

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

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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 *Turfanograptia* 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. Lycoperidae)-*Ephemeropsis-Coptoclava* correlates with Lower Cretaceous deposits in Transbaikalia, Mongolia and North-Eastern China. The fern-species *Adiantopteris sewardi* (Yabe) Vassiljevskaja and *Adiantopteris toyoraënsis* (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*, *Turfanograptia*, paper-shales, Lower Cretaceous.

Zusammenfassung

Larvenfragmente und isolierte Cerci der Eintagsfliege *Ephemeropsis trisetalis* Eichwald und vom Wasserkäfer *Coptoclava longipoda* Ping, und ein Schalenfragment der Conchostrake *Turfanograptia* sp. werden erstmalig aus unterkretazischen Dysodilen von Bajan-Khongor in der Mongolei beschrieben. Die Faunengemeinschaft *Lycoptera* (Fische der Ordnung Osteoglossiformes, Fam. Lycoperidae)-*Ephemeropsis-Coptoclava* tritt gleichzeitig in unterkretazischen Ablagerungen von Transbaikalien, Mongolei, und im nordöstlichen China auf. Das Vorkommen der Farnspezies *Adiantopteris sewardi* (Yabe) Vassiljevskaja und *Adiantopteris toyoraënsis* (Oishi) Vassiljevskaja in Feinsandsteinen von Bajan-Khongor (Jähnichen & Kahlert 1972) und deren Wichtigkeit als unterkretazische Florenelemente werden diskutiert.

Schlüsselwörter: *Ephemeropsis*, *Coptoclava*, *Turfanograptia*, 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 Svita), Mongolia (e.g., Ondai-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, Uéno 1935, Demoulin 1954, 1956, Novojilov 1957, 1960, Meschkova 1961, Ponomarenko 1961, Tschernova 1961, 1962, Jähnichen

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& Kahlert 1969, 1972, Tschernova & Sinitschenkova 1974, Ponomarenko & Popov 1976).

The *Lycoptera-Ephemeropsis-Coptoclava* assemblage correlates with Lower Cretaceous deposits from Transbaikalia (Turgino-Vitimskaja 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** Lameère, 1917

Genus ***Ephemeropsis*** Eichwald, 1864

Type-Species: *Ephemeropsis trisetalis* Eichwald, 1864

Figs 1, 2, Pl. 1, Figs 1–4

Synonyms

- 1848 "Ephemera"-Neuropteren-Larve – Müller *In* Middendorf, A. Th.: 261, t. I(ii), fig. 7: Transbaikalia, Byrka, Lower Cretaceous.
- 1864 *Ephemeropsis trisetalis* – Eichwald: 19–21: Transbaikalia, Turgino-Vitimskaya Svita, Early Cretaceous.
- 1868 *Ephemeropsis orientalis* – Eichwald: 1192–1195, pl. 37, fig. 8: Transbaikalia, Lower Cretaceous.
- 1889 *Ephemeropsis orientalis* – Brauer, Redtenbacher & Ganglbauer: 5, pl. 1, fig. 4a–d: Transbaikalia, Turga, Jurassic.
- 1908 *Ephemeropsis trisetalis* Eichwald – Handlirsch: 603, sine icon: Transbaikalia, Nertschinsk, Towega, Lower Cretaceous.
- 1908 *Ephemeropsis middendorfi* – Handlirsch: 604, sine icon: Transbaikalia, Byrka, Upper Jurassic.
- 1908 *Ephemeropsis orientalis* Eichwald – Handlirsch: 604, sine icon: Transbaikalia, Turga, Upper Jurassic.
- 1908 *Phacelobranthus braueri* Handlirsch: 604, t. 46, fig. 33: Transbaikalia, Turga, Upper Jurassic.
- 1909 *Ephemeropsis orientalis* Reis: Transbaikalia, Upper Jurassic.
- 1924 *Ephemeropsis trisetalis* Eichwald – Cockerell: 137, pl. 1, figs 1–9, text-figs 2–4: Mongolia, Onda-Sair Formation, Lower Cretaceous.
- 1924 *Ephemeropsis melanurus* Cockerell: 139, pl. 1, fig. 10: Ondai-Sair, Lower Cretaceous.
- 1928 *Ephemeropsis trisetalis* Eichwald – Ping: 38, figs 17–18, pl. 2, figs 1–2: North-Eastern China, Jehol Beds, Lower Cretaceous.
- 1935 *Ephemeropsis trisetalis* Eichwald – Uéno: fig. 1, t. I–III: Jehol Beds, Lower Cretaceous.
- 1956 *Ephemeropsis trisetalis* Eichwald – Demoulin: 5, fig. 1 (reconstruction), Jurassic.
- 1961 *Ephemeropsis trisetalis* Eichwald – Tschernova: 862, figs 2–6, pl. 1, fig. 1; pl. 2, fig. 1: Transbaikalia, Lower Cretaceous.
- 1961 *Ephemeropsis trisetalis* Eichwald – Meschkova: 164, figs 1–3: Transbaikalia, Turgino-Vitimskaya Svita, Lower Cretaceous.
- 1962 *Ephemeropsis trisetalis* Eichwald – Tschernova *In* Osnovy paleontologii 9: 58–59, text-figs 64 and 66, pl. 1, figs 1–3 – Transbaikalia, Jurassic.

1970 *Ephemeropsis trisetalis* Eichwald – Semaka: 456, tab. 2 (only mentioned in a flora-list); North-Korea, Prov. North Huanghe, Hanpo Beds, Loc. Kymchon, Upper Cretaceous.

1992 *Ephemeropsis 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 Buriduigol, Bayan-Khongor, Mongolia. This is the western-most occurrence for this taxon.

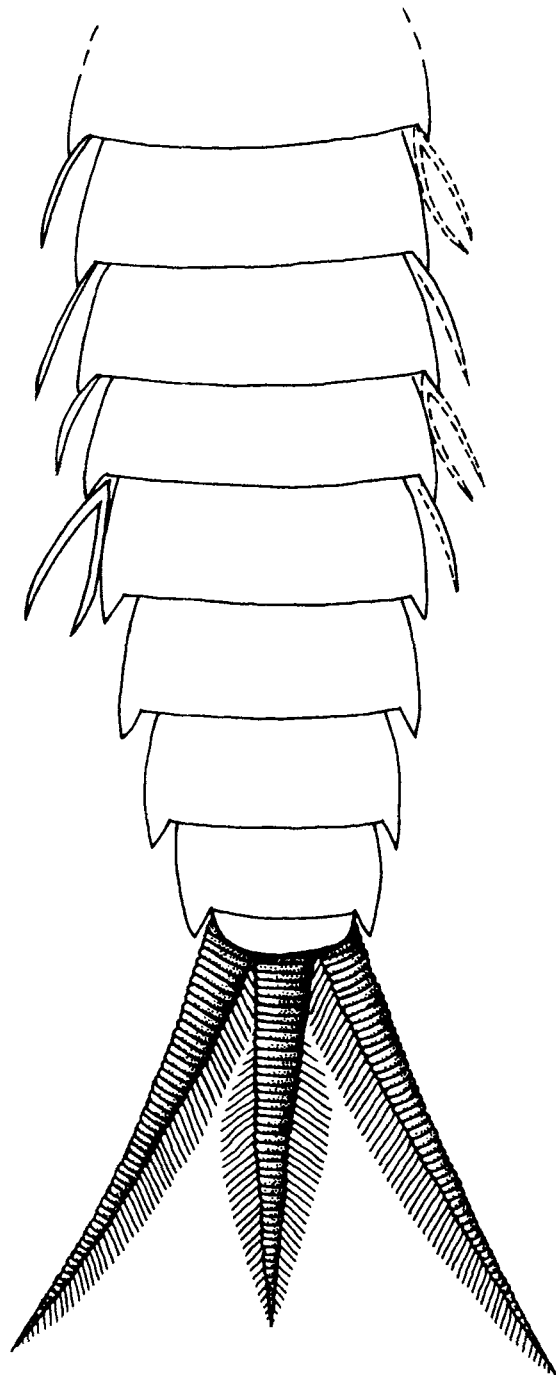


Fig. 1. Nymph-fragment of *Ephemeropsis trisetalis* Eichwald, Bayan-Khongor, Mongolia (MB. J. 1788)

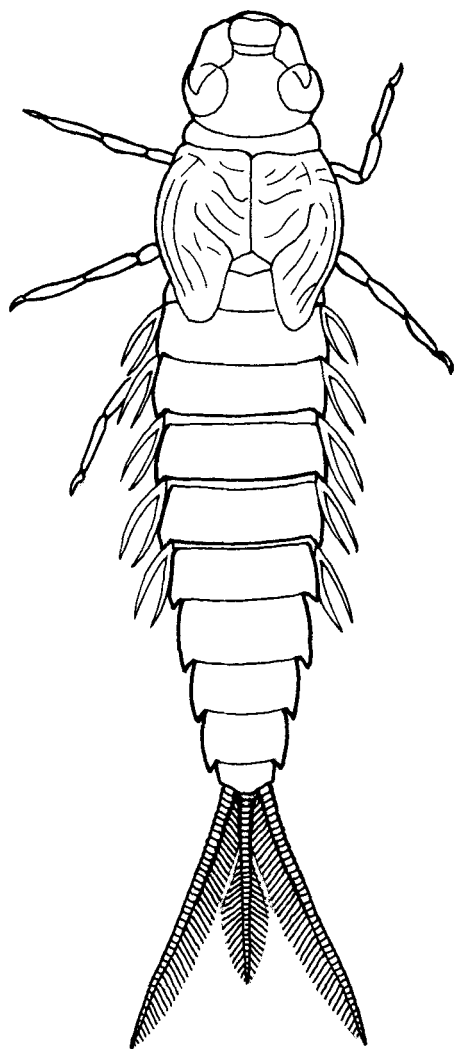


Fig. 2. *Ephemeroptera trisetalis* Eichwald, Transbaikalia, Turgino-Vitimsk Svita (after Meschkova 1961: fig. 2)

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) *Ephemeroptera 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: *Ephemeroptera 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 *Ephemeroptera 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** Ping, 1928

Type species: *Coptoclava longipoda* Ping, 1928

Fig. 3, Pl. 2, Fig. 1

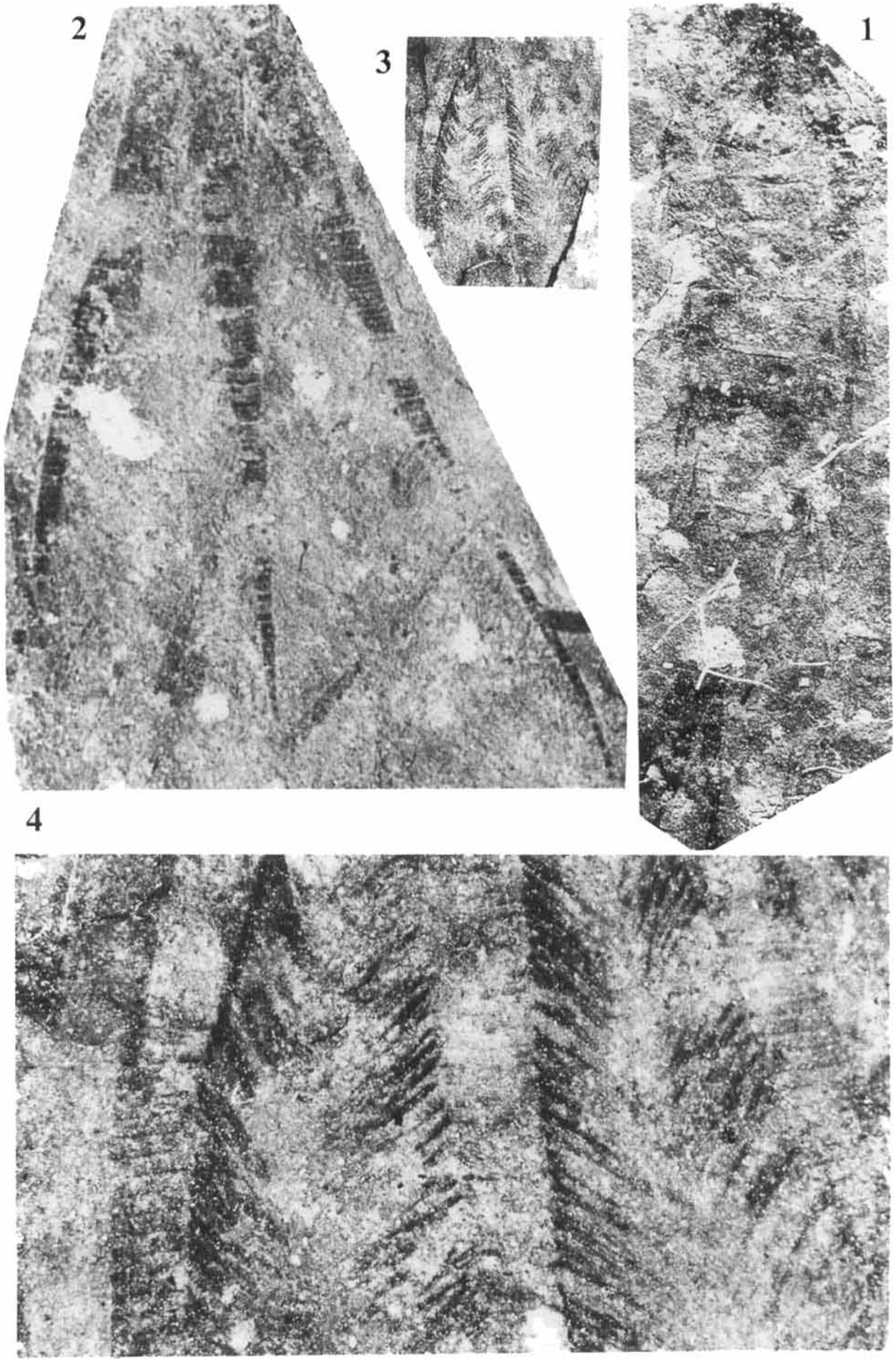
Synonyms

1928 *Coptoclava longipoda* – Ping: 39, figs 19–20; pl. 2, figs 3–4; North-Eastern China, Shantung Province, Laiyang-Formation, Lower Cretaceous.

1961 *Coptoclava longipoda* Ping – Ponomarenko: 67–72, figs 1–6; Transbaikalia, Turgino-Vitimsk Svita, Lower Cretaceous.

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 sclerotized. 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).



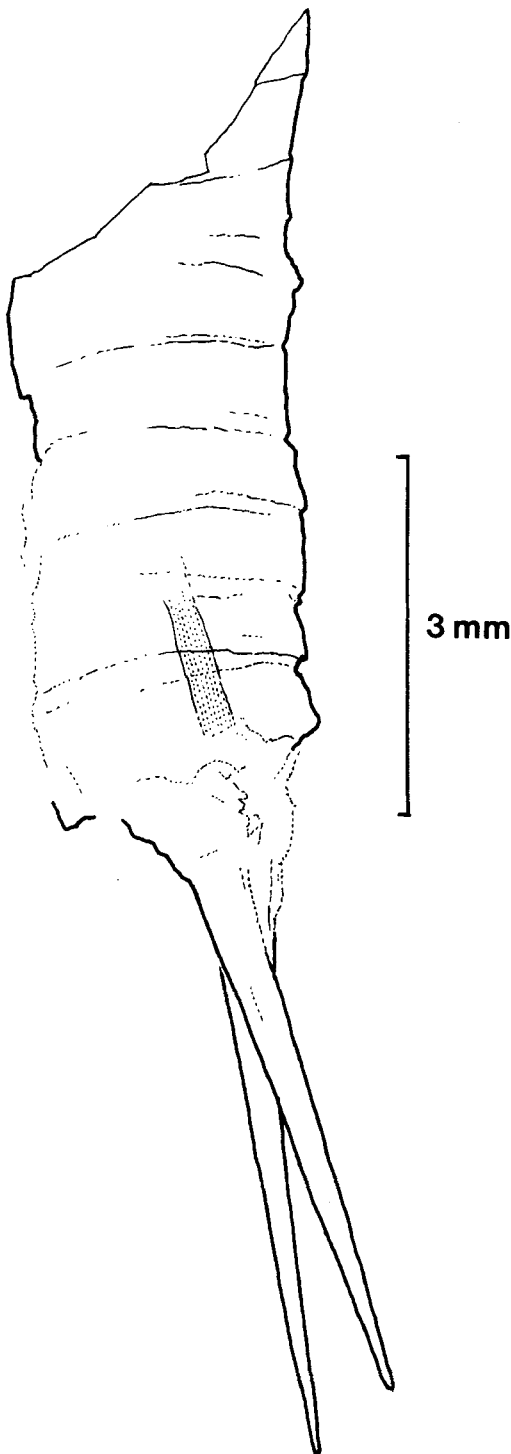


Fig. 3. *Coptoclava longipoda* Ping, nymph-fragment with seven ventral segments, between the last two segments traces of a tracheal trunk preserved by two lines, two sagittiform urogomphi, Mongolia (MB. J. 1793)

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 *Ephemeropsis trisetalis*, 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 Buriduigol, 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).

Plate 1, Figs 1–4. *Ephemeropsis trisetalis* Eichwald from Lower Cretaceous paper-shales of Buriduigol, Bayan-Khongor, Mongolia. 1. Nymph-fragment with seven abdominal segments, tracheal gills and cerci. MB. J. 1788, \times 4. 2. Detached striated cerci (cp. Eichwald, 1868: 1192; genus-diagnose of *Ephemeropsis* "... tres setas articulatas respiratorias et ciliis ornatas genitalibus"). MB. J. 1789, \times 8. 3. Detached ciliated cerci, laterals on the inner side and the paracercus on both sides. MB. J. 1790, \times 4,5. 4. Detached ciliated cerci, laterals on the inner side and the paracercus on both sides. MB. J. 1790, \times 18,4

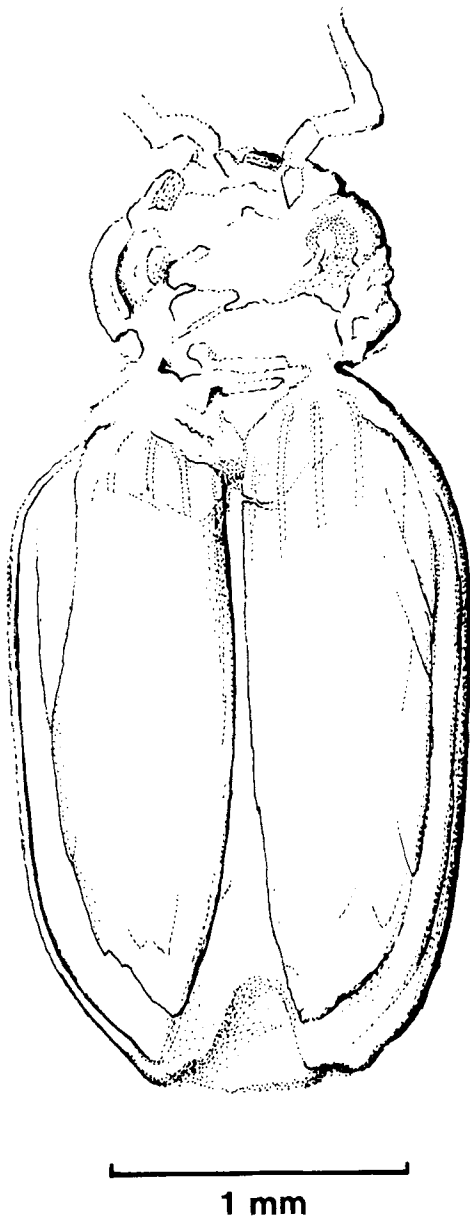


Fig. 4. Coleoptera inc. sed., head deeply withdrawn in the pronotum, with traces of two antennae. Mongolia (NB. J. 1791)

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 in-

termediate position between the archaic Cupediiformes and the two previously mentioned groups (F. Hieke, pers. comm. 1969).

Order **Conchostraca** Sars, 1867

Family **Cyzicidae** Stebbing, 1910 emend. Barnard, 1929 = Bairdetheriidae Novojilov, 1954

Genus **Turfanograptia** Novojilov, 1957

***Turfanograptia* sp.**

Fig. 5A, B, Pl. 2, Figs 2–3

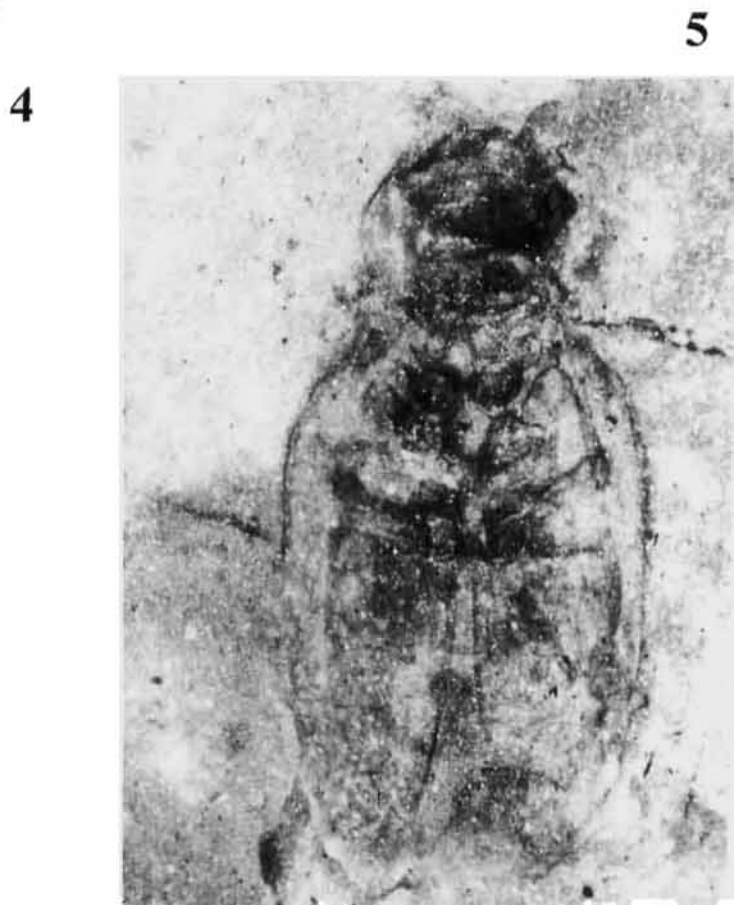
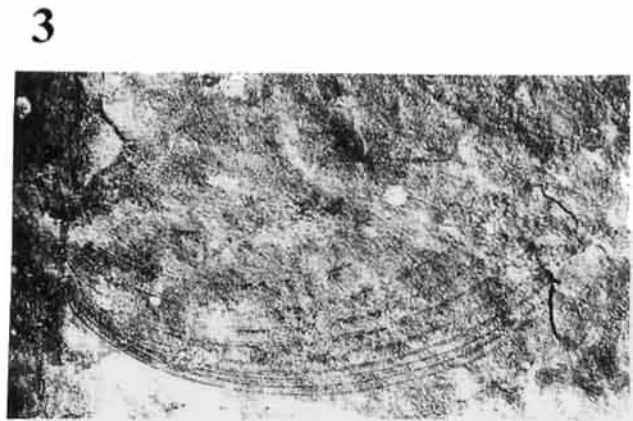
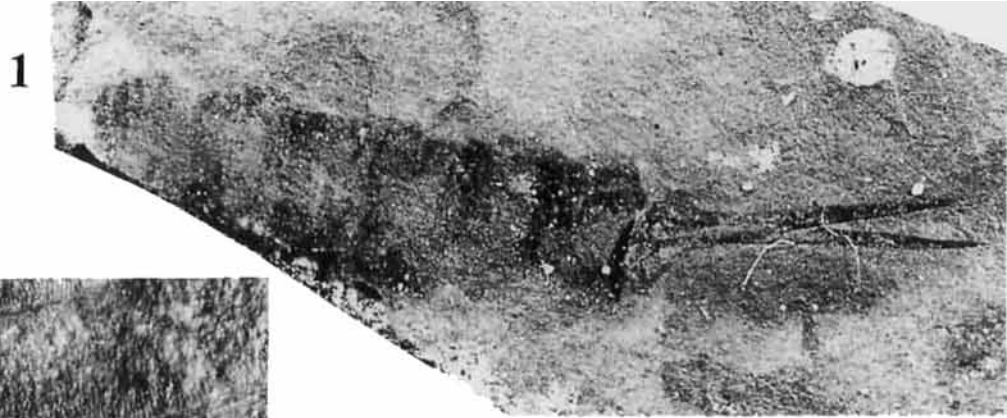
Material: MB. J. 1792: A single shell-fragment from Lower Cretaceous paper-shales of Buriduigol, Bayan-Khongor, Mongolia. This is the western-most occurrence for this taxon.

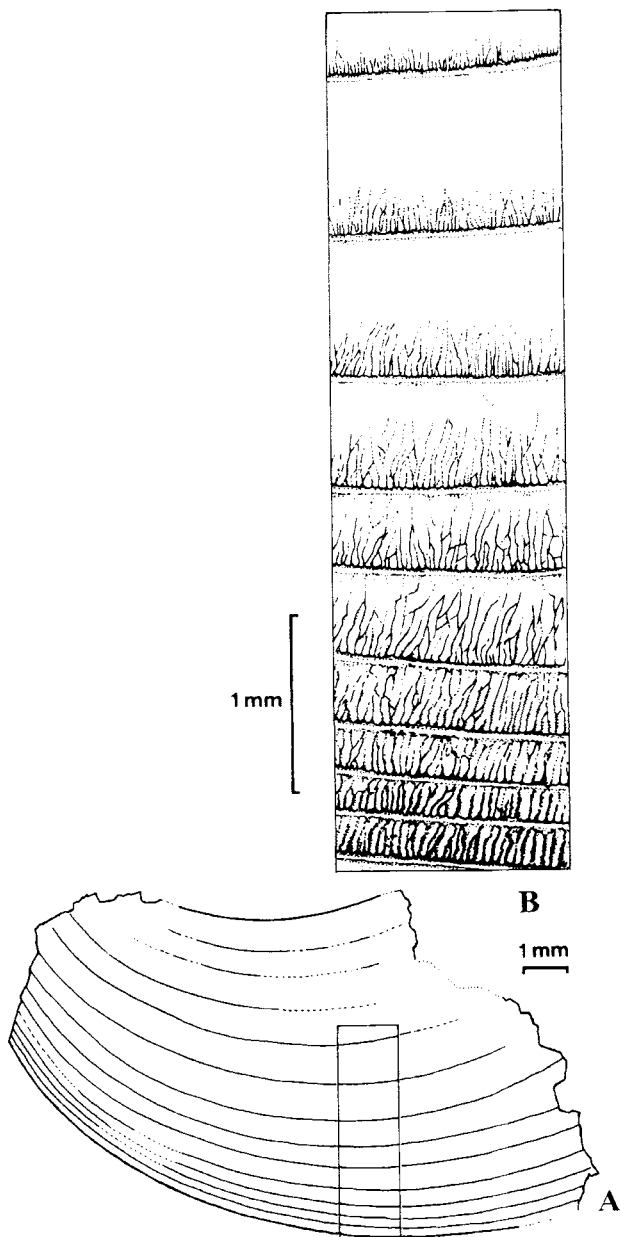
Description: Only one small, thin shell-fragment with about 13 growth-lines, measuring 12 mm long by 7,5 mm high. Growth-lines at the top more widely spread, subsequently are densely arranged. The most important morphological character are the dense, radially arranged long-fibrous striae branching off and linking together resulting in a longitudinal irregular net-like structure. This very characteristic ornamentation corresponds to the genus-diagnosis for *Turfanograptia* 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 *Turfanograptia dichiformis* 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".

Plate 2. Figs 1–5. Water-beetle, coleopteran- and conchostracan remains from Lower Cretaceous paper-shales of Buriduigol, Bayan-Khongor, Mongolia. **1.** *Coptoclava longipoda* Ping, nymph-fragment with six ventral segments, tergites strong sclerotized and two sagittiform urogomphi. MB. J. 1793. $\times 8.5$. **2.** *Turfanograptia* spec., with dense radially arranged long-fibrous striae in the intervals. MB. J. 1792. $\times 16$. **3.** *Turfanograptia* sp., one single shell-fragment with ca. 13 growth-lines. MB. J. 1792. $\times 6$. **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. $\times 32$

Fig. 5. *Turfanograptia* spec. from Mongolia. **A.** Shell-fragment with radially arranged growth-lines, $\times 10$. **B.** With dense, radially





arranged long-fibrous striae in the intervals. Mongolia (MB. J. 1792)

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

Turfanograptia spec. is thus recognised here as a new associate of the *Lycoptera-Ephemeropsis-Coptoclava* assemblage from the Lower Cretaceous of Mongolia as *Turfanograptia chowmincheni* from North-Eastern China.

It is interesting that according to Ponomarenko (pers. comm. 1974) "... not a single specimen of *Turfanograptia* 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'gëy-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 toyoraënsis* (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.

Lena-Basin (Middle Section): Batlyk and Eksenjakh Svita, Berriasian-Barremian, Aptian (Vakhrameev 1958, Kimura 1979, Ohana & Kimura 1995). Southern Primorje (former Nikan-Series), Ussury Bay (Kryštofovič & Prinada 1932: 367); in the Sufjun-Basin with Ussury-, Lipovets- and Galenkov Svita; Barremian, Aptian, Albian (Krasilov 1967, Kimura 1979, Ohana & Kimura 1995). South Eastern Korea Peninsula: former Naktong Beds (Yabe 1905, Oishi 1940); now Sindong-flora (Chang 1985, 1988 non vidimus *In* Ohana & Kimura 1995) Valanginian-Barremian (Ohana & Kimura 1995, Kimura 1979). Japan: Kiyoshuë-Formation (Type-sequence for *Adiantopteris toyoraënsis*, Berriasian (Kimura 1979, Ohana & Kimura 1995), Toyora District, Yamaguchi Prefecture; Oguchi-Formation, Berriasian-Valanginian (Ohana & Kimura 1995), Central Honshu, Tetori-flora, Inner Zone of Japan (Yabe 1905, Oishi 1940). Akaiwa-Formation, Hautërive-Barremian (Kimura & Hirata 1975, Ohana & Kimura 1995), Central Honshu, Tetori-flora (Kimura & Sekido 1976, 1978). Tokura-Formation, Berriasian-Barremian (Kimura et al. 1979), Tetori-flora, North-Eastern Honshu, Gumma Prefecture. Ryošeki-Formation, Berriasian-Valanginian; Lower Monobegawa-Formation, Hautërive-Barremian; Upper Monobegawa-Formation, Aptian-Albian (Kimura & Hirata 1975, Kimura 1979, Ohana & Kimura 1995). Choshi Peninsula, Aptian (Nishida 1960 *In* Kimura & Hirata 1975: 77, Ohana & Kimura 1995), Chiba Prefecture.

From this check-list it is evident that *Adiantopteris sewardi* 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 lignites and clays from the south-western part of the Bumberger Basin (“Lower Limnic Series”) and reported an Ephedreaceae-Conifer-Angiosperm community with an admixture of Hystri-chosphaeroideae. 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 So'g y-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 So'g y-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 *Lycopterocypris 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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