1830. ANNIVERSARY MEMOIRS OF THE BOSTON SOCIETY OF NATURAL HISTORY. 1880.

THE DEVONIAN INSECTS OF NEW BRUNSWICK.

BY SAMUEL H. SCUDDER.

BOSTON:
PUBLISHED BY THE SOCIETY.
1880.

The Devonian Insects of New Brusnwick.

By Samuel H. Scudder.

CONTENTS.

I. Introduction.

INVESTIGATION of fossil remains of the oldest insects is nearly always extremely difficult and perplexing, and often very unsatisfactory in its results. The interest, however, necessarily attaching to the beginnings of life, warrants any labor that may be expended upon them. Especially is this true of the fragments treated of in this paper, because they are as yet the only insect remains which have been found in rocks older than the carboniferous formation in any part of the world. The writer may be pardoned for adding that they possess a special attraction for him, as among the specimens which first directed his particular attention to fossil insects, and he only regrets that so long a period as fifteen years should have elapsed before their full discussion.

The remains consist entirely of broken wings, and were discovered in 1862, by the late Professor C. F. Hartt (at the time of his death director of the geological survey of Brazil), while searching for plant remains in the devonian shales near St. John, New Brunswick. The locality — called Fern Ledges by Mr. Hartt, from the abundance of plant remains which occur in the black shales that are interstratified with the prevailing sandstones — is about a mile west of the town of Carleton, not far from St. John. The rocks form a series of ledges, exposed on the sea-shore between high and low water marks. The beds of sandstone and shale, of which they are composed, have a seaward dip of about 45°, and a strike of about W. 10° N., corresponding very nearly to the trend of the shore. The fossiliferous shales between the enclosing sandstones are worn away by the action of the water, leaving the fossils accessible in only a few places. The whole deposit is of very limited extent; it reaches along the shore for about three hundred and twenty-five paces, exposing a thickness of strata of about forty-five meters, with a width of about ninety meters.

The specimens discovered were six in number, some of them with their reverses. They are now in the museums of the natural history societies of St. John, N. B. and Boston, Mass. I am much indebted to Mr. G. F. Matthew, of the former institution, and to Professor A. Hyatt of the latter, for the opportunity of studying these specimens anew at my leisure.

The plan of the present paper will be seen by a glance at the table above. As the simpler devonian insects, first described, have certain special relations with the Ephemeridae, their description is preceded by an account of the wing structure of the modern May-flies, as a basis of comparison; each of the devonian species is then separately described, and its affinities discussed, and the whole is followed by a general summary. The stratigraphical question being, in this instance, of special importance, Principal Dawson has kindly prepared for me a statement of the case with which the article closes.[1]

II. The Structure of the wings in Ephemeridae; with a note on a jurassic species.

The following statement considers mainly the direction and division of each of the principal veins, and the comparative areas covered by them.

The marginal vein forms the costal border. The mediastinal vein is absent or, perhaps, amalgamated with the scapular in Lachlania, Oligoneuria and Tricorythus; in all others it is simple, and extends to, or almost to, the tip of the wing, keeping at a very short and nearly uniform distance from the margin, with which it is generally connected, especially on the apical half of the wing, by frequent cross veins. On the basal half, the cross veins may be as abundant as apically, but they are generally rarer, and may be entirely absent, even when frequent apically; or they may be absent throughout. In very rare instances, as in Coloburus, an intercalary vein may be found in the apical half of the wing between this vein and the costal margin.

The scapular vein is simple, and reaches the tip of the wing, excepting in the three genera mentioned above, where it may perhaps be said to be amalgamated with the mediastinal, as shown by its forking near the middle of the wing in Tricorythus; in Lachlania, however, it terminates not at the tip, which possesses only the marginal vein, but near the middle of the costal border. It is always connected with the vein below by a greater or less number of, usually many, cross veins.

The externomedian vein is always compound, and always covers at least half, usually much the greater part of the wing. It always divides at the very base, and the upper branch is always forked, while the lower may, although rarely, remain single, and is usually forked to a less extent than the upper branch. Three is, therefore, the smallest number of nervules which may reach the margin in the area covered by

[1] Besides the references given in the bibliography under each species, notices of the devonian insects will be found in the following places: Hartt, on the Devonian plant-locality of the Fern Ledges, Lancaster, N. B., in Bailey's Observations on the Geology of Southern New Brunswick, pp. 131–40. 8vo., Fredericton, 1865; reprinted in substance, in Dawson's Acadian Geology, 2d ed., pp. 513–23. 8vo. London, 1868. Darwin, Descent of man, I, 360. 12mo., London, 1871. Stett. Ent. Zeit., XXVIII, 145–53, *passim*. Trans. Entom. Soc. Lond., 1871, 38–40. American Naturalist I, 445, 625–26. Proc. Boston Soc. Nat. Hist., X, 96, XI, 150–51. Memoirs Boston Soc. Nat. Hist. III, 13–21, *passim*.

the vein, and this number we find in Oligoneuria and, perhaps, in Lachlania. The portion of the area of this vein covered by the upper branch and its forks is almost always greater, generally considerably greater, than that covered by the lower branch; an exception to this will be found in Polymitarcys where the lower area is greater, owing to unusual breadth of wing combined with narrowness of the area covered by the intermedian vein, which has been crowded out of much of its natural ground by this lower branch. Some of the allies of Polymitarcys, especially Asthenopus and Pentagenia, also have this area of the lower branch larger than usual, although not larger than that of the upper branch, and some other genera not placed near it exhibit a similar propensity; but as a general thing, the area covered by the lower is scarcely more than half as large as that covered by the upper branch, and not infrequently it is less than one third its extent. The upper branch usually forks close to the base, occasionally at the very base, and sometimes the upper of the forks is amalgamated at the base with the scapular vein, as in Asthenopus, Tricorythus and Chloeon, and to a certain extent in Coenis, so as to give it the appearance of originating from that vein, and of complete independence of the externomedian; whether thus severed from its connections, or plainly arising from the externomedian root, this upper fork of the upper branch runs in proximity to the scapular vein, parallel or subparallel to it, and, excepting where the venation is occasionally simple (as in Oligoneuria, &c.), always emits from its lower surface in the central portion of the wing one, two, or three nervules; the first and second of these nervules are usually pretty near together at base, but all generally reach the border at unequal distances apart, the inequality being made good by intercalary longitudinal nervules; these intercalary nervules often curve at their inner extremities toward or to one or another of the adjoining nervules, assuming then the appearance of regular branches, while the nervules proper are themselves oftener detached from their base; so that it is sometimes difficult to tell whether a given vein should be considered normal or intercalary. The lower fork of the upper branch is occasionally simple, as in the Tricorythus, but usually forks once at about the middle of its course, rarely near the base, and very frequently encloses an intercalary nervule between these branches, but no intercalary nervules (excepting such as often break up the extreme margin into an irregular meshwork of veins) ever intervene between the upper nervule of this fork and the lower nervule of the upper fork, nor between its lower nervule and the upper nervule of the lower branch of the externomedian vein, excepting in the rare instances where this lower nervule is detached from its base, and takes on the form of an intercalary nervule.

This lower branch, as has been said, is usually forked to a less extent than the upper branch, but a conspicuous exception is found in Polymitarcys where the branch is made up of a large number of sub-convergent simple rays, directed from the outer margin toward various parts of the upper internomedian nervule, but generally lost before reaching it. In general, however, its area is only about half that of the upper branch; it usually forks close to the base, and each or either of its branches may again subdivide once; all other nervules in the area are sure to be intercalary; where it forks only once there is usually a single intercalary nervure midway between the branches, which seems to belong to one or the other of them and to represent its fork; while between it and either branch there

may be other shorter intercalaries; the only exception to this general statement is the case of Polymitarcys already cited, where after division at the base the upper fork must be looked upon as breaking up at once into three rays, while the lower severed from its connections breaks up similarly into a couple of forked rays; the amount of abnormal divergence in this case may be better seen, by stating that it is the only genus of Ephemeridæ in which this area is carried around the lower outer angle of the wing; in all others it stops short of, usually far short of this angle; here it reaches around it half way along the anal margin. The genus agrees, however, with all the others in that all the branching occurs in the basal half of the area. In Oligoneuria and Lachlania the branch is simple and undivided, unless the apparent branch in the latter should be looked upon as such, and not as a cross nervure, like the more directly transverse veins above it.

The area of the internomedian vein is never great, although always more extensive than that of any other vein but the externomedian, and it always includes the lower outer angle of the wing, excepting as above specified in Polymitarcys, and excepting also in the full-angled Tricorythus, where the anal area disputes its sway. Its construction is generally similar to that of the lower branch of the extermomedian vein, although from the form of the area covered by it, its absolute appearance is very different; moreover, one rarely finds in it any intercalary nervures, excepting such as sometimes line the extreme border, the smaller nervures almost always originating from the main stems; the exceptions are found in Leptophlebia, Cloeon, and Baetis. The vein almost invariably forks at its extreme base, and from the upper of these branches sends either, rarely, a single shoot, or, much more frequently, a half a dozen, occasionally a dozen simple or forked shoots to the margin. In the interesting fossil described in the note at the end of this section these shoots appear to originate from the lower branch, the upper remaining simple, just as rarely occurs in living forms as *e. g.*, in some species of Leptophlebia.

The anal vein invariably plays an insignificant part, and is apparently sometimes wanting. Its area seldom reaches even half way along the anal margin, but in Tricorythus it extends even around the lower outer angle, fairly upon the outer margin. Here it is composed of a single vein with three or four short but widely divergent branches; usually it is forked at the base, and occasionally one or the other of these forks imitates the rayed branch of the internomedian by sending a number of parallel branches, often closely crowded, to the margin.

This account of the neuration of the Ephemeridae is based upon much more extended material, and a longer study than that formerly given by me in my first quarto paper on fossil neuroptera, and corrects it in several important particulars, especially in the account of the internomedian vein, which was eroneously stated to be simple[1] and in the fuller statement of the divisions of the externomedian vein.

Note on a Jurassic May-fly.

Hexagenites Weyenberghii, gen. et sp. nov.:—A fragment of a wing only is preserved, in which the entire costal area and base are wanting. The neuration of the parts that remain

[1] This statement was evidently the result of some oversight, since in the digest given on a subsequent page of the same memoir it was remarked that the internomedian vein was "similar in character to the *vena externomedia*."

is perfect and indicate an insect whose alar expanse was nearly 45 mm., and which is most nearly related to Hexagenia; the first inferior nervule of the upper fork of the upper branch of the externomedian vein is thrown off some way before the middle of the wing; the lower branch forks at some distance beyond the middle of its course, and encloses between its branches a single intercalary nervule which extends nearly to the widely spreading fork. At a short distance from the base of the wing the lower branch of the externomedian vein has divided into three branches, the middle one nearer the upper than the lower, all of which continue undivided to the margin; two intercalary nervures of unequal length occur in each of these interspaces, extending almost half way to the base in the lower interspace, besides many short ones near the margin; the lowest of these branches is considerably curved and subparallel to the inner margin. The internomedian vein probably divides at the very base into two branches, the upper of which is simple, runs subparallel to the lowest externomedian nervule, striking the angle of the wing, while the other branch is in close proximity to it and throws off a large number of sinuous simple branches to the anal margin, in doing which its outer half follows an irregular course by a slight change of direction with each emission. The cross-veins are moderately frequent and subuniform throughout the portion of the wing which is preserved excepting in the internomedian area, and the border is much broken by intercalary nervules into cells which are quadrate and generally much longer than broad. The anal area must be very contracted and the form of the wing closely resembles that of Hexagenia.

The specimen is from Solenhofen, and is in the British Museum. The description is drawn up from a very clear sketch magnified 7 diameters, taken with the camera and published by Rev. Mr. Eaton in the Transactions of the Entomological Society of London, 1871. Pl. 1, fig. 10. The species is dedicated to my friend Dr. Weyenbergh, of Cordoba, who has done so much in increasing our knowledge of the Jurassic insect fauna of Bavaria.

III. Platephemera antiqua. Pl. 1, figs. 5, 9, 10.

Platephemera antiqua Scudd., Can. nat., (n. s.) iii, 205, fig. 2 (1867);—Ib., Geol. mag., iv, 387, pl. 17, fig. 2 (1867); — Ib., Dawson, Acad. Geol., 2d ed., 524, fig. 181 (1868); — Ib., Amer. nat., i, 630, pl. 16, fig. 3 (1868); — Ib., Geol. mag., v, 173, 175–76 (1868); — Pack., Guide ins., 77–78, pl. 1, fig. 3 (1869); — Nichols., Man. pal., 185, fig. 128 (1872); — Ib., Anc. life hist. earth, 145, fig. 89 (1877); — Dana, Man. geol., 2d ed., 273, fig. 550 A (1874); — Roem., Leth. geogn., pl. 31, fig. 9 (1876).

Mentioned without name, as the first species, in my letter to Mr. Hartt on the Devonian Insects of New Brunswick (1865); — Bailey, Obs. geol. south. New Brunsw., 140 (1865); — Amer. journ. sc., (2) xxxix, 357 (1865); — Can. nat., (n. s.) ii, 23 (1865); — Trans. entom. soc. Lond., (3) ii, 117 (1865). See also Amer. journ. sc., (2) xl, 277 (1865).

The wing was ample (whence the generic name) and gigantic. Probably a third of the wing is wanting at the base, besides the greater part of the extreme outer edge, but the fragment preserved enables us to judge, probably with considerable accuracy, both the general structure and, by the direction of the nervules and of the margins, the general

form of the wing, which is presumed to be much as outlined on the plate. The wing was probably more than 60 mm. in length, and about 27 mm. in breadth; the alar expanse was therefore at least 125 mm., and probably 135 mm., and the two figures have been so placed as to indicate this expanse.

This is more than double the ordinary size of the larger Ephemeridae and the largest mentioned in Eaton's paper on these insects has an expanse of only 78 mm., and the largest of the jurassic species only 65 mm.

The costal margin is very gently arcuate; the apex probably somewhat pointed, toward which the upper veins are directed without additional arcuation; the greatest breadth was probably a little before the middle of the wing, and the outer perhaps half as long again as the anal margin. The marginal vein runs close to but does not form the margin of the wing, the latter being indicated in the figures on the plate by a dotted line.

The mediastinal vein runs as close as possible to the margin, and is not connected with it by cross veins; these two veins apparently run side by side to the apex, when the marginal disappears and the mediastinal takes its place close to the border. The scapular vein runs sub-parallel to the mediastinal, but at double the distance from it apically as basally, the change occurring rather abruptly near the middle of the preserved portion of the wing; it is connected with the vein above by straight cross-veins at tolerably regular, rather frequent intervals.

As usual in this family, the externomedian vein is apparently divided, probably not far from, or at the base, into two stems, and the upper of these stems is again divided, probably at some distance from the base, into two principal branches; the main portion of the upper branch runs parallel to, but somewhat distant from the scapular vein, approaching it, however, apically, and is everywhere connected with it by cross-veins, very much as in the mediastino-scapular interspace; it throws off from its inferior surface several inequidistant feeble offshoots; the first originate a little before the middle of the wing, and run irregularly but with a gentle downward curve to the outer margin; they have between them and between the outermost and the main branch a number of equally irregular intercalary nervules, all of which are connected together by cross-veins, and thus form over the whole area a mesh work of irregular but usually hexagonal and longitudinally elongated cells, making it impossible to distinguish between normal and intercalary veins, since the latter are as prominent as the former, and invariably arise from cross-veins; while whatever nervules lie next the main branch are united with it by frequent and, equally irregular cross-veins falling from the main branch quite in the manner of the offshoots proper, and forming cells only slightly larger than the others, although generally transversely elongated; together there are about nine rows of cells between the main upper branch and its first offshoot. The lower branch of the upper stem is simple and, originating apparently near the middle of the basal half of the wing, diverges at first slightly from the upper branch, afterwards a little more rapidly, and in its apical fourth curves downward considerably, and is somewhat irregular in its course; its direction is in general parallel to the offshoots, and especially the nearer offshoots of the upper branch, and on the border it is separated from the apex of the upper branch by nearly one-third of the outer margin of the wing; in its simplicity this branch resembles the same nervure in Tricorythus, which is peculiar in this particular among modern Ephemeridae. As in

modern Ephemeridæ generally, there is no intercalary nervule between this lower branch of the upper externomedian stem and the first offshoot of the lower branch, but this interspace is filled with simple and frequent cross veins.

The lower externomedian stem is apparently formed on the same plan as the upper, a feature which appears to have no counterpart among living Ephemeridae; apparently it is composed, like the upper, of two primary branches, which seem to part from each other very nearly at the same considerable distance from the base, (about one-third the distance to the margin), a feature uncommon but not unknown in living Ephemeridae; but instead of having a single independent intercalary or two between the forks, it has several offshoots which depend from the upper branch, just as the offshoots of the upper branch of the upper stem do, while between them in the outer half of their course other intercalaries arise, depending from angular cross veins — the whole united by frequent cross veins (again as in the upper area), to form a mesh-work of irregular cells generally pentagonal, although not often longitudinal; there are thus included between these forks about six rows of cells. The interspaces directly adjoining either side of the lower branch of the upper externomedian stem are slightly wider than the interspaces between the nervules in the area of the lower externomedian stem, possess no intercalaries, and are divided by frequent cross veins. The lower branch of the lower externomedian stem also curves downward at the tip, like the lower branch of the upper stem; the area of the lower externomedian stem repeats, therefore, and on only a little smaller scale, the structure of the area of the upper stem, instead of exhibiting, as in recent forms, distinctive features.

That portion of the fragment of the wing lying below what we have here considered the lower simple branch of the lower externomedian stem, and which is shown in fig. 10 and not in fig. 9, is so fragmentary and so separated from its basal connections that it is difficult to decide to what area of the wing it belongs; it consists of four rows of cells separated by curving nervules a little more uniform in their course than the minor nervules above, with slightly less frequent cross veins; the cells being slightly larger and more regular, frequently quadrangular and usually longitudinal; this field belongs of course either to the externomedian or the internomedian area. The general similarity of the structure of the fields would lead one at first to suppose it to belong to the externomedian area, in which case of course our description of the lower stem and its branches should be modified to receive it. As, too, the form of the fragment would indicate that a very considerable part of the region about the anal angle is lost, the reference of this field to the internomedian area would give that area a very great and very unusual preponderance in the wing. But its reference to the externomedian area, which is certainly possible, would involve quite as great an anomaly; for in that case the lower externomedian stem must be supposed to consist of two branches, the lower lying beyond the present fragment and probably simple, the upper forked and reproducing on a smaller scale the whole of the upper externomedian stem, including the minor offshoots depending from the uppermost branch of each. In this case the area of the lower stem would exceed that of the upper, which occurs in very rare instances in modern Ephemeridae and then only by crowding out of room the lower areas, which the probable wide expanse of this wing would not allow unless this lower area is of an exceedingly disproportionate size. The translation of the facts which I have offered in my description, on the other hand, while it

requires a very unusual development of the internomedian area, leaves the lower externomedian field in its usual proportionate extent as compared to the upper field, and is further supported by several considerations: chiefly by the probability that where repetitions of structure are found — a mark of simplicity much more common among ancient than among recent insects — they are far more apt to occur between repetitive parts than between those which may not be so exactly compared. On the hypothesis sustained above, this repetition occurs in the fields embraced between the two similarly disposed sets of branches into which one vein is divided. On the other suggested (and apparently the only alternative, for the open interspaces on either side of the lower branch of the upper externomedian stem seem to fix that nervule unquestionably) the repetition would be between the whole of one set of branches of this vein, and one portion only of the two of which the other set of that vein is composed. Other arguments may be advanced from the character both of the nervules and of the cells formed by them and the cross veins, which differ slightly from those in the field next above, a difference greater both in extent and in nature than that existing between what we have considered the upper and the lower externomedian fields. Further than this, the slight change of direction in the course of the outer margin, resulting in a slight emargination of this border of the wing, although apparently not found at all in living Ephemeridae, would be far more likely to occur, does far more frequently occur in other insects, between two adjoining areas than in the middle or other part of one.

Considering then the field under discussion as belonging to the internomedian area, we must describe this as plainly of very unusual extent, and as filled as it never is in living types with a large number of intercalary nervules.

It may be remarked that none of the many intercalaries in this wing arise independently, and that they are not more abundant at the extreme outer edge of the wing, as is frequently the case in modern types. The former feature is the more noteworthy, as the independent origin of the intercalary veins in Ephemeridae would naturally be taken as a mark of inferior organization; and yet it does not occur in this oldest member of the group, nor yet in the jurassic species from Solenhofen, described on a previous page; in this last, however, the edge of the wing is more broken by intercalaries than the parts removed from it.

The length of the fragment preserved is 42 mm. and its greatest breadth, 25.5 mm.

The points in which this insect presents the most striking differences from modern types, and upon which we would establish the genus Platephemera, are: the very similar instead of distinctive structure of the framework of the two sets of branches of the externomedian vein, and of the respective areas included between them; the excessive number of the intercalaries in the area included between the lower set of externomedian branches, and their attachment (in the apical half of the wing) to the upper of these branches — from which the previously mentioned peculiar feature mainly depends; the simplicity of the lower branch of the upper externomedian stem in an unusually ramose wing; the unusual extent of the internomedian area and its rich supply of intercalaries; the density and polygonal form of the cells formed by the cross veins below the upper externomedian vein; the emargination of the outer border; and finally the vast dimensions of the wing.

If we look to other early types for species akin to this we shall find a whole group of carboniferous insects with reticulated wings, to which this is evidently related. To this belong those forms to which the generic names Dictyoneura and Breyeria have been given in the old world, and Paolia and Haplophlebium in the new. Several new forms, as yet unpublished, are known to me from the American carboniferous rocks. In all these genera, but especially in Dictyoneura and Haplophlebium (which perhaps should not be separated from each other), the wing is very much larger and slenderer (like a dragon-fly's wing) than the fragment of this devonian wing will allow us to suppose it to be. As in these wings, the mediastinal vein is present, and usually runs into the marginal at some distance from the tip of the wing, and the general relation of the principal veins is similar in all; in none of the others, however, do we find so distinct a meshwork of subordinate veins, nor can they be resolved as here into sets depending from the two principal branches of the externomedian vein. So that while a general similarity of structure may be conceded, there is no occasion for considering the insects as closely affiliated.

The distinction between Platephemera and Gerephemera will be pointed out in treating of the latter insect.

This insect comes from plant-bed No. 7 of Professor Hartt, and was the only insect found at that horizon.

In his "Monograph on the Ephemeridae,"[1] Rev. Mr. Eaton treats of the fossil species which have been referred by one and another author to this family, in a very summary manner,[2] asserting that: "when a fossil comprises only a fragment, or even a complete wing of an Ephemerid, it is hardly possible to determine the *genus*, and impossible to assert the *species*. The utmost that can be learned from such a specimen is the approximate relations of the insect. Neuration by itself is not sufficient to define the species or even the genera of recent Ephemeridae."

While we should not wish to deny the claims of Mr. Eaton to a profound knowledge of the structure of the Ephemeridae, we venture to doubt if he would assert that there are not features in the wing structure of some genera not found in others, and which are, therefore, in so far characteristic of those genera; and it might be worth while to consider whether a careful study of such differences would not reveal some further differences not discernible upon a cursory examination. One should be slow to hazard sweeping statements of a negative character; and after all, it may be enquired, what more is desired, or at least expected, than "the approximate relations of an insect" found fossil in the older rocks. That is precisely the aim of palaeontology the world over; and those who discourage efforts to discover these relations are simply bidding us close one of the volumes of the book of life, quite as valuable as that they study.

In further comments in the same place, Mr. Eaton asserts of the insects of the Devonian discussed in this paper, that "they have all been regarded as allies of the Ephemer-

[1] Trans. Entom. Soc. Lond., 1871, 38-40.

[2] The manner in which Mr. Eaton has confounded names in this section of his work is pretty fair evidence that he has not given the papers he quotes that close attention which would entitle him to use the language of ridicule toward their authors. In the three pages he devotes to this topic, Dyscritus is twice given as "Dyscritius"; articulatus twice as "antiquorum"; occidentalis once as "Brownsoni"; Bronsoni twice as "Brownsoni"; Dana twice as "Scudder"; Scudder six times as "Dawson."

idae." I do not know by whom; certainly not by myself, who first described them. Platephemera he says, may possibly belong to the Ephemeridae, "but there is nothing in the figures to make this certain." The better figures published with this should be sufficient proof that Platephemera belongs where I originally placed it. The neuration agrees in all essential features with that family, and indeed, considering the antiquity of the creature, shows marvellously little divergence from existing types. And although Mr. Eaton has nothing to say of the wing structure of the Ephemeridae as a whole, in distinction from that of other neuropterous families, I can hardly believe that any one who has studied it from the standpoint of the substantial unity of wing structure in all insects, could fail to discover that the Ephemeridae have a special development of wing neuration distinct from all others, permitting formulation, and to which Platephemera conforms to so close an extent, that until we have further light by the discovery of more complete remains we are amply justified in considering it as an antique type of Ephemeridae.

IV. Gerephemera simplex. Pl. 1, figs. 8, 8a.

Gerephemera simplex Scudd., Geol. mag., v, 174–75 (1868).

Mentioned without name, as the fourth species, in my letter to Mr. Hartt: On the devonian insects of New Brunswick, p. 1; Bailey, Obs. geol. south. New Br., 140; Amer. journ. sc., (2) xxxix, 357; Can. nat., (n. s.) ii, 235; Trans. Ent. Soc. Lond., (3) ii, 117—all in 1865.

In the specimen and reverse as first seen by me, scarcely more could be said of this insect than the brief notice already published; nothing appeared but a slight fragment of the tip of a wing, and this would not have been dignified by a name had not the extreme interest attaching to fossil insects from the horizon at which it occurred seemed to demand it. The portion preserved was the upper half of the outer border with the extremities of the veins impinging upon it, and two of the principal veins near the tip of the costal margin; these two veins are as usual in the Ephemeridae and probably represent the marginal and mediastinal (or scapular), and show that the latter reached the border scarcely above the tip of the wing.

Since my first examination, however, Mr. G. F. Matthew has worked out a considerable part of the wing on one of the stones belonging to the St. John Society, which, though very different in certain parts from what would have been anticipated from the portion first exposed, bears out in a measure the statement that was hazarded concerning it, although it proves that the generic name chosen was unfortunate. In this removal of the stone from the surface of the wing, a fragment of the tip with its two veins was flaked off; but as careful drawings had been taken of it, I have replaced the two lines indicating the veins mentioned above upon the drawing made of the wing as it now appears. This gives us indeed a much better clue to the probable form of the wing than we could possibly otherwise have, for the considerable and constantly increasing divergence of the upper and lower veins of the continuous portion of the fragment leave a very strange effect; and, without the aid these two vein-tips furnish, leave the form of the apex of the wing decidedly problematical.

Sandstones and coarse shales, with badly preserved *Cordaites Robbii* Daws., *C. transitionis* Goeppt., and *Alethopteris discrepans* Daws.	26 feet.
Fine-grained, light-greenish shale, with obscure remains	1 foot.
Sandstone and shales, with *Calamites* and obscure markings	23 feet.
Total thickness of the beds embraced in this section . . .	440 feet, 11 inches.

XI. EXPLANATION OF PLATE.

Fig. 1. *Homothetus fossilis* (magn. ⅔). The dotted lines are conjectural; the break in the dotted line representing the outer border indicates the presumed amount of separation at that point to account for the bending of the outer piece of the wing.

Fig. 2. *The same* (1). With no parts restored.

Fig. 3. *Lithentomum Harttii* (1). The dotted lines show the presumed connection of the basal veins with the other fragment.

Fig. 4. *Dyscritus vetustus* (1).

Fig. 5. *Xenoneura antiquorum* (½). The dotted lines indicate the supposed course of the veins and border where they are not preserved. A portion of the base is shaded to show the exact appearance of the concentric ridges; this basal portion is mostly drawn from the same stone as fig. 7, but the small fragment unshaded, at the extremity of the anal vein, and the cross vein are drawn in from the reverse of fig. 5, shown in fig. 6; so also is the larger apical piece with part of the lower margin, these two parts being more complete on the reverse than on the obverse.

Figs. 6 and 7. *The same* (1). With no parts restored. The apical fragment of fig. 7 is not represented; it exists, but is not so complete as in fig. 6.

Figs. 8 and 8ª. *Gerephemera simplex* (1). The two independent lines at the extremity of the costal margin are inserted from a drawing made under the camera when only these lines and the outer margin with the tip of the veins were exposed; in working out the rest of the wing these were broken away, but are here restored. The arrow indicates the direction of 8ª, which represents the contour of the surface of the wing, the upper dotted extremity indicating the costal margin (shown to the left of the arrow), and the dots along its course the position of the veins it crosses.

Fig. 9. *Platephemera antiqua* (1). The faint line of dashes above the marginal vein represents the margin of the wing, indicated on the stone by a slight darkening of the surface. The dotted lines at base and at tip indicate the presumed form of the wing.

Fig. 10. *The same* (1). This figure, the reverse of fig. 9, is so placed in relation to the preceding as to indicate the probable expanse of wing of this insect; a fragment at the lower angle of this specimen is not preserved in fig. 9, which possesses a bit of the outer margin not found in this.

Figs. 1, 2, 4, 6, 8, 10 represent specimens preserved in the museum of the Natural History Society of St. John, N. B.

Figs. 3, 7, 9 represent specimens in the museum of the Boston Society of Natural History.

Fig. 5 is a composite drawing from the specimens in each museum. The Boston Society of Natural History possesses the reverse of a small portion of fig. 8; and the St. John Society the reverse of No. 3, neither of which are engraved.

The plate was executed by Messrs. Sinclair & Son of Philadelphia.