing four wings and two tails: so that either the genus Baetis, as even now restricted, must comprise several distinct types, or Rösel must have erred in giving four wings to his imago.

The species which afforded Swammerdam materials for his admirable history of the Ephemera, abounds to an astonishing extent in the rivers of Holland and Germany, and makes its appearance regularly, in swarms, at the mouths of the Rhine, Meuse, Wael, Leck, and Ysel, during three succeeding days, about the feast of Olophius and St. John. It is considerably larger than E. vulgata, with four wings and two long hairy tails; and has been named E. Swammerdiana by Latreille, in honour of its historian. It clearly belongs, however, to a distinct genus; its larva burrowing in the ground, with short broad legs, and its head cornuted (see tab. xiv.): the first abdominal segment is not furnished with gills, but each of the six succeeding segments has a pair on each side; the posterior in each pair being very small, and termed by Swammerdam rowing fins. The male pupa differs from the female in the larger size of the head, and especially of the eyes.

Reaumur (*Mémoires*, tom. vi. Mém. xii. tab. 42—44.) has given numerous details of a large species, which in several material respects differs from any of the foregoing; it has four wings, and three tails, which in the female are of equal length, but in the male the central one is not half the length of the abdomen: the abdomen of the male is armed at its extremity beneath with a pair of straight appendages of considerable length, in addition to the pair of articulated forceps; the meso- and meta-thoracic spiracles are of large size; the female deposits her eggs in two long oval masses. The larva burrows in ground at the sides of the rivers, and has short broad legs, the mandibles are greatly elongated, curved, and armed along the under surface with two rows of small points, and an apparently articulated hook at the tip; and the gills are of an elongated kidney shape, narrowed

towards the extremity with broad short ciliæ, and a large air-tube running down the centre of each; the two plates on each side of the segment are of nearly equal size. Reaumur has also represented (pl. 45.) another pupa, with simple head and long legs, and in which the gills form a large and broad plate, which is ordinarily folded so as to appear like two narrow plates. He has not described the imago of this species. In the following plate, he has figured two other kinds of pupæ, in one of which (whose imago is not given) the mandibles are very broad, porrected, and dentated, and the gills formed as in the pupa of E. vulgata. The other species appears to be a Cloeon like Goring and Pritchard's figure, but the gills of the pupa are represented like those of E. vulgata.

The family LIBELLULIDÆ *, comprises an extensive and beautiful group of large-sized insects, well known under the common names of

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† M. Charpentier has shown me a thick folio volume of drawings of the different species of this family, of which he is preparing a monograph.