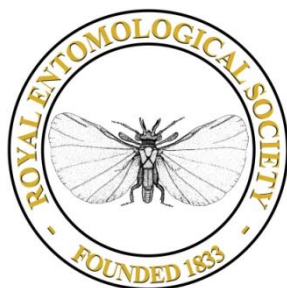


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# HANDBOOKS FOR THE IDENTIFICATION OF BRITISH INSECTS



ODONATA

By

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# ODONATA

By LT.-COL. F. C. FRASER, I.M.S.

**THE ODONATA** or Dragonflies are insects familiar to everyone, and, if we except a few of the larger Neuroptera or Lacewings, there are few insects in this country with which they may be confused. They may be described as large or medium-sized four-winged insects, aerial in habit and amphibious by nature since, apart from the short imaginal stage, they spend the greater part of their lives in water; they are predacious on other insects which they capture when on the wing. The sexes are of the same size, but frequently differ in colour and markings, and although the newly emerged or "teneral" male often resembles the female, this resemblance is lost after a few days on the wing.

**ANATOMY.**—The head (fig. 1) differs markedly in shape in the suborders and families. In the Sub-order **Zygoptera** (fig. 1a) which are the more primitive insects, the large, multi-faceted compound eyes are button-shaped and widely separated from one another, the head is transversely elongate and narrow antero-posteriorly; 3 ocelli (accessory, single-faceted eyes) are present on the rather flat vertex or dorsum of head, the middle or anterior ocellus being somewhat larger than the two lateral ones. The antennae, so conspicuous in the Lepidoptera, are in the Odonata so reduced as to be almost invisible to the casual observer and are filiform and usually 7-jointed, the basal segments being somewhat more robust than the others. The mouth-parts consist of the *labium* (fig. 1, c-f), *labrum* (fig. 1, Lb), and the included jaws and palps. The labium is made up of three subequal lobes, the median one being usually smaller than the others and more or less deeply fissured; the labrum is entire and surmounted by the epistome or *clypeus*, which is divided by a suture into a small triangular area, the *anteclypeus* (fig. 1, Ac), and a larger, broader *postclypeus* (fig. 1, Pc), and this again by the *frons* (fig. 1, Fr), the latter rarely differentiated from the vertex but occasionally and distinctly transversely ridged (*crest*) (*Ceriatgrion*); the *occiput* (*Occ*) is straight and narrow but broadens laterally into triangular areas which are often the site of bright rounded coloured spots (fig. 1, *pos*, *postocular spots*). In the Suborder **Anisoptera** (fig. 1, b) the head is more or less globular, the very large globular compound eyes forming by far the greater part of the head and more or less confluent across its mid-dorsum (save in the GOMPHIDAE (fig. 13, b) and CORDULEGASTERIDAE (fig. 13, d), in the former of which the shape of the head and the separation of the eyes approaches that of the Zygoptera, whilst in the latter the eyes only just meet, or, in the female, may be slightly separated); the occiput is small and triangular, the ocelli are arranged either in a triangle or in a straight line (fig. 13, b) and are incorporated in a somewhat raised conical vertex (fig. 1, v). The labium is composed of three lobes as in the Zygoptera, but

the lateral lobes are of much greater size and completely enclose the middle one (fig. 1, *e* and *f*, *lbm.*); the frons is usually strongly angulated and presents a definite crest which divides it into anterior and superior surfaces (fig. 1, *b*, *Fr*).

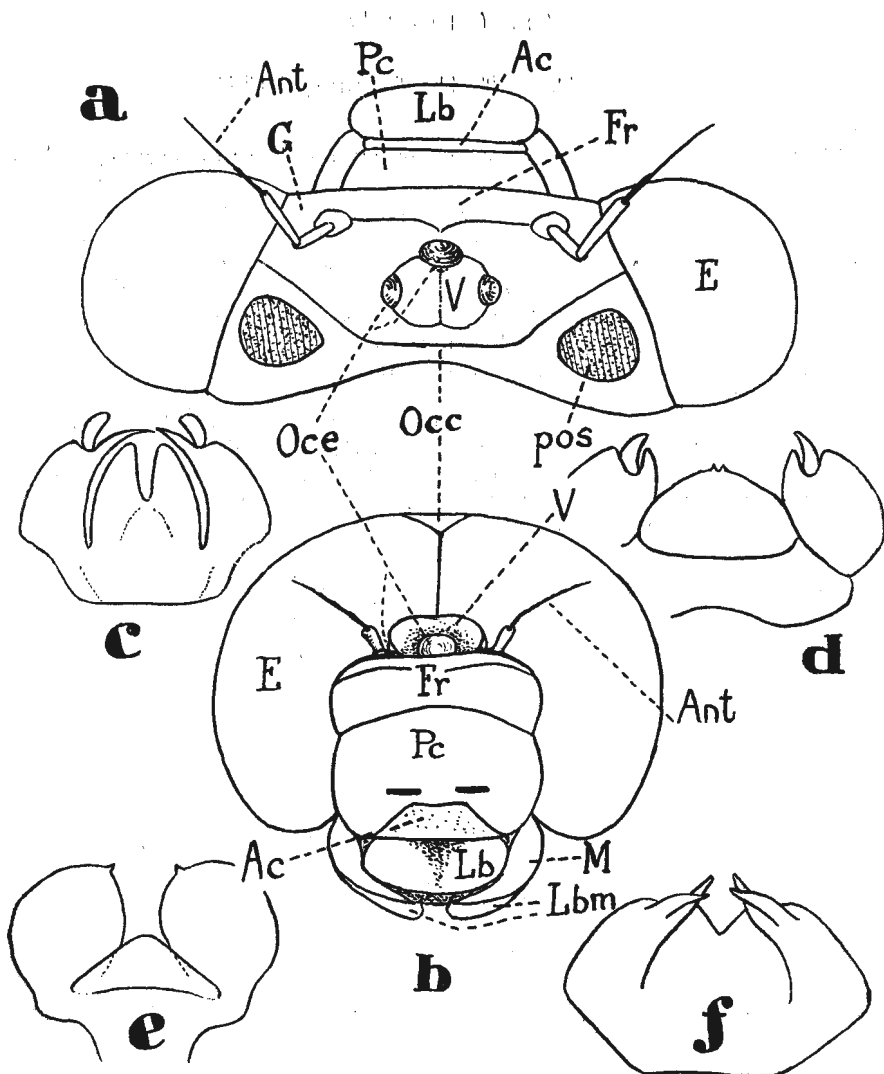


FIG. 1.—*a*. Head of a Zygopterous dragonfly (*Ischnura*). *b*. Head of an Anisopterous dragonfly (*Aeshna*). Labium of: *c*. *Agrion* (Zygoptera). *d*. *Aeshna* (Anisoptera). *e*. Libellulina (Anisoptera). *f*. *Cordulegaster* (Anisoptera). *Ac*, anteclypeus; *Pc*, postclypeus; *Lb*, labrum or upper lip; *Lbm*, labium or lower lip; *Fr*, frons; *Ant*, antennae; *G*, genae or cheeks; *Oce*, ocelli; *E*, compound eyes; *Occ*, occiput; *pos*, postocular spots; *V*, vertex; *M*, base of mandibles.

The *thorax* (fig. 2) is composed of a small anterior separate portion, the *prothorax* (*Pr*) united by membrane to a larger *ptero-* or *synthorax*, which is made up of the closely fused *meso-* and *metathorax*; the synthorax is very oblique, the true dorsum or upper surface looking backwards rather than upwards and the anterior pleurites expanded forwards and upwards to meet in the middle line and thus form a pseudo- or false dorsum (fig. 2, *d*). (In the keys and descriptions which follow, it must therefore be understood that by the "dorsum of thorax" is meant the false dorsum formed by the pleurites.) The tergites and sternites are narrow, the pleurites broad and presenting distinct separating sutural lines: the middorsal suture or *carina* (fig. 2, *mdc*) which often bears a keel or spine in the Anisoptera, the humeral suture (fig. 2, *hs*) in the region of the shoulder, and two lateral sutures, the first (fig. 2, *lsi*) often more or less obsolete (except in *Agrion*) and distinct

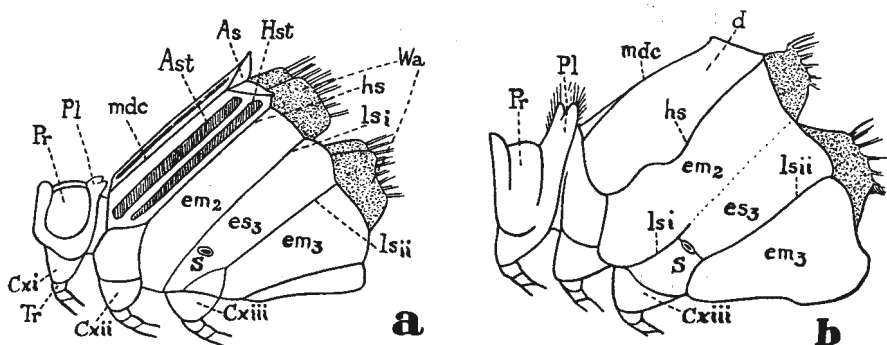


FIG. 2.—*a*. Thorax of a Zygopterous dragonfly (*Agrion*). *b*. Thorax of an Anisopterous dragonfly (Libelluline). *Ast*, antehumeral stripe; *Hst*, humeral stripe; *Mdc*, Mid-dorsal suture or carina; *hs*, humeral suture; *lsi*, first lateral suture; *lsii*, second lateral suture; *As*, antealar sinus; *Pr*, prothorax; *Pl*, posterior lobe of prothorax; *em2*, mesepimeron; *es3*, metepisternum; *em3*, metepimeron; *Cxi*, *ii* and *iii*, coxae; *Tr*, trochanter; *S*, spiracle; *d*, pseudo, or false, dorsum.

only in its upper or lower third. The dorsum of thorax is often marked by conspicuous coloured stripes, an *antehumeral* (fig. 2, *Ast*) situated about midway between the middorsal carina and humeral sutures, and a humeral (*Hst*) lying closely apposed to the anterior border of the humeral suture; between the humeral and first lateral sutures lies the mesepimeral space (*em2*), between the first and second lateral sutures, the metepisternal space (*es3*), and posterior to the second lateral suture, the metepimeral space or *metepimeron* (*em3*). At the lower end of the metepisternal space is situated the opening of the thoracic spiracle (*S*).

The *wings* (fig. 3, *a-d*) in the Zygoptera, lie closely apposed over the dorsum when at rest (but partially open in the *LESTIDÆ*) or, in the Anisoptera, are held horizontally at right angles to the body; they are hyaline or partially opaque, coloured or not, composed of a pleated membrane supported on a system of longitudinal main veins connected by shorter cross-veins. The former veins are six in number and alternate at high (+) or low (−) levels as follows: *Costa* (*C*, +) forming the anterior border of the wing from base to *Nodus*; *Subcosta* (*Sc*, −) extending from base of wing to its apex and fusing with the *Costa* at the *Nodus* which is a false joint situated



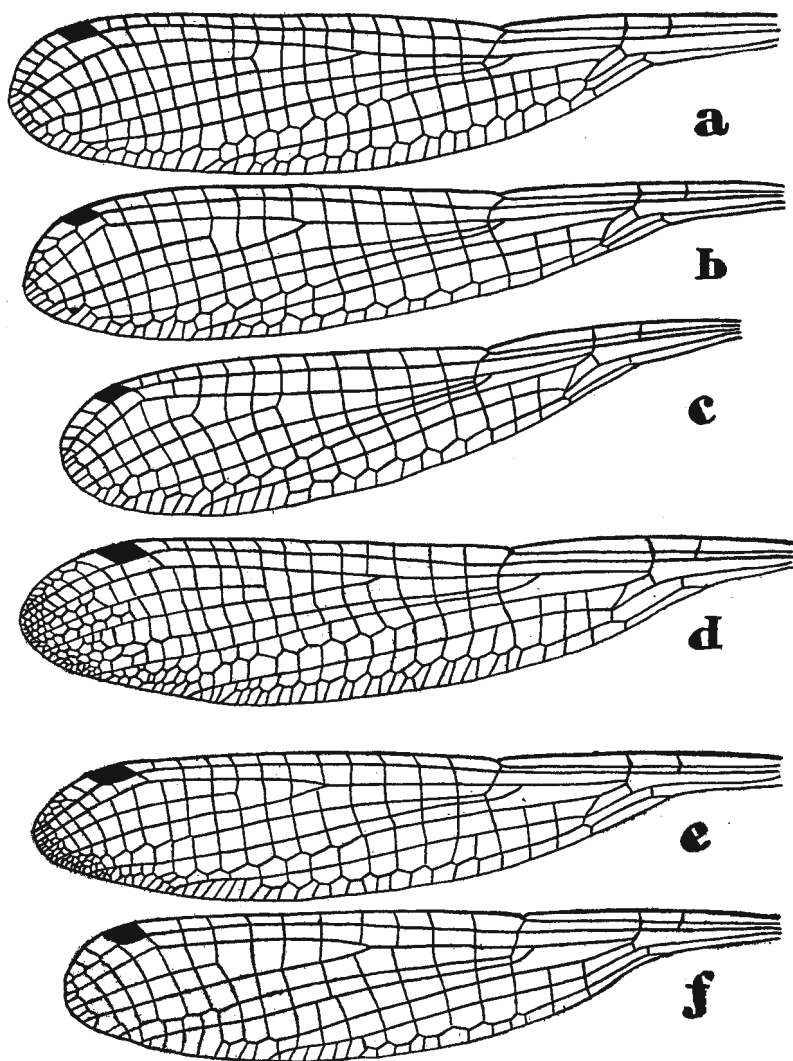
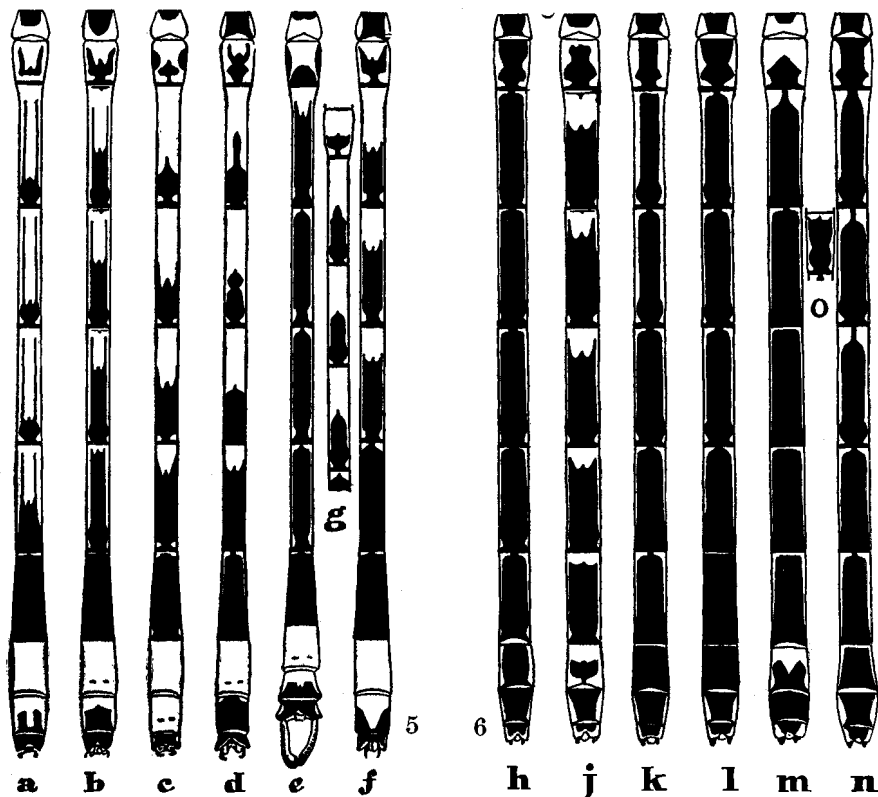


FIG. 4.—Wings of : a, *Pyrrhosoma* ; b, *Coenagrion* ; c, *Ceriagrion* ; d, *Erythromma* ; e, *Enallagma* ; f, *Platycnemis*.

at a variable distance from the base of wing ; at the Nodus (*N*) the Subcosta makes an oblique or bayonet-like bend forward to join the Costa ; *Radius* (*Ri*, +) extending from base of wing to its apex, near which it becomes solidly bound to the combined Costa and Subcosta by the interposition of a chitinous opaque cell, the *pterostigma* (*Pt*) ; *Medius* (*MA*, +), which is fused with the Radius for a short distance at the extreme base of wing (*R* + *M*) and then runs in a gentle curve to end up on the posterior border of the wing at about its middle. After parting company with the Radius,



however, the Medius makes a sharp turn posteriorly and then resumes its course; this turned-down portion forms the upper part of the *Arculus* (*Arc*). The basal portions of the Radius and Medius where they depart from the Arculus are known as the *Sectors of the Arculus* (*Sa*), and may be separated or fused for a short space at this level. (The posterior branch of the Medius or *MP* is quite absent in all dragonfly wings). The Medius is followed



FIGS. 5 and 6.—5. Abdominal markings in the males of: a, *Coenagrion puella* (Lin.); b, *C. pulchellum* (V. d. Lind.); c, *C. hastulatum* (Charp.); d, *C. mercuriale* (Charp.); e, *C. armatum* (Charp.); f, *C. scitulum* (Ramb.); g, *C. scitulum* var., from Essex; segments 2 to 5. 6. Abdominal markings in the females of: h, *C. puella*; j, *C. pulchellum*; k, *C. hastulatum*; l, *C. mercuriale*; m, *C. armatum*; n, *C. scitulum*, o, *C. scitulum* var., from Essex, segment 2.

posteriorly by the *Cubitus* (*CuP*, —) which runs from the base of the wing to the arculus and then in a sharp curve or actual angle to the posterior border of wing. (The anterior branch of the cubitus or *CuA* is absent in all wings of the Odonata). Finally the *Analisis* or *Anal* vein (*IA*, +) runs almost parallel to the Cubitus from base of wing to its posterior margin. The Radius gives off a posterior branch, the *Radial Sector* (*Rs* or *RP*, —) which itself then gives off three or four branches, *Rii*, *Riii*, *Riv* and *Rr*; the two latter are, however, invariably fused to form a single vein (all +). Inter-calated branches are present between *Rii* and *Riii* and between *Riii* and

*Riv* (*IRii* and *IRiii*) and in many wings, also between *Riv* + *v* and the *Medius*. Between *MA* and *CuP*, near the base of the wing, is found a quadrate or triangular cell which is entire in the *Zygoptera* (*quadrilateral*, *Dc*) but divided into two cells in the *Anisoptera*, a lower one forming the discoidal cell proper (*Dc*) and a narrow upper one or hypertrigone (*ht*) (fig. 3, *a* and *c*).

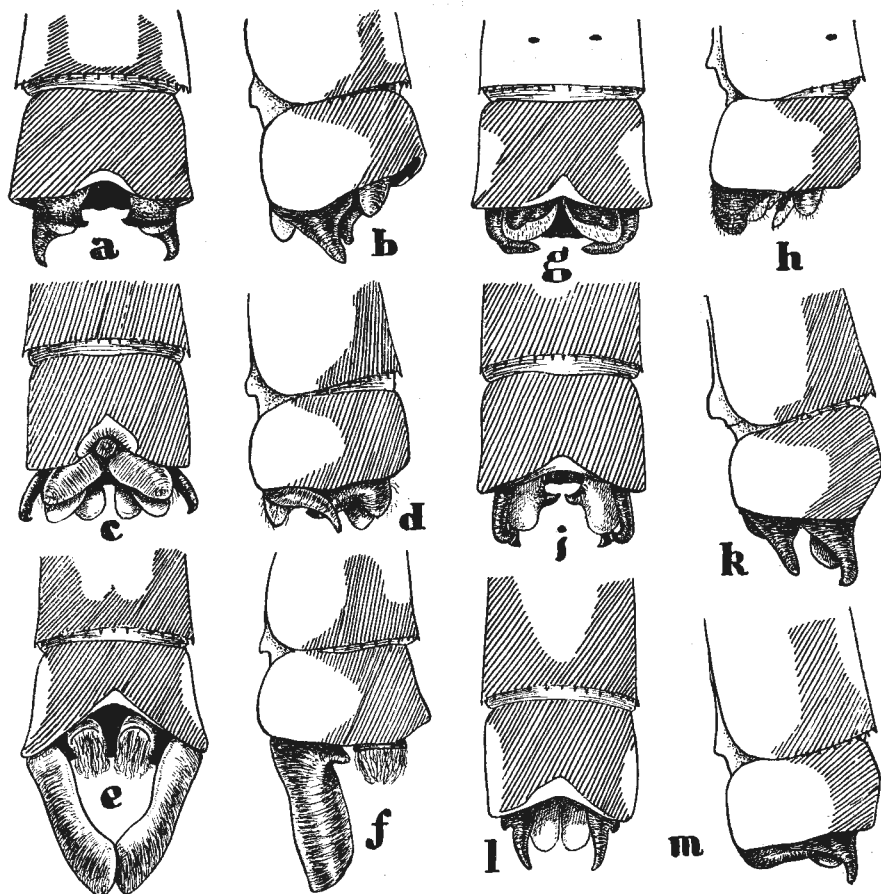


FIG. 7.—Dorsal and left lateral views of anal appendages of: *a* and *b*, *Coenagrion puella* (Lin.); *c* and *d*, *C. pulchellum* (V. d. Lind.); *e* and *f*, *C. armatum* (Charp.); *g* and *h*, *C. hastulatum* (Charp.); *i* and *k*, *C. mercuriale* Charp.; *l* and *m*, *C. scitulum* (Ramb.).

Between the *Costa* and *Radius* run a series of short cross-veins, those distal to the *Nodus* being known as the *postnodals* (*Pns*), those proximal, the *antenodals* (*Ans*): two of the latter, which are much thicker than the rest, are the *primary antenodals* (these primaries once stood alone and still do so in the smaller primitive *Zygoptera* (fig. 3, *b* and 4, *a-f*), but are combined with many others in the higher forms and throughout the *Anisoptera* (fig. 3, *a*, *c* and *d*); in the most recent forms, the character of the primaries has become merged with the others and they are altogether absent). Between

the Cubitus and Anal vein, at the base of the wings, will be found an oblique cross-vein (*Ac* or *Cv*) (fig. 3, *b*) which is usually single, but may be duplicated ; it is an important vestigial structure and represents the end of the path taken by the Anal trachea to rejoin its vein. At the base of the Anisopterous wing is found a short opaque membrane, the *Membranule* (*M*) and immediately adjacent to it, in the male hind-wing, is often found a triangular cell, the *anal triangle* (fig. 3, *a* and 13, *a*, *At*) ; distal to this and posterior to the discoidal cell in the hind wings of the larger Anisoptera, a well

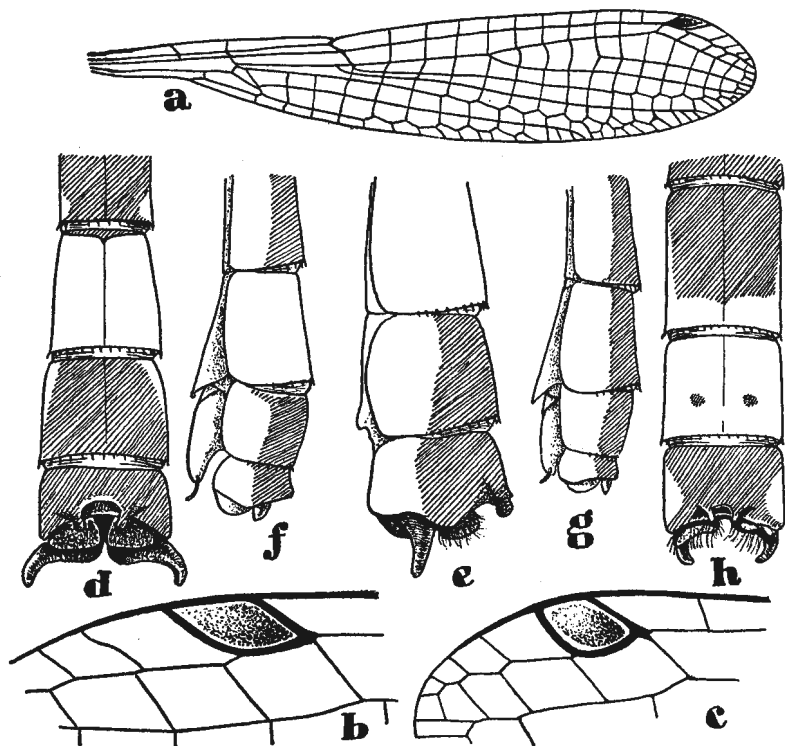


FIG. 8.—*a*, Fore wing of *Ischnura elegans* (V. d. Lind.), male. *b*, Apex of fore wing of same species. *c*, Apex of fore wing of *I. pumilio* (Charp.). *d* and *e*, Dorsal and left lateral views of anal appendages of *I. elegans*. *f*, Left lateral view of end of abdomen of *I. elegans* female (note ventral spine beneath segment 8). *g*, The same of *I. pumilio*. *h*, Anal appendages of *I. pumilio*, dorsal view.

defined group of cells forms the *anal-loop* (figs. 3, *a*, 16, 18, 19 and 20, *Al*). Posterior to the intercalary *IRiii* in the Anisoptera will often be found a strongly curved supplementary vein (*Rspl*) and frequently a similar vein occurs posterior to *MA* (*Mspl*) (figs. 3, *a* and 15, *g*). In some of the larger Anisoptera (*Aeshna*) the intercalary *IRiii* divides into two branches near the level of the pterostigma ; this is known as the *Radial fork* (figs. 3, *a*, *Rf* and 15, *g*, *Fbr*).

The *legs* are composed of five segments from base to distal end, known as the coxa, trochanter, femur, tibia and tarsus. The *coxae* are short,

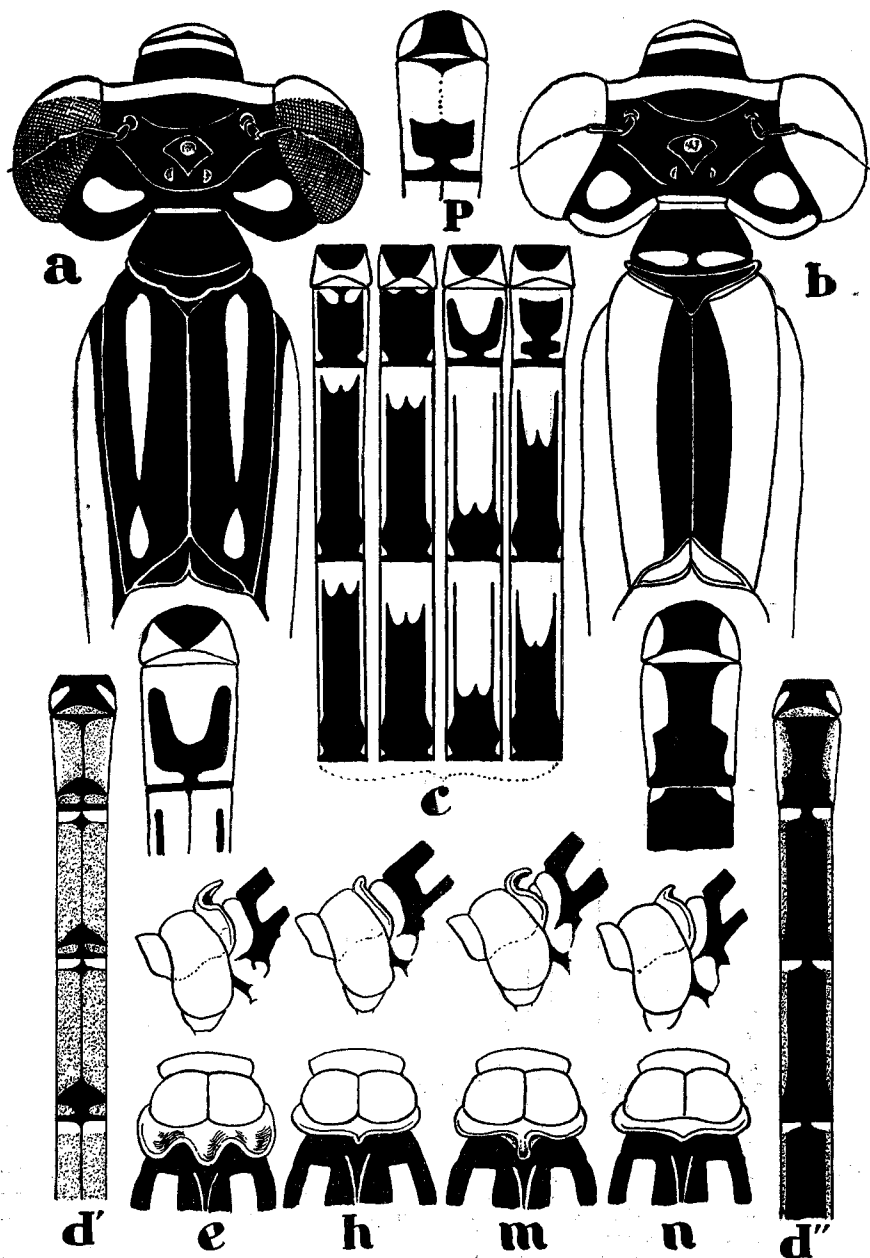


FIG. 9.—a. Head, thorax and base of abdomen of *Coenagrion pulchellum* (V. d. Lind.) male. b. The same of *Ischnura elegans* (V. d. Lind.), orange, heteromorph female. c. Four variations in the markings of abdomen of *C. pulchellum*, male. d'. Segments 1 to 4 and base of 5 of *Pyrrhosoma nymphula* (Sulz.), andromorph female. d''. The same of heteromorph female. Left lateral (upper fig.) and dorsal views of the female prothorax of: e. *C. pulchellum*. h. *C. mercuriale* (Charp.). m. *C. scitulum* (Ramb.). n. *C. puella* (Lin.). p. Base of abdomen of *C. scitulum*, Essex male.

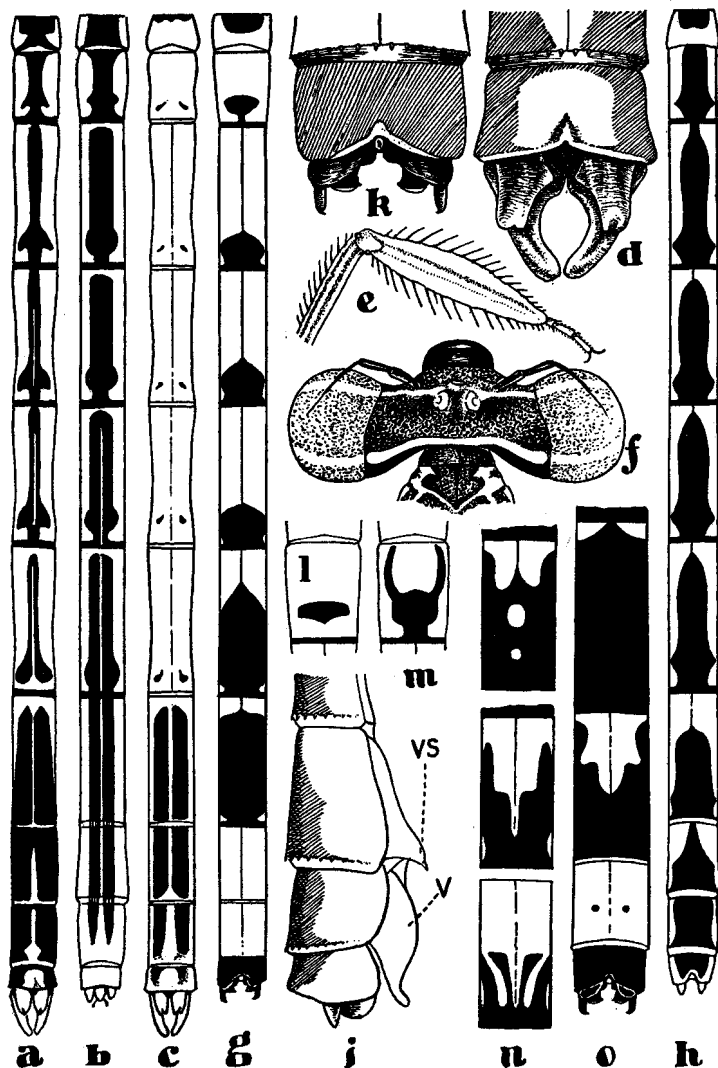


FIG. 10.—Abdominal markings of: *a. Platynemis pennipes* (Pallas), male. *b.* The same of the female. *c.* The same of the newly emerged (teneral) male. *d.* Male anal appendages of *P. pennipes*, seen from above. *e.* Hind leg of same. *f.* Head of male of same species. *g.* *Enallagma cyathigerum* (Charp.), abdominal markings of male. *h.* The same of the female. *i.* End of the female abdomen seen from the right side (*VS*, ventral spine on segment 8, *v*, vulvar scale). *k.* Male anal appendages of *E. cyathigerum*, dorsal view. *l* and *m.* Variations in the markings of segment 2, *E. cyathigerum*, male. *n.* Variations in the markings of segment 8 of same species, male. *o.* Variation in segments 7 to 10 in a specimen from Inverness, male.

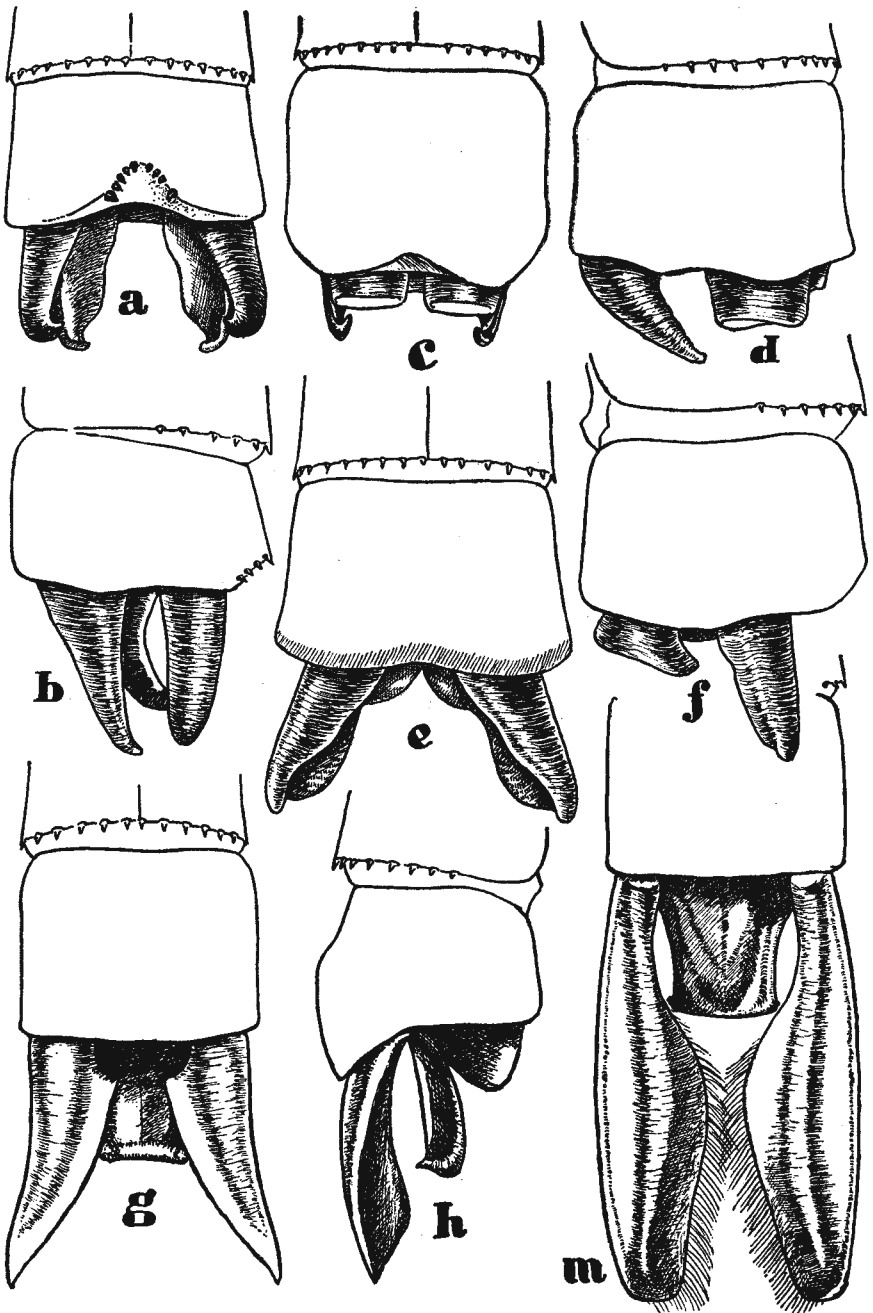


FIG. 11.—Male anal appendages, seen from the dorsum and left side of : *a* and *b*. *Pyrrhosoma nymphula* (Sulz). *c* and *d*. *Ceriagrion tenellum* (Villers). *e* and *f*. *Erythromma najas* (Hanse.). *g* and *h*. *Cordulegaster boltoni* (Donov.). *m*. *Anax imperator* Leach.

cone-shaped segments, the trochanters slim and transversely constricted into short basal and longer distal portions, the femora usually furnished with two rows of spines but the armature very variable in the species and often also in the sexes; tibiae more slim, of the same length or longer than the femora, furnished with hair-like or stouter bristles on each side or, in the males of some families, a membranous keel-like structure on the flexor surface (CORDULIIDAE); tarsus always formed of three segments, the proximal one short, the distal one the longest and ending in two robust claws, each of which may be furnished with a strong spine.

The *abdomen* is usually long and narrow, but may be shorter and stouter

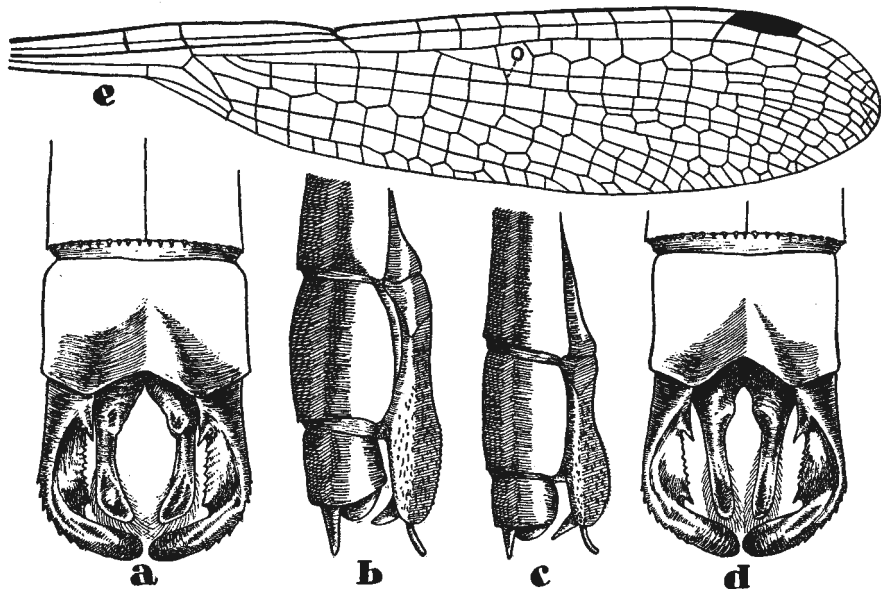


FIG. 12.—*a*. Anal appendages of *Lestes dryas* Kirby, male, dorsal view. *b*. End of abdomen of female of same species, showing ovipositor. *c*. The same of *L. sponsa* (Hanse.). *d*. Anal appendages of *L. sponsa*, male, dorsal view. *e*. Wing of same species (*o*, oblique vein). See also fig. 3, *b*.

in the LIBELLULIDAE; it consists of ten segments, with one or two pairs of anal appendages at the end (fig. 13, *b* and *c*). Each segment is formed by a dorsal convex tergite which covers the whole of the dorsum, sides and adjacent part of the ventral surface, and a ventral sternite united at each side to the tergite by a membranous pleurite which allows of free respiratory movements of the abdomen. Segments 1 to 8 each bear a pair of spiracles which are situated on the pleural membrane. Segment 2 in many species of the Anisoptera bears on each side an ear-shaped process (*auricle* or *oreillet*, fig. 13, *b*, *aur*), the function of which is to act as a “director” to the female during the act of copulation, enabling her to find the situation of the male genitalia. The male genitalia (or sexual apparatus) are situated on the ventral surface of the 2nd and 3rd segments, whilst the genital pore is to be found on the ventral surface of segment 9. The genitalia consist of a deep fossa in which lie a 3-segmented penis protected by a sheath or “guide” and one or two pairs of hooks (*hamules*) by which the female

genitalia link firmly with those of the male. The posterior pair of hamules are usually furnished with an outer and inner lobe or hood (fig. 20, *b-i*).

In the female, the abdomen is generally somewhat shorter and stouter than in the male and is more or less cylindrical throughout. The genitalia are situated on the ventral surface of the 8th and 9th segments; the whole of the Zygoptera and one primitive family of the Anisoptera, the AESHNIDAE, are furnished with a robust ovipositor homologous to that of the Saw-flies,

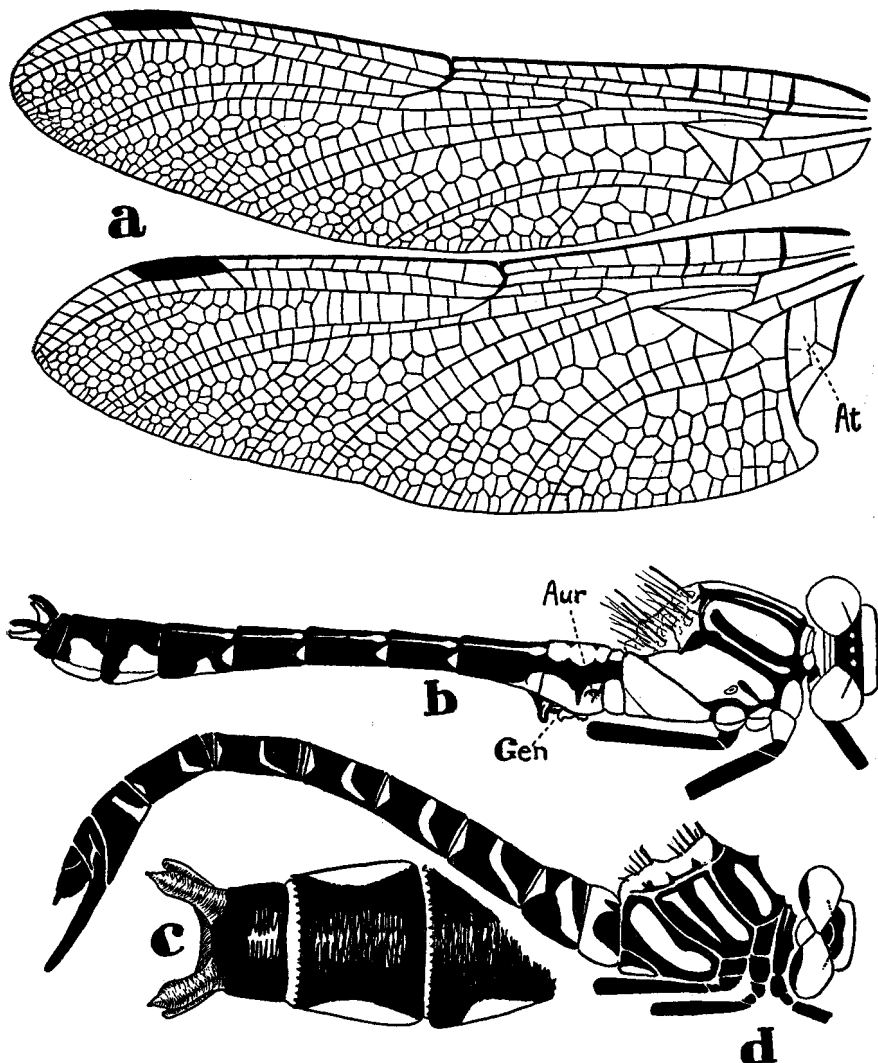


FIG. 13.—*a*. Wings of *Gomphus vulgatissimus* (Lin.), male. *b*. Body markings of same, male. *c*. Dorsal view of end of abdomen and anal appendages of same species, male. *d*. Body markings of *Cordulegaster boltoni* (Donovan), female. *Aur*, auricles or oreillets; *Gen*, male genitalia; *At*, anal triangle of 5 cells.



and protected by lateral valves and with a saw-like edge by which eggs are inserted into the tissues of plants (figs. 8, *f* and *g*; 10, *i*, and 12, *b* and *c*). In the remaining families of the Anisoptera, save the CORDULEGASTERIDAE, in which there is a conspicuous but vestigial ovipositor (fig. 13, *d*), the

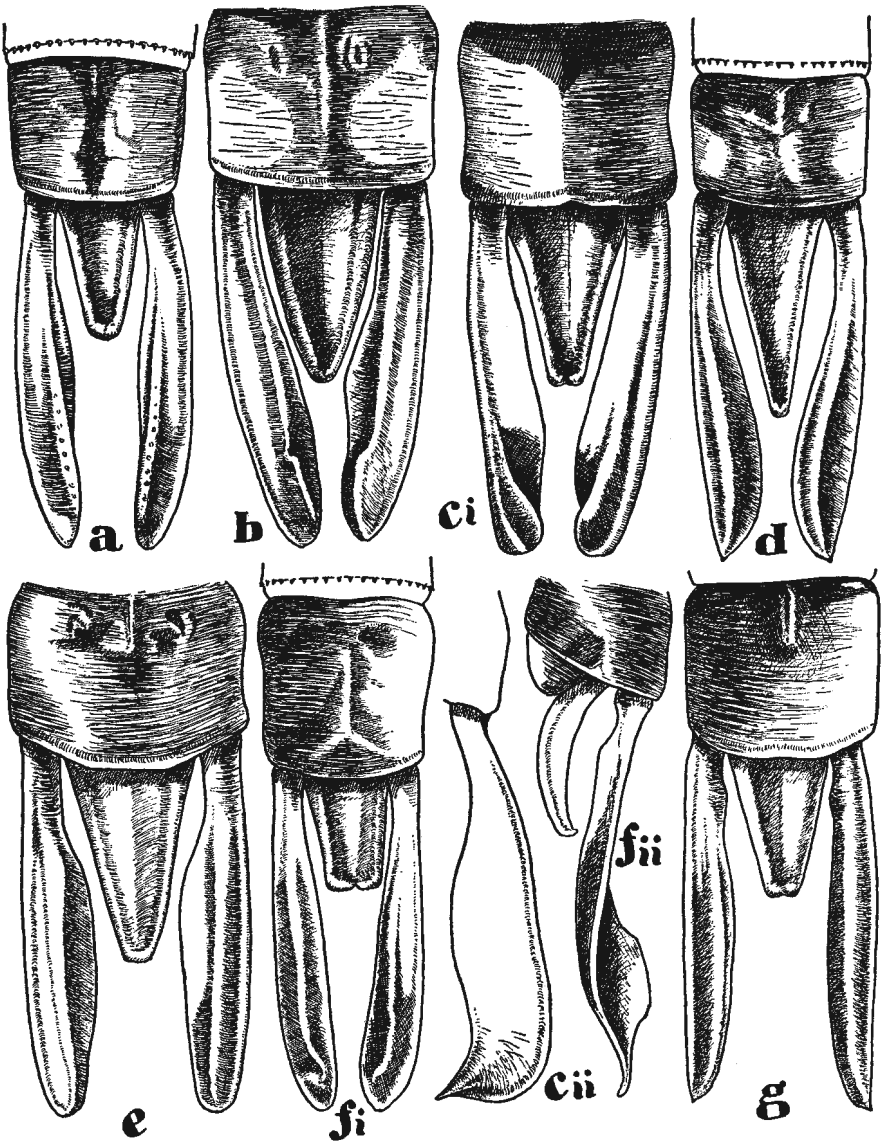


FIG. 14.—Male anal appendages of : *a*. *Aeshna caerulea* (Ström.). *b*. *A. juncea* (Lin.). *ci*. *A. cyanea* (Müller). *cii*. Superior anal appendage of same seen in profile. *d*. *A. mixta* (Lat.). *e*. *A. grandis* (Lin.). *fi*. *Brachytron pratense* (Müller). *fii* Superior anal appendage of same seen in profile. *g*. *A. isosceles* (Müller).

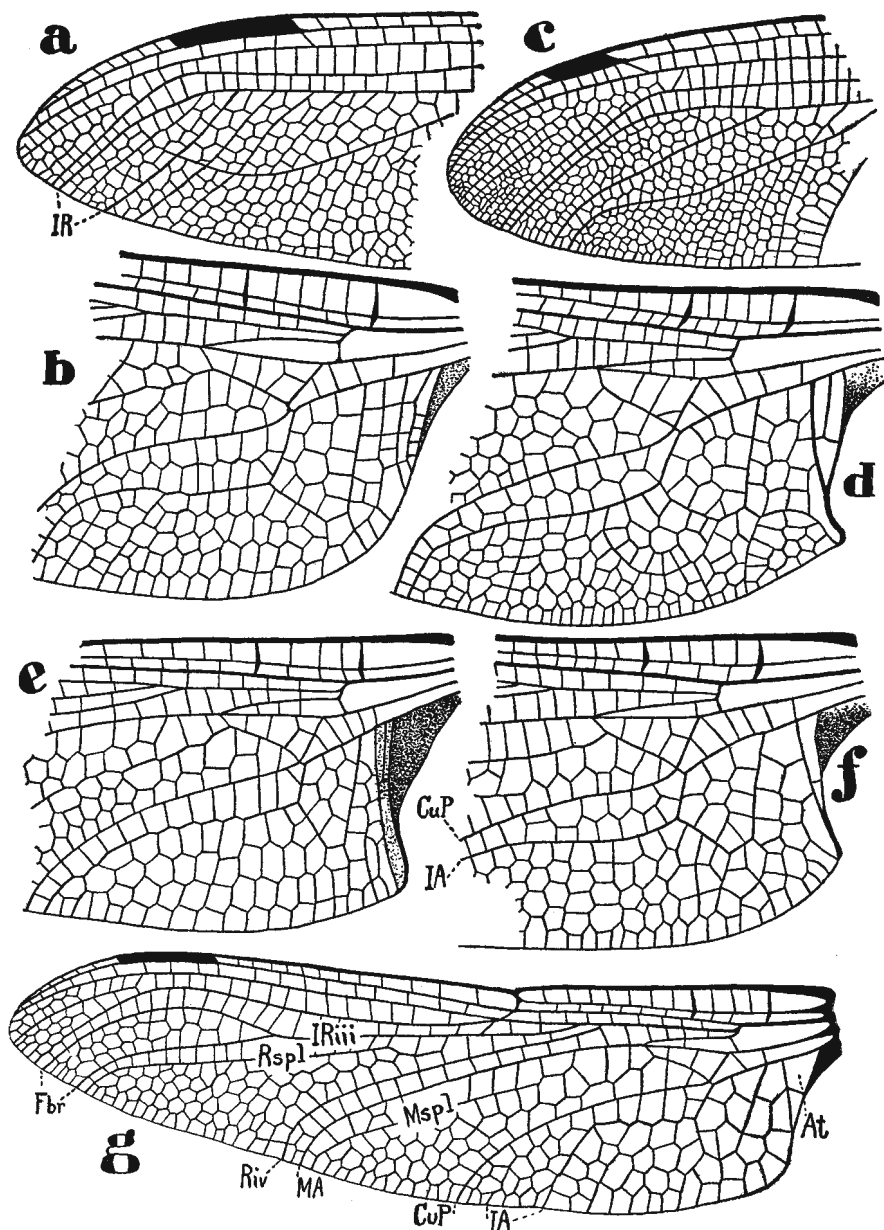


FIG. 15.—a. Apex of wing of *Anax imperator* Leach. b. Base of hind wing of same, male. c. Apex of wing of *Aeshna cyanea* (Müll.). d. Base of hind wing of same, male. e. Base of hind wing of *A. isosceles* (Müll.), male. f. Base of hind wing of *A. juncea* (Lin.), male. g. Hind wing of *Brachytron pratense* (Müll.). Fbr. branches of fork of IRiii. (Other lettering as for fig. 3a).

ovipositor is wanting, the eggs being simply extruded and deposited in water.

*Anal appendages* : in the Anisoptera, the males possess two superior and a single inferior anal appendage, the latter situated *above* the anus and

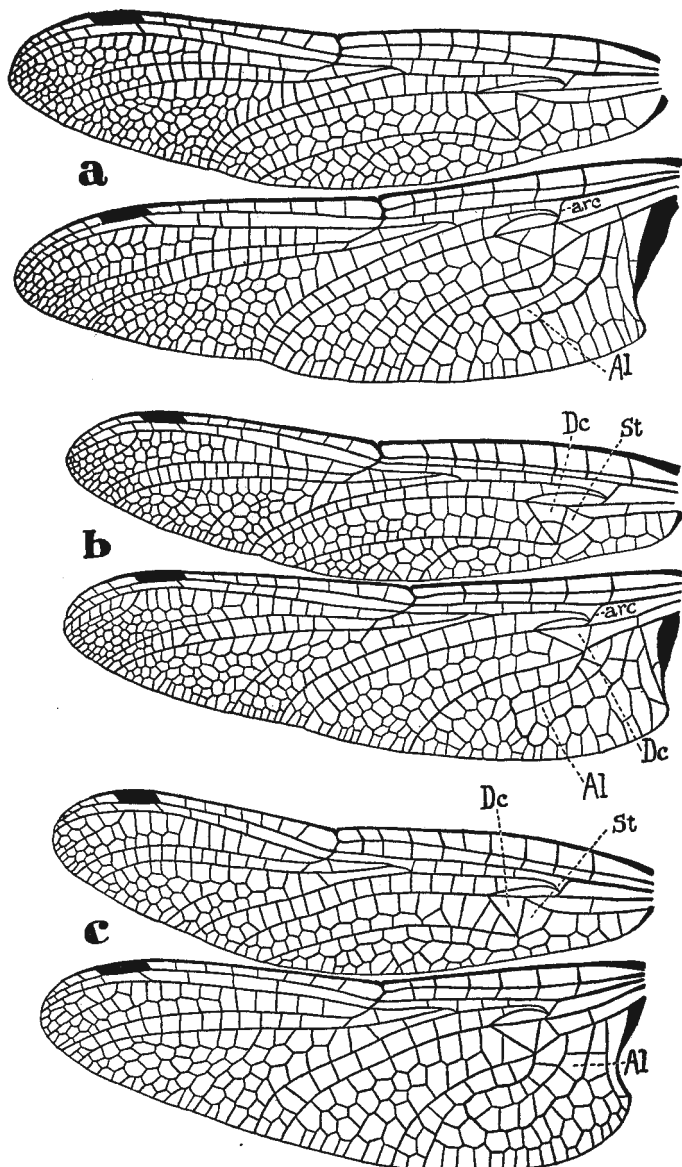


FIG. 16.—Wings of : *a. Somatochlora metallica* (V. d. Lind.), male. *b. Cordulia linaenea* Fraser, male. *c. Oxygastra curtisi* (Dale), male. (British examples of *O. curtisi* show great venational variability.)

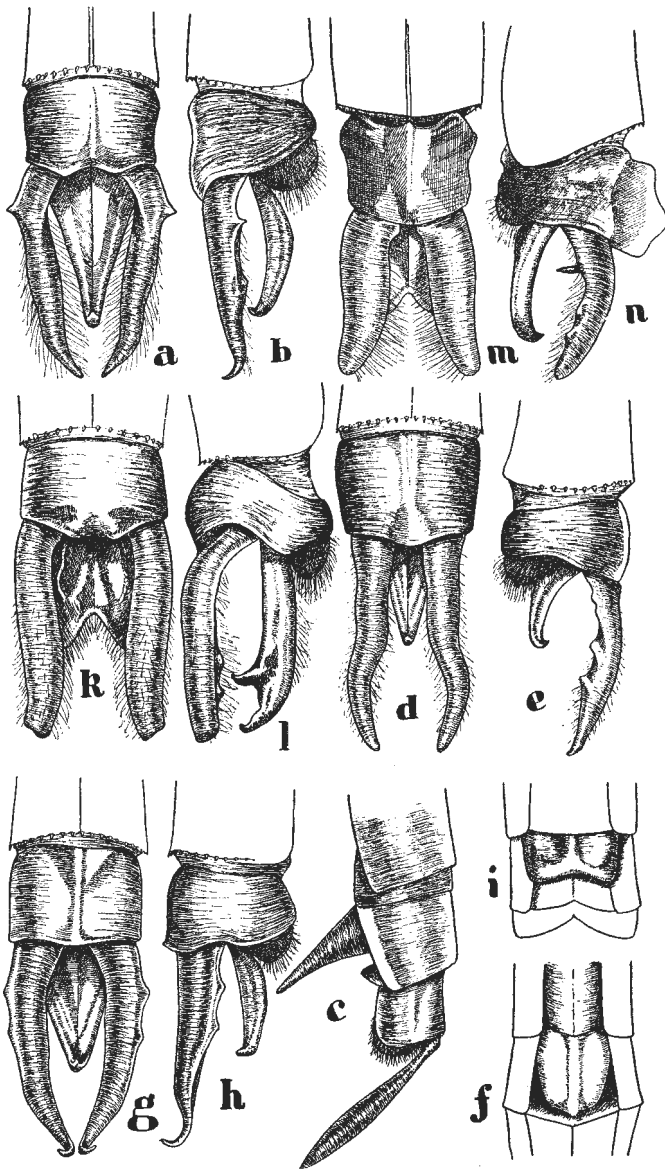


FIG. 17.—a and b. Anal appendages of *Somatochlora metallica* (V. d. Lind.), male, dorsal and right lateral views. c. Genitalia and anal appendages of female of same species, viewed from the left side. d and e. Anal appendages of *Somatochlora arctica* (Zett.), male, dorsal and left lateral views. f. Ventral view of genitalia of female of *S. arctica*. g and h. Anal appendages of *Somatochlora alpestris* (Selys), male, dorsal and right lateral views. i. Ventral view of genitalia of *S. alpestris*, female. k and l. Anal appendages of *Cordulia linaenea* Fraser, male, dorsal and right lateral views. m and n. The same of *Oxygastra curtisi* (Dale), male, dorsal and left lateral views.

corresponding to the *appendix dorsalis* of the nymph (figs. 13, c, 14 and 17). In the Zygoptera, the males possess a pair of inferior as well as a pair of superior appendages, the latter homologous to those of the Anisoptera, the former representing the cerci of the nymph and situated *below* the anus (figs. 7, 11). Both superior and inferior appendages have an infinite variety of shape and are thus of great assistance in the identification of many species; they are employed for the purpose of seizing the female by the neck (prothorax) or head prior to the act of copulation. The females have

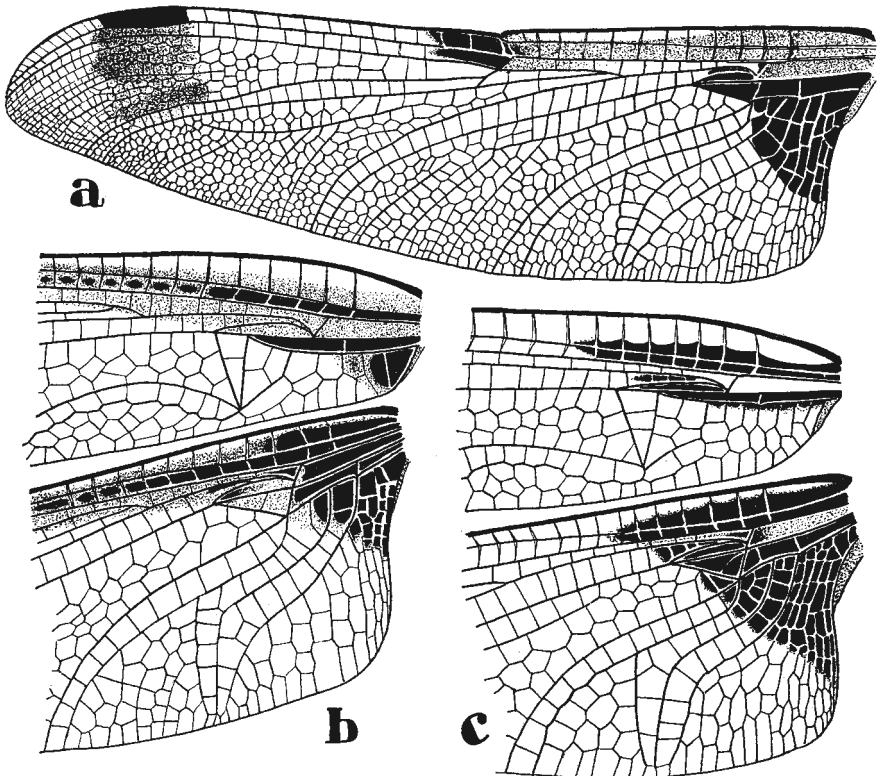


FIG. 18.—a. Hind wing of *Libellula quadrimaculata* Lin., male, var. *praenubila* Newm. b. Base of wings of *L. fulva* Müller, female. c. Base of wings of *L. depressa* Lin., male.

only a single pair of superior anal appendages, these being functionless and more or less rudimentary.

**BIONOMICS.**—Prior to copulation, the male imago curls its abdomen beneath its body so as to bring the genital-pore into contact with the genital-fossa on the underside of the 2nd and 3rd abdominal segments and thus transfer spermatozoa from one to the other organ. This action is nearly always performed whilst in flight and is often repeated before the male actually contacts a female. The male seizes the female by the neck in most species, but by the head in many of the AESHNIDAE and GOMPHIDAE,

employing its anal appendages for this purpose. The two insects thus coupled may fly up and down for some time in "tandem-fashion" before ovipositing begins, but meanwhile, the act of copulation is consummated by the female bringing her abdomen under that of the male and connecting

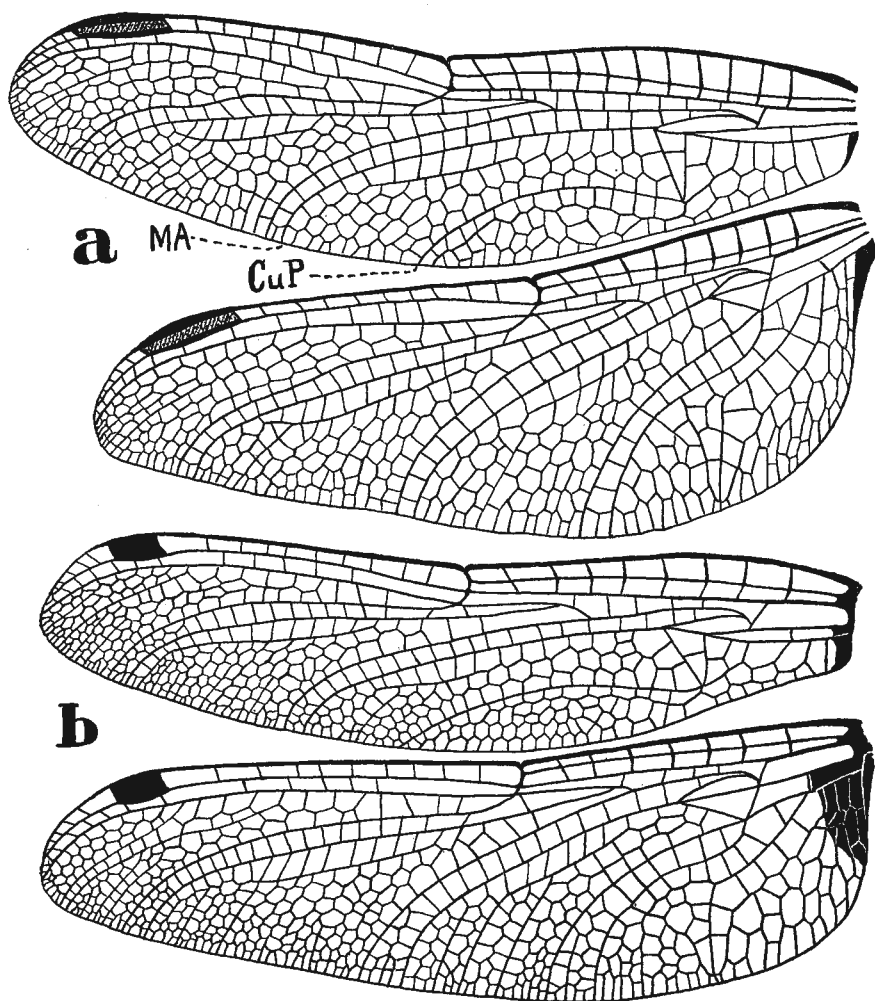


FIG. 19.—Wings of: *a. Orthetrum coerulescens* (Fabr.), male. *b. Leucorrhinia dubia* (V. d. Lind.), male.

her genitalia on segments 8 and 9 with those of the male on segments 2 and 3. This act may take place during flight or whilst at rest and may last for an appreciable period; ovipositing may then take place with the two still *in copula* or the female may desert her mate and carry out this work in solitude.

In the more archaic members of the Order, viz. the Zygoptera and Aeshnidae, the eggs are inserted into the tissues of plants floating or sub-

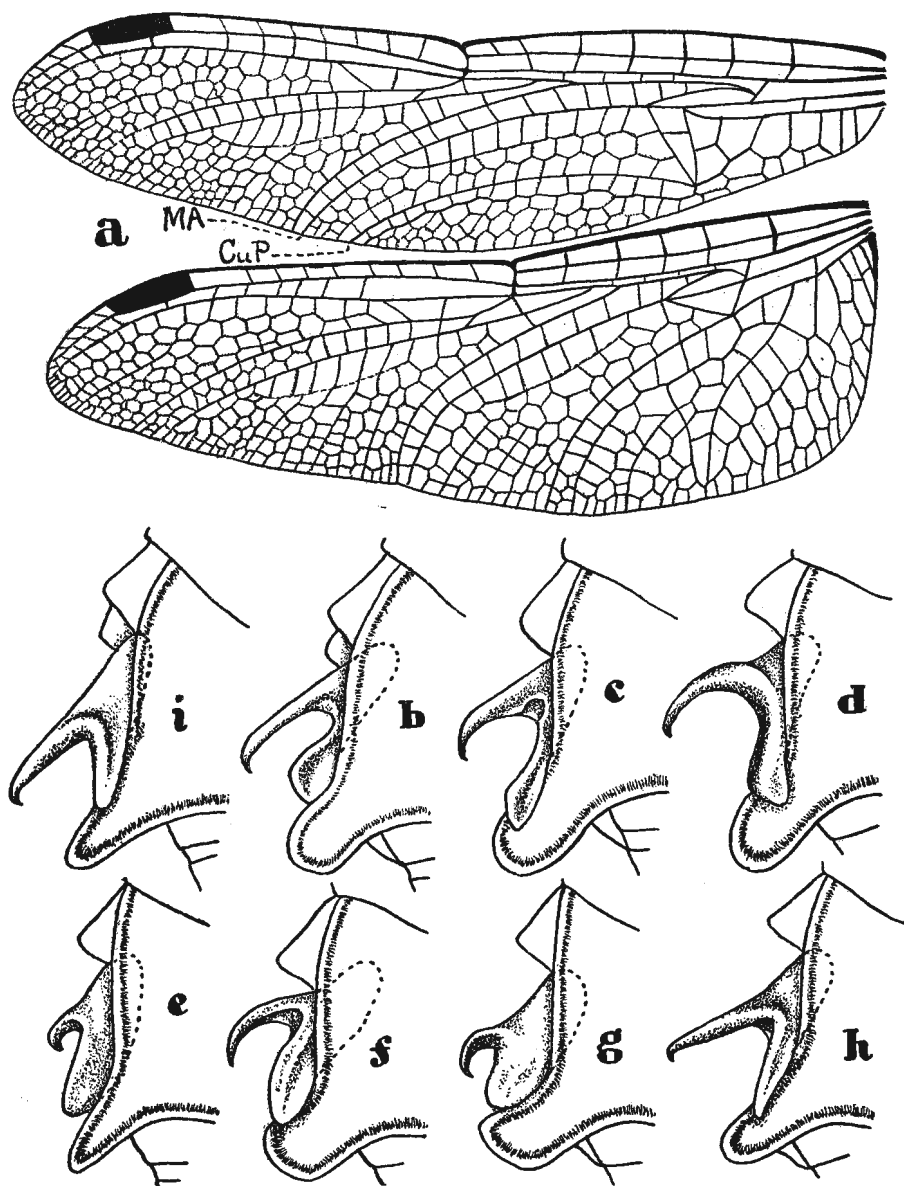


FIG. 20.—a. Wings of *Sympetrum striolatum* (Charp.), male. Male genitalia of: b. *S. striolatum* (Charp.). c. *S. vulgatum* (Lin.). d. *S. nigrescens* Lucas. e. *S. fons-colombei* (Selys). f. *S. scoticum* (Donov.). g. *S. flaveolum* (Lin.). h. *S. meridionale* (Selys). i. *S. sanguineum* (Mull.). (All hamules are shown relatively enlarged to assist in recognition.)

merged in water, but species of *Lestes* insert theirs into stems of osiers, reeds or juncus, etc., well above water-level; *Aeshna* frequently deposits its eggs in any floating object on the water or even into moss about the borders of watery habitats, whilst *Cordulegaster* stabs her eggs into mud or sand in streams heavily shaded by overhanging vegetation. Modern species, not possessing an ovipositor, exude their eggs in masses and deposit them in water whilst in flight, this being accomplished by whipping the surface with the end of the abdomen.

The eggs hatch out at a variable period dependent mainly on prevailing temperatures; the larvae develop in the eggs and emerge as *pronymphs* enveloped in a thin membranous sheath. This stage lasts for but a brief space of time, sometimes for not longer than a minute, but, in the case of *Lestes*, which hatch out of water, it will endure for so long a time as it takes the pronymph to make its way into water when the outer shell at once

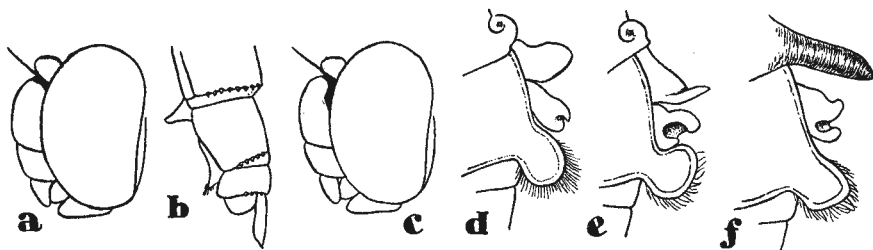


FIG. 21.—a. Head of *Symptetrum striolatum* (Charp.) viewed from the left to show basal black line on frons. b. Genitalia of *Symptetrum vulgatum* (Lin.) seen from the left side, ♀. c. Head of the same species to compare extent of black frontal basal line with that of *S. striolatum*. d. Genitalia of *Orthetrum coerulescens* (Fabr.), male, seen from the right side. e. The same of *O. cancellatum* (Lin.). f. The same of *Libellula depressa* Lin. (Note ventral spine on segment 2.)

bursts and the *nymph* emerges (the *nymph state* has come to be known in common parlance as the *larval* although it is not strictly so). As the nymph grows, it casts its skin from time to time just as do the larvae of Lepidoptera, the number of instars and ecdyses being variable and considerably more numerous than in the case of Lepidoptera. The nymphal state occupies a period of a few months to three years according to the species, this again dependent largely on prevailing temperatures and the abundance of food. (Keys for the identifications of nymphs will be found as an appendix on p. 42). Having attained full growth, the nymph leaves its watery home and climbs up some suitable structure, a reed or trunk of a tree (often at a considerable distance from and height above water) and there undergoes transformation into the imago, a change entirely similar to that prevailing among the Lepidoptera; the exuviae or empty nymphal cases remain *in situ* until the first freshet of rain washes them away.

Imaginal life among British Odonata is usually not longer than six weeks to two months, but some have a season extending from May to September, either in actual individual life or by relays of emergences.

DISTRIBUTION.—The majority of British species are to be found in the southern counties, but others are more or less widely distributed and a few are confined to northern localities in Scotland. Species which breed in streams rarely wander far from such neighbourhoods, but the same does not



apply generally to those breeding in still waters. Two or three species appear to be confined to the Fen districts, whilst others are usually to be sought for in pine woods or heathlands. Females rarely come to water save to oviposit and must be sought in the woods and coppices nearest their watery habitats.

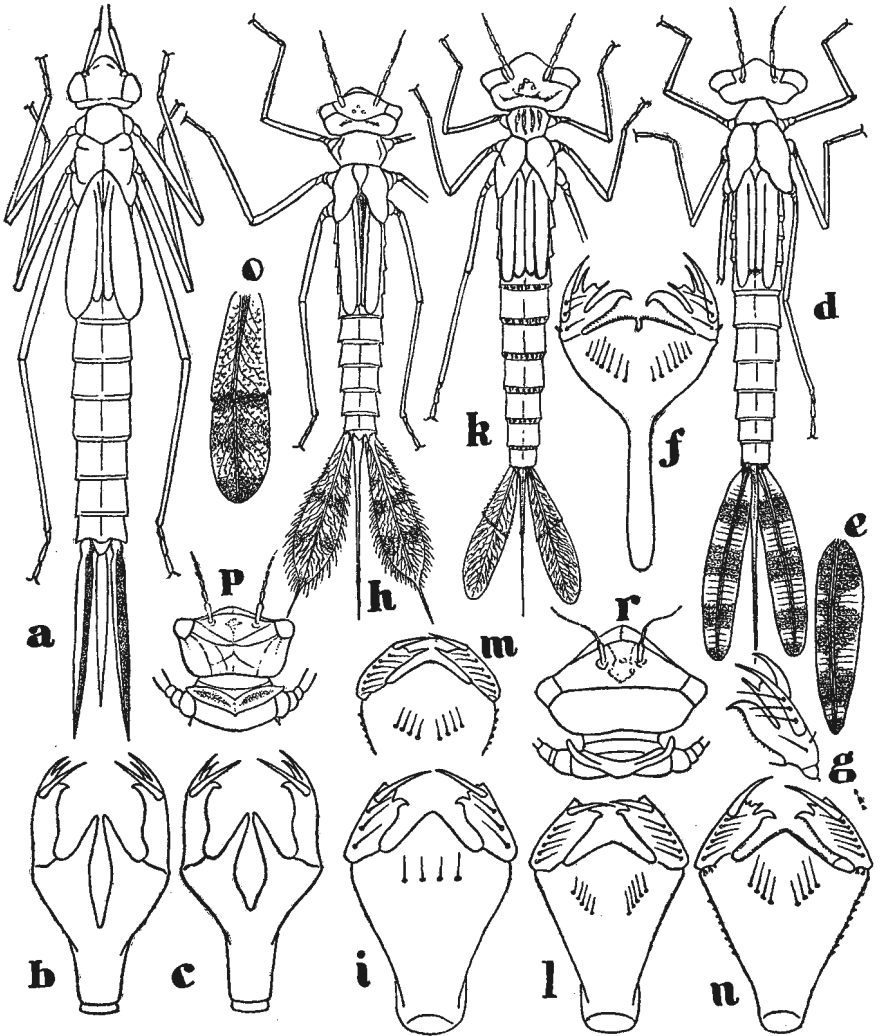


FIG. 22.—a. Nymph of *Agrion virgo* (Lin.). b. Labial mask of same. c. Labial mask of *A. splendens* (Harris). d. Nymph of *Lestes sponsa* (Hanse.). e. Caudal gill of *L. dryas* Kirby. f. Labial mask of *L. sponsa*. g. Lateral lobe of labium of *L. dryas*. h. Nymph of *Platynemesis pennipes* (Pallas). i. Labial mask of same species. k. Nymph of *Coenagrion puella* (Lin.). l. Labial mask of same. m. Labial mask of *Ischnura elegans* (V. d. Lind.). n. The same of *Erythromma najas* (Hanse.). o. Caudal gill of *E. najas*. p. Head and prothorax of *Orthetrum coerulescens* (Lin.). r. The same of *Cordulia linaenea* Fraser.

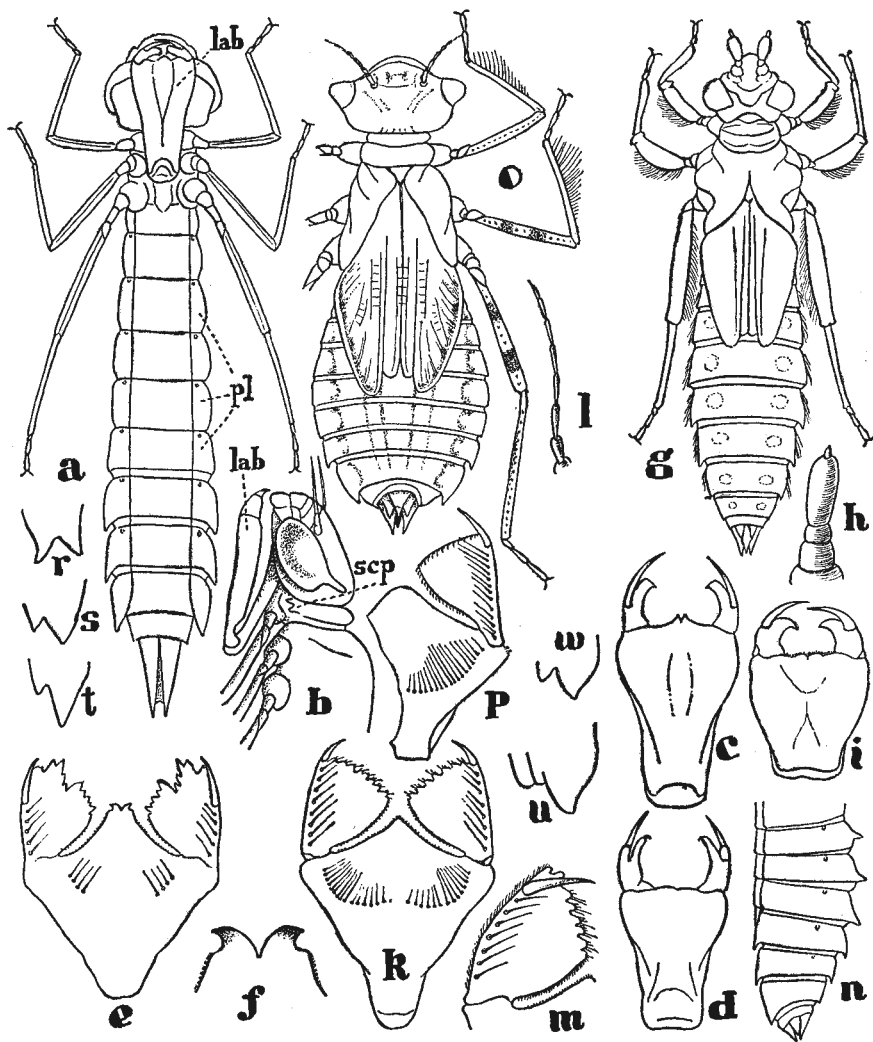


FIG. 23.—a. Nymph of *Anax imperator* Leach, ventral view to show labial mask (*lab.*) and pleurites (*pl.*). b. Head and fore parts of *Anax imperator* seen from the side to show underslung mask (*lab*) and supracoxal process (*scp*). c. Labial mask of *Aeshna cyanea* (Müll.). d. The same of *Brachytron pratense* (Müll.). e. The same of *Cordulegaster boltoni* (Donov.). f. Apex of mid-lobe of labial mask of same species, much enlarged. g. Nymph of *Gomphus vulgatissimus* (Lin.). h. Antennae of same species. i. Labial mask of same. k. Labial mask of *Cordulia linaenea* Fraser. l. Antennae of same. m. Lateral lobe of labial mask of *Orygaster curvisi* (Dale). n. Abdomen of *C. linaenea* viewed from the side. o. Nymph of *Sympetrum fonscolombei* (Selys). p. Labial mask of same. Supracoxal processes of: r. *Aeshna grandis* (Lin.). s. *A. juncea* (Lin.). t. *A. isosceles* (Müll.). u. *A. cyanea* (Müll.) and *A. caerulea* (Ström.). v. *A. mixta* (Latreille).

**DIFFERENTIATION.**—There are few British insects with which dragonflies may be confused, but the larger Neuroptera, *Osmylus*, and larger Chrysopids are occasionally sent in by collectors under the belief that they are Odonata. The very large compound eyes, the inconspicuous antennae, the presence of the nodal joint at about mid point in the costal border of the wings and the unique position of the male genitalia will all serve to separate Odonata from other insects. The sexes are easily determined by the situation of the genitalia, viz., if situated at both ends of the abdomen the sex is masculine, if at the anal end only, then feminine. A glance at the ventral surface of segment 2 will at once disclose the sex, this area being blank in the female.

**ECONOMICS.**—Odonata are not sufficiently numerous in the British Isles to possess any appreciable economic importance or influence for good or evil, although in warmer climates they undoubtedly control pests such as mosquitoes both in the nymphal and imaginal states, as well as various noxious flies and harmful Microlepidoptera.

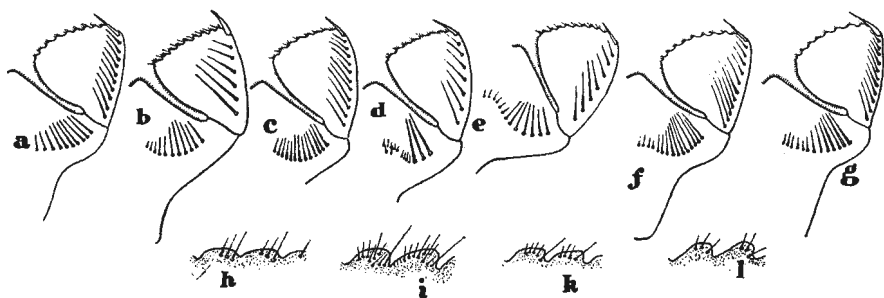


FIG. 24.—Labial mask of: a. *Sympetrum flaveolum* (L.). b. *Somatochlora metallica* (V. d. Lind.). c. *Sympetrum scoticum* (Donov.). d. *Orthetrum cancellatum* (L.). e. *Libellula quadrimaculata* L. f. *Leucorrhinia dubia* (V. d. Lind.). g. *Sympetrum striolatum* (Charp.). Distal border of labial mask showing crenations and serrations and spines of: h. *L. quadrimaculata* L. i. *S. metallica* (V. d. Lind.). k. *S. arcica* (Zett.). l. *S. alpestris* (Selys). Compare the deep serrations of the Cordulines (*Somatochlora*) with the crenations of the Libellulines (*Libellula*).

**FOSSIL HISTORY.**—The fossil record of the Odonata is very complete, dating right back to the Lower Permian, the remains however consisting almost entirely of wing-impressions. A few species, including some of the most classical types belonging to the Suborder *Anisozygoptera*, have been found in the British Lias, whilst more recent species have been found in the Tertiary deposits of the South of England. Thus it has been possible to trace an almost unbroken chain of evolution extending from the Lower Permian to present times.

**CLASSIFICATION.**—The original or Selysian classification of Dragonflies was founded on the venation of their wings. The great fossil discoveries made since then have much enhanced the value of such a basis for classification. A comparison between the venation of fossil and modern dragonfly wings shows that the latter still retain a number of persistent archaic elements by means of which it is possible to place any particular suborder, family or genus in its correct order in the scheme of evolution, and to build up a phylogenetic tree which is substantially correct. Thus it is of great importance that a close study of the dragonfly wing should be made before

attempting to make use of the keys which follow. Of the three suborders into which the Odonata are divided, **Zygoptera**, **Anisozygoptera** and **Anisoptera**, only representatives of the first and last are found in Great Britain, but the fossil evidence shows that the Anisozygoptera flourished in this country in Mesozoic times.

To the list of British Odonata (1945, Kloet and Hincks, *Check List British Insects*) should be added three recent additions to the British fauna, viz. *Coenagrion scitulum* (Rambur), *Somatochlora alpestris* (Selys) and *Sympetrum nigrescens* Lucas. This brings our fauna to a total of 21 genera and 46 species.

**COLLECTING AND PRESERVING ODONATA.**—Dragonflies may be taken at rest or on the wing with the ordinary kite-net, but a swifter stroke must be made on account of their greater speed than in the case of Lepidoptera. A stroke from below when the insect is at rest, or a following one when it is on the wing is more likely to be successful than one made from above or head-on. The cyanide bottle may be used for killing the captured specimens, but it will be found a better plan to place the living insects in paper packets with their wings folded, and delay killing until they are ready for setting. This is necessary if the living colours of the specimens are to be preserved and with a view to assuring this, as soon as the specimens have been removed from the cyanide jar the abdomen must be slit up beneath, along the line of the pleural membranes, by means of fine scissors and then the whole length of the gut, including the usually distended stomach, removed from end to end by means of a pair of fine pointed forceps. The specimen is then immersed in a bottle of methylated spirit for not less and not longer than four hours, which time will serve to fix the colours, sterilize the body contents and yet not make the specimen too rigid to set. Treated in this way, the partial dehydration effected by the spirit will cut down the time needed for drying and setting to a week in the case of small species, and two weeks in the case of the largest, and the natural colours will be almost perfectly preserved. On account of the peculiar oblique shape of the Odonate thorax and plane of the wings, it is more practical to set these insects on their back, a position in which they lie quite flat. Sheets of cork in lieu of setting-boards are employed and a small hole is first made to receive the head of the pin; the hind wings are set first with their costal borders in a dead straight line, the fore wings can then be set at any desired angle to the hind ones. Two or more pins are introduced to steady the abdomen and legs whilst drying out. (Ordinary cork bath-mats are most useful for setting these insects on.)

*Abbreviations employed in the text.*

The following abbreviations are employed in the keys which follow and the notation is that of Tillyard, the latter having been fully explained in the text above: Abd., abdomen; G.C., generally common; L.R., locally rare; Hw., hind wing; L.C., locally common; R., rare. Seasonal occurrences are shown in figures representing the months of the year, e.g. "7-9" July to September.

A glossary explaining all other terms employed is given on p. 46.

*Casual Immigrants.*

Several species of dragonflies have been admitted to the British list on the strength of one or more specimens, the recorded captures of which are in some cases well authenticated but in others extremely doubtful. We are concerned only with those species, the occurrence of which are reasonably authenticated but in cases where the determination is doubtful, the collector is advised to refer the specimens to the British Museum (Natural History) for identification.

*Lestes virens* Charpentier.—One specimen in the Stephens collection, British Museum, said to have been taken in the New Forest. Recorded also from Epping Forest by Doubleday. Inferior anal appendages of male very short, almost obsolete.

*Lestes barbara* Fabr.—One male in the Dublin Museum, reported to have been taken in Ireland. Channel Islands. Inferior anal appendages of male strongly divaricate at apices and much shorter than superiors.

*Gomphus flavipes* Charpentier.—A male in the British Museum (Stephens collection), taken at Hastings, 5.viii.1818. Resembles *G. vulgatissimus*, but abdomen slim and longer, with yellow dorsal spots extending to the end. Middorsal crest of thorax yellow.

*Onychogomphus forcipatus* (L.).—A female in the British Museum (Stephens collection), said to have been taken near London. Male superior anal appendages with the apices bent inwards at a right angle.

*Hemianax ephippiger* Burmeister.—A female in the McLachlan collection, British Museum, taken at Devonport. Wing venation similar to that of *A. imperator*, bases of hind wings rounded in the male. Dorsum of base of abdomen sky-blue, markings on rest of abdomen bright yellow.

*Aeshna affinis* Van der Lind.—One male in the British Museum, taken on the Romney Marshes, Kent, 5.viii.52. Resembles *A. mixta* rather closely but superior anal appendages of male with a basal ventral tooth; the sides of thorax yellowish marked with two black stripes. Female anal appendages shorter than the two last segments of abdomen (as long as or longer in *mixta*).

*Sympetrum meridionale* (Selys).—Resembles *striolatum* very closely but dark markings on sides of thorax much reduced or absent; hamules similar in shape but of nearly even length. Female vulvar scale scarcely projecting, a low rounded profile. Two females and one male recorded from South England.

## KEY TO SUBORDERS.

- 1 (2) Fore and hind wings closely similar in shape and venation; anal area of wings greatly reduced and without membranule; discoidal cells of fore and hind wings undivided, rectangular or acutely pointed distally (figs. 3, *d*; 4, *a-f*); middle lobe of labium approximately the same size as the lateral and more or less deeply cleft (fig. 1, *c*); eyes hemispherical, widely separated by a distance greater than the transverse diameter of the eyes (fig. 1, *a*); males with a pair of superior and inferior anal appendages; female with complete ovipositor (figs. 8, *f, g*; 10, *i*; 12, *b, c*). . . . . **Zygoptera** (below).
- 2 (1) Fore and hind wings differing in shape and basal venation, the hind wing considerably broader than the fore wing, with broad anal field and usually membranule (figs. 3, *a*; 16, *a-c*; 15, *g*); discoidal cell of both fore and hind wings divided into an upper hypertrigone (*ht*, fig. 3, *a* and *c*) and lower triangle (*Dc*, fig. 3, *a, c*); middle lobe of labium usually considerably smaller than the lateral ones and always entire (save in *Cordulegaster*, which has this lobe partially cleft at its middle) (fig. 1, *f*); eyes meeting over dorsum of head and more or less broadly confluent (save in *Gomphus* and *Cordulegaster*, figs. 13, *b, d*); males with only a pair of superior anal appendages and a single inferior (figs. 14, 17); female with or without complete ovipositor (greatly modified in *Cordulegaster* fig. 13, *d*)

Anisoptera (p. 33).

## KEY TO FAMILIES OF SUBORDER Zygoptera.

- 1 (2) First lateral thoracic suture complete (fig. 2, *a, lsi*); anal vein (fig. 3, *d, IA*) widely separated from the posterior border of wing; anal-field of all wings many-celled; more than 2 (usually numerous) antenodals; discoidal cell traversed by one or more cross-veins; cubital cross-veins (fig. 3, *d, Cvs*) usually numerous; body often brilliantly green or blue metallic  
AGRIIDAE (p. 33).
- 2 (1) First lateral suture incomplete medially; anal vein (fig. 3, *b, IA*) fused with posterior border of wing for some distance at base of wing; anal-field single-celled; only 2 antenodals present; discoidal cell entire, never traversed by cross-veins; only a single cubital cross-vein (fig. 3, *b, Ac, Cv*); body colour variable, only occasionally metallic.
- 3 (4) Pterostigma elongate, much longer than broad; an oblique vein present between the main veins *Riii* and *IRiii* (figs. 3, *b, o* and 12, *e*); body metallic coloured, the undersides of thorax and basal segments of abdomen as well as the dorsum of end segments of latter often coated with whitish pruinescence; anal superior appendages conspicuously longer than abdominal segment 10 and forcipate (fig. 12, *a, d*). . . . . LESTIDAE (p. 33).
- 4 (3) Pterostigma usually diamond-shaped, rarely conspicuously longer than broad; no oblique vein present between the main veins *Riii* and *IRiii* (save by accident) (fig. 4, *a-f*); body not or only in part metallic coloured; anal appendages rarely longer than segment 10, usually shorter, rarely forcipate (save in *Ischnura* and *Coenagrion armatum* Charp.) (figs. 8, *d* and *h*; 7, *e* and *f*).
- 5 (6) Discoidal cell regular, an elongate rectangle; cell posterior to discoidal cell with its distal side straight, not angulated; usually only 2 cells between the distal end of discoidal cell and the transverse vein descending from the nodus (fig. 4, *f*) . . . . . PLATYCNEMIDIDAE (p. 32).
- 6 (5) Discoidal cell irregular, costal side much shorter than the posterior, more or less acutely pointed distally; cell posterior to discoidal cell with its distal side markedly angulated; usually 3 cells between the distal end of discoidal cell and the transverse vein descending from the nodus (fig. 4, *a-e*)

COENAGRIIDAE (p. 28).

## Family COENAGRIIDAE.

## KEY TO GENERA.

- 1 (4) Two rows of cells between the costa and radius distal to pterostigma of hind wing; apical venation of hind wing much more closely reticulated than in fore wing (fig. 4, *d* and *e*).
- 2 (3) More than 20 cells between the anal vein (*IA*) and posterior border of wing; head without brightly coloured postocular spots, and thorax without bright antehumeral stripes; abdomen mainly dull black; female without an apico-ventral spine beneath segment 8 (fig. 4, *d*)  
**Erythromma** Charpentier (p. 32).
- 3 (2) Less than 20 cells between the anal vein and posterior border of wing; head with brightly coloured postocular markings, and thorax with brightly coloured antehumeral stripes; female with an apico-ventral spine beneath segment 8 (figs. 4, *e* and 10, *i*) ..... **Enallagma** Selys (p. 32).
- 4 (1) Usually only a single row of cells between the costa and radius distal to pterostigma of hind wing; apical venation of hind wing not more closely reticulated than that of fore wing (fig. 4, *a-c* and *f*).
- 5 (6) Pterostigma of fore wings bicolorous, black proximally, white distally and coloured differently from that of hind wings; segment 10 of male with a dorsal apical bifid tubercle; female polychromatic, with an apico-ventral spine to segment 8 (fig. 8, *a-h*) ..... **Ischnura** Charpentier (p. 31).
- 6 (5) Pterostigma of fore wings unicolorous and of the same colour as that of hind wings; segment 10 of male without an apical dorsal tubercle; females without an apico-ventral spine to segment 8.
- 7 (10) Species coloured red marked with bronzed black; head without bright post-ocular spots.
- 8 (9) Frons with a prominent ridge dividing it into anterior and superior planes at right angles to one another; head with but few hairs; dorsum of thorax without bright antehumeral stripes; abdomen of male and homochromatic female entirely red (figs. 4, *c*; 11, *c* and *d*) ..... **Ceragrion** Selys (p. 30).
- 9 (8) Frons with rounded crest, anterior and superior surfaces not differentiated from one another; head very hairy; dorsum of thorax with bright yellow or red antehumeral stripes; abdomen of both sexes red marked with black (figs. 4, *a*; 9, *d'*, *d''*) ..... **Pyrhosoma** (Charpentier (p. 31).
- 10 (7) Species coloured pale blue marked with black; head with blue or greenish postocular spots. .... **Coenagrion** Kirby (below).

KEY TO SPECIES OF *Coenagrion* KIRBY.

- 1 (12) Males.
- 2 (5) Superior anal appendages longer than broad, apices hooked inward, longer than or of the same length as inferior appendages (fig. 7, *i-m*); black stripes on dorsum of abdominal segments 3 and 4 with a single prolonged median or 3 shorter points of even length at basal end (fig. 5, *d* and *f*).
- 3 (4) Pterostigma large, distinctly longer than broad; superior anal appendages longer than inferior; basal spine of superiors not visible from above (fig. 7, *l* and *m*); black marking on segment 2 of abdomen U-shaped and confluent with the apical black ring by a short stalk; stripes on segments 3 and 4 with 3 short equal points at basal end (fig. 5, *f*)  
**C. scitulum** (Rambur).  
8-11 postnodals in fore wings; abdomen 22-26 mm., hw. 15-18 mm.  
*Confined to Essex. L.R. 6-7. Frequents ponds and weedy dykes or shallows beside streams.*
- 4 (3) Pterostigma small, scarcely longer than broad; superior and inferior anal appendages of the same length; basal spine of superiors visible from above (fig. 7, *i* and *k*); black marking on segment 2 confluent with apical black ring, notched deeply on each side and prolonged as two horns at its basal end; stripes on segments 3 and 4 abruptly narrowed and produced basally (fig. 5, *d*) ..... **C. mercuriale** (Charpentier).  
9-11 postnodals in fore wings; abdomen 22-26 mm., hw. 15-18 mm.  
*Confined to the southern counties. L.C. Occurs in large colonies in bogs or marshy spots bordering rivers. 6-8.*

- 5 (2) Superior anal appendages shortly conical, shorter or but slightly longer than inferiors and with a subbasal inner spine usually directed ventrally (fig. 7, *a-h*).
- 6 (9) Inferior anal appendages narrowly spine-like (fig. 7, *a-d*); marking on segment 2 in the form of a U; those on segments 3 and 4 often with a median short point, the sides prolonged basally as fine black lines; rarely with only the median point present (fig. 5, *a* and *b*); hinder border of prothorax with 3 rounded lobes (fig. 9, *e* and *n*).
- 7 (8) U-marking on segment 2 broad and thickened, usually confluent with the apical black ring by a short broad stalk but often variable in this respect (thus sometimes simulating *puella*), but never broken up into isolated spots (figs. 5, *b*; 9, *c*); antehumeral blue stripes of thorax often interrupted, often deficient in the upper half or with an isolated upper spot; black markings on segments 3 to 5 covering at least the apical half of segments, with median short point and lateral black lines extending almost to base of segments (figs. 5, *b*; 9, *a-c*); anal appendages as in fig. 7, *c* and *d*.

**C. pulchellum** (Van der Linden).

10-12 postnodals to fore wings; abdomen 25-30 mm., hw. 16-21 mm. A very variable species, segment 2 sometimes with similar marking to *puella*, sometimes entirely black save for a narrow basal ring or spots; blue or black may preponderate on abdomen.

*Ponds and canals. L.C. 5-8.*

- 8 (7) U-marking on segment 2 linear, usually separated from the apical black ring, occasionally with the arms separated from the base or the base interrupted at its middle (fig. 5, *a*); antehumeral blue stripes complete, rarely interrupted and then forming an "I"-marking; markings on segments 3 to 5 much shorter than in *pulchellum*, but with the lateral linear prolongations proportionately longer (fig. 5, *a*); anal appendages as in fig. 7, *a* and *b*.

**C. puella** (L.).

11-14 postnodals to fore wings; abdomen 23-30 mm., hw. 16-21 mm. A very variable species; limbs of U-marking on segment 2 may be separated from base; markings on other segments reduced or concealing much of the blue, segment 9 with isolated spots or a single broad crown-shaped apical marking; in the latter forms, segment 8 bearing 2 dorsal black points.

*G.C. Flies over ponds and ditches or damp meadows. 5-8.*

- 9 (6) Inferior anal appendages variable, either shortly conical or of great length and broadly spatulate and with a short dorsal basal spine; marking on segment 2 made up of 3 spots, that on segment 3 with a longish tapered median point or 3 short ones of equal length at base (figs. 5, *c* and *e*; 7, *e-h*); hinder border of prothorax obtusely angulated or trilobate, the median lobe rectangular.
- 10 (11) Antehumeral blue stripes absent or reduced to 1 or 2 spots; marking on segment 2 a short arched apical spot confluent throughout its breadth with the black apical ring; on each side a linear stripe isolated from the apical marking; markings on segments 4 and 5 extending to base of segments but not on segment 3 (fig. 5, *e*); inferior anal appendages of enormous size and quite disproportionate to the size of insect (fig. 7, *e* and *f*).

**C. armatum** (Charpentier).

11-14 postnodals to fore wings; abdomen 22-26 mm., hw. 16-19 mm.

*Confined to the Norfolk Broads. L.R. 5-7.*

- 11 (10) Antehumeral blue stripes present and complete; marking on segment 2 a small elliptical subapical spot confluent by a slender stalk to the apical black ring; an oval spot on each side isolated from the subapical one; dorsal stripes on segments 3 to 5 extending only halfway or less to base of segments (figs. 5, *c*); inferior anal appendages small and inconspicuous (fig. 7, *g* and *h*) . . . . . **C. hastulatum** (Charpentier)

10-12 postnodals to fore wings; abdomen 24-26 mm., hw. 17-19 mm.

*Confined to a few counties in Scotland; flies over marshy spots beside tarns and river shallows. L.R.*

- 12 (1) Females.

- 13 (16) Beneath head palest blue or white from border of eyes to the pit of head, which latter only is black; anal appendages white or black.



- 14 (15) Appendages black; pterostigma black, distinctly longer than broad; hinder border of prothorax with a small median spine very conspicuous in profile (fig. 9, *m*); segments 3 to 7 with narrow but conspicuous basal blue rings finely interrupted mid-dorsally (fig. 6, *n*). Abdomen 22–25, hw. 17–20 mm.  
**C. scitulum** (Rambur).
- 15 (14) Appendages white, black only on dorsum; pterostigma pale, scarcely longer than broad; hinder border of prothorax with small median spine less conspicuous than in *scitulum* (fig. 9, *h*); segments 3 to 7 with only very narrow, very inconspicuous basal blue rings (fig. 6, *l*)  
**C. mercuriale** (Charpentier).
- Abdomen 23–26, hw. 18–20 mm.; two chromatic forms of the female are known: *Homochrome* with blue colouring and markings closely similar to male, and a *heterochrome* with greenish yellow ground-colour and conspicuous blue apical rings on segments 8–10.
- 16 (13) Beneath head broadly black, usually only a white stripe bordering the eyes and rarely extending as far as halfway to pit of head; anal superior appendages black.
- 17 (20) Segments 1, 2 and 8 usually with restricted black markings (but widely variable), black dorsal marking on segment 1 not extending to apical border of segment.
- 18 (19) Marking on segment 2 limited to its apical half, confluent for its whole breadth with apical black border, tapering to a point at base and notched on each side; segments 3 to 7 with fine inconspicuous blue basal rings; segment 8 with black marking very deeply bifid at its basal end (fig. 6, *m*); hind border of prothorax with small conspicuous median pale spine. Abdomen 22–25, hw. 18–20 mm. ....  
**C. armatum** (Charpentier).
- 9 (18) Marking on segment 2 covering more than the apical half and sometimes extending from apex to base of segment, confluent by a narrow stalk with apical black ring, vase-shaped; segments 3 to 7 with broad conspicuous blue basal rings not interrupted on mid-dorsum; segment 8 with a very variable marking extending from apical border to midlength of segment or even to base, its basal end bearing 3 points (fig. 6, *j*); hinder border of prothorax divided by 2 deep notches into 3 lobes, the median rounded and usually the smaller. Abdomen 24–30, hw. 18–23 mm. *Homochrome* forms occur with bright parts of head and thorax blue, but of abdomen green; *heterochrome* forms are green to olivaceous brown with face and segmental rings of abdomen blue. Females may be confused with *puella*.  
**C. pulchellum** (Van der Linden).
- 20 (17) Segments 1, 2 and 8 broadly black on dorsum, this colour extending from apex to base of all segments, including segment 1.
- 21 (22) Marking on segment 2 constricted after the apical dilatation and then broadening towards the base of segment; segment 8 with narrow apical blue ring (fig. 6, *h*); hinder border of prothorax sinuous or crenate (fig. 9, *n*)  
**C. puella** (L.).
- Abdomen 25–29, hw. 19–23 mm. Markings on segments 2 and 8 very variable, the former sometimes separated from the apical ring, the latter often existing as two separate spots or as one large apical spot, with 2 black points on segment 8.
- 22 (21) Marking on segment 2 of even width after the apical dilatation, that is, in its basal half; segment 8 black on dorsum from base to apex (fig. 6, *k*); hinder border of prothorax obtusely angulated. Abdomen 24–26, hw. 19–22 mm.  
**C. hastulatum** (Charpentier).

KEY TO SPECIES OF *Ceragrion* SELYS.

Only one British species ..... **C. tenellum** (Villers).

A smaller and slenderer species than *Pyrrhosoma nymphula*, for which it is apt to be mistaken. Male entirely red save for the following black markings: A narrow line across epistome, the vertex of head and dorsum of thorax, the latter without antehumeral stripes. Postnodals 9–12; abd. 23–26 mm., hw. 15–18 mm.

Found only in marshes and bogs, usually in large compact colonies; flight low, short and weak. Restricted mainly to the southern counties. L.C. 6–9. Anal appendages, fig. 11, *c* and *d* (fig. 4, *c*)

Female polychromatic: 1. *Homochrome*. Entirely similar to the male save for sexual characters. 2. *Heterochrome*. Red as in male, but labrum broadly black as well as dorsum of segments 4-8 and apical end of segment 3. 3. *Heterochrome*. Red colour replaced by ochreous and all segments of abdomen dorsally black. Abd. 23-28 mm., hw. 17-20 mm.

#### KEY TO SPECIES OF *Pyrrosoma* CHARPENTIER.

Only one British species ..... **P. nymphula** (Sulzer).

A larger and more robust species than *Ceragrion tenellum*, which, however, it closely resembles on the wing. Male with ground colour red, humeral stripes bright citron yellow on first emergence, becoming red later; abdomen red with segments 2, and 7 to 9 broadly bronzy black on dorsum. Female polychromatic: 1, *Homochrome*. Similar to the male, but segments 2 to 6 with mid-dorsum narrowly black, broadening apically into a crown-shaped black spot, and segments 7 to 10 broadly black over whole of dorsum. *Heterochrome*. Humeral stripes remain bright citron yellow throughout life; whole of abdominal segments broadly black on dorsum. Neither sex with bright postocular spots and both sexes with humeral stripe interrupted above to leave a small isolated spot. Male: Postnodals fw. 14-16, hw. 12-14. Abd. 25-29 mm., hw. 19-22 mm. Female: Postnodals fw. 13-15, hw. 11-13. Abd. 26-28 mm., hw. 21-24 mm. (figs. 4, a, 9, d' and d'', 11, a and b.)

Breeds in still waters, ponds or even small bog-holes. G.C. (Melanotic heterochrome female. L.C.) 4-8.

#### KEY TO SPECIES OF *Ischnura* CHARPENTIER.

1 (4) Males.

2 (3) Pterostigma of similar shape and size in fore and hind wings, that of fore wing black proximally, bluish-white distally; segment 8 entirely blue or with but a narrow basal black ring; segment 9 entirely black on dorsum; anal appendages divaricate (fig. 8, a, b, d, e) ..... **I. elegans** (Van der Linden). A more robust species with stronger flight than the next. Abdomen broadened perceptibly towards the anal end.

Flies among rank herbage beside ponds, canals or in marshes. G.C. 5-9. Abdomen 22-28 mm., hw. 14-16 mm.

3 (2) Pterostigma of fore wing of different shape and much larger than that of hind wing, that of fore wing yellow distally; only the apical third or fourth of segment 8 blue; segment 9 entirely blue on dorsum, but often bearing two small subdorsal, subapical points of black; anal appendages forcipate with apices converging slightly (fig. 8, c, g, h). Abdomen 22-25 mm., hw. 14-16 mm. .... **I. pumilio** (Charpentier). A more slender species than the last, with weak flight among low herbage, reeds, and bog myrtle on open heaths and bogs. L.R. 6-8. Confined to southern counties of England.

4 (1) Females.

5 (6) Pterostigma of about the same size and shape in fore and hind wings; segment 8 entirely blue dorsally or with not more than a narrow basal black ring. Abdomen 22-29 mm., hw. 15-20 mm. (fig. 8, f)

**I. elegans** (Van der Linden).

Female polychromatic: 1. *Homochrome* similar to male with blue post-ocular spots, rather broader blue or greenish-blue antehumeral stripes and a blue segment 8. 2. *Heterochrome*, var. *violacea*, probably a teneral stage of the homochrome, with sides of thorax violaceous instead of blue. 3. *Heterochrome*, var. *rubellum* (fig. 9, b). All pale coloured parts bright orange, dorsum of head with black band from eye to eye, and thorax with narrow mid-dorsal black stripe. Segments 1 and 2 orange with black dorsal markings, rest of abdomen black save segment 8, which is blue as in the male. 4. *Heterochrome*, var. *infuscans*. All pale parts dark olivaceous, segment 8 fuscous, otherwise marked as in male.

6 (5) Pterostigma of fore wing much larger than that of hind wing; segment 8 entirely black dorsally. Abdomen 22-24 mm., hw. 15-18 mm. (fig. 8, g)

**I. pumilio** (Charpentier).

Female dichromatic : 1. *Heterochrome*. Markings as for male, but ground-colour greenish-yellow and all end segments of abdomen black. 2. Var. *aurantiaca*. Resembles var. *rubellum* of *elegans* save that segments 1 and 2 are entirely unmarked with black and segment 3 is mostly orange ; segments 8 and 9 are black, whilst 10 is ferruginous.

#### KEY TO SPECIES OF *Enallagma* CHARPENTIER.

Only one British species ..... **E. cyathigerum** (Charpentier).

Pale blue marked with coal black and closely resembling some species of *Coenagrion*, but distinguished by the whole of the 8th and 9th abdominal segments blue (*C. hastulatum* has these same segments blue, but its venation and anal appendages are entirely different). Easily distinguished by the apico-dorsal, mushroom-shaped black marking on segment 2, which may be isolated or joined to the apical black ring. Abd. 24–28 mm., hw. 18–20 mm.

Frequently swarms on the borders of lakes and ponds. G.C. 5–9. (figs. 4, e ; 10, g–o.)

Female similar to male, but whole of abdominal segments broadly marked with black on dorsum, and segment 2 with a thistle-head-shaped marking. Distinguished from all species of *Coenagrion* by the presence of a ventral-apical spine on segment 8 (fig. 10, i).

#### KEY TO SPECIES OF *Erythromma* Charpentier.

Only one British species ..... **E. najas** (Hansemann).

The largest and most robust of the smaller British Zygoptera. Distinguished by its venation, red eyes, orange face, black dorsum of head and thorax unrelieved by bright postocular spots or antehumeral stripes. Adults have the blue sides of thorax and whole of abdomen thinly pruinosed whitish. Postnodals 10–14 in fore wings ; abd. 25–30 mm., hw. 19–23 mm. (figs. 4, d ; 11, e and f).

Female similar to male, but face chrome-yellow and dorsum of thorax bearing short yellow antennumeral stripes. Abd. 26–30 mm., hw. 21–24 mm.

Confined to the midland and southern counties. Males frequent canals and lakes whilst females hide up in surrounding vegetation and shrubbery. L.C. 5–8.

### Family PLATYCNEMIDIDAE.

#### KEY TO GENERA.

Only a single genus belonging to this family is found in Great Britain.

**Platycnemis** Burmeister.

Wings narrow and with a long petiole as in the family Coenagrionidae, but with the discoidal cell rectangular, squared distally and with costal and posterior sides nearly equal in length. Hind tibiae of male markedly dilated (figs. 4, f ; 10, e).

#### KEY TO SPECIES OF *Platycnemis* CHARPENTIER.

Only a single British species is known ..... **P. pennipes** (Pallas).

Recently emerged specimens have the ground-colour creamy-white and all the black markings greatly restricted ; fully adult examples are palest blue with the black markings more extensive ; dilated tibiae white or palest blue with black spines in the male only. Male : Postnodals fw. 11–13, hw. 10–12. Abd. 27–31 mm., hw. 19–22 mm. Female : Postnodals fw. 11–13, hw. 10–12. Abd. 27–30 mm., hw. 20–23 mm. (figs. 4, f ; 10, a to f.)

Breeds in clear running streams and in seepages bordering them, both sexes haunting the rank herbage in such spots. On first emergence they often travel great distances from water and are then found flying low in scrub or heather. Not found north of the line of the Wash. L.C. 6–8.

## Family LESTIDAE.

## KEY TO GENERA.

Only a single genus belonging to this family is found in Great Britain. *Lestes* Leach.

KEY TO SPECIES OF *Lestes* LEACH.

- 1 (4) Males.
- 2 (3) Pterostigma less than one third as broad as long, blackish-brown with paler ends; superior anal appendages with acuminate inner subapical spine; inferior appendages spatulate, of even width throughout, directed straight posteriorly (fig. 12, e, d). Abd. 26-33 mm., hw. 19-22 mm.  
*L. sponsa* Hansemann.  
*Along the borders of ponds, wet ditches, often wandering far from water to neighbouring woods when ponds they have bred in are in the open. G.C. 7-9.*
- 3 (2) Pterostigma one third as broad as long, black; superior anal appendages with rather obtuse inner subapical spine; inferior appendages with apices angulated obliquely inwards (fig. 12, a). Abd. 28-33 mm., hw. 20-24 mm.  
*L. dryas* Kirby.  
*Along the borders of dykes or wet ditches; occurs in widely scattered colonies. L.R. 6-8.*
- 4 (1) Females.
- 5 (6) Vulvar scale slender, not extending beyond end of abdomen (fig. 12, c). Abd. 25-30 mm., hw. 20-24 mm. .... *L. sponsa* Hansemann.
- 6 (5) Vulvar scale broad, extending beyond end of abdomen (fig. 12, b). Abd. 26-30 mm., hw. 21-25 mm. .... *L. dryas* Kirby.

## Family AGRIIDAE.

## KEY TO GENERA.

Only a single genus belonging to this family is found in Great Britain. *Agrion* L.

KEY TO SPECIES OF *Agrion* L.

- 1 (4) Males. Body brilliant blue metallic. Pterostigma absent.
- 2 (3) Wings broadly opaque dark brown with blue metallic reflex, apex and base up to level of arculus hyaline. Abd. 36-38 mm., hw. 30 mm. . . . *A. virgo* (L.).  
*Breeds in and flies over clean gravelly bottomed streams in woodland areas. G.C. 5-8.*
- 3 (2) Wings with broad opaque dark band with blue metallic reflex extending from about level of nodus to within a short distance of apex, rest of wings hyaline. Abd. 35-40 mm., hw. 27-32 mm. (fig. 3, d)  
*A. splendens* (Harris).  
*Breeds in and flies over streams with muddy bottoms in more open areas than virgo. L.C. 5-8.*
- 4 (1) Females. Body metallic green with coppery reflex. Pterostigma present.
- 5 (6) Wings dull greyish-brown with dark venation; distance from nodus to pterostigma 3 times as long as that from pterostigma to apex of wing; pterostigma large. Abd. 34-39, hw. 31-35 mm. .... *A. virgo* (L.).
- 6 (5) Wings yellowish to hyaline in adults with green metallic venation; distance from nodus to pterostigma 4 to 5 times as long as that from pterostigma to apex of wing; pterostigma smaller than in *virgo*. Abd. 33-38 mm., hw. 29-36 mm. .... *A. splendens* (Harris).

## KEY TO FAMILIES OF SUBORDER Anisoptera.

- 1 (6) Antennodals in costal and subcostal spaces not or only occasionally aligned with each other; the two primary antennodals conspicuously evident (figs. 3, a; 13, a, 15).
- 2 (3) Eyes widely separated by a space less than the transverse diameter of the eyes; ocelli arranged in a transverse line on vertex backed by a distinct ridge; abdomen without distinct ridge at the sides (fig. 13, b) GOMPHIDAE. (p. 34.)
- 3 (2) Eyes meeting at a point, or more or less broadly confluent across dorsum of head (sometimes very slightly separated in females of Cordulegasteridae).

- 4 (5) Eyes meeting at a point only; ocelli arranged in a triangle about a low-lying vesicle; abdomen without distinct lateral ridges; oreillets on sides of 2nd abdominal segment with irregularly disposed spines; female with conspicuously elongated ovipositor projecting well beyond the short anal appendages (fig. 13, d)..... **CORDULEGASTERIDAE** (below).
- 5 (4) Eyes meeting more or less broadly across dorsum of head; ocelli arranged in a triangle about a raised vesicle; oreillets bordered with a line of 2, 3 or more spines; female with complete zygoterous-like ovipositor not projecting beyond the end of the rather long anal appendages (fig. 1, b)  
**AESHNIDAE** (p. 35).
- 6 (1) Antenodals in costal and subcostal spaces mostly or all aligned with each other; the two primary antenodals absent or not conspicuously thicker than the others (figs. 16, a, b, c; 19, a, b).
- 7 (8) Base of hind wing of male more or less deeply excavated and angulated; conspicuous oreillets on the sides of abdominal segment 2 in the male; a well-marked swelling or prominence on the external posterior border of eyes; all tibiae of the male with a membranous keel on the flexor surface, extending for half their length on the anterior two tibiae and for almost the whole length of hind tibiae; body metallic green or coppery (fig. 16, a, b, c)  
**CORDULIDAE** (p. 37).
- 8 (7) Base of hind wing in both sexes rounded; oreillets absent on the 2nd abdominal segment of male; prominence on external posterior border of eyes either entirely absent or inconspicuous; tibiae of male without membranous keels; body non-metallic (figs. 18, 19 and 20) **LIBELLULIDAE** (p. 38).

### Family GOMPHIDAE.

#### KEY TO GENERA.

Only a single British genus, easily distinguished by the wide separation of the eyes, by the hind wing much broader at the base than the fore wing and by the anal triangle of the same wing made up of 5 cells (fig. 13, a, b and c)..... **Gomphus** Leach.

#### KEY TO SPECIES OF *Gomphus* LEACH.

Only a single British species; the sexes, apart from genitalia, entirely similar and coloured bright grass-green or citron-yellow with sharply defined pattern of black markings. Male with superior anal appendages strongly divaricate and with the inferior appendage deeply bifid, its branches equally divaricate; terminal segments of abdomen somewhat dilated (fig. 13, c). Female with abdomen stouter, of more even width throughout; base of hind wing rounded, not angulated as in the male. Male: Abd. 33–37 mm., hw. 28–32 mm. Female: Abd. 34–37 mm., hw. 30–33 mm.

#### **G. vulgatissimus** (L.).

*L.R., but not uncommon in some years, 5 and 6. Flight swift but not sustained, settles on gravelly shores beside streams in which it breeds; females shelter in neighbouring woods and only come to water to oviposit. Confined to the southern counties, south of and including the Thames Valley.*

### Family CORDULEGASTERIDAE.

#### KEY TO GENERA.

Only a single British genus, the females of which are easily distinguished by the great length of the ovipositor, which projects well beyond the end of abdomen; both sexes coloured similarly, black with well-defined citron-yellow markings; wings long and narrow and with the discoidal cells of the same shape and size (figs. 3, c; 13, d) ..... **Cordulegaster** Leach.

#### KEY TO SPECIES OF *Cordulegaster* LEACH.

Only a single British species, of large size, coloured black with 2 stripes on dorsum of thorax and 3 on each side; abdomen with angulated stripe and apical twin spots on segments 2–8, all markings bright citron-yellow (fig. 13, d). Male: Abd. 54–60 mm., hw. 41–45 mm. Female: Abd. 60–64 mm. (including long ovipositor), hw. 45–46 mm. .... **C. boltoni** (Donovan).

*Males fly low over clean-bottomed streams in which they breed, settling only to feed; females hawk in neighbouring woods, scrub or heather. G.C. 5–9.*

## Family AESHNIDAE.

## KEY TO GENERA.

- 1 (2) Only a single row of cells between *IRiii* and *Rspl*, *Ma* and *Mspl*, *CuP* and *IA* (fig. 15, *g*) ; rarely more than 2 cubital cross-veins . . . . . **Brachytron** Evans.
- 2 (1) More than one row of cells between *IRiii* and *Rspl*, *MA* and *Mspl*, *CuP* and *IA* (fig. 15, *a-f*) ; at least 3 cubital cross-veins.
- 3 (4) *Riii* with an abrupt bend towards the outer end of pterostigma ; the cells between *IRiii* and *Rspl* arranged in orderly, parallel, oblique rows of 2 rows of cells (fig. 15, *a, b*) . . . . . **Anax** Leach.
- 4 (3) *Riii* with not more than a simple curve towards the inner end of or middle of pterostigma ; the cells between *IRiii* and *Rspl* with no special orderly arrangement in rows (fig. 15, *c-f*) . . . . . **Aeshna** Fabricius.

KEY TO SPECIES OF *Brachytron* EVANS.

- Only a single species . . . . . **B. pratense** (Müller)  
 Abd.: Male, 43–46 mm. ; female, 38–42 mm. Hw. : Male, 35–37 mm. ; female, 34–36 mm. Body rather hairy ; T-shaped black spot on frons ; thorax greenish, abdomen black, marked with greenish-blue spots (figs. 14, *fi*, *fi* ; 15 *g*).  
*L.C.* 4–6. *Breeds in still waters and is found flying over ponds, canals or dykes.*

KEY TO SPECIES OF *Aeshna* FABRICIUS.

- 1 (12) Males.
- 2 (5) Venation of wings including pterostigma reddish-brown.
- 3 (4) Wings evenly tinted with pale amber ; anal-triangle 2-celled (fig. 15, *f*) ; thorax reddish-brown with 2 lateral citron yellow stripes ; abdomen with large pale blue and yellow spots ; anal appendages without baso-ventral spine (fig. 14, *e*) ; abd. 54–60 mm., hw. 45–49 mm. . . . . **A. grandis** (L.).  
*Breeds in lakes and ponds, especially in pine woods, but often travels far from water. G.C.* 7–9.
- 4 (3) Wings uncoloured or but faintly tinted yellowish ; a patch of bright amber at base of hind wing adjacent to membranule and root of wing ; anal triangle 3-celled (fig. 15, *e*) ; thorax dull reddish-brown marked with 2 lateral yellow stripes ; anal appendages with a basoventral spine (fig. 14, *g*) ; abd. 47–50 mm., hw. 39–42 mm. . . . . **A. isosceles** (Müller).  
*Confined to the Norfolk Broads ; flies high over water or low scrub in and amongst rushes and reeds. L.R.* 5–7.
- 5 (2) Venation including pterostigma black. Wings uncoloured.
- 6 (9) Anal-triangle 3-celled (fig. 15, *d*).
- 7 (8) Large species with abdomen 51–60 mm., hind wing 44–49 mm. ; superior anal appendages broadened at middle, with medio-ventrally inclined spine at apex (fig. 14, *ci*, *cii*) ; a well-defined black T-shaped spot above frons ; thorax with broad apple-green antehumeral stripes ; abdomen spotted conspicuously with bright green and blue (fig. 15, *c, d*) . . . . **A. cyanea** (Müller).  
*Commonly distributed everywhere and found flying over ponds and lakes, in lanes or wood-ridings and even in gardens and streets of towns. G.C.* 7–9.  
*Not found in Scotland or Ireland.*
- 8 (7) Smaller species with abdomen 44–49 mm., hind wing 37–39 mm. ; superior anal appendages without distal ventral spine (fig. 14, *d*) ; a well-defined black T-shaped spot above frons ; thorax with inconspicuous, incomplete narrow pale blue antehumeral stripes ; pale spots on abdomen entirely blue . . . . . **A. mixta** Latreille.  
*Flies over ponds and lakes, less commonly in ridings in woods. Breeds sparingly in the south and is reinforced by annual immigrations. L.C.* 8–10.
- 9 (6) Anal-triangle 2-celled ; a transverse stripe at lower border of frons and a T-shaped spot above black ; superior anal appendages without basal ventral spine.

- 10 (11) Comparatively small species with abdomen 45–48 mm., hind wing 38–40 mm.; eyes confluent over vertex for a distance not longer than the occipital triangle; forking of *Rs* often ill-defined or absent; membranule entirely cinereous; thorax with inconspicuous pale blue markings; antehumeral stripes reduced to a small spot or absent; pale markings of abdomen azure blue (fig. 14, a) ..... *A. caerulea* (Ström).  
*A northern species found only in some counties of Scotland; breeds in peaty bog-holes, flies only during sunlight in pine woods, often found sunning itself on rocks or the trunks of trees. L.R. 6–8.*
- 11 (10) Much larger species with abdomen 53–58 mm., hind wing 40–47 mm.; eyes confluent over vertex for a distance distinctly longer than occipital triangle; forking of *Rs* well-defined; membranule white at base, cinereous at apex; thorax with narrow sharply-defined complete bright yellowish-green antehumeral stripes, laterally 2 bright yellow stripes narrowly edged with black and with a chain of 3 yellow spots between them; abdominal spots entirely blue (figs. 14, b; 15, f) ..... *A. juncea* (L.).  
*Flies over ponds and lakes; shows a preference for pine woods, but often wanders far from water into urban districts. Often crepuscular. G.C. 7–9.*
- 12 (1) Females.
- 13 (14) Comparatively small species with abdomen 42–44 mm., hind wing 38–41 mm.; eyes confluent over vertex for a distance not longer than occipital triangle; forking of *Rs* often ill-defined or absent; membranule entirely cinereous; a stripe at lower border of frons and a T-shaped marking above black ..... *A. caerulea* (Ström).
- 14 (13) Larger species (save *mixta*); eyes confluent over vertex for a distance equal to 2 or 3 times the occipital triangle; forking of *Rs* well-defined.
- 15 (18) Wings with venation, including pterostigma, reddish-brown; thorax and abdomen reddish-brown, markings rather inconspicuous.
- 16 (17) Large species with abdomen 49–55 mm., hind wing 46–48 mm.; wings uniformly tinted with amber; thorax without distinct humeral stripes; legs entirely reddish-brown ..... *A. grandis* (L.)
- 17 (16) Abdomen 49–54 mm., hind wing 41–45 mm.; wings uncoloured or very palely yellowish, a small bright yellow patch at base of hind wing similar to that of the male; legs black except base of femora, which are reddish-brown ..... *A. isoseeles* (Müller).
- 18 (15) Wings with venation black or blackish-brown; thorax and abdomen brightly coloured and marked.
- 19 (22) Forking of *Rs* well before the level of pterostigma.
- 20 (21) Abdomen 52–58 mm., hind wing 43–50 mm. Thorax with broad apple-green antehumeral stripes and very broad lateral ones of the same colour, the posterior of these extending to posterior border of thorax; membrane white except extreme lower end; dorsal paired spots of abdomen apple-green; 2 to 3 rows of cells between *CuP* and *IA* in hind wing at their distal ends. *A. cyanea* (Müller).
- 21 (20) Abdomen 45–48 mm., hind wing 40 mm. Thorax with antehumeral stripes bluish, reduced to a small lower linear spot or altogether absent; lateral stripes moderately broad, blue, the posterior one extending to posterior border of thorax in its upper part only; membranule black except for extreme upper part; dorsal paired spots pale blue; only a single row of cells between *CuP* and *IA* in hind wing at their distal ends *A. mixta* Latreille.
- 22 (19) Abdomen 50–54 mm., hind wing 42–46 mm. Forking of *Rs* at or even distal to the level of the proximal end of pterostigma; antehumeral stripes of thorax almost obsolete, mere linear yellow lower spots; lateral stripes of thorax narrower than in the preceding, bright yellow narrowly edged with black, the posterior one well separated from end of thorax; paired apical spots of abdomen bright yellow; 2 rows of cells between *CuP* and *IA* in hind wing at their distal ends (fig. 15, f) ..... *A. juncea* (L.).

KEY TO SPECIES OF *Anax* LEACH.

Only a single British species, the largest and most robust of our Odonate fauna. Thorax pale jade-green, unmarked; abdomen broadly blue at base and along both sides of

dorsum, the mid-ridge of latter, the intersegmental joints and a fine transverse line near the base of segments 2 to 8 finely black. Female similar, but the blue replaced by greenish or olivaceous. The base of hind wings rounded in both sexes, together with the distinctive character of the apical venation (fig. 15, a) will serve to separate this species from any *Aeshna*. Abd.: Male, 53–61 mm.; female, 49–57 mm. Hw.: Male, 45–57 mm.; female, 46–51 mm. (figs. 11, m and 15 a, b).

**A. imperator** Leach.

*L.C. in the southern counties, rare in the Midlands, and not extending beyond Yorkshire. 5–9. Breeds in ponds and lakes, which the males rarely leave; females hawk high in woodlands and are rarely seen save when they return to oviposit in ponds.*

## Family CORDULIIDAE.

### KEY TO GENERA.

- 1 (4) Discoidal cells, at least in the fore wings, traversed by a cross-vein; subtriangle (fig. 16, b, c, *St*) in fore wings 2 or 3-celled; anal-loop (*Al*) squared at end or with apex produced posteriorly; segment 10 without a dorsal spine.
- 2 (3) Base of discoidal cell (*Dc*) of hind wing slightly basal to line of arculus (fig. 16, b, *arc*); discoidal cell of hind wing free of cross-veins **Cordulia** Leach.
- 3 (2) Base of discoidal cell of hind wing in line with arculus (fig. 16, a, *arc*); discoidal cells of fore and hind wings traversed by one or two cross-veins **Somatochlora** Selys.
- 4 (1) Discoidal cells normally free of cross-veins (British specimens, however, show about 20 per cent. of these cells traversed); subtriangle (*St*) of fore wings a single cell; base of discoidal cell in hind wing distal to level of arculus (fig. 16, c); anal-loop, hind wing, pointed at end and directed towards apex of wing; segment 10 with strong dorsal keel-like spine (fig. 17, n) **Oxygastra** Selys.

### KEY TO SPECIES OF *Oxygastra* SELYS.

Only a single species is known belonging to this genus; of green metallic colouring marked conspicuously with chrome yellow, the sexes closely similar but the female differing by the costal borders of wings, to about midway across, more or less deeply tinted with amber yellow (fig. 16, c) ..... **O. curtisi** (Dale).

Distinguished from all other species of the family Corduliidae by the conspicuous mid-dorsal row of chrome-yellow spots extending from end to end of abdomen; by the conspicuous bright yellow dorsal keel on segment 10 and by the shape of the anal appendages (fig. 17, m, n), superiors unguulate, slightly divaricate at apices and furnished with a ventral subbasal spine conspicuous in profile; inferior rather deeply notched. Male: Abd. 36–39 mm., hw. 32–34 mm. Female: Abd. 34–35, hw. 33–34 mm.

*Confined to two localities in Hampshire and Devon; breeds in sluggish rivers with muddy bottoms, but leaves these habitats in the imaginal state to fly in birch and pine woods bordering heathy moors. Flight low, swift and erratic, rarely sustained for long. L.R. 6–8.*

### KEY TO SPECIES OF *Cordulia* LEACH.

Only a single British species, of bronzed or coppery metallic colouring and with rather hairy thorax; all wings with a small amber-tinted area at bases; the sexes closely similar, but the abdomen of male constricted at segment 3, expanded at end segments, whilst that of female tapers gradually from the base to apex and the wings are often diffusely tinted with yellow. Male: Abd. 34–38 mm., hw. 31–34 mm. Female: Abd. 37–39 mm., hw. 35–36 mm. (figs. 16, b) ..... **C. lineaena** Fraser.

Superior anal appendages abruptly truncated at apices; inferior deeply bifid, its branches divaricate and each bearing a small robust spine on the outer side (fig. 17, k, l). Female genitalia a small inconspicuous triangular scale, bifid at



apex, which serves to distinguish it from the female of *Somatochlora metallica*, which it otherwise closely resembles.

*Breeds in lakes and canals and hawks along the borders of such waters, where it may easily be mistaken for S. metallica. G.C. in the southern counties, R. in the midland and northern counties, unknown in Scotland and Ireland. 5-8.*

#### KEY TO SPECIES OF *Somatochlora* SELYS.

- 1 (6) Males.
- 2 (5) Only 1 cross-vein in the cubital space of fore wings (fig. 16, a).
- 3 (4) Both sexes with thorax and basal segments of abdomen brilliant emerald green metallic; frons metallic green encircled below and on each side with a broad continuous bright ochreous band; superior anal appendages widely separated at base, rather more than twice the length of segment 10, tapering to an acuminate upturned point and with 2 lateral spines, a subbasal prominent and acute and a medial obtuse; inferior appendages three-fourths the length of superiors (figs. 17, a, b; 16, a); abd. 37-40 mm., hw. 34-36 mm. .... *S. metallica* (Van der Linden).  
*Flies along borders of canals or ponds in pine woods. L.C. 6-8.*
- 4 (3) Both sexes of a duller metallic golden green; frons metallic green encircled by a narrow stripe below and a small isolated spot on each side; superior anal appendages closely apposed at base, markedly sinuous as viewed dorsally, curving first inwards, then outwards and finally again inwards, the apex not turned up; inferior appendages only half the length of superiors (fig. 17, d, e, f); abd. 35-36 mm., hw. 32-37 mm. *S. arctica* (Zetterstedt).  
*A northern species confined to Scotland; breeds in bogs and seepages on hill-sides, generally on the borders of pine and birch woods. Flies high in bright sunlight or low over bog-pools. L.R. 6-8.*
- 5 (2) 2 cross-veins in the cubital space of fore wings. Colour of thorax and head similar to the last; superior anal appendages well separated at the base; shaped very similar to those of *metallica*, but the lateral spines much closer together, the distal one basal to middle of appendage; inferior anal appendage only half the length of superiors (fig. 17, g, h, i); abd. 30-32 mm., hw. 28-30 mm. .... *S. alpestris* (Selys).  
*A northern species found only in Scotland in similar situations to the last. L.R. 6-8. (Only a single British record is known of this rare European boreo-alpine species.)*
- 6 (1) Females. Coloured metallic as in the males.
- 7 (10) Only 1 cross-vein in cubital space of fore wings.
- 8 (9) Vulvar scale very prominent in profile, projecting at almost a right angle to abdomen; no dorso-basal oval yellow spot on 3rd segment of abdomen; abd. 42-44 mm., hw. 34-36 mm. (fig. 17, c) *S. metallica* (Van der Linden).
- 9 (8) Vulvar scale shorter, more obtuse, rounded at apex, sloping strongly posteriorly and almost parallel to abdomen; a large oval yellow spot on each side of dorsum near base of segment 3 of abdomen; abd. 35-37 mm., hw. 30-32 mm. (fig. 17, f) .... *S. arctica* (Zetterstedt).
- 10 (9) 2 cross-veins in the cubital space of fore wings; vulvar scale short, broadly truncated, apical border shallowly concave; abd. 33 mm., hw. 32 mm (fig. 17, i) .... *S. alpestris* (Selys).

#### Family LIBELLULIDAE.

##### KEY TO GENERA.

- 1 (2) The most distal antenodal very oblique, incomplete, extending only as far as the subcosta (Sc); *MA* and *CuP* in fore wings converging strongly distally at wing border, the discoidal field contracted accordingly; base of hind wings without blackish-brown markings (fig. 20, a)  
*Sympetrum* Newman.
- 2 (1) The most distal antenodal complete, extending through the subcosta to as far as the radius; *MA* and *CuP* diverging more or less strongly distally at wing border, the discoidal field dilated accordingly; base of hind wing usually with blackish-brown markings (absent in *Orthetrum*) (figs. 18, a, b, c; 19, a, b).

- 3 (4) Not more than 8 antenodals in fore wings; pterostigma short and stout, blackish; *Riii* not sinuous or undulated (fig. 19, b) **Leucorrhinia** Brittinger.
- 4 (3) Considerably more than 8 antenodals in fore wings; pterostigma narrow and elongate; *Riii* markedly sinuous and undulated (figs. 18, a; 19, a).
- 5 (6) Sectors of arculus in fore wings meeting only at arculus or with but a slight fusion; bases of hind wings with conspicuous blackish-brown markings; always one or more supplementary cross-veins to the bridge (fig. 18) **Libellula** L.
- 6 (5) Sectors of arculus in fore wings with a distinct fusion before meeting arculus; bases of hind wings without blackish-brown markings; never any supplementary cross-veins to the bridge (fig. 19, a) ..... **Orthetrum** Newman.

KEY TO SPECIES OF *Libellula* L.

- 1 (6) Males.
- 2 (3) Middle segments of abdomen about 3 times as broad as long, markedly flattened; a pair of stout spines, confluent at base, on ventral surface of segment 1 (fig. 21, f); fore wings with blackish streak at base extending into discoidal cell; hind wing with broad triangular spot of the same colour and same extent limited anteriorly by *Sc* (fig. 18, c); abdomen of adults cobalt blue spotted with bright yellow laterally; subadults greenish-yellow as in the female; abd. 26–28 mm., hw. 34–36 mm. .... **L. depressa** L.  
*Breeds in and flies over any kind of pond, lake or bog-hole; females wander far from water and frequent woods and scrub. G.C. 5–8. Often an immigrant.*
- 3 (2) Middle segments of abdomen only twice as broad as long; abdomen broad at base and tapering to the apex, not markedly depressed; no ventral spines below segment 1.
- 4 (5) Fore wings devoid of dark markings at base; hind wing with triangular black opaque spot at base limited anteriorly by *CuP* and usually extending into discoidal cell; a conspicuous black spot at nodus in all wings (occasionally also a dark blackish area beneath pterostigma—var. *praenubila* Newman) (fig. 18, a); abd. 27–32 mm., hw. 32–36 mm.  
**L. quadrimaculata** L.  
*Breeds in marshes, rushy ponds and brackish backwaters and frequents the neighbourhood of such waters. A common immigrant. G.C. 5–9.*
- 5 (4) Fore wings with narrow black rays in subcostal and cubital spaces extending respectively to basal antenodal vein and arculus; hind wing with similar rays in subcostal and cubital spaces, but rather more extensive, that in the latter confluent with a small triangular black spot adjoining the membranule (fig. 18, b); abdomen pruinose blue in the adult, but this often interrupted by a broad black V on middle segments; subadult males coloured similar to female; abd. 26–29 mm., hw. 35–38 mm. .... **L. fulva** Müller.  
*Breeds in and flies along the border of sluggish muddy streams or dykes; usually occurs in large colonies. L.C. 5–6.*
- 6 (1) Females.
- 7 (8) Middle segments of abdomen about 3 times as broad as long; abdomen bright brownish-yellow with brighter yellow lateral spots on segments 3–6; markings of wings similar to male; no yellow tinging of costal area of wings in subadults. Abd. 24–28 mm., hw. 33–37 mm. **L. depressa** L.
- 8 (7) Middle segments of abdomen only twice as broad as long; usually, and especially in subadults, some conspicuous yellow tinting of costal area of wings.
- 9 (10) A conspicuous black spot at nodus in all wings, no black markings at base of fore wings; apices of wings not tipped with black (fig. 18, a). Abd. 29–31 mm., hw. 35–40 mm. .... **L. quadrimaculata** L.
- 10 (9) No black spot at nodus; fore wings with black rays in subcostal space usually broken up into a series of isolated spots extending to nodus or one cell beyond it; apices of all wings conspicuously tipped with black (fig. 18, b). Abd. 26–29 mm., hw. 35–37 mm. .... **L. fulva** Müller.

KEY TO SPECIES OF *Leucorrhinia* Brittinger.

Only a single British species easily identified by its conspicuously creamy-white face with black lip and base of frons, by the well-defined blackish-brown markings at base of hind wings, by the short, stout oval pterostigma (fig. 19, b) and by the crimson markings on dorsum of thorax and abdomen against a black background. In the young male and in all females, the markings are bright yellow instead of crimson; in the latter sex, the abdomen bears broad arrow-head shaped spots on segments 3 to 6. Male: Abd. 24-27 mm., hw. 24-27 mm. Female: Abd. 21-24 mm., hw. 23-27 mm. .... *L. dubia* (Van der Linden).

*L.R., confined mainly to Scotland and the northern counties of England, but small colonies in the south-east. 5-7. Flies low over heather bordering bogs or low lying swampy situations, flight erratic, swift but not sustained.*

KEY TO SPECIES OF *Orthetrum* NEWMAN.

- 1 (4) Males.
- 2 (3) Pterostigma relatively large, 3 mm., bright ochreous; membranule white; thorax with broad humeral dark brown stripes; abdomen *without* black longitudinal stripes, pruinose blue in adults, coloured as in the female in subadults; genitalia as for fig. 21, d; abd. 27-30 mm., hw. 28-32 mm. (fig. 19, a) ..... *O. coerulescens* (Fabricius).  
*Breeds in and flies over most still waters alike in open spaces and woodlands, but is especially common over and around bogs and marshy heathlands. G.C. 6-9.*
- 3 (2) Pterostigma black, this black interrupting the bright yellow line of costa, relatively small, 2-2.25 mm.; membranule dark grey; thorax with narrow inconspicuous dark humeral stripes; a conspicuous black festooned stripe extending whole length of abdomen on each side of dorsum, but this largely concealed by bluish pruinoscence in full adults; genitalia as for fig. 21, e; abd. 30-35 mm., hw. 35-40 mm. .... *O. cancellatum* (L.).  
*Flies over or in the neighbourhood of ponds or lakes, especially those on peaty moors or brackish waters near the southern sea-board; females frequently rest on bare spots among heath or bracken not far from water. L.C. 5-7.*
- 4 (1) Females.
- 5 (6) Pterostigma bright ochreous; thorax with pale bluish antehumeral stripes between dark reddish-brown; abdomen olivaceous with diffuse ill-defined brownish subdorsal stripes; wings in subadults suffused at base and along costa with golden yellow; abd. 26-30 mm., hw. 28-34 mm.  
*O. coerulescens* (Fabricius).
- 6 (5) Pterostigma black; thorax with antehumeral stripes reduced to fine dark lines deficient above and below; abdomen olivaceous-yellow with a black festooned subdorsal stripe on each side as in subadult male; abd. 29-34 mm., hw. 35-41 ..... *O. cancellatum* (L.).

KEY TO SPECIES OF *Sympetrum* NEWMAN.

- 1 (14) Males.
- 2 (11) Legs black or dark brown striped outwardly with yellow.
- 3 (6) Base of hind wings with a broad yellow spot extending to or beyond the cross-vein *Ac* and membranule; inner branch of hamule much shorter and much narrower than outer (fig. 20, e, g).
- 4 (5) The yellow basal spot of hind wing with sharply defined border extending only to cross-vein *Ac*; venation over greater part of wing and especially at base and along costal border reddish; pterostigma bright yellow with thick black borders; mid-dorsum of abdominal segments 8 and 9 conspicuously black. Male: Abd. 24-26 mm., hw. 27-29 mm. (fig. 20, e)  
*S. fonscolombei* (Selys).  
*Lakes and ponds; chiefly an immigrant. L.C. in occasional years. 6-9.*
- 5 (4) The yellow basal spot of hind wing rather diffusely limited, extending to within about 2 cells of nodus and from costal to posterior borders of wing; venation, within the area covered by yellow, similarly coloured, elsewhere black; pterostigma reddish ochreous between black borders; abdominal segments 8 and 9 pale reddish with or without inconspicuous black dorsal line (fig. 20, g). Male: Abd. 22-25 mm., hw. 25-28 mm. .... *S. flaveolum* (L.).  
*Small weedy ponds. R. 7-8. Immigration common.*

- 6 (3) Base of hind wing with small yellow spot of ill-defined limits, but usually extending to as far as cross-vein *Ac* and membranule; inner branch of hamule as long as or longer than outer.
- 7 (10) A narrow black basal line to frons extending downwards on both sides along borders of eyes (fig. 21, c).
- 8 (9) Inner and outer branches of hamules approximately of the same length, inner branch broad at base, tapering to apex which is curled inwards; outer branch slightly constricted at base, broad, compressed and bevelled inwardly at apex; gap between hamules rather wide; base of hamules short, not longer than broad (fig. 20, c). Abd. 24–28 mm., hw. 24–29 mm. (fig. 21, c)

***S. vulgatum* (L.).**

*Weedy ponds and lakes. R. 7–8. An occasional immigrant.*

- 9 (8) Inner branch of hamule distinctly longer than outer, the former slimmer and evenly curved throughout; outer branch not constricted at base, broad, compressed, truncate at apex; gap between branches very wide; base of hamules elongate, about twice as long as wide (fig. 20, d). Abd. 27 mm., hw. 26 mm. .... ***S. nigrescens* Lucas.**

*Ponds and lochs in Scotland, Ireland and North England.*

- 10 (7) A narrow black line to frons but not extending downwards along borders of eyes (fig. 21, a); inner branch of hamule slender, straight and distinctly longer than outer; yellow stripe on outer sides of legs well defined (figs. 20, a, b). G.C. 6–11. Abd. 26–29 mm., hw. 27–29 mm.

***S. striolatum striolatum* (Charpentier).**

*Ponds and lakes.*

- 11 (2) Legs black, without a yellow stripe on outer side.
- 12 (13) Full adults entirely black; subadults greenish-yellow strongly marked with black, thorax with broad black bands, that on metepisternum enclosing 3 small yellow spots (fig. 20, f). Abd. 20–24 mm., hw. 22–26 mm.

***S. scoticum* (Donovan).**

*Open heathy moorlands or open pine woods around peaty bog-holes and ponds. L.C. 7–10.*

- 13 (12) Thorax and abdomen mainly bright red; abdomen rather short, constricted at middle segments, dilated at the end (fig. 20, i). Abd. 21–24 mm., hw. 24–27 mm. .... ***S. sanguineum* (Müller).**

*Weedy ponds. L. 6–9.*

- 14 (1) Females.
- 15 (24) Legs black striped with bright yellow.
- 16 (19) A well defined yellow area at base of hind wing extending at least to as far as the cross-vein *Ac* and end of membranule.
- 17 (18) Anterior border of fore wing conspicuously yellow from base to well beyond level of nodus; yellow area of hind wing extending to well beyond level of discoidal cell. Abd. 23–26 mm., hw. 26–29 ..... ***S. flaveolum* (L.).**
- 18 (17) Anterior border of fore wing uncoloured; yellow area of hind wing not extending beyond the cross-vein *Ac*. Abd. 24–26 mm., hw. 28–31 mm.

***S. fonscolombeii* (Selys).**

- 19 (16) No definite area of yellow at base of hind wing.
- 20 (23) Black basal line of frons not extending down along border of eyes; vulvar scale projecting more or less prominently as seen in profile.
- 21 (22) Sides of thorax greenish-yellow marked with an oblique band of ferruginous enclosed by fine black lines; vulvar scale broadly triangular, its apical border straight and perpendicular to long axis of abdomen. Abd. 25–28 mm., hw. 27–30 mm. .... ***S. striolatum striolatum* (Charpentier).**
- 22 (21) Sides of thorax yellow marked with a broad oblique black band enclosing bright yellow spots; vulvar scale smaller, narrowly triangular, its apical border convex and at an angle with long axis of abdomen. Abd. 26 mm., hw. 27 mm. .... ***S. nigrescens* Lucas.**
- 23 (20) Black basal line of frons extending down along the border of eyes (fig. 21, c); vulvar scale closely similar to that of *striolatum*. Abd. 24–27 mm., hw. 27–29 mm. .... ***S. vulgatum* (L.).**
- 24 (15) Legs black, unmarked with yellow.
- 25 (26) Thorax laterally and beneath greenish-yellow with inconspicuous black lines on former. Abd. 22–26 mm., hw. 25–29 mm. .... ***S. sanguineum* (Müller).**
- 26 (25) Thorax yellow laterally with a broad black band enclosing 3 yellow spots; beneath black marked with a conspicuous yellow *fleur-de-lys*. Abd. 19–24 mm., hw. 23–26 mm. .... ***S. scoticum* (Donovan).**

## APPENDIX I.

## THE NYMPHS OF BRITISH ODONATA.

Not all the nymphs of the British Odonata have been found in this country, but most have been described, either from British or European material; some are imperfectly known or have not yet received the careful study necessary to render easy the identification from the descriptions available. Within the genera or even families, differences are often so slight that it is difficult to furnish a key for identification of species without entering into somewhat lengthy descriptions of minute details.

The obvious and best method for identification is to breed out the nymphs, yet much may be learnt from a dead nymph or even a cast skin (*exuvia*) by examination of the venation which is usually visible in the wing-pads. For this purpose, the nymph should be examined whilst still fresh and moist, as much of the detail is lost after it has become desiccated. Close attention should be given to the shape of the mask (labium or lower lip), the inner surface of which should also be examined for details of its armature, and the number, character and disposition of the setae (spines) carefully noted. The number and character of the dorsal and lateral spines of the abdomen are also important.

As some dragonflies breed solely in still waters, whilst others are equally confined to running water, the character of the streams, whether swift with clean gravelly or sandy bottoms, or sluggish with muddy bottoms, will give some hint for the identification of the species.

## KEY FOR IDENTIFICATION OF NYMPHS.

- 1 (26) Long, slender nymphs with abdomen comparatively long, slim and cylindrical, without pleurites, ending in 3 caudal gills of variable length and shape. Nymphs progress by walking and swimming, employing the caudal gills for this latter purpose (fig. 22, *a, h, k, d*).....Suborder **Zygoptera**.
- 2 (5) Legs very long, slim and spidery; middle lobe of labium split for half its length by a wide fusiform fissure; basal segment of antennae as long as the rest of the segments taken together; dorsal gill flat, foliate; lateral gills triangular in section, pointed at apex (fig. 22, *a, b, c*)....Genus **Agrion**.
- 3 (4) Dorsal gill only slightly shorter than the laterals; fissure of middle lobe more than four times as deep as broad. Habitat: Rapid clear swift running streams with clean sandy or gravelly bottoms (fig. 22, *a, b*)....**A. virgo** (L.).
- 4 (3) Dorsal gill markedly shorter than laterals; fissure of middle lobe of labium less than four times as deep as broad. Habitat: Sluggish streams with muddy bottoms (fig. 22, *a, c*).....**A. splendens** (Harris).
- 5 (2) Legs of moderate length; middle lobe of labium without a fissure (save in *Lestes*); basal segment of antennae not markedly elongate; dorsal and lateral caudal gills lamella-shaped and closely similar in size and shape.
- 6 (9) Middle lobe of labium with a short crack-like fissure; movable hook at apex of lateral lobes armed with long setae (spines); lateral lobes coarsely notched to form four lobes; caudal gills very long, obtusely rounded at apices, without nodal line, tracheated at right angles to the longitudinal axis (fig. 22, *d* to *g*).....Genus **Lestes** Leach.
- 7 (8) Caudal gills of even width from base to apex; only 2 setae on the movable hook (fig. 22, *d, f*).....**L. sponsa** (Hansemann).  
Breeds in marshes, weedy ditches and canals.
- 8 (7) Caudal gills tapering strongly towards apex; 3 setae on the movable hook (fig. 22, *e, g*). Same habitats as for the last.....**L. dryas** Kirby.
- 9 (6) Middle lobe of labium without a fissure; movable hook without setae; caudal gills variable, usually with a nodal-line and with trachea running at an acute angle to the longitudinal axis (fig. 22, *i, l, n, h, k* and *o*).  
Nymphs found usually amongst water-weed. Superfamily COENAGROIDEA.
- 10 (11) Middle lobe of labium with only 4 setae (two sets of 2 arranged horizontally); lateral lobes with 3 setae; nodal-line present, although indistinct, in caudal gills which are produced acuminate at apices and fringed with alternating long and short spines (fig. 22, *h, i*).....**Platycnemis pennipes** (Pallas).  
Breeds in seepages bordering streams or heavily weeded rivers.
- 11 (10) Middle lobe of labium with not less than 6 setae (arranged in an arc of 2 sets); caudal gills with nodal-line more or less strongly defined; apices and armature variable.

- 12 (13) Caudal gills with nodal-line at right angles to axis or mid-rib of gill, apex obtusely rounded, apical half with three transverse pigmented bands; trachea mapped out in dark pigment; antennae with only 6 segments (fig. 22, *n, o*). Breeds in ponds and lakes . . . **Erythromma najas** (Hansemann).
- 13 (12) Caudal gills with nodal-line oblique or angulated to midrib; apex more or less acute; antennae with 6 or 7 segments.
- 14 (17) Caudal gills relatively long and narrow, tapering gradually to an acuminate apex . . . . . Genus **Isechnura** Charpentier.
- 15 (16) Middle lobe of labium with two sets of 4–5 setae; lateral lobes with 6 setae (fig. 22, *m*). Overall length 20–25 mm. . . . . **I. elegans** (Van der Linden). Breeds in weedy ponds and lakes and is found amongst weed.
- 16 (16) Middle lobe of labium with two sets of 6 setae; lateral lobes with 5 setae Only 15–20 mm. long. . . . . **I. pumilio** (Charpentier). Breeds in runnels and seepages in marshy spots.
- 17 (14) Caudal gills shorter and broader.
- 18 (23) Antennae with 7 segments.
- 19 (20) Middle lobe of labium with only 2 setae (1 on each side of middle line); caudal gills rather obtusely pointed . . . . . **Ceriagrion tenellum** (Villers). Breeds in marshes, usually in open heathy situations.
- 20 (19) More than 2 setae on middle lobe of labium.
- 21 (22) Middle lobe of labium with two sets of 3–4 and the lateral with 7 setae; caudal gills with basal, medial and subapical pigmented bands; apices acutely pointed . . . . . **Pyrhosoma nymphula** (Sulzer). Breeds in almost any kind of still water, ponds, lakes and marshes.
- 22 (21) Caudal gills without pigmented bands; apices obtusely pointed  
Genus **Coenagrion** Kirby.  
*C. mercuriale* (Charp.) with 5 setae on lateral lobes, and two sets of 3–4 on middle lobe; *C. pulchellum* (V. d. Lind.) with 6 setae on lateral lobes and two sets of 4 on middle lobe; *C. puella* (L.) with 6 setae on lateral lobes and two sets of 5 on middle lobe (fig. 22, *k, l*); *C. scitulum* (Ramb.) with 6 setae on lateral lobes and two sets of 5 on middle lobe.  
Breed in weedy ponds and marshes, canals, etc.
- 23 (18) Antennae with only 6 segments.
- 24 (25) Caudal gills without pigmented bands; apices obtusely pointed  
Genus **Coenagrion** Kirby.  
*C. hastulatum* (Charp.) with 5–7 setae on lateral lobes and two sets of 3–5 on middle lobe; *C. armatum* (Charp.) with 6–7 setae on lateral lobes and two sets of 4 or 5 on the middle lobe.  
Same habitats as for other Coenagrions (*vide* 22).
- 25 (24) Caudal gills with transverse pigmented bands at level of nodal-line; apex acute and abruptly tapered . . . . . **Enallagma cyathigerum** (Charpentier). Breeds in weedy ponds and lakes, etc.
- 26 (1) Much larger, more robustly built nymphs with stout abdomen rounded or arched dorsally and of variable shape, often bearing dorsal and lateral spines on the abdominal segments; caudal gills absent, but 5 short spine-like appendages surrounding the anal orifice; ventral pleurites present. Nymphs progress by walking or jet-propulsion, this latter effected by squirting water forcibly from the anal orifice (fig. 23, *a, b, g* and *o*)  
Suborder **Anisoptera**.
- 27 (28) Tarsi of the two anterior pairs of legs with only 2 segments, the hind pair with 3; labium flat and rectangular; antennae with only 4 segments, the third of which is as long as the rest taken together (fig. 23, *g, h* and *i*)  
**Gomphus vulgatissimus** (L.).  
Breeds in swift running streams with clean sandy bottoms, in which the nymph burrows and may be obtained by dredging.
- 28 (27) Tarsi of all legs with 3 segments; antennae filiform, with 7 segments (fig. 23, *a, b, l* and *o*)
- 29 (44) Labium elongately triangular and very flat, without setae (fig. 23, *c*).
- 30 (31) Very large nymphs of not less than 50 mm. in length. Eyes markedly flattened, situated laterally, forming the larger part of the sides of the head and with their posterior borders in a transverse straight line (fig. 23, *a* and *b*); venation of wing-pads always very distinct (fig. 16, *a* and *b*)  
**Anax imperator** Leach.

Breeds in weedy ponds and lakes.

- 31 (30) Smaller nymphs of less than 50 mm. in length. Eyes more globular and occupying the antero-lateral portions of head and with their posterior borders meeting at a distinct angle.
- 32 (33) Eyes comparatively small, forming the extreme anterior corners of the head and less than half the side of the head. Profile of eyes and front of head strongly angulated (fig. 23, *d*) ..... **Brachyiron pratense** (Müller). Breeds in dykes, canals and rushy lakes and ponds.
- 33 (32) Eyes much larger, occupying quite half the sides of head; profile of eyes and front of head obtusely angulated.
- 34 (35) Dorsal appendage at end of abdomen without a notch at its apex; supracoxal process as in fig. 23, *t*. Confined to the area of the Norfolk Broads. Breeds in the dykes of the Broads ..... **Aeshna isosceles** (Müller).
- 35 (34) Dorsal appendage of abdomen with distinct notch at apex.
- 36 (37) Labial mask (*labium*) almost as broad behind as in front; supracoxal process as in fig. 23, *s* ..... **Aeshna juncea** (L.). Breeds in ponds and lakes with a preference for peaty waters and bog-holes in pine woods.
- 37 (36) Labial mask tapering posteriorly and much narrower behind.
- 38 (41) Small nymphs of not longer than 35 mm.
- 39 (40) Spines on the sides of abdominal segments 7 to 9 only; supracoxal process as in fig. 23, *u*. Confined to a few districts in N. Scotland.  
**Aeshna caerulea** (Ström).  
Breeds in bog-holes on peaty heaths and pine forest.
- 40 (39) Spines on segments 6 to 9; supracoxal process as in fig. 23, *w*. Confined to the S. of England ..... **Aeshna mixta** Latreille.  
Breeds in rushy ponds and canals.
- 41 (38) Larger nymphs of more than 40 mm. in length.
- 42 (43) Length about 44 mm.; supracoxal process as in fig. 23, *r*. Breeds in rushy ponds and lakes ..... **Aeshna grandis** (L.).
- 43 (42) Length about 48 mm.; supracoxal process as in fig. 23, *u*. Same habitat as for the last. .... **Aeshna cyanea** (Müller).
- 44 (29) Labial mask short, deeply hollowed out and spoon-like, the opposing borders of the lateral lobes crenate or more or less deeply toothed, the lobes themselves broadly triangular.
- 45 (50) Nymphs very hairy, often coated with mud and debris in which they live.
- 46 (47) Very large, bulky nymphs of not less than 40 mm. in length; lateral lobes of mask very deeply serrate along opposing borders and the teeth closely interlocking when the lobes are closed; 4 setae (spines) on each lateral lobe and 5 on each side of mid-line of middle lobe; abdomen fusiform  
**Cordulegaster boltoni** (Donovan).  
Breeds only in running water, usually clear streams with sandy bottoms. Nymphs hide beneath curtains of water-weed in bed of streams.
- 47 (46) Smaller nymphs of not more than 25 mm. in length; abdomen more or less broadly fusiform or oval and short. Found only in still waters or sluggish streams with dirty bottoms. Nymphs hide in water-weed or debris near margins of habitats.
- 48 (49) Only about 20 setae on the middle lobe of labial mask, all of which are in alignment and without grouping (fig. 24, *e* and *h*)  
**Libellula quadrimaculata** L.  
The 5 outer setae longer than the rest; 7 to 8 setae on the lateral lobes; 25 mm. in length. Breeds in ponds, lakes and often in brackish and peaty waters, bog-holes, etc.
- 49 (48) Not less than 30 setae on middle lobe of mask and most of these in groups of spines smaller than the outer ones.
1. Setae on middle lobe: Two groups of 10 very small ones medially and 3 on each side much longer than the rest; 4 or 5 minute ones between these two groups; 4 setae on lateral lobes. .... **Libellula fulva** Müller.  
Breeds in sluggish streams, dykes and canals with muddy bottoms.
  2. Setae on middle lobe: Two groups of tiny spines in the middle numbering 4 or 5; 9 on each side in an arc of about the same size or gradually diminishing in length from without inwards; 9 to 10 setae on the lateral lobes ..... **Libellula depressa** L.  
Breeds in any kind of pond, lake or canal.

3. Setae on middle lobe about 30 in number. Two groups of 4 and two of 7 very minute spines medially and 3 much longer spines on the outer side; 7 setae on the lateral lobes (fig. 24, d)

***Orthetrum cancellatum* (L.).**

Breeds in ponds and lakes, often of a brackish nature.

4. Setae on middle lobe about 40 in number. Two groups of 12 minute spines medially joined to 2 outer ones much longer than the rest by a chain of 4 or 5 small setae; only 3 setae on the lateral lobes

***Orthetrum coerulescens* (Fabricius).**

Breeds in marshes and shallow weedy ponds.

- 50 (45) Nymphs not hairy or not markedly so. Usually clean and free from clinging mud and debris.

- 51 (52) The opposing borders of labial mask with 7 to 8 (rarely 9) deep and broad serrations or teeth, each tooth bearing one or more bristles (fig. 23, k and m)

**CORDULIIDAE.**

1. Distal border of mask with 8 large serrations, each bearing 4 to 6 spines; middle lobe with two sets of 11 setae; lateral lobes with 7 to 8. Lateral spines on abdominal segments 8 and 9; no well-defined dorsal spines ..... ***Oxygastra curtisi* (Dale).**  
Breeds in sluggish streams.

2. Distal border of mask with 9 large serrations, each bearing 3 to 4 spines; lateral lobes with 8 setae (rarely 9); middle lobe with two sets of 13 to 15 spines. Lateral spines on segments 8 and 9; dorsal recurved obtuse spines on segments 4 to 9 (fig. 23, k)

***Cordulia linaenea* Fraser.**

Breeds in large ponds, lakes, canals and more rarely in swamps. Will breed in brackish water. Nymphs hide in weed or debris in shallows.

3. Distal border of mask with 9 large serrations, each bearing 8 to 9 spines, one being much longer than the rest. Middle lobe with two sets of 11 to 12 setae, lateral lobes with 6 to 7 setae (fig. 24, b and i)

***Somatochlora metallica* (Van der Linden).**

Breeds in ponds, canals and, in Scotland, in bog-holes on moorlands. Nymphs shelter in water-weed.

4. Distal border of labial mask with 7 large serrations, each bearing 5 to 7 spines, one being longer than the rest; middle lobe with two sets of 12 to 14 setae, lateral lobes with 7 to 9 setae (fig. 24, k)

***Somatochlora arctica* (Zetterstedt).**

Breeds in small runnels or seepages in sheltered situations on moorlands or bordering forests in Scotland.

5. Distal border of labial mask with 10 large serrations each bearing 3 to 4 spines, one being longer than the rest; middle lobe with two sets of 13 setae, lateral with 8 setae (fig. 24, l)

***Somatochlora alpestris* (Selys).**

Breeds in similar situations to the last, in Scotland.

- 52 (51) The opposing borders (distal) of labial mask with 9 crenate processes not amounting to teeth, each bearing setae similar to those of the Corduliidae (fig. 23, p)..... **LIBELLULIDAE.**

1. Lateral lobes with 11 setae, middle lobe with two sets of 14 setae, the outer ones longer than the inner. A small dorsal spine on segment 5, long slender ones on segments 6 to 8, and lateral ones on segments 8 and 9, that on the latter of great length (fig. 24, g)

***Sympetrum striolatum* (Charpentier).**

Breeds in any type or size of pond, sheltering in water-weed. *S. nigrescens* has a similar nymph.

2. Lateral lobes with 14 setae, middle lobe with two sets of 10-18 setae, the middle ones of the rows the longest. No dorsal spines to abdomen, but very short ones on the sides of segments 8 and 9 (fig. 23, p)

***Sympetrum fonscolombi* (Selys).**

Breeds in ponds in the Channel Islands, but has rarely been discovered breeding in Britain.

3. Lateral lobes of mask with 11 setae, middle lobe with two sets of 11 to 15, usually 13 to 14, all of about the same length. Obtuse dorsal spines on segments 6 to 8, and short ones on the sides of 8 and 9 (fig. 24, a) ..... ***Sympetrum flaveolum* (L.)**  
Breeds in weedy ponds.



4. Lateral lobes with 11 setae, middle lobe with two sets of 13, becoming progressively shorter from without inwards. Short recurved spines on dorsum of segments 5 to 7, sometimes a vestigial one on 8. Lateral spines on segments 8 and 9 (fig. 24, c)

*Sympetrum scoticum* (Donovan).

Breeds in peaty marshes and ponds on open heaths.

5. Lateral lobes of mask with 10 to 12 setae, middle lobe with two sets of 14 to 15 setae. Dorsal spines on segments 3 to 8, that on the former very small; lateral spines on segments 8 and 9

*Sympetrum vulgatum* (L.).

Breeds in similar habitats to *S. striolatum*.

6. Lateral lobes of mask with 9 to 11 setae, middle lobe with two sets of 12 to 13 setae. Dorsal spines on segments 5 to 8, lateral ones on segments 8 and 9 ..... *Sympetrum sanguineum* (Müller).

Breeds in weedy ponds and lakes.

7. Lateral lobes with 11 setae, middle lobe with two sets of 12 to 15 setae. Slender sharp spines on dorsum of segments 4 and 5, obtuse ones on segments 6 and 7 (fig. 24, f).... *Leucorrhinia dubia* (Van der Linden).

Breeds in marshes or peaty bog-holes in open situations.

## GLOSSARY OF TERMS AND ABBREVIATIONS EMPLOYED IN THE TEXT.

Abd.: Abdomen.

Anal: End of abdomen. Posterior portion or portion nearest to the thorax when applied to the wing, etc.

Andromorph: A female coloured and marked like the male.

Antehumeral: Anterior to the humeral suture of thorax. Usually applied to coloured stripes on dorsum of thorax in some of the smaller Zygoptera (fig. 2, *Ast*).

Antennae: Slender pair of sensory organs carried on the dorsum of head internal to eyes; very small and inconspicuous in the Odonata. (fig. 1, *Ant*.)

Apical: The part or segment of any organ furthest removed from the thorax.

Arculus: A short transverse vein uniting the Radius with the base of the discoidal cell at base of wings (fig. 3, *Arc*).

Auricle: A small ear-like process situated at the sides of segment 2 of the abdomen in some male Odonata (fig. 13, *Aur*).

Basal: The part or segment of any organ nearest the thorax.

C.: Common.

Carina: A low ridge or crest on mid-dorsum of thorax and abdomen. Also applied to the lateral ridges of abdomen.

Clypeus: The part of the face between the upper lip and frons.

Costa: The anterior border of wings, from base to nodus.

Crenate, -tions: A border thrown into semicircular ridges or scalloped.

Dorsum: The upper surface or back.

Epistome: See *Clypeus*.

Femur: The thigh—the third segment of the leg.

Filiform: Thread-like.

Frons: The forehead or upper part of face, usually rounded in the Zygoptera, angulated or ridged in the Anisoptera.

Genitalia: The sexual organs.

G.C.: Generally common.

Heterochrome: Differently coloured. A female differing in colour and markings from the male.

Heteromorph: Of different form. Used here in the same sense as heterochrome.

Homochrome: Of similar colour. A female coloured like the male.

Humeral: The shoulder.

Hw.: Hind wing.

Lab.: Labrum, the upper lip.

Lbm.: Labium, the lower lip.

L.R.: Local and rare.

Nodal-line: A false joint in the caudal gills of some Zygoptera.

Nodus: A false joint in the middle of anterior border of wings.

Occiput: The posterior part of the head.

Ocelli: Accessory single-faceted eyes—3 in number on dorsum of head in the Odonata.

- Pleurites : Soft membranous lateral portions of an abdominal segment.  
 Polychromatic : Possessing different colour forms.  
 Postoculars : Applied to rounded coloured spots situated on the occiput or back of head in some of the smaller Zygoptera.  
 Prothorax : The anterior separated portion of thorax.  
 Pterostigma : An opaque chitinated cell near the apex of wing on the costal border.  
 Pterothorax : See *Synthorax*.  
 R. : Rare.  
 Serrate, -tions : Saw-like border.  
 Setae : Fine, hair-like spines.  
 Suture : A joint or the line of fusion of two adjacent parts.  
 Synthorax : The main part of thorax made up of the fused meso- and metathorax, and which carries the wings and the two hinder pairs of legs.  
 Tarsus : The end or distal portion of the leg, consisting of 3 segments in the Odonata.  
 Teneral : The soft and uncoloured condition of the newly emerged imago.  
 Tergites : The upper or dorsal parts of segments.  
 Thorax : The middle division of the insect body, between the head and abdomen.  
 Tibia : The shin—the fourth segment of the insect leg.  
 Ventrums : The belly or underside of abdomen.  
 Vertex : The upper part of head.  
 Vestigial : Remains of. A trace of. Usually applied to the remnants of an organ which has been almost lost.  
 NOTE.—All other terms are explained in the preface, or where they occur in the text.

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