



## Teuthoidea from the Bohemian Cretaceous Basin (Czech Republic) – A Critical Review

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5 Text-Figures and 2 Plates

*Czech Republic  
Upper Cretaceous  
Teuthoidea  
Taxonomy*

### Contents

Zusammenfassung .....	359
Abstract .....	359
1. Introduction .....	359
2. Systematic Part .....	360
3. Remarks on the Upper Cretaceous Teuthoids' Occurrence .....	364
Acknowledgements .....	365
Plates 1-2.....	366
References .....	369

## Teuthoiden aus dem Böhmischem Kreidebecken (Tschechische Republik) – Eine kritische Revision

### Zusammenfassung

Teuthoiden treten im Übergangsbereich vom Unteren zum Mittleren Turonium des Böhmischem Kreidebeckens (BCB) auf. Fünf Gattungen (darunter drei neue – *Paraglyphiteuthis* n.g., *Marekites* n.g. und *Eoteuthoides* n.g.) sowie sechs und/oder sieben neue Arten werden auf der Basis taxonomischer Revisionen aus alten Sammlungen neu beschrieben. Die Radiation und Diversifikation in dieser Gruppe findet im obersten Teil des Unteren Turonium bis Mittleren Turonium des BCB statt. Eine dieser neu aufgestellten Gattungen, *Eoteuthoides* n.g. stellt wahrscheinlich auch eine neue Familie dar und ist damit möglicherweise die älteste Art der Decabrachia/Decembrachiata sensu ENGESER & BANDEL, 1988. *Glyphiteuthis* sp. cf. *G. minor* FRITSCH verbleibt weiterhin unter offener Nomenklatur, obwohl einige Unterschiede festzustellen sind. Das Auftreten und die Radiation der Teuthoiden im Unteren Turonium und Mittleren Turonium ist möglicherweise verbunden mit paläoklimatischen und ökologischen Veränderungen im Unteren Turonium. Eventuell ist auch das lokale Sterben der Belemniten auf die Verkleinerung ihres Lebensraums in der Zentral-Europäischen Paläoprovinz zurückzuführen.

### Abstract

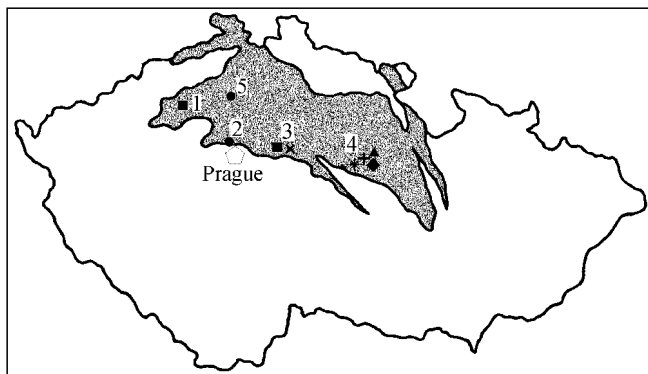
Teuthoids occur in the Lower and Middle Turonian boundary interval in the Bohemian Cretaceous Basin (BCB). Five genera (three of them new – *Paraglyphiteuthis* n.g., *Marekites* n.g. and *Eoteuthoides* n.g.) and six and/or seven species are described on the basis of recent taxonomical re-evaluations of old collections. The radiation and diversification of this group is marked in the uppermost part of the Lower Turonian through the Middle Turonian in the BCB. One of these recently established genus – *Eoteuthoides* n.g. – probably represents a new family too and it seems to be the earliest taxon of Decabrachia/Decembrachiata sensu ENGESER & BANDEL (1988). *Glyphiteuthis* sp. cf. *G. minor* FRITSCH is still retained in the open nomenclature however some differences are marked. Appearance and radiation of teuthoids is recorded in the uppermost Lower Turonian and Middle/Upper Turonian. It is possibly associated with palaeoclimatical and ecological changes in the Lower Turonian and may be connected with the local extinction of belemnites and their area reduction in the Central European palaeogeographical province.

### 1. Introduction

Teuthoids from the BCB were studied in detail by few authors in the past. The first record of find of a teuthoid in the BCB is *Glyphiteuthis ornata* REUSS n. gen. n. sp. A.E. REUSS described this species in 1854 from the upper parts

of the Bílá Hora Formation (Lower–Middle Turonian boundary) of the local stratigraphic scale. FRITSCH (FRITSCH & SCHLÖNBACH [1872] and FRIČ [1879]) mentioned discovery of a new species *Glyphiteuthis minor* FRITSCH also

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Text-Fig. 1. Schematic map of the Bohemian Cretaceous Basin and the position of teuthoid localities.

1 = Lipence near Louny; 2 = Bílá Hora, Prague; 3 = Zdánice near Kourim; 4 = Vinary near Vysoké Mýto; 5 = Polomené hory.  
*G. ornata*: 2,5; *G. minor*: 1,3; *G. sp. cf. G. minor*: 3; *S. convexa*, *M. vinarensis*, *P. crenata* and *E. caudata*: 4.

from upper sequences of the Bílá Hora Formation in Lipence near Louny (Text-Fig. 1). FRITSCH (1910) described four species – *Styloteuthis convexa* FR., *Styloteuthis caudata* FR., *Styloteuthis? vinarensis* FR. and *Glyphiteuthis crenata* FR. from the Middle/Upper Turonian locality Vinary near Vysoké Mýto. These species are critically reviewed and analysed here. The genus *Styloteuthis* FRITSCH included three different species belonging to different families and orders which are designated as type species of independent genera (*Marekites* n.g. and *Eoteuthoides* n.g.) here and one new family could be designated later.

*Glyphiteuthis crenata* FR. is raised to the rank of a new genus *Paraglyphiteuthis* n.g. within the Trachyteuthididae NAEF, 1921 with respect to marked differences from *Glyphiteuthis* REUSS especially in median field and rhachis. However, the single incomplete specimen available does not permit the formal designation of a new taxon.

ZAHALKA (1914–1938) reports the finding of *G. ornata* REUSS from the upper Middle Turonian from Polomené hory (NNW from Prague). Dr. J. SOUKUP discovered a specimen of *Glyphiteuthis* REUSS in 1937 (leg. in museal sample) which is retained here in the open nomenclature with respect to some morphological differences from *G. minor* FRITSCH.

## 2. Systematic Part

**Class:** Cephalopoda CUVIER, 1797  
**Subclass:** Coleoidea BATHER, 1888  
**Superorder:** Vampyromorphoidea ENGESER & BANDEL, 1988  
**Order:** Prototeuthida NAEF, 1921  
**Suborder:** Prototeuthina NAEF, 1921  
**Family:** ? Plesiotеuthididae NAEF, 1921  
**Genus:** *Styloteuthis* FRITSCH, 1910

Type species: *Styloteuthis convexa* FRITSCH, 1910, subsequent designation BÜLOW-TRUMMER (1920).

Original diagnosis: FRITSCH (1910: p. 12): "Loligenschulpen mit solidem runden Stiel der Längsachse".

Emended diagnosis: Small Prototeuthid with aragonite spoon shaped conus with rhachis.

## *Styloteuthis convexa* FRITSCH, 1910

(Tab. 1, Fig. 6, Text-Fig. 2)

- 1910 *Styloteuthis convexa* FR., FRITSCH 1910, Tab. 1, Fig. 1. p. 12.  
 1920 *Styloteuthis convexa* FRITSCH, BÜLOW-TRUMMER, p. 251.  
 1922 *Styloteuthis convexa* FRITSCH 1910, NAEF, p. 119, 297.  
 1987 *Styloteuthis convexa* FRITSCH, RIEGRAF, p. 97.  
 1995 *Styloteuthis convexa* FRITSCH, 1910, RIEGRAF, p. 150.

Material: Holotype No. O3221 stored in the National Museum, Prague.

Short description: The specimen consists of a pearl aragonite gladius with a preserved length of 15 mm, comprising a broad spoon-shaped conus with rhachis. The rhachis is broken at the anterior part and it is not preserved there. The conus is complete and three dimensionally preserved. The posterior preserved part of the gladius is pear-shaped. Concentric growth lines are indicated upon the whole dorsal surface. The median field of the gladius is developed as a rhachis. Lateral asymptotes are present. The most posterior part of the gladius does not form a rostrum (Text-Fig. 2).

Remarks: NAEF (1922) and JELETZKY (1966) included the genus *Styloteuthis* FRITSCH into the family of Plesiotеuthididae NAEF. This genus is poorly known. A single species of *Styloteuthis* – *Styloteuthis convexa* FRITSCH – more resembles taxa of the rank of the Palaeololiginidae NAEF, 1921 rather than species of the Plesiotеuthididae – *Plesiotеuthis* WAGNER, *Paraplesiotеuthis* NAEF, *Maioteuthis* REITNER & ENGESER, or *Boreopeltis* ENGESER & REITNER. *Palaeololigo oblonga* (WAGNER) is similar to *S. convexa* with respect to the character of the median field, rhachis and growth lines. The shape, size and lateral asymptotes are different. The Trachyteuthid *Glyphiteuthis minor* FRITSCH & SCHLÖNBACH (Trachyteuthididae NAEF) differs from *S. convexa* by having a different shape of conus, median field and especially a rhachis. The shape of gladius of *S. convexa* is slightly similar to *Teudopsis bunellii* DESLONGCHAMPS and upper Jurassic Muensterelid DOYLE. These far and morphological affinities show only an unclear systematic position of this taxon in teuthoids. The largest similarity seems to be to the family Palaeololiginidae – *Mesoteuthina* NAEF, 1921.

Geographic and stratigraphic distribution: Middle/Upper Turonian, Czech Republic (BCB), Vinary near Vysoké Mýto.

**Suborder:** Mesoteuthina NAEF, 1921

**Family:** Palaeololiginidae NAEF, 1921

**Genus:** *Marekites* n.g.

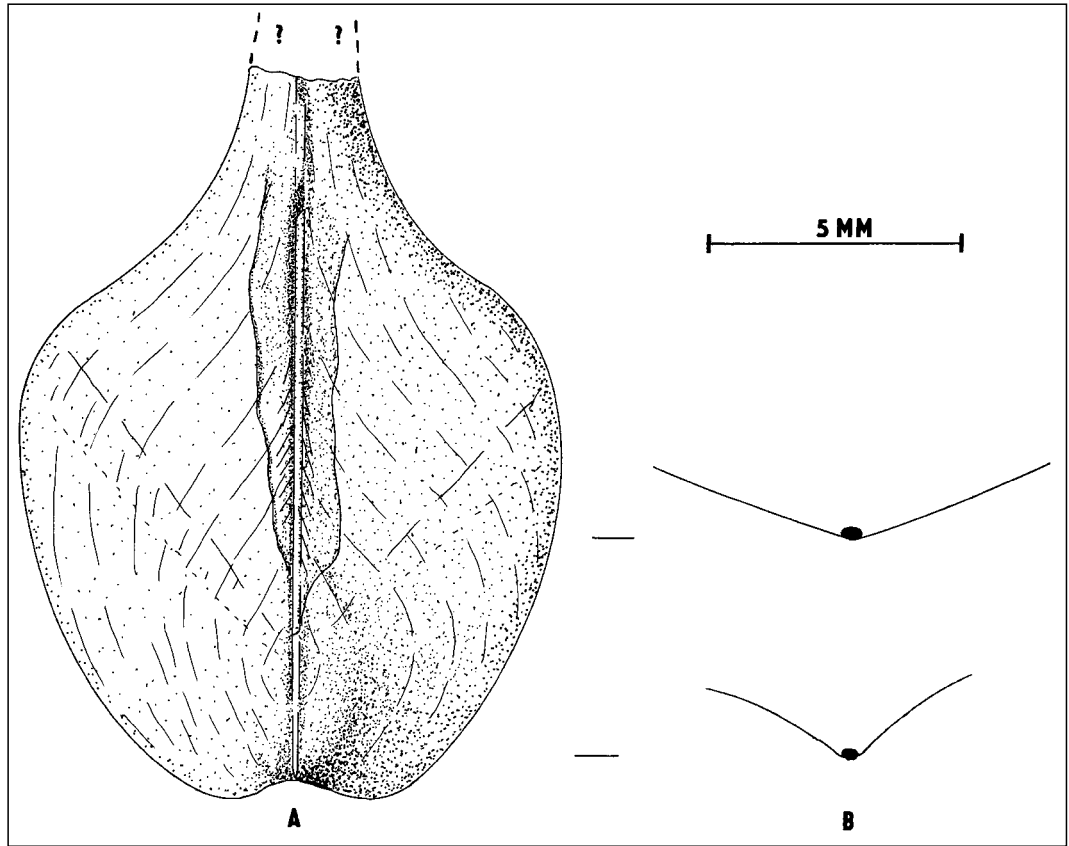
Type species: *Styloteuthis? Vinarensis* FRITSCH, 1910.

Derivatio nominis: After palaeontologist Dr. Jaroslav MAREK, Czech cephalopod worker.

Diagnosis: Small Palaeololiginid with the rhachis diverging anteriorly. The growth lines connect in 1/3 of the posterior part and form thin anteriorly diverged rhachis. Visible tapering in the middle of the gladius.

Differential diagnosis: *Marekites* n.g. differs from the genus *Palaeololigo* NAEF, 1921 by having a different shape of the gladius and rhachis which is markedly flattened in *Marekites* n.g. The gladius in *M. vinarensis* (FRITSCH, 1910) is pear-shaped – other Palaeololiginids have previously oval shape of gladius. Growth lines are also different in *Marekites* n.g. and asymptotes are not apparent in this genus (Text-Fig. 3).

Text-Fig. 2.  
Gladius of *Styloteuthis*  
FRITSCH – *S. convexa*.  
A: gladius.  
B: cross-section.



***Marekites vinarensis* (FRITSCH, 1910)**

(Tab. 1, Fig. 7, Text-Fig. 3)

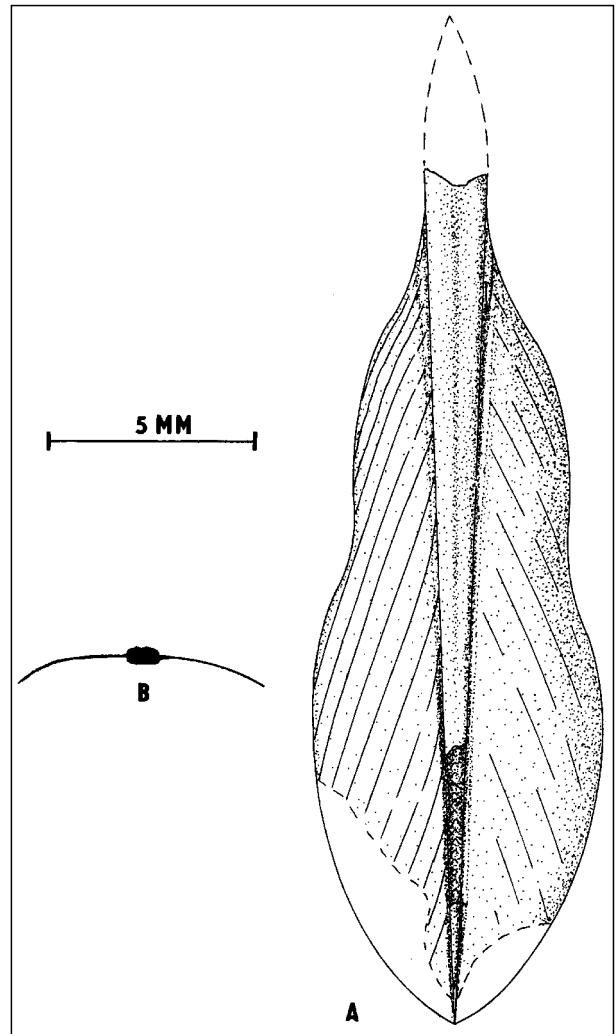
- 1910 *Styloteuthis? Vinarensis* FR., Taf. 5, Fig. 3, p. 13.
- 1910 *Plesiotheuthis Winarensis* FR., Taf. 5 – explanation.
- 1920 *Plesiotheuthis (?) Winarensis* FRITSCH, BÜLOW-TRÜMMER, p. 265.

Material: A single specimen O3223 – holotype stored in the National Museum Prague.

Description: The single specimen comprises the majority of a small (25 mm) gladius. Maximal width (8 mm) of the gladius at one third. Aragonite gladius is preserved in gray quartzitic marlstone like a not compressed positive. The spoon-shaped conus is almost complete, the most apical part is missing. Growth lines are present and clearly apparent. The median field of the gladius is developed as a rachis. Growth lines connect in one third of posterior part and form very small ribs on the rachis. Anterior part of rachis is smooth. The rachis diverges anteriorly at an angle of approximately 7° and expands to a maximum preserved width of 2 mm. Gladius is slightly tapered in one half.

Remarks: *M. vinarensis* is similar to *Palaeololigo oblonga* (WAGNER) with respect to similar character of posterior part of gladius. It differs from *P. oblonga* in median constriction of the gladius. Gladius of *M. vinarensis* slightly resembles gladii of present cephalopods (*Loligo*) however it is strongly (probably originally) mineralized by aragonite and this similarity could be explained as convergency.

Geographic and stratigraphic distribution: Middle/Upper Turonian, Czech Republic (BCB), Vinary near Vysoke Myto.



Text-Fig. 3.  
Gladius of *Marekites* n. g. – *M. vinarensis*.  
A: gladius.  
B: cross-section.

Family: Trachyteuthididae NAEF 1921

Genus: *Glyphiteuthis* REUSS, 1854

Type species: *Glyphiteuthis ornata* REUSS, 1854.

***Glyphiteuthis ornata* (REUSS, 1854)**

(Tab. 1, Figs. 1, 2)

1845 *Glyphiteuthis ornata* nov. gen. et spec., REUSS, p. 2, Tab., Figs. 1-2.

1872 *Glyphiteuthis ornata* REUSS, FRITSCH et SCHLÖNBACH, p. 7, 15-16.

1879 *Glyphiteuthis ornata* REUSS, FRIČ, p. 16, 85, 96.

1910 *Glyphiteuthis ornata* REUSS, FRITSCH, p. 13-14, Tab. 5., Fig. 5.

1920 *Glyphiteuthis ornata* d'ORBIGNY, BÜLOW-TRUMMER, p. 251.

1922 *Glyphiteuthis ornata* REUSS, NAEF, p. 140-141.

?1914-1938 cf. *Glyphiteuthis* sp., ZAHALKA, p. 429.

1995 *Glyphiteuthis ornata* REUSS, 1854, RIEGRAF, p. 150.

1998 *Glyphiteuthis ornata* REUSS, 1854, RIEGRAF, JANSSEN et SCHMITT-RIEGRAF, p. 309.

**Material:** Specimens No. O4093 and No. O6099 stored in the National Museum of Prague, a part of rhachis No. Bh001 from the collections of the Institute of Geology and Palaeontology, Charles University, Prague.

**Short description:** Specimens of this species are quite large. The length of the gladii is 185 mm (O6099) and 238 mm (O4903) and maximal width 69 mm and 75 mm. A massive and strongly ribbed rhachis (keel) is typical. The median field of the gladius is strongly granuled. A connection of growth lines in the median area is not apparent. Lateral asymptotes are marked and fully developed in specimen (O6099), however, median asymptotes are not clear. The sepia-like apical rostrum (Tab. 1, Fig. 4) is developed in the most posterior part. Gladii are three-dimensionally preserved. Rhachis (keel) does not diverge anteriorly and it is the strongest ribbed at the anterior part of the gladius.

**Remarks:** *G. ornata* and *G. minor* FR. resemble Jurassic and Cretaceous species of the genus *Trachyteuthis* MEYER – *T. hastiformis* (RÜPPEL), *T. libanotica* (FRAAS), *T. palmeri* (SCHEVILL) and *T. zhuravlevi* HECKER et HECKER in typically granuled and wide median field and shape of the gladius. Both representatives of *Glyphiteuthis* differ from Trachyteuthids in strongly developed and ribbed rhachis (keel). *Glyphiteuthis* and Trachyteuthids represent a very close evolutionary lineage with probable common ancestor.

**Geographic and stratigraphic distribution:** Lower/Middle Turonian boundary (Bílá Hora Formation – uppermost parts of *Mytiloides labiatus* Zone), upper Middle Turonian (Jizera Fm.), Czech Republic (BCB), Prague – Bílá Hora, Polomené hory (NNW from Prague).

***Glyphiteuthis minor***

**FCHLÖNBACH, 1872**

(Tab. 2, Fig 1)

FRITSCH et SCHLÖNBACH, 1872

1872 *Glyphiteuthis minor* FR., FRITSCH et SCHLÖNBACH, p. 17, Tab. 16, Fig. 13a-c.

1879 *Glyphiteuthis minor* FR., FRIČ, p. 16, 85, 96.

1910 *Glyphiteuthis minor* FR., FRITSCH, p. 13, Tab. 5, Fig. 4.

1920 *Glyphiteuthis minor* FRITSCH, BÜLOW-TRUMMER, p. 251.

1922 *Glyphiteuthis minor* FRITSCH, NAEF, Fig. 49, p. 141.

**Material:** Positive and negative of specimen No. O5860, O5861, stored in the National Museum, Prague.

**Short description:** The length of the complete aragonite gladius is 80 mm and width 31 mm. The rhachis (keel) is fully developed and slightly diverges towards the anterior part where it is strongly ribbed. Growth lines are well preserved in negative (O5861) and they connect

at the rhachis (keel). Granulation is apparent in anterior part of median field mainly. Both lateral and median asymptotes are present in spoon-shaped conus. No rostrum is posteriorly developed.

**Remarks:** *G. minor* is similar to *G. ornata* in the shape of the gladius. FRITSCH (FRITSCH et SCHLÖNBACH, 1872) mentioned that *G. minor* is a juvenile specimen of *G. ornata*. In addition he retained *G. minor* as an independent species with respect to shortage of material and unknown ontogeny of *G. ornata*. *G. minor* differs from *G. ornata* in the following:

- 1) Rhachis (keel) slightly diverges anteriorly.
- 2) Strong ribs are developed mainly in  $\frac{1}{3}$  towards the anterior part.
- 3) Median asymptotes are fully developed.
- 4) Granulation of median field is tiny and it is present in more anterior part of the gladius.
- 5) Apical rostrum is not developed.

*G. minor* is retained here as independent species too with respect to above cited differences.

**Geographic and stratigraphic distribution:** Lower/Middle Turonian boundary (Bílá Hora Fm. - uppermost part of *Mytiloides labiatus* Zone), lower Middle Turonian, Czech Republic (BCB), Lipence near Louny, Zdánice near Kourim.

***Glyphiteuthis* sp. cf. *G. minor***

**FRITSCH et SCHLÖNBACH**

(Tab. 1, Fig. 8)

**Material:** A single specimen No O1736 stored in the National Museum, Prague (leg. by Dr. J. SOUKUP in 1937).

**Short description:** The length of the almost complete gladius is 60 mm (estimated) and width of one half of conus is 13,2 mm. The surface of aragonite spoon-shaped conus is almost smooth. Growth lines apparent in a band conus area. Median asymptote is present. Rhachis (keel) and median field is smooth without ribs and granulation. Apical rostrum is not developed.

**Remarks:** *G. sp.* resembles *G. minor* mainly in the shape of the gladius. The character of median field and rhachis (keel) is strongly different especially in absence of ribs and granulation.

**Geographic and stratigraphic distribution:** Lower Middle Turonian (Bílá hora Fm.), Czech Republic (BCB), Zdánice near Kourim.

**Genus: *Paraglyphiteuthis* n.g.**

Type species: *Glyphiteuthis crenata* FRITSCH, 1910.

**Derivatio nominis:** Para-contemporaneous with the genus of *Glyphiteuthis* REUSS.

**Diagnosis:** Trachyteuthid with poorly and tiny granuled narrow median field. The rhachis (keel) is narrow and strongly regularly ribbed.

**Differential diagnosis:** *Paraglyphiteuthis* n.g. differs from common *Glyphiteuthis* REUSS by marked different character of the median field and especially by the regularly ribbed rhachis (keel) which is the area where growth lines connect. Wings are much more widespread anteriorly than in *Glyphiteuthis*. The anterior part of the median field of *Paraglyphiteuthis* n.g. gladius is more narrow and has poorly preserved granulation. It seems to be developed like a thin belt surrounding the rhachis (keel).

***Paraglyphiteuthis crenata* (FRITSCH, 1910)**

(Tab. 1, Fig. 9; Tab. 2, Figs. 2–3)

1910 *Glyphiteuthis crenata* FR., FRITSCH, p. 14, Tab. 5, Fig. 6, Text. Fig. 2.

1920 *Glyphiteuthis crenata* FRITSCH, BÜLOW-TRUMMER, p. 251.

1995 *Glyphiteuthis crenata* FRITSCH, 1910, RIEGRAF, p. 150.

**Material:** A holotype No. O3258, O3259 (positive and negative) stored in the National Museum, Prague.

**Short description:** The length of the incomplete gladius is 160 mm and its width 54 mm. The rhachis (keel) is narrow and strongly regularly ribbed at places of growth lines connecting. The median field is narrow too and growth lines are apparent here. No asymptotes and growth lines are visible at the flat pearl conus.

**Remarks:** *P. crenata* differs from *G. ornata* and *G. minor* by having a very narrow regularly ribbed rhachis (keel). Granulation is tiny and poor and no large ribs are present in *P. crenata*.

**Geographic and stratigraphic distribution:** Middle/Upper Turonian, Czech Republic (BCB), Vinary near Vysoke Myto.

? Superorder: Decembranchiata  
WINCKWORTH, 1932

? Suborder: Teuthina NAEF, 1916

Family: new - new name to be created

Genus: *Eoteuthoides* n.g.

Type species: *Styloteuthis caudata* FRITSCH, 1910.

Derivatio nominis: Eo-oides – the first like teuthid.

**Diagnosis:** Small teuthid with free rhachis and vanes developed. Vanes are smooth without asymptotes and growth lines. Posterior vanes are inrolled. The gladius is secondarily phosphatized.

**Differential diagnosis:** *Eoteuthoides* n.g. differs from representatives of Prototeuthina NAEF and Mesoteuthina NAEF by having anterior and posterior vanes developed and derived from rhachis and with non-developed asymptotes and growth lines. *Eoteuthoides* n.g. shows more similarities to present teuthids of the family Goniatidae HOYLE with respect to shape and character of the gladius. The gladius of *Eoteuthoides* n.g. is smaller than in most contemporary teuthids (Text Fig. 4).

***Eoteuthoides caudata* (FRITSCH, 1910)**

(Tab. 1, Fig. 5; Text-Fig. 4)

1910 *Styloteuthis caudata* FR., FRITSCH, p. 13, Tab. 5, Fig. 2.

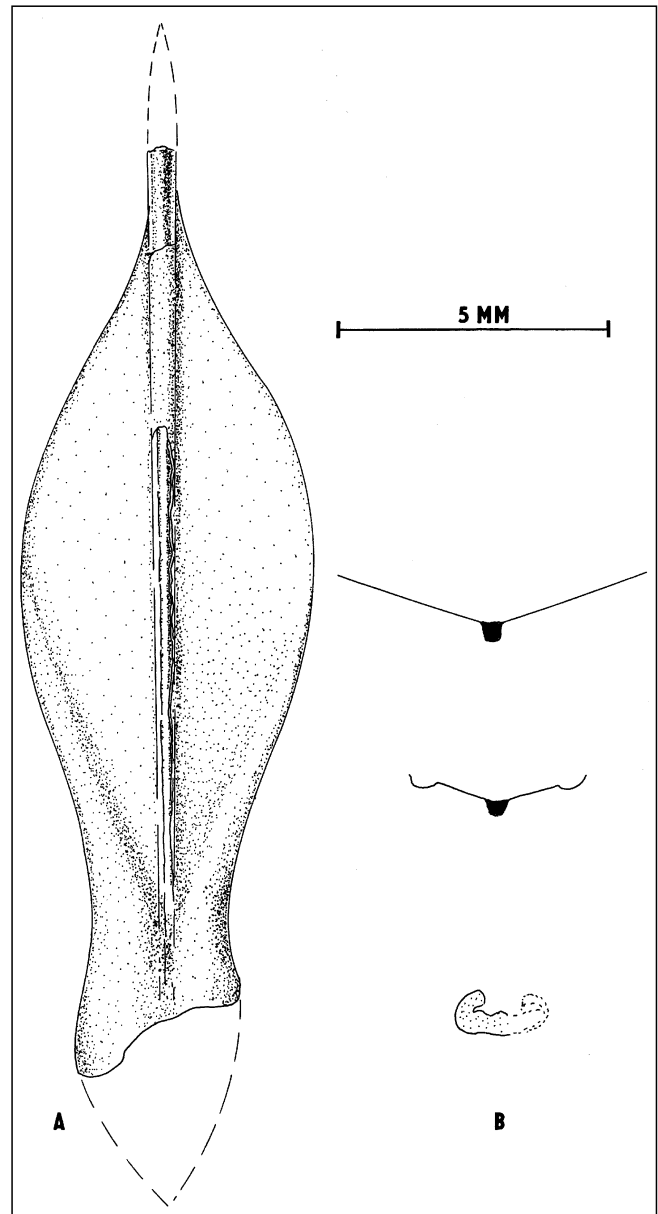
1920 *Styloteuthis caudata* FRITSCH, BÜLOW-TRUMMER, p. 251.

1922 *Styloteuthis caudata* FRITSCH, NAEF, p. 119.

1995 ? *Styloteuthis caudata* FRITSCH, 1910, RIEGRAF, p. 150.

**Material:** Holotype No. O3222 stored in the National Museum, Prague.

**Short description:** The single well preserved specimen comprises the majority of a very small 18 mm long phosphatized gladius. The preserved part of free rhachis is short and the width is 0,8 mm. The rhachis expands laterally to thin smooth lateral parts – vanes. No asymptotes or growth lines are developed. There are two bands developed along the vanes. The anterior part of the band is thin. It arises along the anterolateral vana border in the place of the greatest diameter across the vanes in the anterior expanded portion. This band expands towards the posterior part through the constricted portion and continues to the poorly preserved



Text-Fig. 4.  
Gladius of *Eoteuthoides* n.g. – *E. caudata*.  
A: gladius.  
B: cross-section.

rest of inrolled vanes in the expanded posterior portion. It is not clear if the small tubular conus arised in the apex because this part is not completely preserved.

**Remarks:** The gladius of *Eoteuthoides* n.g. is not mineralized by aragonite as in *Styloteuthis* FRITSCH and *Marekites* n.g. which were found together with *E. caudata* in the same locality, stratigraphical level and in the same type of sediment. The gladius was observed by microscope and deformations visible in vanes proved the elastic origin of the gladius. HEWITT & WIGNALL (1988) determined that original mineralogy of Trachyteuthis was francolite. DOYLE (1991) admitted the possibility of diagenetic replacement of original aragonite. It is quite difficult to explain different mineralogy (phosphatic in *Eoteuthoides* n.g. and aragonite in *Styloteuthis* FRITSCH and *Marekites* n.g.) in the same type of sediment and the same place of finds. Aragonite gladii of *Styloteuthis* and *Marekites* n.g. are original, the gladius of *Eoteuthoides vinarensis* was probably conchiolinic originally and secondarily phosphatized.

Geographic and stratigraphic distribution: Middle/Upper Turonian, Czech Republic (BCB), Vinary near Vysoke Myto.

### 3. Remarks on the Upper Cretaceous Teuthoid Occurrence

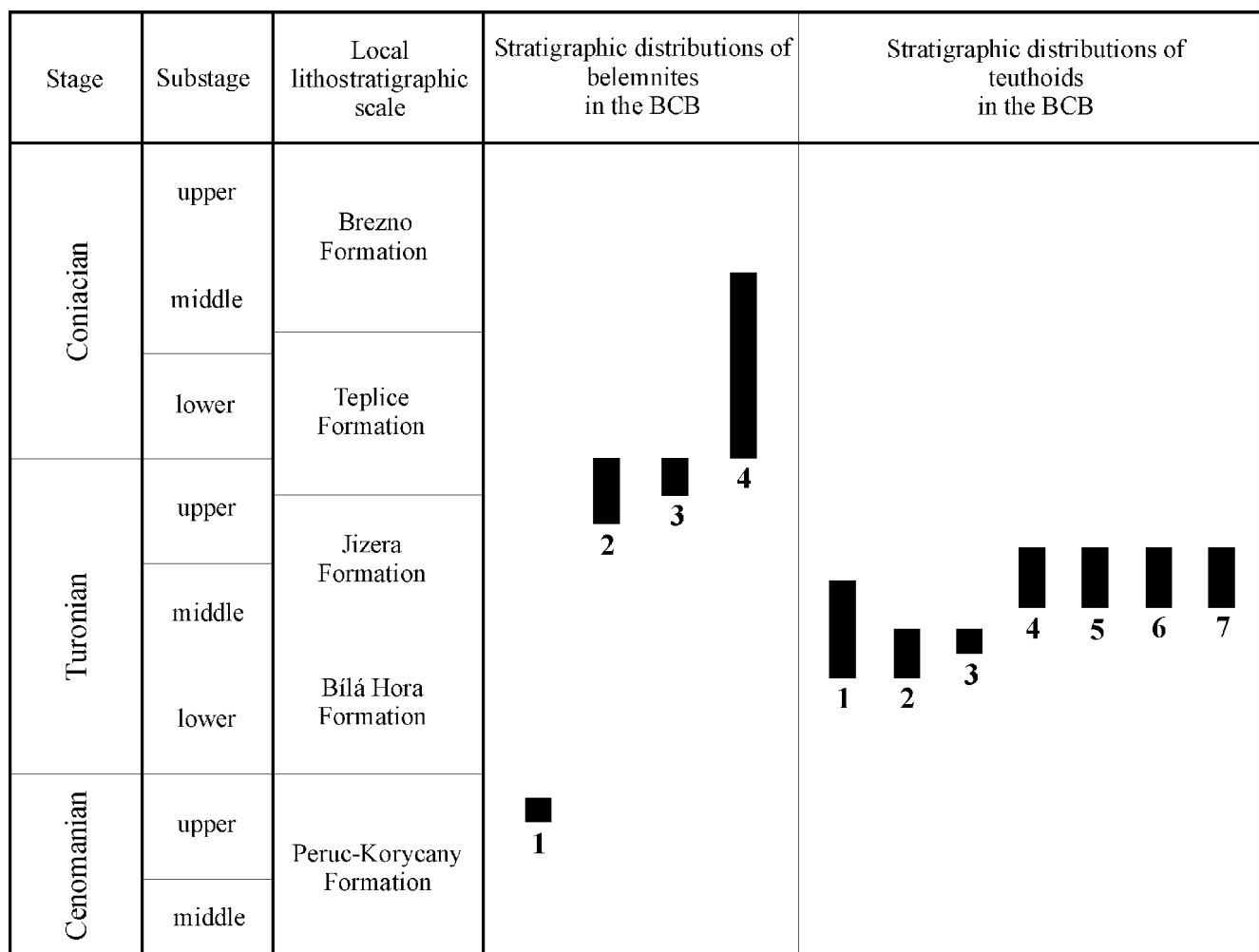
Mesozoic teuthoids are known especially from the Jurassic and Cretaceous sediments with a high preservative potential. Lower Jurassic teuthoids were described frequently in the past from the posidonian shales of European region. HALL (1985) and HALL & NEUMANN (1989) report on the finds of the Lower Jurassic teuthoids also from the North America. Upper Jurassic and the Lower Cretaceous teuthoids are more widespread. They are recently recorded from Germany Solnhofen Lithographic Limestones mainly – BANDEL & LEICH (1986), ENGESER (1988), Heligoland island (ENGESER & REITNER, 1985), Russia – Volga region (HECKER & HECKER, 1955), Cuba (SCHEVILL, 1950), Kapverds Islands (REITNER & ENGESER, 1982), Antarctica (DOYLE, 1991) and Australia (DOYLE, 1991, p. 176). Rich and diversified teuthoids are reported from the Upper Cretaceous of North America (MILLER, 1957; MILLER &

WALKER, 1968; GREEN, 1977; NICHOLS & ISAAK, 1987), Lebanon and Syria (ROGER, 1952), Czech Republic (this paper).

Upper Cretaceous teuthoids are very rare in the Central European biogeographical Subprovince. They occur in the Lower to Middle Turonian in the Bohemian Cretaceous Basin (see above). Their occurrence and radiation are probably connected with palaeoclimatical and palaeoecological changes in this area and also with belemnites reduction (their absence resp.) in this time interval. The Lower and Middle Turonian is characterized by the lowermost belemnites diversity in the Central European palaeobiogeographical Subprovince (CHRISTENSEN, 1976). Belemnites became more diverse here in the Upper Turonian but they are very rare (CHRISTENSEN, 1982, KOŠTÁK, 1996).

Coleoids diversity, stratigraphy and the relation between belemnites and teuthoids appearances in the BCB are shown in Text Fig. 5.

The radiation of teuthoids began in the Lower/Middle Turonian boundary and continues to Middle/Upper Turonian in the BCB. Occurrence and radiation of teuthoids in that time are not connected with sedimentary preservative potential (they occur in different types of sediments – glauconitic sandstones, glauconitic marlstones, calca-



Text-Fig. 5.

Coleoids diversity, stratigraphy and the relation between belemnite and teuthoid appearances in the BCB.

Belemnites (Belemnitellidae): 1 = *Praeactinocamax plenus* (BLAINVILLE); 2 = *Praeactinocamax bohemicus* (STOLLEY); 3 = *Praeactinocamax* aff. *bohemicus*. 4 = *Goniocamax lundgreni* (STOLLEY).

Teuthoids: 1 = *Glyphiteuthis ornata* REUSS; 2 = *Glyphiteuthis minor* FRITSCH & SCHLÖNBACH; 3 = *Glyphiteuthis* sp. cf. *G. minor* FRITSCH & SCHLÖNBACH; 4 = *Paraglyphiteuthis crenata* (FRITSCH); 5 = *Marekites vinarensis* (FRITSCH); 6 = *Styloteuthis convexa* (FRITSCH); 7 = *Eoteuthoides caudata* (FRITSCH).

reous and quartzite marlstones). Most of the gladii are strongly mineralized by aragonite. The gladius of *Eoteuthoides caudata* is probably postmortally phosphatized.

ENGESER & BANDEL (1988, p. 111) state that the radiation of "higher decapods" probably took place in the Early Tertiary quite some time after the belemnoid coleoids became extinct. It is possible that this radiation began sooner – during the Late Cretaceous in areas with virtual absence of belemnoid coleoids

#### Acknowledgements

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## Plate 1

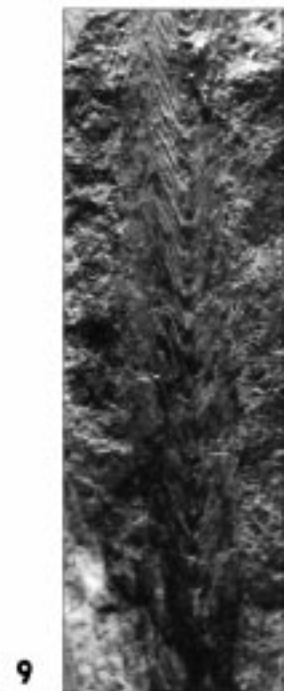
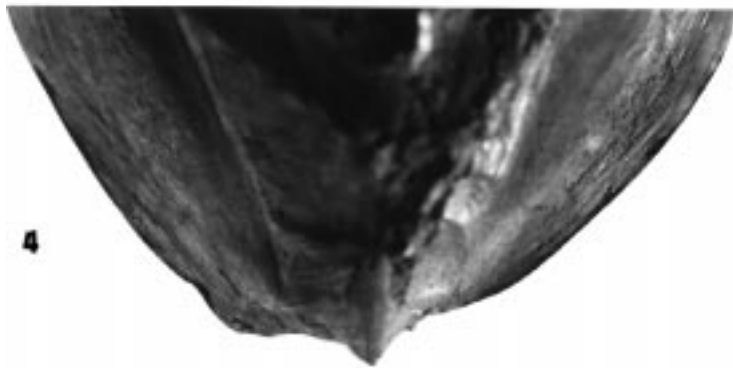
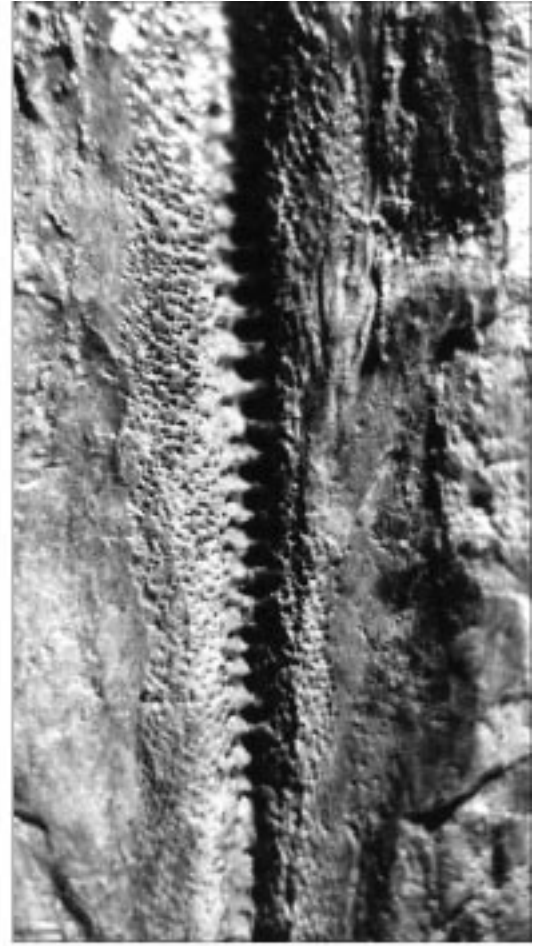
- Fig. 1: *Glyphiteuthis ornata* REUSS.  
Specimen No. O6099, National Museum, Prague.  
× 1.5.
- Fig. 2: *Glyphiteuthis ornata* REUSS.  
Specimen No. O4903, National Museum, Prague.  
× 1.8.
- Fig. 3: *Glyphiteuthis ornata* REUSS.  
Specimen No. O4903, National Museum, Prague – detail of strongly ribbed rhachis and granuled median field.  
× 2.5.
- Fig. 4: *Glyphiteuthis ornata* REUSS.  
Specimen No. O6099, National Museum, Prague – detail of the most apical part with “rostrum” developed.  
× 1.5.
- Fig. 5: *Eoteuthoides caudata* (FRITSCH).  
Specimen No. O3222, National Museum, Prague.  
× 2.
- Fig. 6: *Styloteuthis convexa* (FRITSCH).  
Specimen No. O3221, National Museum, Prague.  
× 2.
- Fig. 7: *Marekites vinarensis* (FRITSCH).  
Specimen No. O3223, National Museum, Prague.  
× 2.
- Fig. 8: *Glyphiteuthis* sp. cf. *G. minor* FRITSCH & SCHLÖNBACH.  
Specimen No. O1736, National Museum, Prague.  
× 0.1.
- Fig. 9: *Paraglyphiteuthis crenata* (FRITSCH).  
Specimen No. O3258, National Museum, Prague – detail of strongly and regularly ribbed rhachis.

Natural size.

Specimens 5–7 are coated with ammonium chloride.

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## Plate 2



1



2



3

Fig. 1: *Glyphiteuthis minor* FRITSCH & SCHLÖNBACH.  
Specimen No. O5861, National Museum, Prague.  
× 0.1.

Fig. 2: *Paraglyphiteuthis crenata* (FRITSCH).  
Detail of strongly and regularly ribbed rhachis.  
Specimen No. O3259. National Museum, Prague.  
Natural size.

Fig. 3: *Paraglyphiteuthis crenata* (FRITSCH).  
Specimen No. O3258. National Museum, Prague.  
× 0.1.

Specimen 1 is coated with ammonium chloride.  
All photos are taken by M. KOŠTAK.

## References

- BANDEL, K. & LEICH, H., 1986: Jurassic Vampyromorpha. – Neues Jahrbuch für Geologie und Paläontologie, Monatshefte, 1986, 129–148.
- BÜLOW-TRUMMER, E. von, 1920: Fossilium Catalogus 1: Animalia. Pars 11; Cephalopoda Dibranchiata. – 313 p.
- ČECH, S., KLEIN, V., KRÍŽ, J. & VALEČKA, J., 1980: Revision of the Upper Cretaceous stratigraphy of the Bohemian Cretaceous Basin. – Věstník Ústředního Ústavu geologického, **55**, 227–296.
- CHRISTENSEN, W.K., 1976: Palaeobiogeography of Late Cretaceous belemnites of Europe. – Paläontologische Zeitschrift, **50**, 3/4, 113–129.
- CHRISTENSEN, W.K., 1982: Late Turonian–early Coniacian belemnites from western and central Europe. – Bulletin of the Geological Society of Denmark, **31**, 63–79.
- CRICK, G.C., 1896: On a specimen of *Coccoteuthis hastiformis* RÜPPEL sp. from the Lithographic Stone (Lower Kimmeridgian) of Eichstätt, Bavaria. – Geological Magazine, **4/3**, 439–443.
- DONOVAN, D.T., 1977: Evolution of the dibranchiate Cephalopoda. – Symposia of the Zoological Society of London, **38**, 15–48.
- DONOVAN, D.T., 1983: *Mastigophora* OWEN, 1856: A little-known genus of Jurassic coleoids. – Neues Jahrbuch für Geologie und Paläontologie Abhandlungen, **165**, 484–485.
- DOYLE, P., 1990: Teuthid cephalopods from the Lower Jurassic of Yorkshire. – Palaeontology, **33**, 193–207.
- DOYLE, P., 1991: Teuthid cephalopods from the Upper Jurassic of Antarctica. – Palaeontology, **34/1**, 169–178.
- ENGESER, T., 1988a: Fossil “octopods” – a critical review. – In: M.R. CLARKE & E.R. TRUEMAN (eds): The Mollusca, 12, Palaeontology and neontology of Cephalopods. – 355 p.
- ENGESER, T. & BANDEL, K., 1988: Phylogenetic classification of coleoid cephalopods. – In: J. WIEDMANN & J. KULLMANN (eds): Cephalopods – present and past, 763 p.
- ENGESER, T. & PHILLIPS, D., 1986: Redescription of two specimens previously recorded as fossil teuthids (Coleoidea, Cephalopoda). – Bull. Brit. Mus. (Nat. Hist.), Geology, **40**, 249–264.
- ENGESER, T. & REITNER, J., 1986: Teuthiden aus dem Unterapt (“Töck”) von Helgoland (Schleswig–Holstein, Norddeutschland). – Paläontologische Zeitschrift, **59**, 245–260.
- FRÍČ, A., 1879: Studie v oboru Křídového útvaru v Čechách. II. Bílohorské a Malnické vrstvy. – p. 144.
- FRITSCH, A., 1910: Miscellanea palaeontologica – II. Mesozoica.
- FRITSCH, A. & SCHLÖNBACH, U., 1872: Cephalopoden der b(hmischen Kreideformation, 54 pp.
- GREEN, R. G., 1977: *Niobrarateuthis walkeri*, a new species of teuthid from the Upper Cretaceous Niobrara Formation of Kansas. – Journal of Paleontology, **58**, 992–995.
- HALL, R., 1985: *Paraplesioteuthis hastata* (MÜNSTER), the first squid recorded from the Jurassic of North America. – Journal of Paleontology, **59**, 870–874.
- HALL, R. & NEUMAN, A.G., 1989: *Teudopsis cadominensis*, a new teuthid squid from the Toarcian (Lower Jurassic) of Alberta. – Journal of Paleontology, **63**, 324–327.
- HECKER, E.L. & HECKER, R.F., 1955: Remains of Teuthoidea from the Upper Jurassic and Lower Cretaceous of the Middle Volga area. – Voprosy Paleontologii, **2**, 36–44 (in Russian).
- HEWITT, R.A. & WIGNALL, P.B., 1988: Structure and phylogenetic significance of *Trachyteuthis* (Coleoidea) from the Kimmeridge Clay of England. – Proceedings of the Yorkshire Geological Society, **47**, 149–153.
- JELETZKY, J.A., 1966: Comparative morphology, phylogeny and classification of fossil Coleoidea. – University of Kansas Paleontological Contributions, Mollusca, **7**, 162 pp.
- KOŠTAK, M., 1996: Late Turonian – Coniacian belemnites (genera *Actinocamax* MILLER and *Gonioteuthis* BAYLE) from the Bohemian Cretaceous Basin. – Věstník Ústředního Ústavu geologického, **71/2**, 97–105.
- MILLER, H.W., 1957: *Niobrarateuthis bonneri*, a new genus and species of squid from the Niobrara Formation of Kansas. – Journal of Paleontology, **31**, 809–814.
- MILLER, H.W. & WALKER, M. W., 1968: *Enchoteuthis melanae* and *Kansasteuthis lindneri*, new genera and species of teuthids, and sepiid from the Niobrara Formation of Kansas. – Transactions of the Kansas Academy of Science, **71**, 176–183.
- NAEF, A., 1921: Das System der dibranchiaten Cephalopoden und die mediterranen Arten derselben. – Mitteilungen aus der Zoologischen Station zu Neapel, **22**, 527–542.
- NAEF, A., 1922: Die fossilen Tintenfische – Eine paläozoologische Monographie, 322 pp.
- NICHOLS, E. & ISAAK, H., 1987: Stratigraphic and taxonomic significance of *Tusoteuthis longa* Logan (Coleoidea, Teuthida) from the Pembina Member, Pierre Shale (Campanian), of Manitoba. – Journal of Paleontology, **61**, 727–737.
- d’ORBIGNY, A., 1845: Mollusques vivants et fossiles. – Céphalopodes acatapulifères, Paris.
- REITNER, J. & ENGESER, T., 1982: Teuthiden aus dem Barrem der Insel Maio (Kapverdische Inseln). – Paläontologische Zeitschrift, **56**, 209–219.
- REUSS, A.E., 1854: Loliginidenreste in der Kreideformation. – Abh. k. böhm. Ges. Wiss., **5**, VIII 1–5, Prague.
- ROGER, J., 1952: Sous-classe des Dibranchiata Owen, 1836. – In: J. PIVETEAU (ed): Traité de paléontologie, **2**, 755 p.
- SCHEVILL, W.E., 1950: An Upper Jurassic sepioid from Cuba. – Journal of Paleontology, **24**, 99–101.
- TOLL, R.B., 1982: The comparative morphology of the gladius in order Teuthoidea (Mollusca: Cephalopoda) in relation to system and Phylogeny. – MS-Dissertation, The University of Miami.
- TOLL, R.B., 1988: Functional morphology and adaptive patterns of the teuthoid gladius. – In: M.R. CLARKE and E.R. TRUEMAN (eds): The Mollusca, **12**, Palaeontology and neontology of Cephalopods, 355 p.
- WOODWARD, S.P., 1883: On a new genus of fossil “Calmary” from the Cretaceous formation of Sahel–Alma, near Beirut, Lebanon. – Syria, **2/10**, 1–5.
- ZAHÁLKA, Č., 1914–1938: Útvar křídový v Českém středohoří. – Roudnice nad Labem.