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THE LOWER PERMIAN INSECTS OF KANSAS. PART 6.

DELOPTERIDAE, PROTELYTROPTERA, PLECTOPTERA AND A NEW COLLECTION OF PROTODONATA, ODONATA, MEGASECOPTERA, HOMOPTERA, AND PSOCOPTERA.

BY FRANK M. CARPENTER.

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DURING the summer and fall of 1932, since the previous part of this series of papers was sent to the press, the writer was enabled by a grant from the Milton Fund of Harvard University to make an extensive trip to the central and western parts of the United States for the purpose of collecting fossil insects. One of the formations investigated was the Lower Permian limestone at Elmo, Kansas, where about two thousand specimens were obtained, bringing the total number of insects in the Harvard collection from this locality to some forty-three hundred.

Most of this new material, however, was collected in a layer of limestone which has not previously been worked for insects. The layer was first found during the summer of 1931 by Mr. C. B. Read, of the United States Geological Survey, who very kindly furnished me with a complete description of its position. It is exposed in a short gully running from east to west about four hundred feet northwest of the quarry which yielded the Harvard collection of 1927 (see plate 1 of Part 1 of this series of papers, 1930). With the exception of this new limestone bed the stratigraphy here is essentially the same as indicated by Dunbar in his diagrammatic section of the region (1924). In figure 1, plate 1, I have included a photograph of part of the 1932 quarry, showing the position of the new layer in relation to the rest of the Elmo limestone. The floor of this quarry is the top of the stump layer (D). Resting upon this floor is the white, blocky limestone (C) which at other exposures has produced the insects comprising the Sellards, Yale, and earlier Harvard collections. This layer is exposed in small gullies scattered irregularly over about ten acres, although it is not everywhere fossiliferous. In all these other gullies this blocky layer of limestone is overlain by several feet of

* This series of studies has been aided by a Sheldon Traveling Fellowship from Harvard University, three National Research Fellowships, and by grants from the Carnegie Foundation, the Bache Fund of the National Academy of Sciences, and the Milton Fund of Harvard University.

coleoptera may prove to be an archaic remnant of the older Protelytroptera, at a stage when the elytron was still tegminous and more or less flat. The family Elytroneuridae, in which the elytra were flat and tegminous, may have been a survival of that very group which was the common ancestral stock of the Protocoleoptera and the more distinctly elytrophorous Protelytroptera.

Order PLECTOPTERA.

The may-flies constitute a very prominent part of the fauna of the Elmo limestone. In the Sellards collection there are nearly forty specimens, of which about a dozen are well preserved. In the Yale collection there are ninety-two specimens, of which one-third were estimated by Tillyard to be in a good state of preservation. In the collection at the Museum of Comparative Zoology there are more than one hundered and fifty specimens, about one-half of which are well preserved. This amounts to a total of more than 280 specimens of may-flies from this single formation. The importance of this fine series of fossils in the study of the geological history and the phylogeny of these insects can be realized if we bear in mind that they constitute the earliest record of true Plectoptera; and with the exception of a single wing from the Permian of Russia and a few doubtful nymphal forms, they comprise the sole representatives of the group prior to the Jurassic.

The specimens in the Sellards collection were studied by Dr. Sellards himself, who published preliminary descriptions of twelve species, based on the best specimens in the material at his disposal (1906). These type specimens I was able to examine and photograph in 1927 in Austin, Texas, although a few of the types could not be found at that time. Unfortunately, a short time after my study of them, all the types were accidently destroyed during the process of renovation of the building in which they were deposited, but the remainder of Sellards collection has been loaned to the Museum of Comparative Zoology. The may-flies in the Yale collection were subjected to an intensive study by Tillyard (1932), who has published a detailed account of his conclusions, together with the descriptions of four new species. These specimens, now at the Peabody Museum, I have also been able to examine.

In his account of the Yale collection Tillyard covered completely certain phases of the phylogeny of the may-flies which consequently require no further discussion. He thoroughly treated the complicated

question of the homology of the veins of the Plectoptera, showing that the evidence provided by these fossils supports in every way the conclusion reached by Lameere in 1922 that the media is represented by both MA and MP, and the cubitus by CuA and CuP. Much of Tillyard's discussion was concerned with an attempt to disprove the view advanced by Martynov in 1923 that the media was only represented by MA; but Martynov had already abandoned that idea and accepted Lameere's, as he states in a paper published in February, 1932, the same month as Tillyard's.[20] In this paper I have therefore employed without change this system of nomenclature.

The conclusions which Tillyard reached on the synonymy of certain of Sellards' genera and species very nearly coincides with those to which I was led in my survey of the types in 1927. But Tillyard was not able to ascertain the differences between the fore and hind wings of these Permian may-flies and consequently he confused certain of these differences with true specific characteristics. Fortunately the new material in the Harvard collection contains specimens which enable us to distinguish satisfactorily between the two pairs of wings. Also, Tillyard was not able to determine much about the body structure of these insects and although he presented a reconstruction of *Protereisma permianum*, his figure is incorrect in many respects and gives an erroneous idea of the habitus of the Permian may-flies. Again we are fortunate in having in the Harvard collection a series of fine specimens which show clearly the body structure of these ancient insects.

[20] Tillyard's remarks concerning my translation of Martynov's Russian paper are somewhat misleading. He states (1932, p. 100) that it was very unfortunate that I "did not see fit" to include Martynov's figures in the translation; and that I did not realize the importance of having the figures to use in connection with the text. But in the introduction to the translation, I stated that "the twelve figures accompanying the original article are essential for a complete understanding of the problems under discussion"; and also pointed out that the nature of the original figures was such that they would have required retouching before they could have been copied. The publication of the translation without the figures cost me personally not less than a hundred dollars, and the reproduction of the illustrations would of course have greatly increased this amount. I naturally assumed that anyone who was interested in the figures in Martynov's paper and who did not have access to the article in the original journal (Rev. Russe Ent. **18:** 145–174), would secure a copy of the issue containing the paper from the entomological society which published it.

Family PROTEREISMATIDAE.

Protereismephemeridae, Sellards, 1907, Amer. Journ. Sci. **23**: 345.
Protereismidae, Handlirsch, 1919, Denkschr. Akad. Wiss. Wien Math. Naturw. Kl. (96) **82**: 63.
Protereismatidae, Tillyard, 1932, Amer. Journ. Sci., **23**: 237.

Fore wing: elongate-oval in shape, somewhat narrowed basally; costa submarginal, forming an arch at the base of the wing; Sc terminating near the apex of the wing; R1 more or less parallel to Sc; Rs originating from R1 near the base, but almost immediately coalescing with MA for a short distance; Rs with three complete triads; R4 + 5 arising a little proximad of the middle of the wing; MA with a single triad arising also at about mid-wing; MP with a single triad originating proximad of the origin of Rs, occasionally closer to the origin of MA; CuA arising from the stem of Cu at the base of the wing, but directed anteriorly and immediately touching M or joined by a short strut to M; CuA with a well developed triad; CuP unbranched; A1 and A2 arising from a thick chitinous stem, joined to the recurved stem of Cu; A1 without a well defined triad.

Hind wing: similar to the fore in shape and size, being only slightly smaller. The venation is also similar to that of the fore wing, but differs in the following points: the costa is closer to the anterior margin in the hind wing than in the fore; CuA does not approach M at the base as closely in the hind wing as in the fore; the hind wing has a well developed triad on A1; and A1 and A2 arise from a common stem at a point where there is a series of thickened cross-veins.

The general habitus of these insects was more or less intermediate between that of the recent Plectoptera and the Palaeodictyoptera. The head was broad, with large globular eyes in both sexes (apparently), and bearing prominent antennae with 11 subequal segments. The thorax was slender and elongate, the prothorax very broad and flattened, having the appearance of possessing small lateral expansions like those found in many Palaeodictyoptera. The legs were nearly homonmous, the fore pair being only a very little longer (4 mm.) than the others, and this difference may have been confined to the male. The coxa and trochanter were very short, but the femur was long and slender; the tibia a little shorter than the femur; the tarsus longer than the tibia and possessing five segments, the metatarsus being the longest and the fourth the shortest. Small tibial spurs were present and also a single small spine at the distal end of each of the tarsal segments. The tarsal claws were prominent. The

abdomen was elongate in the male and only slightly shorter in the female. Ten segments are visible in the abdomen from above; the terminal filaments were present in both sexes and in the male were at least as long as the abdomen, containing upwards of 40 segments; the genital claspers of the male were very much like those in existing species.

As Tillyard has already pointed out, these Permian may-flies undoubtedly passed through the subimaginal stage characteristic of existing may-flies, for the condition of the wings and of the body resembles that of recent may-flies in that state. The structure of the nymphs of these Lower Permian may-flies is very little known, since no well preserved nymphs have been found in the Elmo limestone. One faintly preserved specimen was taken by the writer in 1927; it shows two long filamentous abdominal setae and the general habitus of the recent nymphs, but most of the body is an obscure mass, probably because the delicate gills were folded or twisted over and across the abdomen. Several specimens of may-fly nymphs have been found in the Permian (Upper) of the Old World and in all probability belong to the Protereismatidae or to related families.

Genus *Protereisma* Sellards.

Protereisma, Sellards, 1907, Amer. Journ. Sci. (4) **23**: 347.
Protereisma, Tillyard, 1932, ibid. (5): **23**: 244.
Protechma, Sellards, 1907, ibid. (4): **23**: 349.
Prodromus, Sellards, 1907, ibid., p. 349.
Bantiska, Sellards, 1907, ibid., p. 341.
Rekter, Sellards, 1907, ibid., p. 349.
Pinctodia, Sellards, 1907, ibid., p. 352.
Mecus, Sellards, 1909, ibid., **27**: 151.

Since this is the only genus of the family, it is clearly defined by the characteristics already given under the family. The genotype is *Protereisma permianum* Sellards.

In this genus Tillyard recognized eight species, of which six were originally described by Sellards and placed by him in four genera. I agree entirely with Tillyard's view that all of Sellards' genera except Misthodotes and Esca are identical with Protereisma. Misthodotes is a valid genus, for which Tillyard erected a separate family. The affinities of Esca are not clear; the species included in the genus was not figured by Sellards and when I examined his collection of types in 1927 I was unable to locate the fossil on which he based his descrip-

tion. Since all of Sellards types have subsequently been lost, this genus will probably remain obscure and perhaps should be regarded as a synonym of Protereisma or dropped from the literature altogether.

The classification of these Permian may-flies is rendered difficult by the variability of many venational features, which were supposed by Sellards to be constant in the species. In his classification of the species of Protereisma Tillyard made use of the relative lengths and breadths of the wings, but he also employed certain venational characteristics which he considered constant in the species. From my study of the specimens in the Harvard collection as well as those in the Peabody Museum, I am convinced that some of the venational characteristics with which Tillyard separated the species are subject to much individual variation also, and that others are merely differences between the fore and hind wings; only one specimen (No. 5427) in the entire Yale collection was complete enough to permit a comparison of the wings and from that he was able to ascertain only that the hind wing was shorter than the fore and had a broader anal area. There are numerous specimens of Protereisma in the Harvard collection which have the bases of the fore and hind wings preserved and which have enabled me to ascertain the differences. Of these fossils the following are the most important: No. 3404, 3405, 3420, all *permianum;* and No. 3414, *arcuatum.* Other specimens, although having only one wing preserved, indicate by the position of its attachment to the thorax whether it is a fore or a hind wing, and so enable further comparison. A careful study of these fossils has revealed the following differences between the fore and hind wings:

1. The costa is closer to the margin of the wing in the hind wing than in the fore wing.

2. R1 and Sc are either fused basally or very nearly fused in the fore wing, but in the hind wing they are decidedly remote from each other.

3. CuP always touches or very nearly touches M at the base of the fore wing, but is remote from M in the hind wing.

4. A1 possesses in the hind wing a well defined triad which is absent in the fore wing.

5. A1, IA, and A2 in the fore wing originate from a strong stem arising from the base of the wing; in the hind wing they arise some distance away from the base of the wing at a chitinous node formed by the partial alignment of two or more cross-veins; between this

node and the base of the wing there is a single stout vein apparently formed by the coalescence of the basal parts of A1, IA, and A2.

Now if we consider the characteristics used by Tillyard to distinguish the species of Protereisma we note that he has employed some of these mentioned in the above list. For example, one of the characteristics used in his key to identify *gracile* is that Sc and R are fused basally; but this is now seen to be a feature common to *all fore* wings, and not present in the hind wings of any species. *Sellardsi* was separated from the others by having CuP practically touch M at the base of the wing, which is a characteristic of *all hind* wings. The variation of certain veins in individuals of a species was considered by Tillyard and he noted that many of the basal connections of the veins were unstable, such as the amount of anastomosis between Rs and MA, the length of the costal brace, and the depth of the forks of Rs and MA. From my study of the entire lot of more than 250 specimens of this family, I am convinced that the following venational features are also subject to individual variation, some of which were used by Tillyard in his classification of the species.

1. The shape of the arch formed by the costal vein varies considerably even in the wings of the same individual.

2. The point of origin of the triad of MP is as variable as that of the triads of Rs and MA; it may arise close to the base, almost below the distal end of the costal vein or near to the first forking of MA; and between these extremes there is a complete series of intermediate conditions, as shown in specimens No. 3404ab, 3408ab, 3409ab, and 3390ab of the Harvard collection.

3. The relative widths of the costal and subcostal spaces do not appear to be constant. The majority of specimens have the costal and subcostal spaces subequal in width or the costal space a little wider; but a few wings have been found in which the subcostal space is the broader. This feature does not, however, appear to be associated with any other characteristics that might indicate specific difference, nor does it appear to be confined to either the fore or hind wing. Specimen No. 5438 of the Yale collection, which has a narrow costal space, is a fore wing, as shown by the structure of CuP and the anal veins at the base; but in the Harvard collection there is a wing (No. 3424ab) which also has a narrow costal area, although it is obviously a hind wing, as indicated by its point of attachment to the thorax. Now if we again consider the characteristics on which Tillyard based the species of Protereisma, we note that one of the chief diagnostic

features of *sellardsi* is that the triad of MP arises close to the base, about the level of the costal brace. But the specimens mentioned above in the discussion of this vein show a complete series of gradations from the extreme condition in the type of *sellardsi* to the more normal one. *Gracile* was characterized as having the costal space narrower than the subcostal, which for reasons given above I consider to be only an individual variation.

In view of the evidence supplied by the new material, then, I believe that the number of species in the genus is even less than supposed by Tillyard. *Latum* Sellards and *insigne* Tillyard are at once separated from all others by their large size, the fore wings being more than 25 mm. long. *Arcuatum* Sellards is distinguished by the arched anterior margin, and *elongatum* Sellards by the small number of cross-veins. The remaining species recognized by Tillyard, i. e., *gracile* Sellards, *minus* Sellards and *sellardsi* Tillyard, are in my opinion identical with *permianum*.

Protereisma permianum Sellards.

Figures 26 and 27.

Protereisma permianum Sellards, 1907, Amer. Journ. Sci. (4) **23**: 348; figs. 3, 4.
Protereisma permianum Tillyard, 1932, ibid. (5) **23**: 247; figs. 5, 14.
Protechma acuminatum Sellards, 1907, ibid. (4) **23**: 349; fig. 8.
Prodromus rectus Sellards, 1907, ibid., p. 349; fig. 10.
Scopus gracilis Sellards, 1907, ibid., p. 352; fig. 12.
Protereisma minus Sellards, 1907, ibid., p. 254.
Protereisma gracile Tillyard, 1932, ibid. (5) **23**: 252; fig. 15.
Protereisma minus Tillyard, 1932, ibid., p. 254.
Protereisma sellardsi Tillyard, 1932, ibid., p. 251; fig. 16.

Length of fore wing, 15–20 mm.; width, 4.8–6 mm.; length of hind wing, 17–19 mm.; width, 4.6–5.7 mm. In the specimens which appear to be imagines the membrane of the wings is hyaline and the cross-veins are distinctly brown; in the wings which apparently belong to subimagines the membrane has a uniformly brown tint. Anterior margin straight, not curving until about one-fourth the wing length from the apex; cross-veins numerous; subcostal and costal spaces usually subequal, occasionally one or the other somewhat broader; origin of IMP usually nearly as far distal as the first fork of Rs, but sometimes arising more distad; CuP strongly waved.

Length of antennae, 4 mm.; width of head, 2.8 mm.; length of head, 1.2 mm.; length of thorax, 5.5 mm.; width of prothorax, 3 mm.; length of fore legs, 24 mm.; length of hind and middle legs, 20 mm.; length of abdomen (small specimen), 16 mm.

The holotype specimen, No. 970, was originally in the Sellards collection and was studied and photographed by me in 1927. Since that specimen has subsequently been destroyed along with the other types, I take this opportunity to designate No. 3405ab in the Harvard collection as the neotype. A second specimen, originally in the Sellards collection, consisted only of the body and was placed doubtfully by Sellards in this species or *latum*. This fossil, which has also been lost, is apparently the one to which Tillyard referred as a paratype.

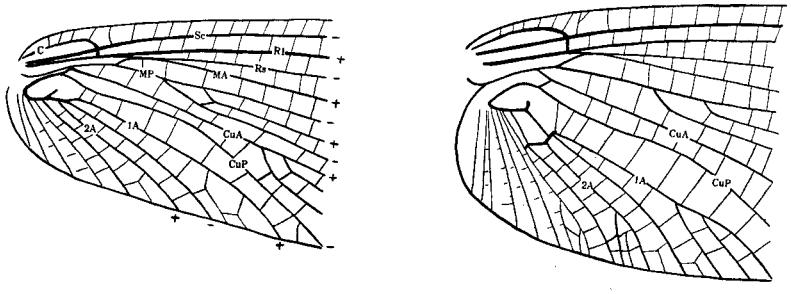

FIGURE 26. *Protereisma permianum* Sell., bases of fore and hind wings, drawn from specimens No. 3404ab, 3405ab, and 3420ab, Mus. Comp. Zoology.

In the Harvard collection there are over forty specimens which can be assigned to this species without question as well as many others which probably belong here. The most important of these fossils are included within the Nos. 3397–3406. Only about a third of the specimens were found in the upper layer of limestone. The restoration of this species, shown in figure 27, is based mainly on the following fossils in the Museum of Comparative Zoology:

No. 3405ab, an excellent specimen, showing the right wings outspread, free from each other, and the two left wings also outspread but slightly overlapping; also showing portions of the body, including one antenna and most of the legs except the tarsi. This fossil shows distinctly the differences between the fore and hind wings.

No. 3404ab, consisting of a fore and hind wing and portions of the body, the legs being especially clear.

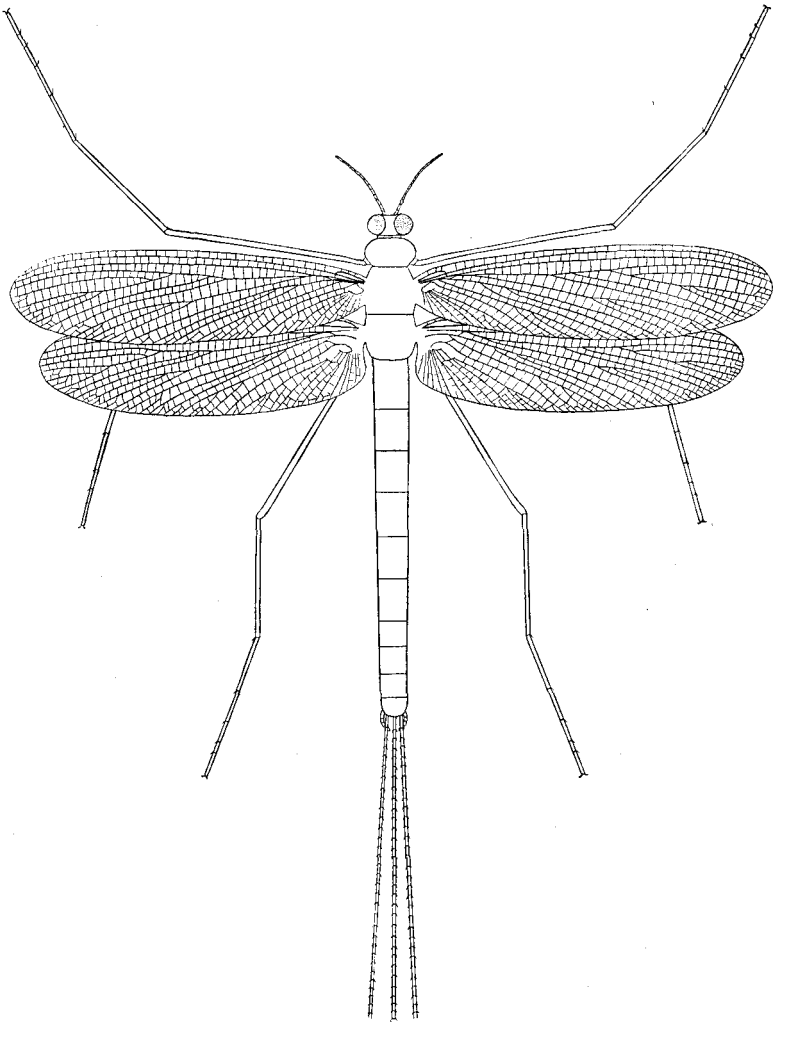

FIGURE 27. *Protereisma permianum* Sell., reconstruction, based on several specimens in the Museum of Comparative Zoology.

No. 3403ab, consisting of the basal halves of two wings and the complete body, showing the antennae and abdomen especially well.

No. 3402ab, a fine lateral view of the whole insect, showing all wings partially overlapped and the legs, including the complete tarsi of two legs.

No. 3400 and 3401, excellent hind wings, showing the anal area unusually well.

Tillyard has already given reasons for synonymizing *acuminatum* and *rectum* with *permianum* and he suggested that *minus* Sellards might also be another synonym. The type of *minus* was somewhat distorted and from my examination of it, I am convinced that the apparent straightness of CuP described by Sellards was due to this distortion. Except for this feature and its slightly smaller size, there are no differences between this wing and that of *permianum*. I have placed *gracile* here also because I believe the characteristics on which Sellards and Tillyard recognized this species were only individual ones. Sellards believed that the wing was distinguished by its slenderness, but this was without definite basis because the posterior part of the wing was missing. Furthermore the apical part of the wing was much wrinkled, as shown by the irregularity of the veins in Sellards' figure; and Sellards himself stated that the wing had suffered "lateral compression," obscuring the radial area at the base. For these reasons, the shape of the type wing cannot be considered as indicative of a similar shape in the species. Tillyard believed that he recognized about a dozen specimens in the Yale collection belonging to *gracile*, which he distinguished by the slenderness of the wing, the fusion of R and Sc at the base, and the broad subcostal space, which was wider than the costal. I have already mentioned above, however, that the fusion of R and Sc at the base is the usual condition if the fore wings of Protereisma, and have pointed out that the relative widths of the costal and subcostal spaces vary even in the same specimen. I therefore regard all specimens in the Yale collection determined by Tillyard as *gracile* to be *permianum*. I have also placed *sellardsi* Tillyard as a synonym of the latter. This species was based upon a single specimen, characterized by having triad of MP arise nearer the base of the wing than in the other species. I have pointed out above, however, that the place of origin of this triad is subject to as much individual variation as the other triads. The species was also based upon the close approximation of CuP and M at the base; but this peculiarity is common to all fore wings of members of the genus, and not confined to any one species.

Protereisma elongatum (Sellards).

Bantiska elongata Sellards, 1907, Amer. Journ. Sci. (4) **23**: 349; fig. 7.
Protereisma elongatum Tillyard, 1932, ibid. (5) **23**: 254.

Hind wing: length, 15–19 mm.; width, 5–5.5 mm.; fore wing probably a little larger. Costal margin straight, curving only in the distal third of the wing; cross-veins fewer than *permianum;* costa (in the hind wing at least) closer to the margin than in *permianum* and other species of Protereisma; CuP markedly waved.

The holotype, No. 976, was present in the Sellards' collection when I studied it in 1927; since it has subsequently been lost, I designate specimen No. 3424ab in the Museum of Comparative Zoology (lower layer) as the neotype. This specimen consists of a fine hind wing and portions of the body. The wing is shown to be a hind wing by the place of attachment to the thorax; it has the same venational features at the base as the hind wing of *permianum.* The basal part of Sc overlaps R at the base, but this is caused by an obvious fold in the wing membrane at this point. I believe that the only definite and constant feature that distinguishes this wing is the smaller number of cross-veins. The proximity of the costal vein to the margin may only be true of the hind wing, but even there it is closer to the margin than in the hind wing of *permianum.* I have not seen any fore wing that can be assigned to this species without question and the specimen mentioned above is the only one in the Harvard material which can be placed here with certainty, though some of the other wings with a more or less open type of venation may belong to this species.

Protereisma arcuatum (Sellards).

Figure 28.

Rekter arcuatus Sellards, 1907, Amer. Journ. Sci. (4) **23**: 349; fig. 6.
Protereisma arcuatum Tillyard, 1932, ibid. (5) **23**: 295; fig. 17.

Length of fore wing, 16–17 mm.; width, 4.7–5 mm.; hind wing a little smaller; costal margin straight for the proximal two-thirds, but curved downwards much sooner than in the foregoing species of the genus; apex pointed; cross-veins numerous; CuP distinctly waved. Tillyard states that the basal part of the anterior margin is strongly curved downward, but that assertion was apparently based upon Sellards' figure, which shows this part of the wing restored in dotted lines. Neither Sellards' specimen nor any specimens in the Yale collection show this part of the wing. In one wing of the Harvard col-

lection (No. 3414ab), however, this region of the wing is preserved and is the same as in the other species of the genus.

The holotype was No. 598 in Dr. Sellards' collection, and was studied by me in 1927; since it is now lost, I designate No. 3414ab in the Museum of Comparative Zoology as the neotype. This fossil, which was collected in the lower layer, consists of the left hind wing, part of the right fore wing and most of the body, including the head, the prothorax, the abdomen and the genitalia. The latter are very well preserved and show that the insect was a male. On the same piece of limestone and only a few millimeters away is a specimen of *Protereisma permianum.* In addition to this specimen there is another representative of *arcuatum,* collected in the upper layer (No. 3413ab); this includes only the apical half of the wing, probably a fore one.

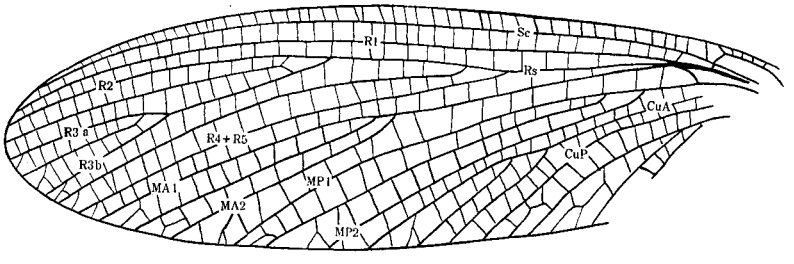

FIGURE 28. *Protereisma arcuatum* Sell., drawn from specimen No. 3414ab, Mus. Comp. Zoology.

Protereisma latum Sellards.

Figure 29.

Protereisma latum Sellards, 1907, Amer. Journ. Sci. (4) **23**: 349.
Protereisma latum Tillyard, 1932, ibid. (5) **23**: 256; fig. 7.

Length of fore wing, 22–25 mm.; width, 6.7–7.5 mm.; hind wing slightly smaller; costal margin straight for the basal two-thirds, distally curved as in *arcuatum;* cross-veins about as numerous as in *elongatum;* anal area of hind wing much broader than in *permianum.*

The holotype was originally No. 124 in the Sellards collection; since that is lost I designate No. 3419ab in the Harvard collection as the neotype; this was collected in the upper layer of limestone.

There are four good specimens of this insect in the Museum of Comparative Zoology: No. 3419ab, the neotype, is an excellent hind

wing, complete and well preserved; No. 3392ab is a complete though somewhat wrinkled hind wing; No. 3391ab, is the basal two-thirds of a fore wing: and No. 3390ab is a fore wing lacking part of the anal area. All of these were collected by the writer in the lower layer, except for the neotype and No. 3391ab, which were taken in the upper layer. This fine species is easily recognized by its large size and relatively broad hind wing. Since the complete wing of this species has not previously been figured, I include here a drawing of the hind wing.

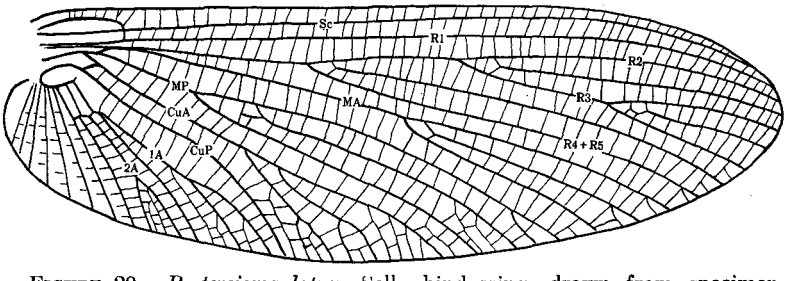

FIGURE 29. *Protereisma latum* Sell., hind wing, drawn from specimen No. 3419ab, Mus. Comp. Zoology.

Protereisma insigne Tillyard.

Protereisma insigne Tillyard, 1932, Amer. Journ. Sci. (5): 259; fig. 18.

Length of hind wing, about 27 mm.; width, 9.4 mm.; fore wing unknown; costal margin straight almost to the very apex of the wing, so that most of the apical curvature takes place in the hind margin, and the apex of the wing is anterior to the longitudinal axis of the wing; cross-veins numerous.

Holotype: No. 1112, Peabody Museum; a hind wing, lacking the distal part.

In the Museum of Comparative Zoology there is one specimen (No. 3436) which I consider to belong here; it consists only of the apical portion of the wing, but it has a width of 8 mm.; and could only fit this species or a new one. The chief feature of this fossil is that the apex is decidedly "off center," that is, above the longitudinal axis of the wing. A comparison of this fossil with the photograph of *insigne* given in Tillyard's paper shows that the outline of the two wings would make a perfect fit, the Harvard fossil including the portions missing in the type. The new specimen was collected in the upper layer of limestone.

Family Misthodotidae.

Fore wing: smaller and relatively broader than that of the Protereismatidae; costa submarginal, but not so strongly developed as in the previous family; Sc terminating on the margin before the apex of the wing; Rs arising from Rs near the base; MA and Rs fused basally, no free part of MA visible; Rs with 3 triads; MP with a single triad; CuA arising from the stem of Cu2 and joined to MP by a short strut, as in the Protereismatidae; CuA without a definite triad, at most with a terminal twig; anal area as in the Proteresimatidae; crossveins relatively few.

Hind wing: broader than the fore wing, with a more rounded posterior margin; venational like that of the fore wing with the exception of the differences indicated in the Proteresimatidae.

These insects had a shorter abdomen and less elongate legs than the Protereismatidae; the structure of the antennae and tarsi is unknown. The family is much less common in the Elmo limestone than the Protereismatidae, and seems to be absent in the upper layer of the limestone, although additional material may show that it does occur there.

Genus *Misthodotes* Sellards.

Dromeus Sellards, 1907, Amer. Journ. Sci. (4) **23**: 351 (*nec Dromeus* Reiche).
Misthodotes Sellards, 1909, ibid. **27**: 151.
Misthodotes Tillyard, 1932, ibid. (5) **23**: 261.

This is the only genus in the family and consequently needs no further diagnosis. Three species have been described, *obtusus* Sellards (genotype), *biguttatus* Tillyard, and *ovalis* Tillyard. The wings of the latter species are distinguished by their large size, being 15 mm. long; those of *biguttatus* apparently differ from the others by the presence of a color pattern, consisting of two large blotches of brown. Neither of these two species is represented in the Museum of Comparative Zoology.

Misthodotes obtusus Sellards.

Dromeus obtusus Sellards, Amer. Journ. Sci. (4) **23**: 351.
Misthodotes obtusus Sellards, ibid., **27**: 151.
Misthodotes obtusus Tillyard, 1932, ibid. (5) **23**: 261; fig. 19, 20.

Length of fore wing, about 11 mm.; width, 4.3 mm.; length of hind wing, 10.5 mm.; width, 3.9 mm.; costal margin straight, except in the distal region; CuP slightly waved; imago wing without pigmentation.

The holotype specimen of this species was No. 1048 and its counter part 1385 in the Sellards collection; since these have been lost, I designate specimen No. 5470 in the Peabody Museum as the neotype. In the Harvard collection there are two specimens of this insect, No. 3425ab, consisting of a nearly complete hind wing, apparently from a subimago; and No. 3429, the apical part of a fore wing. The Yale specimen mentioned above consists of all four wings and many portions of the body, though details are not visible. Since this is a more complete specimen than either of the two in the Harvard material, I have designated it as the neotype. The various specimens of this species, especially the neotype, show that the fore and hind wings of the members of this family were like those of the Proteresimatidae in general features and differed from each other in the same manner.

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