First record of *Ephemeropsis*, *Coptoclava*, Coleoptera inc. sed. and *Turfanograptus* from Lower Cretaceous paper-shales of the western-most site of Mongolia

Hellmut Jähnichen¹ & Eberhard Kahlert¹

With 5 figures and 2 plates

Abstract

Nymph-fragments (and detached cerci) of the may-fly *Ephemeropsis trisetalis* Eichwald and the water-beetle *Coptoclava longipoda* Ping, a coleopteran and a shell-fragment of the conchostracan *Turfanograptus* sp. are described for the first time from Lower Cretaceous paper-shales of Bajan-Khongor, Mongolia. The assemblage *Lycoptera* (fishes included in the Order Osteoglossiformes, Fam. Lycopteridae) - *Ephemeropsis-Coptoclava* correlates with Lower Cretaceous deposits in Transbaikalia, Mongolia and North-Eastern China. The fern-species *Adiantopteris sewardi* (Yabe) Vassiljevskaja and *Adiantopteris toyoraensis* (Oishi) Vassiljevskaja occur in fine-sandstones of Bajan-Khongor (Jähnichen & Kahlert 1972). Their importance as Early Cretaceous flora-elements is discussed.

**Key words:** *Ephemeropsis*, *Coptoclava*, *Turfanograptus*, paper-shales, Lower Cretaceous.

Zusammenfassung


**Schlüsselwörter:** *Ephemeropsis*, *Coptoclava*, *Turfanograptus*, Dysodil, Untere Kreide.

Introduction

Comprehensive mapping of the geology and mineral resources was carried out in the nineteen sixties by German geologists in Mongolia in the South-Changay-Plateau between the rivers Bajdaragin-gol and Taican-gol in the region of Bajan-Khongor. A yellowish-grey, soft silty, limonitic fine grained sandstone and paper-shales were given to the authors for palaeobotanical investigations. From the weathered fine-sandstone a poorly preserved Early Cretaceous flora was described (Jähnichen & Kahlert 1972). By contrast, the paper-shales produced no macro-palaeobotanical material, but did contain some fossil animal remains.

The thin, fine-splitting paper-shales are grey-brownish, gypsum-efflorescences are destroying the sediment. According to Berkey & Morris (1924/25) the paper-shales are limnic, semi-arid sediments deposited in salt-pans, flood-plains and near-shore layers.

The fossil remains of the paper-shales and argillites have been described from Transbaikalia (Turgino-Vitimskaja Svia), Mongolia (e.g., On-dai-Sair Formation) and the Jehol Beds of North-East China by many authors (e.g., Eichwald 1864, 1868, Müller In Middendorf 1848, Brauner et al. 1889, Handlirsch 1906–1908, Reis 1909, Berkey & Morris 1924/25, Cockerell 1924, 1927, Ping 1928, Ueno 1935, Demoulin 1954, 1956, Novojilov 1957, 1960, Meschkova 1961, Ponomarenko 1961, Tschernova 1961, 1962, Jähnichen

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¹ Museum für Naturkunde, Institut für Paläontologie, Invalidenstraße 43, D-10115 Berlin, Germany.

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The Lycoptera-Ephemeroptera-Coeloptera assemblage correlates with Lower Cretaceous deposits from Transbaikalia (Turgino-Vitimskaya Svita), Mongolia (Ondai-Sair) and North-Eastern China (Jehol Beds) / (for details see Chang & Jin 1996).

The studied material is deposited at the Institut für Paläontologie, Museum für Naturkunde der Humboldt-Universität, Berlin (MB).

Systematic paleontology

Order Ephemeroptera Haytt & Arms, 1890
Family Hexagenitidae Lamèère, 1917
Genus Ephemeroptera Eichwald, 1864

Type-Species: Ephemeroptera trisetalis Eichwald, 1864
Figs 1, 2, Pl. 1, Figs 1–4

Synonyms
1848 “Ephemeria”-Neuropteren-Larve – Müller In Middendorf, A. Th.: 261, t. 1(i), fig. 7; Transbaikalia, Byrka, Lower Cretaceous.
1868 Ephemeroptera orientalis – Eichwald: 1192–1195, pl. 37, fig. 8; Transbaikalia, Lower Cretaceous.
1889 Ephemeroptera orientalis – Brauer, Redtenbacher & Ganglbauer: 5, pl. 1, fig. 4a–d; Transbaikalia, Turga, Jurassic.
1908 Ephemeroptera trisetalis Eichwald – Handlirsch: 603, sine icon; Transbaikalia, Nertschinsk, Towega, Lower Cretaceous.
1908 Ephemeroptera middendorfi – Handlirsch: 604, sine icon, Transbaikalia, Byrka, Upper Jurassic.
1908 Ephemeroptera orientalis Eichwald – Handlirsch: 604, sine icon; Transbaikalia, Turga, Upper Jurassic.
1908 Phacelobranchus braueri Handlirsch: 604, t. 46, fig. 33; Transbaikalia, Turga, Upper Jurassic.
1909 Ephemeroptera orientalis Reis: Transbaikalia, Upper Jurassic.
1924 Ephemeroptera trisetalis Eichwald – Cockerell: 137, pl. 1, figs 1–9, text-figs 2–4; Mongolia, Onda-Sair Formation, Lower Cretaceous.
1924 Ephemeroptera melanurus Cockerell: 139, pl. 1, fig. 10; Ondai-Sair, Lower Cretaceous.
1928 Ephemeroptera trisetalis Eichwald – Ping: 38, figs 17–18, pl. 2, figs 1–2; North-Eastern China, Jehol Beds, Lower Cretaceous.
1956 Ephemeroptera trisetalis Eichwald – Demoulin: 5, fig. 1 (reconstruction), Jurassic.
1961 Ephemeroptera trisetalis Eichwald – Tschernova: 862, figs 2–6, pl. 1, fig. 1; pl. 2, fig. 1; Transbaikalia, Lower Cretaceous.
1962 Ephemeroptera trisetalis Eichwald – Tschernova In Osnovy paleontologii 9: 58–59, text-figs 64 and 66, pl. 1, figs 1–3 – Transbaikalia, Jurassic.

1992 Ephemeroptera trisetalis Eichwald – Carpenter: 20, fig. 14/6a–c.

Material: MB. J. 1788–1790; Two nymph-fragments and five larvae irregularly embedded and with detached cerci from Lower Cretaceous paper-shales of Buriduin-gol, Bayan-Khongor, Mongolia. This is the western-most occurrence for this taxon.

Fig. 1. Nymph-fragment of Ephemeroptera trisetalis Eichwald, Bayan-Khongor, Mongolia (MB. J. 1788)
Fig. 2. *Ephemeropsis trisetalis* Eichwald, Transbaikalia, Turgino-Vitimsk Svita (after Meschkova 1961: fig. 2)

**Description:** Nymph-fragments without cephalon, thorax and extremities, consisting of five specimens irregularly embedded on a small area 60 × 30 mm. The best preserved specimen contains eight abdominal segments with traces of tracheal gills along the sides of the abdomen and has three cerci (Pl. 1, Fig. 1). The abdominal segments are 39.5 mm long, the lateral cerci are 12.5 mm in length, and the paracercus is 11.0 mm long. Detached cerci are also preserved. The laterals are provided with ciliae only on the inner side, while the paracercus is ciliated on both sides. The ciliae are typically 1.8 mm long (Pl. 1, Figs 2–4).

**Further occurrence:** According to Ponomarenko (pers. comm. 1974) *Ephemeropsis trisetalis* was collected in 31 localities of the Transbaikalia- and Amur-Region, in seven localities of North-East- and Central Mongolia, and also in seven localities of North- and East China.

**Comments:** *Ephemeropsis trisetalis* was established by Eichwald (1864) on the basis of material from the Turgino-Vitimskaya Svita of Transbaikalia. Further studies have confirmed the presence of *E. trisetalis* from Mongolia and North-Eastern China, see reference in the synonymy-list. After comprehensive studies of about 1700 fossil larvae from Transbaikalia and Mongolia Meschkova (1961) produced a reconstruction of the nymph indicating the cephalon, thorax, segments, extremities and tracheal gills. In addition, she discovered that the deeply split tracheal gills (Demoulin 1956) have a different exterior shape directly depending on favourable conditions of preservation. In fine-grained material the gills have a shallow, leaflike shape, but in our material only traces of the exterior and inner margins of the gills are preserved (Figs 1–2).

Tschernova & Sinitschenkova (1974) first illustrated the full venation of the front wing of *E. trisetalis* from the Turgino-Vitimsk Svita of Transbaikalia.

Tschernova (1961) confirmed the inclusion of *Ephemeropsis trisetalis* within the family Hexagenitidae Lamere, 1917, as already postulated by Demoulin (1954), because the Early Cretaceous specimens are essentially different from members of the Paedephemeridae.

Order *Coleoptera* Linné 1758  
Family *Coptoclavidae* Ponomarenko, 1961  
Genus *Coptoclava* Png, 1928  

**Type species:** *Coptoclava longipoda* Png, 1928  
Fig. 3, Pl. 2, Fig. 1

**Synonyms**


**Material:** MB. J. 1793: One fragment with counterpart from Lower Cretaceous paper-shales of Buriduin-gol, Bayan-Khongor, Mongolia. This is the western-most occurrence for this taxon.

**Description:** A single nymph-fragment with counterpart containing six and four ventral segments, 9 mm in length. Tergites strongly sclerotised. From the last reduced segment two sagittiform chitinized urogomphi extend over 5 mm in length. Between the last two segments traces of a tracheal trunk are represented by two lines without spiral thickenings, as in the reconstruction by Ponomarenko (1961: fig. 5) (Fig. 3, Pl. 2, Fig. 1).
Comments: The genus *Coptoclava* with a single species, *C. longipoda*, was established and described by Ping (1928) from the Lower Cretaceous Laiyang-Formation of Shantung Province, North-Eastern China. After comprehensive investigations of 221 specimens from the Turgino-Vitimsk Svita of Tansbaikalia and 7 specimens from the Ondai-Sair Formation of Mongolia Ponomarenko (1961) presented a complete description of *C. longipoda*. This included the body structure of the full imago containing mandibulae, thorax, ventral segments, extremities, a complex tracheal-system and urogomphi. The middle and hind legs were used as swimming-rowing and the fore legs as catching organs. Growth-stages of larvae were distinguished.

According to Ponomarenko (1961: 72) "the nymphs of *Coptoclava longipoda* were restricted to lakes with sapropelitic soils and sparse vegetation. Larvae of *Coptoclava* concurrently occur with nymphs of *Ephemerosis triseta*, the latter possibly serving as nutriment for the former".

**Coleoptera inc. sed.**

Fig. 4, Pl. 2, Fig. 4–5

Material: MB. J. 1791: A single imprint with counterpart from Lower Cretaceous paper-shales of Buriduin-gol, Bayan-Khongor, Mongolia. This is the western-most occurrence for this taxon.

Description: Body with a straight-ovulate shape, 3 mm in length and 1.7 mm in width. Head deeply withdrawn in the pronotum. Eyes probably flat. Both first members of the antennae are relatively thick, curved outwards and nearly twice as long as thick. Their length corresponds to the distance between the attachment positions on the head. The pronotum is a little broader than long, with the greatest width in the centre. The pronotum tapers weakly both anteriorly and posteriorly. On the upper side there are recognizable structures.

The elytra are 0.8 mm long, and are distinctly broader than the base of the pronotum. The angle of the shoulder observable, in the first fifth part with 3–4 longitudinal ribs (Fig. 4, Pl. 2, Figs 4–5).
Comments: Since coxae and legs are not preserved, the taxonomic position of this specimen could not be assigned. On the basis of the morphological features of the pronotum and the elytra the specimen may belong to the Heteromera or Malacodermata, perhaps demonstrating an intermediate position between the archaic Cupediformes and the two previously mentioned groups (F. Hiecke, pers. comm. 1969).

Order Conchostraca Sars, 1867  
Genus Turfanograpta Novojilov, 1957

Turfanograpta sp.  
Fig. 5A, B, Pl. 2, Figs 2–3

Material: MB J. 1792: A single shell-fragment from Lower Cretaceous paper-shales of Buriduin-gol, Bayan-Khongor, Mongolia. This is the western-most occurrence for this taxon.

Description: Only one small, thin shell-fragment with about 13 growth-lines, measuring 12 mm long by 7.5 mm high. Growth-lines at the top more widely spread, subsequently are densely arranged. The most important morphological character are the dense, radially arranged long-fibrous striae branching off and linking together resulting in a longitudinal irregular net-like structure. This very characteristic ornamentation corresponds to the genus-diagnosis for Turfanograpta given by Novojilov (1957: 237, fig. 1), however, the presence of tubercles ("usually with a short spine") on the margins of the growth-lines can not be confirmed (Fig. 5, Pl. 2, Figs 2–3).

Comments: Within the Palaeontological Atlas of North-East China (1980: 71–72, pl. 34, figs 1–3) two new species are described as Turfanograpta dichoforms and T. filiformis Wang from the Dalazi-Formation of Yanji (former Jehol Province). The fine ornamentation of the latter is identical to that of T. chowmincheni from Sinkiang and the new material from Bayan-Khongor, Mongolia. But the real organic nature and presence of tubercles ("tumorlike" spines) were not acknowledged by Wang who assumed "... the latter may be fibrous structures of the retained valves leading to somewhat irregular marginal sculpture".

1. Coptoclava longipoda Ping, nymph-fragment with six ventral segments, tergites strong sclerotized and two sagittiform urogomphi. MB. J. 1793, × 8.5.  
2. Turfanograpta spec., with dense radially arranged long-fibrous striae in the intervals. MB. J. 1792, × 16.  
3. Turfanograpta sp., one single shell-fragment with ca. 13 growth-lines. MB. J. 1792, × 6.  
4–5. Coleoptera inc. sed. With counterpart, head deeply withdrawn in the pronotum, with two preserved antennae, recognized structures on the counterpart. MB. J. 1791, × 32

Fig. 5. Turfanograpta spec. from Mongolia.  
A. Shell-fragment with radially arranged growth-lines, × 10.  
B. With dense, radially
It is interesting that according to Ponomarenko (pers. comm. 1974) “... not a single specimen of Turfanograpta within several thousands of conchostracan shells has been determined from the Lower Cretaceous deposits of Mongolia”.

**Stratigraphy**

Concerning the stratigraphical correlation of the paper-shales at Bayan-Khongor of the So‘g‘ey-Chundey- Basin, the Early Cretaceous flora (Jähnichen & Kahlert 1972) of the fine-grained sandstones from the same “Limnic Series” is highly significant. Recent understanding of Adiantopteris (“Adiantites”) sewardi (Yabe) Vassiljevskaja and Adiantopteris toyoraensis (Oishi) Vassiljevskaja which thought to be only accessories, are very important components of an Early Cretaceous flora, which is found in Eastern Siberia, Southern Primorje, the South Eastern Korean Peninsula, Japan and Mongolia.


In terms of their morphological features *Turfanograpta dicoformis* and *T. filiformis* are very similar, and the latter may belong within the range of *Turfanograpta chowmincheni*. Therefore, *Turfanograpta chowmincheni* is the first record from North-Eastern China as *Turfanograpta* sp. from the western-most site of Mongolia. Together with the records from Sinkiang the known geographic range is significantly enlarged.

*Turfanograpta* spec. is thus recognised here as a new associate of the *Lycopter-Ephemeroptera-Coptoclava* assemblage from the Lower Cretaceous of Mongolia as *Turfanograpta chowmincheni* from North-Eastern China.
From this check-list it is evident that *Adiantopteris sewardii* ranges from Berriasian to Albian. In the Oguchi-Akaiwa- and Tokura-Formations it is common to very abundant from Berriasian to Barremian times. Therefore, the paper-shales of Bayan-Khongor may probably range from Berriasian to Barremian in age. W. Krutzsch (1970; *In Abschlußbericht ...* p. 638—643) analysed the palynoflora of different arenaceous limestones and clays from the south-western part of the Bumburger Basin (“Lower Limnic Series”) and reported an Ephedraceae-Conifer-Angiosperm community with an admixture of Hystriochosphaeroideae. On the basis of the presence of different angiosperms (fam. indet.) Krutzsch postulated a Cenomanian age, but probably ranging down to the Albian and also up to the Turonian and possibly even to Conacian.

In any case we are dealing here with a younger sequence than in the paper-shales of the Sogé-Chundey-Basin. Last but not least E. Herrig, Greifswald, (1970 *In Abschlußbericht ...* p. 647—652) gave a very interesting account of two samples of limestone-bearing schists from the paper-shales-facies of the Sogé-Chundey-Basin, in the Western area of the Buriduin-gol. In these samples there is a great predominance of *Cypridea* ex gr. *bispinosa* Galeeva, associated with *Cypridea spinigera* Ljubimova, *Darwinula tubiformis* Ljubimova, *Darwinula contracta* Mandelstam and *Lycoperoecyris debilis* Ljubimova.

This ostracode-assemblage was correlated with the Dzunbain subsvita (“Dark-grey series”) of Eastern Mongolia, probably of Barremian age (Ljubimova 1956).

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