

**Article V.—FOSSIL DRAGONFLIES FROM FLORISSANT,
COLORADO.**

BY T. D. A. COCKERELL.

***Lithæschna* gen. nov. (Æschnidæ.)**

Type *L. needhami*, sp. nov. (Fig. 1.) Florissant, Station 14 (W. P. Cockerell, July 7, 1906). A genus of apparently primitive Æschnidæ, partaking of the characters of the Gomphinæ and that group of Æschminæ in

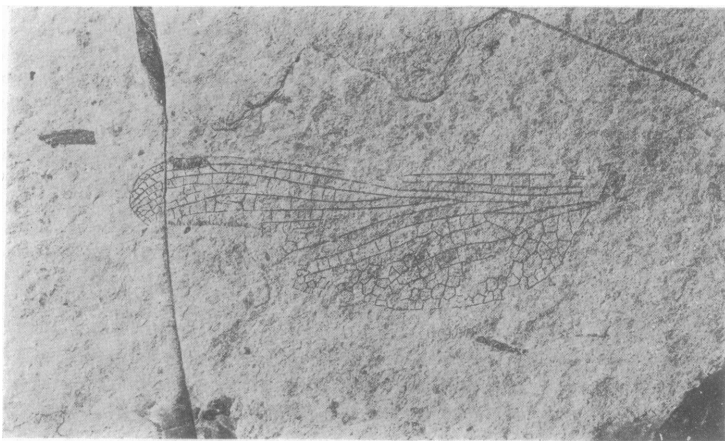


Fig. 1. *Lithæschna needhami* sp. nov. About twice natural size. Veins inked in photograph.

which the radial sector is unbranched. I am greatly indebted to Dr. J. G. Needham for placing in my hands a number of his unpublished figures and notes, and for helpful suggestions, all of which have enabled me to determine the relationships of the fossil far more exactly than would otherwise have been possible.

The following table shows how *Lithæschna* may be separated from a number of genera of Æschmines in which the radial sector is unbranched. It is based exclusively on the hind wings.

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| Oblique vein separated from origin of M_2 by several cells ¹ | 1. |
| Oblique vein separated from origin of M_2 , if at all, by not more than α cell and a half | 2. |

¹ This is also a character of *Phyllopetalia* (Chilian region), and in a less degree of *Cordulegaster* and *Chlorogomphus*.

1. M_2 strongly bent, separated at the bend from Rs by 3 or 4 rows of cells; triangle with few cells (Solenhofen, Bavaria; Jurassic) *Morbæschna*.¹
 M_2 moderately bent, not thus separated from Rs; triangle with many cells (Jurassic; Bavaria) *Cymatophlebia*.
2. Stigma elongated, its lower margin bounding $4\frac{1}{2}$ cells; anal loop rather large, with 7 or 8 cells 3.
 Stigma shorter, bounding less than 3 cells below 4.
3. Anal region more developed with 4 rows of cells between the anal loop and the inner margin: basal space reticulate *Boyeria irene*, Fonsc.
 Anal region less developed, with 3 rows of cells between the anal loop and the inner margin: basal space free from crossveins *Basiæschna janata* Say.
4. Anal loop large, with 10 cells *Hoploneschna armata* Hagen.
 Anal loop with not over 5 cells 5.
5. Opposite the brace, M_2 nearer to M_1 than to Rs 6.
 Opposite the brace, M_2 nearer to Rs than to M_1 7.
6. Anal loop of 3 cells; triangle of 3 cells; oblique vein separated from origin of M_2 by $1\frac{1}{2}$ cells (Borneo) *Dolæschna*.
 Anal loop of 4 cells; triangle of 2 cells; oblique vein separated from origin of M_2 by one cell *Gomphæschna furcillata* Say.
7. Anal loop of 5 cells; triangle of 3 cells; oblique vein arising at origin of M_2 *Lithæschna needhami* Ckll. (n. g., n. sp.).

Although the radial sector (Rs) in these forms is unbranched, there is an oblique cross-vein below Rs, which seems to indicate the beginning of a branch, especially in *Boyeria*. This oblique vein is below the sixth cell from origin of M_2 , and fifth from the oblique vein properly so-called in *Gomphæschna*; below the sixth cell from origin of M_2 and seventh from the oblique vein in *Boyeria*; below the seventh cell from origin of M_2 and second from the oblique vein in *Morbæschna*; below the seventh and fifth from the oblique in *Dolæschna*; below the seventh and sixth from the oblique in *Basiæschna*. In his diagrams, Dr. Needham designates the oblique vein proper by O; the oblique vein below the Rs may be called O_2 . I cannot distinctly determine the existence of O_2 in *Lithæschna*.

In order to further elucidate the characters of *Lithæschna needhami*, it is necessary to discuss them one by one, in comparison with the allied genera.

Anal angle.

Little developed in *Lithæschna*, thus approaching *Basiæschna* and differing from *Boyeria*.

Rows of cells between first part of Cu_2 and lower margin of wing.

Three in *Gomphæschna*.

Four in *Basiæschna* and *Lithæschna*.

Four to five in *Boyeria*.

Six in *Cymatophlebia*.

Six to seven in *Morbæschna*.

¹ Described by Dr. Needham on p. 141, *post*.

Triangle.

In *Lithæschna* practically as in *Basiaschna*, with two cross-nervures. It is not so elongated as in *Boyeria*.

Anal loop.

With 3 cells in *Dolæschna*, as also in *Gomphoides stigmatus* Say.

With 4 cells in *Morbæschna*, as also in *Gomphæschna*.

With 5 cells in *Lithæschna*.

With 6 cells in *Æschna polydore* Heer (fossil at Æningen), and, as Dr. Needham remarks, shaped much as in *Lithæschna*.

With 7 cells in *Basiaschna*, and not very different from *Lithæschna* in form.

With 8 cells in *Boyeria*.

Cubitus (Cu₁ and Cu₂).

In *Lithæschna* Cu₂ is moderately bent at base, much as in *Gomphus*,— not so strongly bent as in *Gomphæschna*. It then runs parallel with Cu₁, for at least 7 cells, when it branches, enclosing 5 or 6 cells, the upper branch being arched, and so approaching nearer to Cu₁. This is not unlike *Morbæschna*, *Boyeria*, *Basiaschna* and *Gomphæschna*, but differs entirely from *Gomphus*.

Antenodal sectors.

Eight in *Gomphæschna*.

Eleven in *Lithæschna*, or possibly 12.

Twelve in *Hoplonæschna*.

Thirteen in *Basiaschna*.

Fifteen in *Boyeria*.

Oblique vein.

- 1. Arising at same point as origin of M₂ from M₁ *Lithæschna*.
- 2. Forming the apical margin of cell from about the middle of which M₂ arises from M₁ *Hoplonæschna*.
- 3. Forming the apical margin of the cell, the base of which is even, or nearly even, with the origin of M₂ from M₁ . . . *Boyeria*, *Gomphæschna*, and *Basiaschna*.
- 4. Arising several cells beyond the origin of M₂ from M₁ *Morbæschna*.

Stigma.

Stigma not especially slender.

Bounding 1½ cells below *Gomphæschna*.

Bounding 2½ cells below . . . *Lithæschna*, *Hoplonæschna* and *Morbæschna*.

Stigma slender, bounding 4½ cells below *Basiaschna* and *Boyeria*.

In *Lithæschna* the stigma is slightly swollen, rather over 2½ times as long as broad, and is much like that of *Morbæschna*, except that it is longer in the latter. The brace is essentially the same in all these genera.

Radial sector.

Strictly unbranched in *Lithæschna*; it is separated from M₂ by a single row of cells, except at the place where they are widest apart (at bend of M₂). where there are 3 or 4 double cells. In *Gomphæschna* the double cells begin at about the same point, but continue to margin.

*M*₂ and Radial sector.

At the point of greatest distance between *M*₂ and *Rs*, there are —

- a. Two rows of cells between: *Lithæschna* and *Gomphæschna*.
- b. Three rows of cells between: *Basiæschna*, *Boyeria* and *Hoplonæschna*.
- c. Four rows of cells between: *Morbæschna*.

The number or single-row or simple cells beyond the oblique vein, before the doubling begins, is —

- Four in *Morbæschna*.
 Seven in *Gomphæschna*.
 Eight in *Lithæschna*.
 Nine in *Hoplonæschna*.
 Eleven in *Boyeria* and *Basiæschna*.

*M*₂.

1. Gently curved, a little nearer to *Rs* than to *M*₁, opposite brace (a Gomphine character) *Lithæschna*.
 2. Gently curved, about equally distant from *Rs* and *M*₁, opposite brace.
Gomphæschna.
 3. More abruptly curved, and nearer to *M*₁ . . . *Boyeria* and *Hoplonæschna*.
 4. Still more abruptly curved or bent, and much nearer to *M*₁ . . . *Morbæschna*.
- Gomphæschna* has three rows of cells between *M*₁ and *M*₂ in apical field of wing, except on extreme margin, where there are five. *Lithæschna* has four rows, but an extra row of two cells only at apical margin.

Basiæschna has five rows, but six on extreme margin. *Boyeria* has seven rows but nine on extreme margin. *Hoplonæschna* has about seven on extreme margin, but fewer in submarginal area, though at least five.

*M*₃ and *M*₄.

1. Distal part of *M*₃ and *M*₄ strongly undulate *Morbæschna*.
2. Distal part of *M*₃ and *M*₄ slightly undulate *Gomphæschna*.
3. Distal part of *M*₃ and *M*₄ not or hardly undulate
Lithæschna, *Boyeria* and *Basiæschna*.

In *Lithæschna* *M*₃ and *M*₄ are separated by only a single row of cells, at least to near margin (actual margin at this point obliterated); this agrees with *Gomphæschna*, and differs from *Boyeria*, etc.

It appears from all the above, that as long as we confine our attention to the basal field of the wing of *Lithæschna*, we find much resemblance to *Basiæschna*; but in the apical field this disappears, and the resemblance is rather to *Gomphæschna*, while certain characters are decidedly Gomphine. We are at liberty to infer, perhaps, that the apical field in *Basiæschna* has undergone change, while the basal field has remained comparatively stationary.

Lithæschna needhami is represented by a single hind wing, about 33 mm. long. The species is appropriately dedicated to the author whose writings and investigations have made this study possible. The wing is hyaline, without markings.

Lithagrion Scudder. (Agrionidæ.)**Lithagrion hyalinum Scudder.**

(Fig. 2).

At Station 14 a good specimen was found, with its reverse. The stigma has a brace vein (this fact is not apparent from Scudder's figure), the quadrangle is not divided by any cross-veins, and vein M_3 arises nearer nodus than arculus. Scudder's specimen did not show the whole of the stigma; it is perfect in ours, 3 mm. long, bounding $3\frac{1}{2}$ cells below. Its inner corner is not produced and pointed, as it is in *Heteragrion* and *Amphi-*

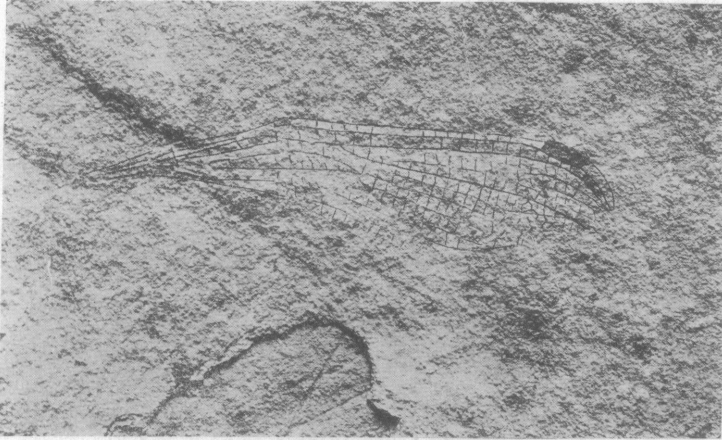


Fig. 2. *Lithagrion hyalinum* Scudder. $2\frac{1}{2}$ times natural size. Veins inked in photograph.

pteryx. In *Epallage* the stigma also bounds between three and four cells, but it is very long, and one of the bounding cells is very long, while there is no brace-vein. In *Archilestes* there is a brace, and the stigma with its subtending cells is very much like that of *Lithagrion*. The stigma of the fossil also recalls that of *Ortholestes*, but in that genus there is no distinct brace, or at least the oblique vein serving that purpose arises beyond the basal corner of the stigma. Scudder figures only one antenodal cross-vein in *Lithagrion hyalinum*. In our example, the antenodals are mainly obliterated, but I feel quite confident that there are at least three. This is, no doubt, a primitive character, and the whole appearance suggests very strongly the Calopterygine genus *Micromerus*.

The subquadrangle of *Lithagrion hyalinum* is strongly bent at the arculus, and veins M_{1-3} and M_4 arise from the upper part of the arculus, — more

so than Scudder's figure shows, both being well above the middle of the arculus.

Lithagrion umbratum Scudder, with its smoky wings, the stigma bounding five cells below, and the cells of the first two rows between nodus and stigma higher than long, appears to represent a distinct genus, which may be called *Melanagrion*, gen. nov.

Melanagrion umbratum also has this peculiarity, that the arculus is bent, and M_4 arises from it at the bend, which is *below* the middle, and away from the origin of M_{1-3} . This is an arrangement like that found in *Epallage*; whereas *Lithagrion hyalinum* has the arculus and arising M veins almost as in *Ortholestes*. The quadrangle of *Lithagrion hyalinum* is somewhat longer, especially on the upper side, than Scudder's figure would suggest.

***Hesperagrion prævolsans* sp. nov.**

(Fig. 3.)

Station 14.— Type in Amer. Mus. Nat. Hist.; reverse at University of

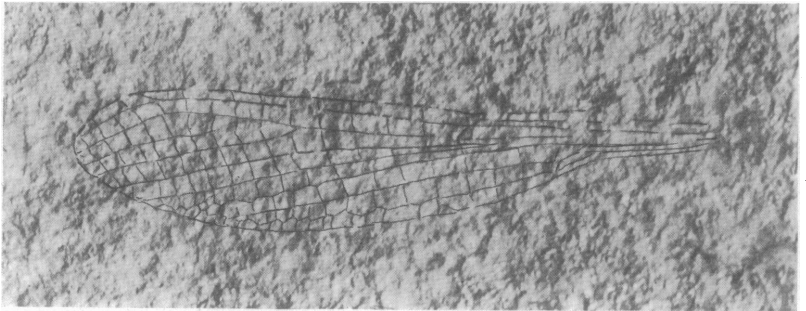


Fig. 3. *Hesperagrion prævolsans* sp. nov. $3\frac{1}{2}$ times natural size. Veins inked in photograph.

Colorado. Represented by a single perfectly hyaline wing, $21\frac{1}{2}$ mm. long. Veins brown: stigma hyaline with a dark margin.

The venation agrees with that of *H. heterodoxum* Selys, as figured by Needham (Proc. U. S. Natl. Mus., XXVI, pl. liv, f. 5), except in the following slight particulars —

1. The stigma is more oblique, and longer in a diagonal direction, so that it is truly lanceolate.
2. The costal cell following the stigma is much longer than high.
3. The oblique apical side of the quadrangle is not noticeably shorter than the upper side.
4. The antenodal portion of the costa is visibly arched.

5. The cells between the nodus and the stigma, on costal margin, number eleven.

I was at first inclined to refer the wing to *Agrion exsularis* Scudd., but it differs as follows:—

1. The stigma is differently shaped, being more produced diagonally.
2. The upper side of the quadrangle is much longer; the quadrangle (as also the stigma) of *exsularis* is like that of *Enallagma*.
3. There are only three simple cells between M_1 and M_2 before the doubling begins; in *A. exsularis* there are four.

Trichocnemis aliena Scudd. agrees better with *H. prævols* in regard to the quadrangle, but the other characters are as in *A. exsularis*. The subquadrangle is represented as having a cross-vein, which certainly is not present in *H. prævols*. If *T. aliena* and *A. exsularis* had not been described by the same author, I should suspect their identity.

Hesperagrion is a genus still extant in our southwest.

