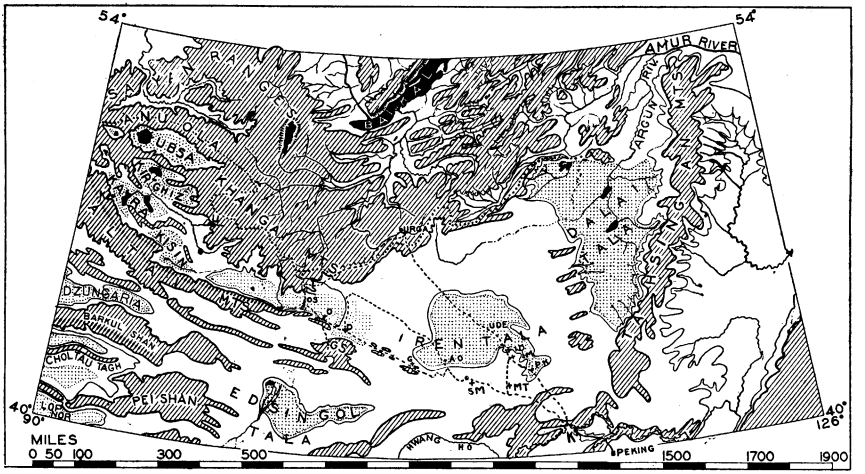


Fig. 1. Map of the Gobi region.

The mountainous areas are shaded with slanting lines; the lowlands are white; the deeper depressions are stippled.

Ondai Sair is indicated by the index letters OS, south of the letters MTS of KHANGAI MTS. Ust Balei is not marked on the map, but it lies on the large river that leads northwestward out of Lake Baikal, near the prong of mountain-country that projects toward this river from the Sayan ranges.

56(117:51.7)

Article VI.—FOSSILS IN THE ONDAI SAIR FORMATION, MONGOLIA[1]

BY T. D. A. COCKERELL

INTRODUCTION

I am indebted to The American Museum of Natural History for the opportunity to study a most interesting collection of fossils in the paper shales of the Ondai Sair formation of the Gobi Desert. These were collected by Messrs. Charles P. Berkey and F. K. Morris, on the Third Asiatic Expedition of the Museum. Messrs. Berkey and Granger (American Museum Novitates, No. 77) discuss the Ondai Sair formation, and state that it is "at least as old as the Cretaceous, perhaps the Lower Cretaceous or Comanchean, rather than the Upper Cretaceous. In this locality, at Mt. Uskuk, the series is sharply delimited by an unconformity, above which no fossils of this type are to be found; and it is limited also below by a much greater unconformity, beneath which lie folded strata with coal beds, conglomerates and intrusives, all judged to be of Jurassic age, as well as many still older formations."

[1]Publications of the Asiatic Expeditions of The American Museum of Natural History. Contribution No. 37.

Mr. Frederick K. Morris has been good enough to write me at considerable length, summarizing the observations and conclusions of the investigators. I venture to quote the following:

"We found the fish-bearing paper shales associated with sandstones in which were sauropod reptiles at Ondai Sair. At the Oshih (Ashile) basin we searched the paper shales this year again for fossils, but found only the remains of a few plants, too badly macerated prior to deposition to be identified. The paper shales of the Oshih basin carry gypsum crystals, which perhaps points to bitter waters in which the fauna of Ondai Sair could not live. The Oshih and Ondai Sair basins are very probably continuous and form one basin. Sauropods and primitive predentates are found in each locality, although perhaps there is a slight difference between the two faunas. At Oshih the paper shales lie far higher in the series, not less than five hundred feet above the chief sauropod beds; but a few large sauropod vertebræ were seen only one hundred feet below a horizon which, on other grounds, we believe is correlated with the paper shales. At Ondai Sair, as I have said, the sauropods are found close to the paper shales and essentially of the same age.

"Fish-bearing shales are found in North China and have been called Jurassic, on the assumption that the fishes were indeed the *Lycoptera middendorffi* described by Reis. Paper shales were seen by us on the main road to Urga, between Ude and Tuerin, but our brief search of them did not reveal any fossils. We think this basin may be of the same age as the fish shales of Ondai Sair.

"The Oshih-Ondai Sair basin is the oldest true basin found by us in Mongolia; its sandstones rest directly upon the strongly disturbed old rocks that have passed through one or more mountain-bearing revolutions. At Ondai Sair the basement was chiefly pre-Cambrian rocks—graywackes and slates invaded by granites. At Oshih less is seen of the basement, but we found an inlier of crystalline limestone, cut by syenite and granite; also other inliers of the old graywacke series of which the Altai range to the south is principally composed; and a younger chain of strongly folded porphyries, which may be what Doctor Berkey and I judged to be Jurassic in other localities last year. Clearly, there is a great unconformity beneath the Oshih and Ondai Sair and, so far as we know, these basins, which carry the paper shales, date the beginning of the basin or gobi sedimentation; that is, the beginning of deposition of shallow masses of continental sediments—alluvial fans, flood-plains, deltas, playa lake deposits and, locally, deposits in shallow but more permanent lakes. These deposits are but little disturbed and it is in them that all the vertebrate fossils are found.

"The accurate dating of the oldest of these basin deposits is of great importance, not only for paleontology but for the dating of the last great disturbance prior to the Altai uplift.

"We found marine beds of Permian age involved in the older mountain-folding. Apparently younger than these, is a vast series of shales, sandstones, conglomerates and surface volcanic rocks—ash, tuffs and flows of rhyolite, trachyte and basalt which are strongly folded. After folding, these rocks had been eroded to a peneplane. This latter series is wholly non-marine and carries obscure plant remains and, locally, coal. We named these rocks the Tsetsenwan series.

"South of Mongolia the Lower Jurassic in northern China carries coal and is strongly folded, even slaty in places, and has porphyries very like those in the Mongolian series just mentioned. In northern China, therefore, a folding took place sometime between Middle Jurassic and late Jurassic time. In view of the physical similarity between the Lower Jurassic rocks of the Western Hills and the Tsetsenwan series in Mongolia, and because in China also the fish-bearing shales are not severely disturbed, it has seemed to us that for reasons of structural geology it is likely that the earliest basin lands are possibly of Comanchean age. The "Upper Jurassic or Lower Cretaceous" of Reis may well be what we call in America, Comanchean.

"The significance of the Ondai Sair fauna is increased when we consider that there is apparently a chain of basins extending from Siberia across Mongolia into China; if the fauna proves to be the same or of nearly the same age in all, this fact would correlate the entire column of post-mountain-folding, continental sediments in the three regions."

ONDAI SAIR BIOTA

The following species were obtained by the Expedition in the Ondai Sair formation:

Reptilia: *Protiguanodon mongoliense* Osborn, Amer. Mus. Novitates, No. 95, 1923.

Pisces: *Lycoptera middendorffi* Johannes Müller, 1848. Exceedingly abundant in the paper shales (Pl. II, fig. 1). The specimens agree with *L. middendorffi* in the proportions of the fins, rather than with *L. sinensis* A. S. Woodward, from the Lower Jurassic (?) of the Province of Shantung, China. These fishes will be discussed more fully in a later contribution; they form a new family, **Lycopteridæ**, apparently

ancestral to the Cyprinidæ, and have scales scarcely differing from those of the European minnow.

Crustacea: *Estheria middendorffi* T. R. Jones, 1862. Exceedingly abundant in the paper shales (Pl. II, fig. 2).

Insecta: *Ephemeropsis trisetalis* Eichwald, 1864
Ephemeropsis melanurus, new species
Cymatophlebia (?) *mongolica*, new species
Trichopterella torta, new species
Indusia reisi, new species
Chironomopsis gobiensis, new species
Coleoptera, spp. incert.

Plants: *Baiera furcata* (Lindley and Hutton)
Phyllocladites (?) *morrisi*, new species
Czekanowskia sp.
Equisetaceæ (?) fragments

Concerning this biota, we have to ask, (a) does it appear, taken as it stands, to be Upper Jurassic or Lower Cretaceous? (b) is it identical, or nearly identical, with that of the supposed Upper Jurassic fish shales of the Transbaikal country directly north of the Gobi Desert?

With regard to the first question:

(1) The dinosaur, I learn from Dr. W. D. Matthew, is provisionally referred to the Cretaceous, but it is not of itself decisive as to age.

(2) The fish is singularly modern in aspect and affinities, but it belongs to a type always considered Jurassic.

(3) The *Estheria*, as an organism, is of no value in determining age, except within very wide limits. Similar species are living today.

(4) The insects do not clearly indicate age; they are on the whole of modern type, but such forms are known to occur in the Jurassic.

(5) The plants appear to represent a Jurassic flora, but similar forms have been found in the Cretaceous. Thus the contemplation of this biota apparently leaves us where we were before, in uncertainty as to whether it is Upper Jurassic or Lower Cretaceous.

Turning now to the second question, it must evidently be answered in the affirmative. The Transbaikal fish shales are found in several places, for instance: Turga, about 60 miles north of Mongolia, directly north of the Gobi Desert; Konduevskoe or Konduyewskaya, about 90 miles due east of Turga; Nertchinsk or Nertstschinsk, 100 miles north-northwest of Turga.

These shales are, just as those from Ondai Sair, full of *Lycoptera middendorffi*, *Estheria middendorffi* and *Ephemeropsis trisetalis;* they also

carry plants which appear to be *Baiera* and *Czekanowskia*. It does not appear possible that such an association could occur in two deposits of very different age. I have not had access to the important paper by O. Reis, "Die Binnenfauna der Fischschiefer in Transbaikalien," Explor. Géolog. chem. de fer Sibérie (Petrograd, 1910), but Mr. Morris has sent me photographs of the plates, with explanations, and a brief statement of Reis's position. The beds have always been considered Upper Jurassic but Reis confessed to finding in the fauna puzzling affinities ranging from early Tertiary to Jurassic, although the strongest bonds appeared to be with the Upper Jurassic or Lower Cretaceous.

As Reis records a number of organisms not yet found in the Ondai Sair, it will be well to review the more significant of them:

(1) Some additional fish remains are too fragmentary to be of much value. One of these, based on some fins, is called *Stichopterus woodwardi*. The generic name is new and has been omitted from Jordan's Classification of Fishes and Genera of Fishes. The genus is, however, probably unrecognizable.

(2) There is a series of Mollusca, referred to *Lymnæa*, *Paludina*, *Cerithium* and *Cyrena*. *Lymnæa obrutschewi* Reis is closely similar to *L. accelerata* White, from the Comanchean near Cañon City, Colorado, except that it is smaller. *Paludina pura* Eichwald very closely resembles *Lioplacodes veternus* Meek and Hayden, from the American Jurassic, but is also smaller. It is a shell with much the aspect of the modern *Bythinia tentaculata* Linné, but I think it is safe to call it *Lioplacodes purus*.[1] *Cyrena pusilla*[2] Reis is a very small species but characteristic of the genus and having the general form of Cretaceous species. *Cerithium gerassimowi* Reis is not closely related to anything known to me, but the approximately similar types belong to later epochs.

(3) The additional insects are of no consequence. One beetle is named *Carabites latecostatus*, but its family position is uncertain.

(4) Numerous ostracods are recorded by Joseph Georg Egger, with a plate of figures. They are referred to described species, but distinctive characters are few and I do not know what reliance can be placed on them. Our confidence in the determinations is not increased by finding one of the species referred to *Cypris faba*, the common ostracod of the Miocene at Wangen (Œningen) in Baden.

(5) The additional fragmentary plants convey little information. *Pinus witimi*, based on a winged seed, suggests a much later epoch; but

[1]Comparison may also be made with the genus *Baikalia* Martens, living today in Lake Baikal.
[2]The name *Cyrena pusilla* is preoccupied by *Cyrena pusilla* "Parreyss," Phil., Abbild. II. 78. Cyrena, Tab. 1, f. 7 (February 1846), from the Nile. The fossil species described by Reis may be known as **C. reisi**, new name.

there is no reason why this should not be called *Pityospermum witimi*. The genus *Pityospermum* of Nathorst includes winged seeds resembling *Pinus*, found in the Jurassic. Another Siberian species, *Pityospermum maackianum*, was described by Heer as *Pinus maackiana*.[1]

UST BALEI BIOTA

There remains one other method of attacking our problem, by comparison with the biota of the Ust Balei beds, north of Irkutsk and west of Lake Baikal. These beds were first mentioned by Trautschold in 1867, and since then have proved fruitful of plants and insects. They are universally recognized as Jurassic and generally ascribed to the Middle or "Brown Jura," more or less equivalent to the Lower Oölite. Since those who consider the *Lycoptera* shales Jurassic, agree in placing them in the Upper Jurassic, it is not to be expected that they should carry the same biota as the Ust Balei; but there might be some similarity.

The Ust Balei insects, as recorded, number about 25 species, as follows:

Blattoidea: *Ophismoblatta sibirica* (B., R. and G.)[2]; *O. maculata* (B., R. and G.). The first is a wing, the second a nymph.

Mantoidea: *Pseudohumbertiella grandis* (B., R. and G.). Based on half a wing; was supposed to be a mantid, but Handlirsch thinks it may better be referred to the locustoids.

Dermaptera: *Baseopsis* (?) *sibirica* B., R. and G. Based on the anterior half of an insect; was supposed to be an earwig, but Handlirsch regards it as unrecognizable, perhaps a beetle larva.

Orthoptera: *Parapleurites gracilis* B., R. and G. A good tegmen, referred by Handlirsch to his family Locustopsidæ.

Panorpatæ: *Mesopanorpa hartungi* (B., R. and G.). Referred to the family Orthoplhebidæ.

Plecoptera: *Mesonemura maacki* B., R. and G. (imago); *Mesoleuctra gracilis* B., R. and G. (larva); *Platyperla platypoda* B., R. and G (larva).

Ephemeroidea: *Mesobaëtis sibirica* B. R. and G.; *Mesoneta antiqua* B., R. and G. These are May-fly nymphs of

[1]This is spelled *maakiana* in the books, but it was named after Maack, the celebrated Siberian explorer.

[2]Brauer, Redtenbacher and Ganglbauer (1889).

ordinary size, quite unlike the giant forms of the fish shales.

Odonata: *Palæophlebia synlestoides* B., R. and G. (an imperfect wing). *Samarura gigantea, minor, pulla, angustata* and *rotundata,* all of B., R. and G. (nymphs).

Coleoptera: *Carabocera prisca* B., R. and G.; *Timarchopsis czekanowskii* B., R. and G.; *Doggeria sibirica* Handl.; *Memptus braueri* Handl.; *M. redtenbacheri* Handl. Five beetles of rather doubtful affinities. *Elaterites sibiricus* Heer is said to come from Irkutsk.

Diptera: *Mesopsychoda dasyptera* B., R. and G.

Lepidoptera or Homoptera: *Phragmatæcites damesi* Oppenheim; *Palæocossus jurassicus* Oppenheim; two remarkable insects considered by Handlirsch to be primitive Lepidoptera, but Tillyard has recently given apparently conclusive reasons for referring the Palæontinidæ to the Homoptera. They are recorded from East Siberia, and were, I presume, from Ust Balei.

These insects show no affinity with those of the fish shales, and since they constitute an analogous fresh-water and lake-side fauna, the absence of the large ephemerids is especially noteworthy. The number of species (especially in view of the fragmentary condition of many) is too small to permit any very decisive conclusions, and it is much to be desired that the locality should be explored again for additional material. We can, however, state that the Ust Balei fauna is not that of the fish shales.

Heer described a number of plants from Ust Balei, but as Seward has shown, his work needs radical revision. So far as we know it, the flora does not seem to correspond with that of the fish shales.

We must then conclude that the fish shales of Ondai Sair and the Transbaikal contain a fairly homogeneous biota, which must be approximately of one age. This biota is quite distinct from that of the Ust Balei beds, and presumably much later. It may be Upper Jurassic, but there is no proof that it is not Lower Cretaceous. Actually, it presumably belongs to a period near the beginning of the Lower Cretaceous and its classification as Jurassic or Cretaceous may be merely a matter of arbitrary definition. In any event, this biota, which represents an early stage in

the development of a number of groups still surviving, is of great interest and well merits further investigation.

INSECTS

EPHEMERIDA

(PLECTOPTERA)

The May flies were well developed as early as the Permian, with many genera. Numerous species are known from the lithographic stone of Bavaria (Jurassic), and a series of nymphs or larvæ has been obtained from the Jurassic rocks of Siberia. The Permian species, constituting a family, Protereismatidæ, are remarkable for having the hind wings as large, or nearly as large, as the upper. Nevertheless the venation is singularly modern, as can be seen by comparing the Permian *Prodromites*[1] *rectus* (Sellards) with such a genus as the living *Ameletus*. Thus it may be said that at least some of the Permian wings approach the modern Siphlonuridæ in structure and it is therefore perhaps less surprising to find apparently genuine siphlonurids in the Jurassic. The genus *Pædephemera* of Handlirsch, with four species in the lithographic stone of Bavaria, scarcely differs at all in the wings from *Siphlonurus*, except that the hind wings are appreciably larger. The gigantic Mayfly nymphs from the fish shales of Siberia have also the characters of the Siphlonuridæ, but differ from *Siphlonurus* in having more double abdominal gills, herein agreeing better with Bengtsson's genus *Siphlurella*. The venation of the adult, as shown by the Mongolian material, is more like that of *Ephemerella*, but also shows distinct affinity with the Permian *Prodromites*. The modern siphlonurids will then constitute a subfamily Siphlonurinæ, in contrast with the gigantic Mesozoic Ephemeropsinæ.

EPHEMEROPSIS Eichwald

Eichwald in 1864 founded the genus on an unfigured nymph from Siberia, which he called *E. trisetalis*. It came from the shales of the Transbaikal country, in the vicinity of Nertchinsk, north of the Gobi Desert. In 1868 the same author obtained a larger specimen from the same formation and vicinity and set it forth, with a figure, as *E. orientalis*. As Handlirsch remarks, this is very probably the same as *E. trisetalis*. Considerably earlier, in 1848, Müller had figured the tail of one of these nymphs in Middendorff's "Reise," the locality being Byrka, Siberia. Handlirsch bases his *E. middendorffi* on this figure but, except that the caudal appendages are said to be only about 15 mm. long (instead of 20

[1] **Prodromites**, new name for *Prodromus* Sellards, 1907 (not Distant, 1904).

mm. or over), there is nothing to distinguish it. In 1889, Brauer, Redtenbacher and Ganglbauer figured a nymph from Turga, Siberia, which they considered to be *Ephemeropsis orientalis*. Handlirsch, on their account, founds a new generic name, *Phacelobranchus*, calling the species *P. braueri*. The genus is founded on the fact that the tracheal gills are beset with fine hairs, as in the siphlonurid genus *Chirotonetes* Walker, which, however, has quite differently shaped gills. These hairs are seen only with difficulty and I cannot doubt that they exist in true *Ephemeropsis* as well. O. Reis (1910), in describing the fauna of the fish shales of the Transbaikal, figures *Ephemeropsis orientalis* with six pairs of double gills, the outer portion ciliated. The figure represents a "restoration" and in some details is not very accurate. Without having the original types, it is difficult to be positive about the actual characters of the four supposed species, but my present opinion is that they are all synonymous, and accordingly to be designated *Ephemeropsis trisetalis* Eichwald. Furthermore, I am not at present able to discern that the Ondai Sair species is separable from Eichwald's.

Ephemeropsis trisetalis Eichwald

Plate I, Figures 1 to 9; Text Figures 2, 3, 4

NYMPH.—The one nearly complete Ondai Sair specimen is about 40 mm. long from front of thorax to base of caudal appendages (Pl. I, fig. 1). The thorax is about 13 mm. wide, thus considerably broader than in the Reis restoration, the body distinctly tapering posteriorly as in the figure of *Phacelobranchus*. I believe the last two pairs of gills are not double, but it is difficult to be sure that the inner lobe is not concealed beneath the abdomen (Pl. I, figs. 1, 2). The outer tapering lobe, resembling a slender knife blade in form, is about 5 mm. long, as described for *E. trisetalis* (Pl. I, fig. 3). The hind margins of the last two abdominal segments are laterally produced and pointed, as in the modern *Siphlonurus*. This feature is not brought out by Reis, but it is better indicated in the figure of *Phacelobranchus*, though even here the projections of the last segment are not nearly long enough. The lateral caudal appendages are 23.5 mm. long; the middle one is evidently shorter, but my best specimen does not show the extreme tip (Pl. I, figs. 4, 5). I have been fortunate in finding nymphal wing pads, with venation as shown in the figures (Fig. 2 and Pl. I, figs. 6, 7). The drawing, figure 2, shows the branching of the radius (radial sector), about 6 mm. from base and 5 from apex of wing, and what looks like a faint cross vein from the lower branch to the vein below.

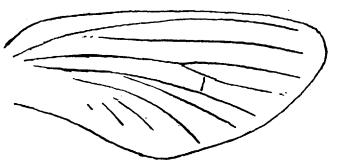
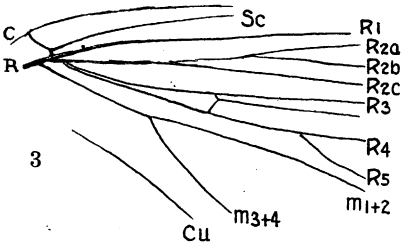


Fig. 2. Nymphal wing of *Ephemeropsis*.

WINGS.—Part of the adult wing has been preserved in one instance (Figs. 3, 4, and Pl. I, figs. 8, 9). It has the following characters: costa strongly arched at base, the strong oblique vein ending in the highest part (basad of this in *Ephemera*); sub-

costa normal, but at oblique vein very close to radius; radius (R_1) stout, practically parallel with subcosta; radial sector branching early, but not widely spreading, the upper branch forking about 7.5 mm. from its origin, the fork thus formed very narrow, its lower branch not elbowed, but doubling of cells beginning after the fourth; R_3 eventually widely divergent from R_4 (following Tillyard's nomenclature),[1] leaving a large open reticulated area, with some supplementary longitudinal veins; R_{4+5} (M_{3+4} of Miss Anne Morgan) forking about 7.7 mm. from base of wing, the fork very wide, the lower branch most divergent but not elbowed at base, several supplementary longitudinal veins between the branches; first cubitus close to second, with no place for oblique veins to margin.



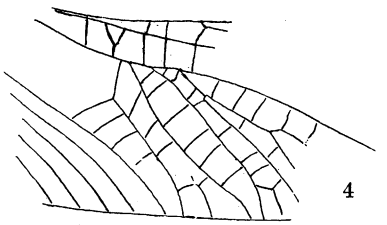


Fig. 3. Venation of the basal part of adult wing of *Ephemeropsis:* an analysis of the photograph, Plate I, Fig. 10.

C, costa; Sc, subcosta; R, radius; R1, 2, 3, 4, 5, branches of radius; Media, with branches m_{1+2}, $_{3+4}$; Cu, cubitus.

Fig. 4. Venation of part of the wing of *Ephemeropsis.* Compare with Plate I, Fig. 11.

The above description is based on the supposition that the wide fork so conspicuous in the specimen is actually the last radial fork of Tillyard, the medial fork of other authors. Difficulty arises, however, when we attempt an analysis of the radial branches, unfortunately somewhat disturbed by breakage. Leaving the wide fork out of the question, the radial branches lie close together, forking at extremely acute angles. The main branch of the sector is thicker and darker than the others and divides early, its upper branch again forking as described above. From the base of the main sector below appear to arise two branches, the one at the extreme base being the stem of the wide fork (supposed above to be R_{4+5}); the other, a little (1.3 mm.) farther along, is resolved on close inspection into two rather weak veins, practically contiguous, but after about 3 mm. gradually diverging, as shown in the figure. The uppermost of these veins again divides 4 mm. farther on, but the lower section is angulated basally, meeting a cross vein. The second or lower of these veins diverges widely apicad from the supposed R_4 and about 8 mm. from its origin branches again with a wide fork, the lower portion being so

[1]Tillyard, 1923. Trans. New Zealand Institute, LIV, p. 227.

delicate as to appear like a supplementary vein. Now, if we assume that the conspicuous wide fork represents Tillyard's media (cubitus of Miss Morgan), then the weak fork above it and more apicad, although appearing doubtfully to belong to the primary venation, is the last fork of the radial sector, usually conspicuous in May-fly wings. On this basis, the veins above are all branches or divisions of R_2, except the lowermost, which is R_3. It then appears that R_3 arises from the sector at practically the same point as R_{4+5}, contrary to what we might expect, and contrary also to the condition in the Permian *Prodromites*. It is possible, however, to maintain that the closely adjacent veins arising from near the base of the sector are actually R_4 and R_5, separate to base, the vein R_3 being placed as usual.

Very competent authors who have intensively studied the venation of May flies have already given us three quite different interpretations, so perhaps we may be excused if we hesitate to dogmatize about the homologies in *Ephemeropsis*. If the vein R_2 can present so many ramifications, other veins may also show unexpected complexity, and the determination of the basic scheme of venation becomes difficult. Certainly the wing pad of *Ephemeropsis* does not suggest that the complexities of the adult wing are directly derived from the primary veins.

It is proper to state that we have no absolute proof that the wing described belongs to the same species as the nymphs; but as it occurs with them and is of suitable size, I cannot doubt that it is identical.

HORIZON AND LOCALITY.—Ondai Sair formation (paper shales), Ondai Sair, Mongolia. The wing and wing pads were in the field parcel No. 79. The nearly entire nymph is in field parcel No. 64, but pieces of the same nymphs are also from parcel No. 79.

Ephemeropsis melanurus, new species

Plate I, Figure 10

SPECIFIC CHARACTERS.—Abdominal gills 4.3 mm. long, double, both parts sharply pointed; the outer slender, curved below the middle; the inner broad, its width about 1.4 mm., caudal appendages fringed as in *E. trisetalis*, but much smaller, probably about 10 mm. long (about 8 mm. preserved), the appendages and their fringes black (fringes pale in *E. trisetalis*). The median tail at base is only about half a millimeter wide, while that of *E. trisetalis* is a full millimeter; but nevertheless at 7 mm. from base the tail with fringes is 2.5 mm. across, the fringes being very long.

HORIZON AND LOCALITY.—Ondai Sair formation (paper shales), Ondai Sair, Mongolia.

Although this specimen shows only the structures described, it is certainly a distinct species. Both the caudal appendages and the gills are sufficiently characteristic for recognition.

ODONATA

Æshnidæ

Cymatophlebiinæ (Cymatophlebiina Handlirsch)

CYMATOPHLEBIA Deichmüller

This genus was based on a species from the lithographic stone of Solnhofen in Bavaria. A new figure was given by Needham (1907) in Bull. Amer. Mus. Nat. Hist., XXIII, p. 141. The Mongolian fossil is too incomplete for certain generic reference, but what there is agrees sufficiently with *Cymatophlebia.*

Cymatophlebia (?) **mongolica,** new species

Plate II, Figures 3, 4, 5

Costa and radius very stout; cells between costa and subcosta before nodus broader than high, thus much broader than in *C. longialata* (Germar); cells between subcosta and radius in same region similarly broad; radius in this region nearer to media than to subcosta; nodus as in *Cordulegaster;* costal cells beyond nodus broader than high; media branching at lower end of the very oblique subnodus; M_2 bent near base as if by a cross vein to R_5, but I think this is merely a distortion. These characters are from the type, in parcel No. 64.

HORIZON AND LOCALITY.—Ondai Sair formation (paper shales), Ondai Sair, Mongolia.

Another specimen (also with No. 64) shows the nodus and part of the region just beyond. It is so much distorted that it looks like another species, M_1 being under the radius, and the end of the subcosta thrust upward. It is of value only as showing an early duplication of cells between M_1 and M_2, a character of *Cymatophlebia*, only whereas in the latter the paired cells are about equal, in our fossil the first few paired cells show the upper one very large and the lower very small, hardly a fifth the size of the upper. More apicad, the cells rapidly become subequal. Still another specimen (field label No. 79) shows part of the sub-basal region of wing and indicates the presence of high narrow cells in the hind wing, the lower portion folded over and much confused.

TRICHOPTERA

TRICHOPTERELLA, new genus

GENERIC CHARACTERS.—Size medium; wings broad; costal margin very gently arched, slightly concave near base; radius (R_1) straight to R_1-R_2 cross vein, then arched upward, resuming a direct course at a higher level; radial sector arising near base of wing, branching to form a long discoidal cell, the base of which is more acute than the base of the first fork; cross vein at end of discoidal cell somewhat oblique; separation of R_2 from R_3 a short distance before end of discoidal cell, of

R_4 and R_5 just beyond discoidal cell; no R-M cross vein; media apparently with only two branches, but the ends of these are obliterated and it is not impossible that they forked near the apical margin; fork of media at about same level as fork of R_4 and R_5; M-Cu cross vein obliquely arising from media a little before the fork and joining the cubitus at the fork or very slightly before it; first anal straight to end, parallel with and remote from second; postcosta or second anal forming with the others the usual pointed cell, enclosing a smaller cell toward base. Only the anterior wing is known.

Trichopterella torta, new species

Figure 5

SPECIFIC CHARACTERS.—Anterior wing 15.5 mm. long, 6 mm. wide; veins pale brown, no markings preserved; discoidal cell 3.8 mm. long; R_5 branching 5.7 mm. from base of wing; long anal cell ending 5 mm. from base of wing; length of cubital fork 4 mm.

HORIZON AND LOCALITY.—Ondai Sair formation (paper shales), Ondai Sair, Mongolia. In parcel No. 64.

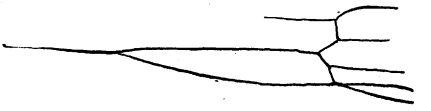


Fig. 5. Discoidal cell of wing of *Trichopterella torta.*

The numerous Trichoptera from the Lias are all small, the anterior wings ranging from 3.2 to 9 mm. long, only one species exceeding 5 mm. Two of the Lias genera, also represented by small species, occur in the Jurassic. The entirely separate and parallel-running first anal of *Trichopterella* is equally seen among the Lias genera, such as *Necrotaulius*, *Mesotrichopteridium* and *Pseudorthophlebia*. All these insects, however, have the characteristic anal cells, which are lacking in Tillyard's Mesopsychidæ (four genera) from the Upper Triassic of Queensland.

On the other hand, *Trichopterella* seems to be specialized, after the manner of the Tertiary and modern *Setodes*, in the reduction of the media to two simple branches; but it is not impossible that these were forked near the margin. The media and cubitus of *Trichopterella* separate very early, at the same level as the origin of the radial sector, hence the cellula thyridii is very long, nearly twice as long as the discoidal.

There is a rather wide crack in the rock across the middle of the wing, but this does not obscure the venation.

There is one Jurassic genus, *Mesotaulius* of Handlirsch, from the lithographic stone of Bavaria, which has the anterior wings 31 mm. long. It has little affinity with *Trichopterella.*

The living genus *Alepomyia* Banks from Newfoundland has a two-branched media, but is otherwise quite distinct from *Trichopterella*.

Reis recorded a trichopterous larva case from the fish shales of the Transbaikal. A similar or identical species occurs in the Ondai Sair shales, as follows:

Indusia reisi, new species

Plate II, Figure 10, on the stem of *Phyllocladites*

SPECIFIC CHARACTERS.—A larva case was found contiguous with the base of a specimen of *Phyllocladites morrisi*. It is cylindrical, straight, very broad, composed of grains of sand, and similar to that of the modern genus *Stenophylax*. On the east side of the main draw, half way between Uskuk and Hsanda Gol, F. K. Morris found a heavy slab, about 15 mm. thick, showing numerous specimens of *Estheria middendorffi* and a few caddis cases on one side, and on the other very numerous caddis cases. From this additional material it can be determined that *Indusia reisi* cases are sometimes as much as 22 mm. long, very slightly curved, 2 mm. diameter at the little end, 3.7 at the larger. The distinct pebbles are mainly at the larger end, the choice of materials varying with age, as in *Stenophylax*. The case figured by Reis was ornamented with ostracods.

HORIZON AND LOCALITY.—Ondai Sair formation (paper shales), Ondai Sair, Mongolia.

DIPTERA

Chironomidæ

CHIRONOMOPSIS Handlirsch

This genus was based on *Chironomus arrogans* Giebel, a name founded on Brodie's figure of a supposed *Chironomus* from the English Purbeck. It shows no distinct generic characters and I have used the name only in a general sense, as applicable to fossil Chironomidæ of uncertain status.

Chironomopsis gobiensis, new species

Plate II, Figures 6, 7

SPECIFIC CHARACTERS.—Female. Length about 7 mm.; head small, with large eyes; antennæ long and slender, with cylindrical joints, longer than broad, not visibly hairy; palpi extended, about half as long as antennæ; thorax elevated, gibbous anteriorly; legs long, tibiæ apparently longer than femora, hind tibiæ about or nearly 3 mm. long. Color as preserved, brown, evidently dark brown or blackish in life.

HORIZON AND LOCALITY.—Ondai Sair formation (paper shales), Ondai Sair, Mongolia. In parcel No. 79.

Several specimens, apparently referable to a single species, have been found. So far as visible, the antennæ and mouth parts strongly suggest the bloodsucking *Culicoides* group, but it would be going too far to affirm distinctly that this is a bloodsucking form. It is possible that

the bloodsucking habit among Diptera arose without reference to the Mammalia, as *Simulium* is known to attack young fish and Culicidæ have been seen to prey an cold-blooded vertebrates, reptiles and amphibians. Thus the opportunities for the development of such habits presumably existed before there were any Diptera.

C. gobiensis is evidently the species reported as "mosquitoes," but I think it is practically certain that it does not belong to the Culicidæ. It is very different from *Mesopsychoda dasyptera* Brauer, Redtenbacher and Ganglbauer, from the Jurassic of Ust Balei, Siberia.

COLEOPTERA

There are two or three species of beetles in the Ondai Sair collection, but their preservation is so poor that I do not venture to describe them (Pl. II, fig. 8). The *Carabites latecostatus* of Reis is certainly not represented.

PLANTS

GINKGOALES?

Baiera furcata (Lindley and Hutton)

Plate II, Figure 9

The plant remains in the Ondai Sair shales are fragmentary and not readily referable to particular species. There is, however, one specimen which, so far as it goes, appears to agree exactly with *Baiera furcata* (Lindley and Hutton) Braun, which Seward calls *B. lindleyana* (Schimper), disregarding priority. This *B. furcata*, or fossils indistinguishable from it, may be either Jurassic or Lower Cretaceous. Seward states that it is known from the Middle Jurassic of Chinese Dzungaria; he is also disposed to refer to it the plant from the Lower Cretaceous of the Black Hills, which Fontaine recorded as *Czekanowskia nervosa* Heer. *Baiera* is in general highly characteristic of the Jurassic but rare in the Lower Cretaceous.

From the Siberian Jurassic, Heer recorded a *Trichopitys setacea*. The genus *Trichopitys* of Saporta, with *Baiera*-like foliage, was originally based on a plant from the Permian, which appears to be related to the Ginkgoales. Seward has suggested that *T. setacea* does not belong to the Permian genus, but is to be compared with *Baiera lindleyana*.

In the Ondai Sair shales are robust shoots bearing stalked obpyriform bodies more or less comparable with the fruits of *Trichopitys heteromorpha* as figured by Zeiller. In one specimen, at least, there is a distinct seedlike impression at the base, and on closer analysis there seems to be

nothing to separate the species from *Phyllocladites* Heer (*Drepanolepis* Nathorst), which occurs in the Jurassic of Spitzbergen. Seward defines the genus as consisting of strobili of open habit with single-seeded sporophylls, of uncertain systematic position but probably gymnospermous. The general resemblance to the fruiting shoots of the Ginkgoales is sufficiently close to suggest a possibility that these are after all the fruits of *Baiera furcata*, or at least belong with the foliage which cannot be separated from the latter species. There is, however, some indication of possible narrow bract scales, suggesting remote affinity with *Larix*. It seems desirable to give this organism a name, so it may be introduced as follows:

Phyllocladites (?) **morrisi,** new species

Plate II, Figures 10, 11; Text Figure 6

SPECIFIC CHARACTERS.—Stout erect shoots, at least two inches long, the straight stiff stem about 2 mm. wide about 35 mm. from apex; sporophylls on short stout stalks about 2 mm. long. Sporophylls 6 to 7 mm. long, about 3.5 wide near base, obpyriform, with very obtuse apex. Ovules or seeds circular.

HORIZON AND LOCALITY.—Ondai Sair formation (paper shales), Ondai Sair, Mongolia. In parcel No. 64.

Named after Mr. Frederick K. Morris, who collected the material.

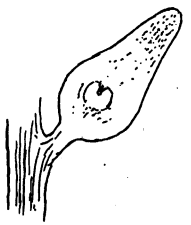


Fig. 6. *Phyllocladites morrisi.*

I sent a sketch of this plant to Dr. E. W. Berry; he kindly replied that he was not able to place it with any species known to him.

Czekanowskia species

Four contiguous broad-linear (1.5 mm. diameter) leaves, the portion preserved 56 mm. long, resemble pine needles, but apparently belong to *Czekanowskia*. It is impossible to refer them to any particular species.

Ondai Sair formation, "No. 64, Ondai Sair."

Reis has figured similar leaves, but apparently more slender, from Turga. He referred them to *Czekanowskia* sp. The genus is characteristic of Jurassic strata, but is reported from the North American Cretaceous.