

# THE PHYLOGENY OF THE ZYGOPTEROUS DRAGON-FLIES AS BASED ON THE EVIDENCE OF THE PENES\*

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This paper is merely the briefest outline of the writer's discoveries with regard to the inter-relationship of the major groups of the Zygoptera, a full account of which will appear in his thesis on the subject. Three papers<sup>1</sup> by the writer discussing the value of this organ in classification of the Odonata have already been published.

At the beginning, this study of the Zygoptera was viewed as an undertaking to define the various genera more exactly. The writer in no wise questioned the validity of the Selysian conception that placed the Zygopterous subfamilies in series with the richly veined "Calopterygines" as primitive and the Pro-toneurinae as the latest and final reduction of venation.

However, following Munz<sup>2</sup> for the Agrioninae the writer was able to pick out here and there series of genera where the development was undoubtedly from a thinly veined wing to one richly veined, *i. e.*, *Megalagrion* of Hawaii, the *Argia* series, *Leptagrion*, etc. These discoveries broke down the prejudice in the writer's mind for the irreversibility of evolution in the reduction of venation in the Odonata orders as a whole. Undoubtedly in the Zygoptera many instances occur where a richly veined wing is merely the response to the necessity of greater wing area to support a larger body.

As the study progressed the writer found almost invariably that generalized or connecting forms were usually sparsely veined as compared to their relatives. The first startling discovery was that *Hypolestes* (*Ortholestes*) was a near relative of *Amphipteryx* and not Lestid at all, others followed; *Hemiphlibia* had no near relatives in the Cœnagrioninae but was probably nearer the Megapodagrioninae, that the minute *Micromerus* was the least specialized Libellagine genus that the Megapodagri-

\*A second paper will appear in the Ohio Jour. of Sci. for December.

<sup>1</sup> Ent. News, July, 1916, Jan., 1917, July, 1917.

<sup>2</sup> Mem. Amer. Ent. Soc. No. 3, 1919.

onine penes were "Calopterygid" rather than Cœnagrionid. Building up from such discoveries the writer has been forced to the conclusions presented in this sketch.

The primitive Zygopter must have been a small insect no larger (if as large), than *Ortholestes*, *Miocora*, *Argiolestes*, or *Micromerus* that had a reduced venation, in which there were probably but two antenodals, in which  $M_3$  and  $R_s$  arose near the subnodus, in which there may or may not have been a few more extra sectors than  $M_{1a}$ . That the breathing by caudal as well as by *abdominal gills* is a specialized method, the primitive Odonate method being by rectal gills.<sup>3</sup> That the development of the families and subfamilies was radiate and not serial.

These conclusions reverse some of our previous views. The nodus has passed distad in the richly veined Calopterygine series instead of having passed basad in the "reduced" Cœnagrionid wing. The forks of  $M_3$  and  $R_s$  have changed very little, which agrees with venational studies in other orders. The wings have increased in size merely by the lengthening of some or all the veins and by the addition of extra sectors. Thus *the nodus is merely the apex of Sc*, which has been free to lengthen just as its sister longitudinal veins have lengthened and so has moved out as the wing increased in area, which has made the forks of  $R_s$  and  $M_3$  appear to have moved basad more than they really have.

Interwoven with these are the two elusive factors:

1. Heredity, which tends to hang on to old structures; and
2. Orthogenesis, which may increase a tendency beyond the actual needs of the insect.

The writer hopes that his friends will deal leniently with these startling innovations until he is able to present the evidence in full. His own views have been completely reversed during this study.

The sixteen subfamilies of Zygoptera recognized by the writer fall into four major groups, or families, the *Agrionidæ*, *Lestidæ*, *Hemiphlebidae*, and *Cœnagrionidæ*. The list of subfamilies will be discussed as a list because the writer has been unable to construct, without exceptions, a natural key based on either wings or penes. Probably the major groups can be defined in larval characters when these are better known. Drs. Calvert and Tillyard are in possession of material that should solve this problem.

<sup>3</sup> See page 23.

## I. Agrionidæ.

1. *Megapodagrioninæ*.
2. *Philoganginæ*.
3. *Amphipteryginæ*.
4. *Epallaginæ*.
5. *Polythorinæ*.
6. *Agrioninæ*.
7. *Libellaginæ*.
- (8. *Platystictinæ*?)

## II. Hemiphlebidæ.

9. *Hemiphlebinæ*.

## III. Lestidæ.

10. *Perilestinæ*.
11. *Synlestinaæ*.
12. *Lestinaæ*.

## IV. Coenagrioninæ.

- (8. *Platystictinæ*?)
13. *Pseudostigmatinæ*.
14. *Platycneminaæ*.
15. *Protoneurinaæ*.
16. *Cœnagrioninæ*.

## I. AGRIONIDÆ.

This family is roughly defined by a combination of characters: two rows or more of cells between  $M_{1a}$  and  $M_2$  at the level of the stigma; no oblique vein between  $M_2$  and  $R_s$  distad of the subnodus; naiadal labium cleft.

Known exceptions to the first character are *Trineuragrion* and *Tatocnemis* and the genera in the *Platystictinæ*. The inclusion of the latter here of course depends on the correctness of Fraser's identification<sup>4</sup> of the *Protosticta* naiad. When the study of the penes showed that *Hypolestes* (*Ortholestes*) was not Lestid but belonged near *Amphipteryx* the Selysian definition of Zygopterous families had to be discarded. That discovery put *Hypolestes* with its two antenodals into the Agrionidæ. With the bar against two antenodals in the Agrionidæ lifted, the *Megapodagrioninæ* became Agrionid on the strength of their extra sectors and the cleft labium in the naiad, (*Thaumatoneura*<sup>5</sup>, *Argiolestes*<sup>6</sup>).

1. **Megapodagrioninæ.** Figs. 91-124. *Nesolestes*, (*Protolestes*)<sup>7</sup> (*Allolestes*), *Neurolestes*, *Podolestes*, *Trineuragrion*, (*Melanagrion*) *Riphidolestes*, *Argiolestes* (*Metagrion*) *Wahnesia*, *Podopteryx*, *Paraphlebia*, *Thaumatoneura*, *Rhinagrion*, (*Phenacolestes*), *Tatocnemis*, *Megapodagrion*, *Heteropodagrion*, *Dimeragrion*, *Allopodagrion*, (*Lithagrion*) *Philogenia*, *Heteragrion*, (*Mesagrion*), *Oxystigma*<sup>8</sup>.

The most primitive genera in the above list are *Podolestes* and *Rhinagrion*. These in their simple venation, simple penes

<sup>4</sup> Rec. Ind. Mus. XVI, p. 465, 1919.

<sup>5</sup> Calvert, Ent. News 26, p. 300.

<sup>6</sup> Tillyard, Biology of Dragonflies, p. 278, "Mask—resembling that of the *Epallaginae*."

<sup>7</sup> Parenthesis indicates that the penis has not been studied.

<sup>8</sup> Probably *Lestoidea* belongs in this subfamily. Its penis is unknown.

and appendages stand as generalized forms intermediate between the various specialized groups of this subfamily. The tips of branches are represented by *Podopteryx*, *Thaumatoneura Oxystigma* and *Tatocnemis*. The writer believes the primitive members of this subfamily to be very close to the ancestral Zygoptera, in size, venation, penes and male appendages. This subfamily falls into three distinct groups by the penes and venation. 1. Afric-oriental, 2. Mexican; 3. South American.

2. **Philoganginæ.** Figs. 38-39. *Philoganga*.

A very archaic genus in which adjustment to great size was made by the hasty method of merely lengthening all the principal veins of the wing. While the naiad is not known the penis and venation indicate a position near the *Amphipteryginæ* and *Megapodagrioninæ*.

3. **Amphipteryginæ.** Figs. 82-90. *Hypolestes*, (*Pseudolestes*), *Diphlebia*, *Pentaphlebia*, *Amphipteryx*, *Devadatta*.

The simplest member of this series is the little *Hypolestes* in which there are but two antenodals. The penis of this genus, Figs. 88-89, is close to that of *Amphipteryx*, Figs. 86-87. It has none of the Lestine features found in Figs. 1-15. Needham described<sup>9</sup> what is probably its naiad but could not believe his eyes because of its "Calopterygine" characters that suggested *Diphlebia*.<sup>10</sup> These naiads with their unspecialized labia and antennæ are very close to those of the *Megapodagrioninæ*. The extremely discontinuous distribution of these small genera shows them to be very primitive.

4. **Epallaginæ.** Figs. 28-37 and 40-41. *Epallage*, *Anisopleura*, *Bayadera*, *Pseudophæa*, *Dysphæa*.

This series has its closest relatives in the *Polythorinæ* as is shown by the ventral abdominal gills in their naiads.<sup>11</sup> Both families are very primitive in the unspecialized antennæ and labia of the naiads but the pairs of gills are surely a specialization as none occur in the other Zygoptera nor in the Anisoptera. The male appendages in this subfamily are intermediate between the *Megapodagrion* type with dilated appendages and the *Polythorine* type with a basal spur. *Anisopleura* and *Epallage* are the more generalized genera.

<sup>9</sup> Ent. News XXII, p. 151, 1911.

<sup>10</sup> Tillyard Proc. Linn. Soc., N. S. Wales, 34 pp. 370-383, 1909.

<sup>11</sup> Needham, Ent. News XXII, p. 149-150, 1911. (*Anisopleura*, *Bayadera*). Hagen, Zool. Anz. Vol. III, pp. 304-305, 1880. (*Anisopleura*, *Bayadera*). Ris. Tijdsch. v. Ent. LV, p. 168, 1912. (*Euphæa*).

5. **Polythorinæ.** Figs. 16-27. *Miocora*, *Cora*, *Euthore*, *Polythore*, *Chalcopteryx*.

*Miocora* and *Cora* are the most generalized genera. This and the preceding family form a short lateral branch at the base of the Agrionid tree characterized by ventral gills in the naiad.<sup>12</sup> The peculiar arculus is not primitive but is derived from a normal arculus as is shown by the position of its upper end in the angle formed by  $M_4$ . *It has been pulled into this illogical position by the shortening of the upper limb of the arculus.*

The ventral abdominal gills are considered by the writer to be specialized and not archaic, *i. e.*, they do not hark back of the Zygoptera to Ephemeropterid gills or the like. The primitive method of breathing in the Odonate orders seems to have been rectal because that is the method in the Anisoptera and in the first two instars in Zygopterous naiads. Also any Zygopterous naiad lives normally by rectal breathing after the external gills have been removed. If this is true the caudal gills are a comparatively late acquisition which applies also to the ventral paired gills. The writer reasons that the slender stature of the adult Zygoptera was reflected in the larva or developed there parallel, that with the diminishing diameter of the abdomen the rectal gill basket became crowded which necessitated the development of external gills. This development of external gills then took place along two lines. 1. Caudal and ventral gills in the Polythorine-Epallagine branch; and 2. Caudal gills in the other Zygoptera.

6. **Agrioninæ.** Figs. 42-73. *Caliphæa*, *Neocharis*, (*Dictérias*), *Heliocharis*, *Cyanocharis*, *Phaon*, *Vestalis*, *Lais*, *Hetaerina*, *Mnais*, *Psolodesmus*, *Climacobasis*, *Umma*, *Sapho*, (*Archineura*), *Agrion*, *Matrona*, *Matronoides*, *Neurobasis*.

The first eight are the primitive forms, while *Archineura*, *Matronoides* and *Neurobasis* are highly specialized in rich venation and naiadal characters. *Caliphæa* shows relationship to the *Epallaginæ* in the recurrent penis lobes, but to the primitive Agrionines, especially *Hetaerina* and the South American series in its arculus and quadrangle. A study of the penes, figs. 48-53, at once showed the South American series of *Neocharis*, *Heliocharis* and *Cyanocharis* to be Agrionine. These are in South America where primitive genera might be expected and again

<sup>12</sup> Calvert, Ent. News, XXII, pp. 49-64, 1911. (*Cora*).

connect the broad-winged specialized Oriental genera with the petiolate primitive subfamilies. *Lais* and *Heterina* are a primitive side line in which two of the penis lobes are usually lost. The nymphs of this subfamily are very specialized in the deeply cleft labium and in the stalked antennæ. One such from South America, probably of the *Neocharis* series, is in Williamson's collection, while those of *Phaon*,<sup>13</sup> *Vestalis*,<sup>14</sup> *Heterina*<sup>15</sup>, *Agrion*,<sup>16</sup> *Matrona*,<sup>17</sup> *Neurobasis*,<sup>18</sup> have been described. One glance at the labium of *Neurobasis* will convince the most skeptic that it is highly specialized with its profound cleft and long spines.

7. **Libellaginæ.** Figs. 74-81. *Micromerus*, *Libellago*, (*Rhineura*), *Rhinocypha*, (*Disparocypha*).

The unspecialized penes in this group are in *Micromerus*, Figs. 80-81, and in the plain-winged *Rhinocyphas*, Figs. 78-79. These insects are small with primitive black-tipped wings. The specialized penes with elaborate lobes occur in those large *Rhinocyphas* with pictured wings. This indicates that the primitive Libellagine insect was smaller than the average pictured winged *Rhinocypha* of today and that it has a two-lobed penis similar to those of the Epallaginæ, also that its wings had the very generalized black tips common in Agrionidæ. The stalked antennæ of the naiads of *Libellago*<sup>19</sup> and *Micromerus*<sup>20</sup> indicate some relationship to the Agrionidæ. Here curiously enough we have the short, wide body correlated with rectal breathing. See page 23.

8. **Platystictinæ.** Penes not figured<sup>21</sup> but two lobed and resembling those of the *Epallaginæ* and *Megapodagrioninæ*. *Platysticta*, *Palæmnema*, (*Protosticta*).

If Fraser<sup>22</sup> has correctly identified his exuvium as *Protosticta* then this series surely goes here being exceedingly reduced forms probably derived from a Megapodagrionine stock. The writer before seeing Fraser's figures had thought

<sup>13</sup> Karsch. Die Insecten der Berglandschaft Adeli, p. 48, 1893. (Phaon?)

<sup>14</sup> Ris Tijdsch. v. Ent. LV, p. 177, 1912.

<sup>15</sup> Needham, N. Y. State Mus. Bull. 68 p. 227, 1903.

<sup>16</sup> Hagen, C. R. Soc. Ent. Belg. 23 pp. LXV-LXVII, 1880.

<sup>17</sup> Fraser, Rec. Ind. Mus. XVI, p. 463, 1919.

<sup>18</sup> Needham. Ent. News, XXII, p. 147, 1911.

<sup>19</sup> Karsch, Insect. Berglandschaft Adeli, p. 48, 1893.

<sup>20</sup> Fraser, Rec. Ind. Mus. XVI, p. 197, 1919.

<sup>21</sup> Kennedy. Ent. News, Julp, 1917. Figs. of penes of Palæmnema and Platysticta.

<sup>22</sup> Fraser, Rec. Ind. Mus. XVI, p. 465, 1919.

this group a remote relative of the Pseudostigmatinae because of the regular venation, the penes, and the male appendages. Dr. Calvert possesses nymphs of *Palæmnema* which should settle the matter.

## II. HEMIPHLEBIDÆ.

9. **Hemiphelbinæ.** Penis not figured but has characters of the *Megapodagrioninae*, *Lestidæ*, and *Cænagrioninae*. *Hemiphlebia*.

Because of the singular penis and male claspers this could be associated with no group in the *Cænagrionidæ*. Its irregular cross veins suggest the *Aggrionidæ*. It certainly has no near relatives among the known *Odonata*. Its location in Australia is highly suggestive of a very ancient stock.

## III. LESTIDÆ.

This family is characterized by the cleft labium of the naiad, the regular gizzard patches without specialized large teeth, the penis lacking the terminal lobe, the male appendages and the occurrence of an oblique cross vein between  $R_s$  and  $M_s$  distad of the subnodus.

10. **Perilestinæ.**

Penis not figured but truly Lestid in that it lacks the terminal segment. Male appendages and gizzard Lestid. The writer suggests the following as a possible explanation of the long bridge in this family. The ancestral Lestid may have been an attenuate insect like *Perilestes*. When the other subfamilies were developed from this by increasing the area of the wings to sustain the heavier body the other forks retreated basad but left the fork of  $R_s$  behind in the apical half of the wing where it occurs normally in *Perilestes* because in this case it has never moved back.

11. **Synlestinae.** Figs. 10-15. *Synlestes*, *Chlorolestes*.

These appear to be true Lestids. Tillyard<sup>23</sup> has shown them to be Lestid by venation. The penes lack the terminal segment and the patches in the gizzard occur in fours while they are armed with fine teeth only, as in the other two subfamilies. The naiad<sup>24</sup> has a cleft labium but has generalized gills, which

<sup>23</sup> Proc. Linn. Soc. N. S. W. 39, p. 193, 1914.

<sup>24</sup> Tillyard, Biology of Dragonflies, p. 83, Fig. 32 G., 1917.

would seem to connect the specialized *Lestinæ* with the primitive members of the *Agrionidæ*.

12. **Lestinæ.** Figs. 1-9. *Megalestes*, *Austrolestes*, *Lestes*, *Archilestes*.

The naiads with their highly specialized gills and labia as well as gizzards show this to be a group much more specialized than the venation would indicate. The position of the oblique vein beyond the subnodus shows that something unusual has happened in the development of this wing. *It surely has not developed* to its present form *over the same course* as that which must have been followed by *Hypolestes*, for instance, otherwise the oblique vein would not be where it is. The latest and most specialized forms in this group are the two species of *Archilestes*. *Megalestes* is the most aberrant member of the series and may be a connecting link between the *Synlestinae* and *Lestinae*.

#### IV. CÆNAGRIONIDÆ.

This family is distinguished at once from all the preceding by the fact that the naiad has no median cleft in the middle labial lobe. The penes always have the last segment present. The shaft spines when present are never long or heavy as in many *Agrionid* genera. Except in the *Psendostigmatinae* there are seldom extra sectors other than  $M_{1a}$ .

(8. **Platystictinae?**)

The writer does not have any conclusive data to show where this subfamily belongs. See subfamily 8 under *Agrionidæ*.

13. **Psendostigmatinae.** Penes not figured but distinctly *Cænagrionid*.

Dr. Calvert<sup>25</sup> has shown by the naiad that these are truly *Cænagrionid*. The stalked caudal gills in *Copera*<sup>26</sup> and *Mecistogaster* may indicate relationship. The penes show that the small forms, *Mecistogaster jocaste* and *ornatus* are generalized and are the forms connecting to the *Cænagrionid* stem, while *Microstigma* and *Megaloprepus* are the most specialized.

<sup>25</sup> Ent. News, 22, p. 449, 1911.

<sup>26</sup> Fraser, Rec. Ind. Mus. XVI, p. 464, 1919.

14. **Platycneminae.** Penes not figured. *Metacnemis*, *Allocnemis*, *Chlorocnemis*, *Prionocnemis*, *Copera*, *Platycnemis*, *Amphicnemis*, *Cæliccia*, *Pericnemis*, *Indocnemis* *Idiocnemis*, *Calicnemis*, *Stenocnemis*.

The labia of *Copera*<sup>27</sup>, *Platycnemis*<sup>28</sup> and *Calicnemis*<sup>29</sup> are of the uncleft Cœnagrionid type, while the peculiar stalked gills of *Copera*<sup>25</sup> are remarkably like those in *Mecistogaster*<sup>30</sup>. The penes do not indicate any close relationship to the *Protoneurinae*. The genera fall into two groups: An Eurafrikan group and an Oriental group.

15. **Protoneurinae.** Penes not figured. (*Proneura*), *Peristicta*, *Neoneura*, *Idioneura* *Microneura*, *Protoneura*, *Epipleoneura*, *Epipotoneura*, *Phasmoneura*, *Psaironeura*, *Neosticta*, *Austrosticta*, *Isosticta*, (*Oristicta*) *Chloroneura*, *Disparoneura*, *Indoneura*, *Nososticta*, *Notoneura*, *Risioneura*.

These are probably reduced Cœnagrionids though the penes in the less reduced forms are Agrionid-like and the naiads are queer in being Agrionid in some characters and apparently Cœnagrionid in others. Only the naiad of *Chloroneura*<sup>31</sup> has been well described.

The penes of the *Disparoneura* series as well as of the primitive South American *Peristicta* are four lobed and could be classed (on penis characters alone) among the Agrionid penes. Some species of *Disparoneura* and *Caconeura* have penes<sup>32</sup> almost identical with those of *Amphipteryx*, figs. 86–87, and *Hypolestes*, figs. 88–90. It is yet possible that a study of the naiads will show a part or all of the *Protoneurinae* to belong in the Agrionid series of subfamilies.

16. **Cœnagrioninae.**

Penes not figured but of diverse types in which there are seldom the elaborate lobes found in many Agrioninae, and in which the shaft is never completely covered with hairs as in the *Megapodagrioninae*. This subfamily contains approximately seventy genera, which are too many to list here.

The writer considers its older genera to be little later in origin than the older *Agrionidæ*. The current confusion in the

<sup>27</sup> Fraser, Rec. Ind. Mus. XVI, p. 464, 1919.

<sup>28</sup> Rousseau, Ann. Biol. Lacustre, III, p. 352, 1909.

<sup>29</sup> Fraser, Rec. Ind. Mus. XVI, p. 465, 1919.

<sup>30</sup> Calvert, Ent. News, 22, p. 455, 1911.

<sup>31</sup> Fraser, Rec. Ind. Mus. XVI, p. 466, 1919.

<sup>32</sup> Kennedy, Ent. News, XXVIII, Pl. XXI, Figs. 9–17, 1917.

classification is due to two things: 1, The attempt to show phylogeny by venation which is hopeless because of the numerous convergences; and 2, The failure to recognize that there are four major series and not three as outlined by de Selys. These are:

1. The ARGIA series with long leg spines, the most generalized members of which are *Onychargia* and *Diargia* and which has developed through *Argia* into the giant *Hyponeura*.

2. The CÆNAGRION-PSEUDOGRION. These have short tibial spines, females without a vulvar spine and have a rounded frons. These start with such genera as *Erythromma* and *Cercion* and end in the large modern genera mentioned above.

3. The ENALLAGMA-ACANTHAGRION series. This series is characterized by short tibial spines, rounded frons, females with a vulvar spine. This splits into two series on the nature of the male appendages.

(a) The *Enallagma* series with forked appendages.

(b) The *Acanthagrion* series with the dorsal appendages slanting downward.

4. The NEHALENNIA-TELEBASIS series. These have short tibial spines, females without vulvar spine, and have an *angulate frons*. This is the series that has been heretofore mixed through the first three series with interminable confusion. The penes are characteristic in many of the species of this series which indicates its validity. This falls into two distinct series.

(a) The CHROMAGRION-NEHALLENIA-TEINOBASIS series with appendages that have a large basal spine.

(b) The CERIAGRION-TELEBASIS-METALEPTOBASIS series in which the appendages do not have a well developed basal spine.

The curious *Argiallagma* of Florida and Cuba has characters of series 1, 3 and 4 and appears to be a very ancient insect.

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#### EXPLANATION OF PLATES I, II AND III.

##### LESTINÆ—

Figs. 1-2. *Megalestes major* Selys. Kooloo, Carleton.

Figs. 3-4. *Archilestis grandis* (Rambur). Tucson, Ariz.

Figs. 5-6. *Lestes disjunctus* Selys. Bluffton, Ind.

Figs. 7-8. *Austrolestes cingulatus* (Burm.) Victoria, Australia.

Fig. 9. *Austrolestes tenuissimus* Tillyard. Cooktown, Australia.

Figs. 10-11. *Chlorolestes conspicua* Selys. (S. Africa).

Figs. 12-13. *Chlorolestes tessallata* (Burm.). (S. Africa).

Figs. 14-15. *Synlestes weyersi* Selys. Victoria, Australia.

## THORINÆ—

- Figs. 16-17. *Thore gigantea* Selys. St. Fe de Bogata, Lindig, 1862.  
 Figs. 18-19. *Miocora* sp. Columbia.  
 Figs. 20-21. *Cora cirripa* Calvert. Carillo, Costa Rica.  
 Figs. 22-23. *Cora marina* Selys. Panima, Guatemala.  
 Figs. 24-25. *Euthore fasciata inlactea* Calvert. Peru.  
 Figs. 26-27. *Chalcopteryx rutilans* (Rambur). Matto Grosso, Brazil.

## EPALLAGINÆ—

- Figs. 28-29. *Epallage fatima* (Charp). Asia Minor.  
 Figs. 30-31. *Bayadera indica* (Selys). Anam.  
 Figs. 32-33. *Dysphæa lugens* Selys. Borneo. (See Figs. 40-41).  
 Figs. 34-35. *Euphæa splendens* Selys. Ceylon.  
 Figs. 36-37. *Anisopleura comes*. Hagen, India.  
 Figs. 38-39. *Philoganga* sp. Sarawak, India.  
 Figs. 40-41. *Dysphæa limbata* Selys. (See Figs. 32-33.)

## AGRIONINÆ—

- Figs. 42-43. *Heterina sanguinea* Selys. (This penis like some species of *Lais*.)  
 Figs. 44-45. *Heterina fuscibasis* Calvert. Chapada, Brazil. (This penis like that of *Lais pudica*).  
 Figs. 46-47. *Vestalis amœna* Selys. Borneo.  
 Figs. 48-49. *Heliogaris amazonica* Selys. Chapada; Brazil.  
 Figs. 50-51. *Cyanogaris valga*. Needham (S. Amer.).  
 Figs. 52-53. *Neogaris cothurnata* Fœrster. Tumatumari, Brit. Guiana.  
 Figs. 54-55. *Phaon iridipennis* (Burm.) Usambara, Africa.  
 Figs. 56-57. *Climacobasis modesta* (Laidlaw). Lower Siam.  
 Figs. 58-59. *Mnais andersoni* McLachlan. Burma.  
 Figs. 60-61. *Psolodesmus dorothea* Willsm. Formosa.  
 Figs. 62-63. *Sapho ciliata* (Fabr.) Togo, Bismarcksburg, Africa.  
 Figs. 64-65. *Umma longistigma* (Selys). Camerun, Africa.  
 Figs. 66-67. *Agrion mingrelica*. Kobaletz, (Caucasus?).  
 Figs. 68-69. *Matrona basilaris* Selys. Shanghai, China.  
 Figs. 70-71. *Neurobasis kaupi* Brauer. Celebes.  
 Figs. 72-73. *Matronoides cyaneipennis* Fœrster.

## LIBELLAGINÆ—

- Figs. 74-75. *Libellago caligata* Selys. Natal.  
 Figs. 76-77. *Rhinocypha angusta* Selys. Sumatra.  
 Figs. 78-79. *Rhinocypha eximia* Selys. Celebes.  
 Figs. 80-81. *Micromerus stigmatizans* Selys. Mt. Ophir. (Malacca?).

## AMPHIPTERYGINÆ—

- Figs. 82-83. *Devadatta argyroides* (Selys). Sarawak.  
 Figs. 84-85. *Diphlebia lestoides* (Selys). Lilyvale. N. S. W., Australia.  
 Figs. 86-87. *Amphipteryx agrioides* Selys. S. Geronimo, Guatemala.  
 Figs. 88-89. *Hypolestes (Ortholestes) clara* Calvert. Kingstown, Jamaica.  
 Fig. 90. *Hypolestes (Ortholestes) abbotti* Calvert. Santiago, Cuba.

## MEGAPODAGRIONINÆ—

- Figs. 91-92. *Thaumatoneura inopinata* McLachlan. Costa Rice.  
 Figs. 93-94. *Paraphlebia quinta* Calvert. Guatemala.  
 Figs. 95-96. *Rhipidolestes aculeata* Ris. Formosa.  
 Figs. 97-98. *Argiolestes grisea* Selys. Australia.  
 Figs. 99-100. *Argiolestes icteromelas* Selys. Queensland, Australia.  
 Figs. 101-102. *Argiolestes alpinus* Tilly. Australia.  
 Figs. 103-104. *Wahnesia montivagans* Fœrster. Sattelberg.  
 Figs. 105-106. *Podopteryx roseonotata* Selys. Aru Islands.  
 Figs. 107-108. *Neurolestes trinervis* Selys. (Camerouns).  
 Figs. 109-110. *Nesolestes alboterminata*, Victoria, Australia.  
 Figs. 111-112. *Podolestes orientalis* Selys. Borneo.  
 Figs. 113-114. *Philogenia terraba* Calvert. Costa Rica.  
 Figs. 115-116. *Megapodagrion mercenarium* (Hagen). St. Fe de Bogata.  
 Figs. 117-118. *Allopodagrion contortum* (Selys) Brazil.  
 Figs. 119-120. *Dimeragrion percubitale* Calvert. Brit. Guiana.  
 Figs. 121-122. *Rhinagrion macrocephala* (Selys). Labauan.  
 Figs. 123-124. *Heteragrion flavidorsum* Calvert. Bolivia.





