Fusiteuthis polonica, a rare and unusual belemnite from the Maastrichtian

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A specimen of *Fusiteuthis polonica*, from the basal Maastrichtian of the "Saturn" chalk pit at Kronsmoor in northwest Germany, is described. It came from the uppermost part of the *Belemnella lanceolata* Zone, ca. 9.5 m above the base of the Maastrichtian as defined on belemnites. *Fusiteuthis* was very rare, but widely distributed. Single occurrences are known from northwest Germany, Poland and Crimea. It has been recorded only from the lowest and uppermost parts of the Maastrichtian; the longevity of this genus was thus slightly less than 6 myr. *Fusiteuthis* belongs to the Upper Cretaceous belemnite family Belemnitellidae.

Key words: Belemnitellids, *Fusiteuthis*, taxonomy, Maastrichtian, northwest Germany.

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Introduction

Kongiel (1962) established his new genus and new species *Fusiteuthis polonica* on the basis of a single specimen from the greensand with phosphorites of Bochotnica quarry near Kazimierz Dolny in the Vistula Valley, central Poland (Fig. 1). This greensand was considered to be of latest Maastrichtian age by Kongiel (1962). The age of the greensand is discussed below. Later, Naidin (1973, 1975) recorded two specimens of *Fusiteuthis* sp. from the Upper Maastrichtian of Crimea (Fig. 1).

J.A. Jeletzky (unpublished manuscript for the *Treatise on Invertebrate Paleontology*, copy obtained by the author in 1972) suggested, nevertheless, that the genus *Fusiteuthis* is dubious being based, possibly, on a pathological specimen. Christensen (1997) agreed, because the holotype is slightly asymmetrical in ventral view (Fig. 2A).

In this context, it is worthy of note that another monotypic belemnitellid genus *Belemnocamax* Crick, type species *B. boweri* Crick, was established on the basis of only two specimens from the Middle Cenomanian of Lincolnshire, England. This genus was also considered dubious and earlier authors, Stolley (1919) and Jeletzky (1946), among others, suggested that the two specimens were pathological forms of another Cenomanian belemnite species. This suggestion, however, was invalidated by later records of this unusual, diminutive species from eastern England and northwestern Germany. It was described in detail by Christensen (1993). *B. boweri* is now considered to be derived from an unknown stock.

The aim of the present paper is to describe a specimen of *F. polonica* from the basal Maastrichtian of the "Saturn" chalk pit at Kronsmoor, northwest Germany (Fig. 1), and confirm the status of the taxon.

Systematic palaeontology

Family Belemnitellidae Pavlow, 1914
Genus *Fusiteuthis* Kongiel, 1962

Type species: By monotypy *F. polonica* Kongiel, 1962.

Diagnosis.—Medium-sized, slender belemnitellid with a shallow alveolus and a short ventral fissure; guard lanceolate in ventral and lateral views; dorsolateral longitudinal depressions present, guard smooth.

Discussion.—The monotypic genus *Fusiteuthis* is placed in the family Belemnitellidae, because it has an alveolus, which is connected through the ventral fissure with the surface of the guard, and dorsolateral longitudinal depressions. Dorsolateral longitudinal double furrows are absent. The interior characters are not known, because the fragile nature of the anterior end precludes the guard to be split in the median plane to reveal them.

Distribution.—See below.

Fusiteuthis polonica Kongiel, 1962

Fig. 2.

Fusiteuthis polonica; Kongiel 1962: 28, pl. 1: 1–3.
Fusiteuthis polonica; Kongiel-Christensen 1997: 76, pl. 2: figs. 6, 7.

Type: The holotype, by original designation, is the original of Kongiel (1962: pl. 1: 1–3), from the upper Upper Maastrichtian, Bochotnica quarry near Kazimierz Dolny in the Vistula Valley, central Poland. It is housed in the Museum of the Earth (Muzeum Ziemi) in Warsaw, Poland and registered as MZ VIII Mcd 162. Measurements of critical characters of the holotype are shown in Table 1. It is re-figured here as Fig. 2A.

Material.—One specimen, MGUH 26406 (Fig. 2B), from the basal Maastrichtian, uppermost part of the *Belemnella lanceolata* Zone, "Saturn" chalk pit at Kronsmoor, northwest

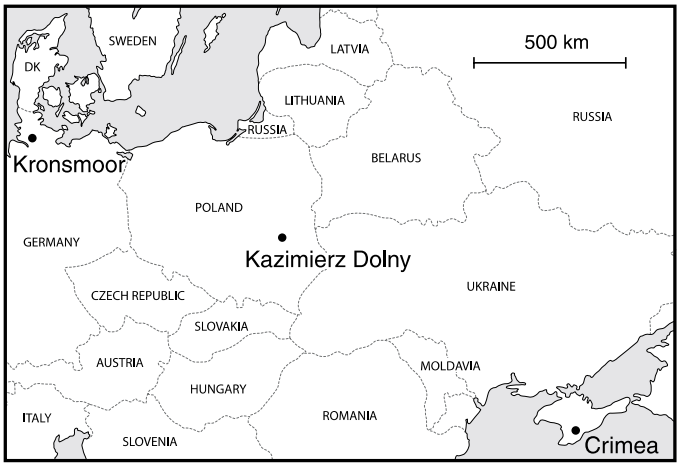

Fig. 1. Dots show the geographical occurrences of the Maastrichtian belemnitellid genus *Fusiteuthis* Kongiel.

Germany. It came from ca. 3.5 m below marker horizon G 610, which is a pyrite-impregnated bed, that is ca. 9.5 m above the base of the Maastrichtian and ca. 0.5 m below the top of the *Belemnella lanceolata* Zone (Fig. 3). It was collected by the late Dr. M.-G. Schulz.

Description.—Measurements of the critical characters are shown in Table 1. Guard ca. 51 mm, slender and lanceolate in ventral and lateral views; maximum lateral diameter is situated in the middle part of guard; alveolus shallow; cross-section of anterior end oval, with dorsoventral diameter slightly larger than lateral diameter; ventral fissure short; guard slightly prolonged ventrally around the ventral fissure; apical end acute; guard smooth; interior characters are not known, because the fragile anterior end precludes the guard to be split in the median plane to reveal them.

Discussion.—MGUH 26406 is smaller than the holotype and is therefore considered to be an adolescent specimen. It has a relatively deeper alveolus than the holotype, but this may be related to the fact that the anterior end of the guard is better preserved. The Slenderness Quotient (SQ), which is the length of the guard divided by the dorsoventral diameter at the alveolar end, of the holotype (SQ = ca. 21) is about twice the value of that of MGUH 26406 (SQ = 10), whereas the ratio of the length of the guard divided by the maximum lateral diameter is very closely similar in the two specimens.

Distribution of *Fusiteuthis*

The holotype of *F. polonica* came from a greensand with phosphorites in the Bochotnica quarry. The greensand is sandwiched between the so-called Kazimierz Opoka of late Late, but not latest, Maastrichtian age and marly gaizes with limestone intercalations of Danian age (Machalski and Walaszczyk 1987, 1988; Hansen et al. 1989; Machalski 1996, 1998). The base of the greensand rests upon the strongly burrowed top of the Opoka, which is a Polish term for siliceous limestone.

Table 1. Dimensions in mm of *Fusiteuthis polonica* Kongiel.

	Holotype	MGUH 26406
L	83	51.1
LAP	73.9	42.3
D	9.1	8.8
DVDAE	4*	4.1
LDAE	4*	3.7
DVDP	–	5.1
LDP	–	4.7
MLD	10*	5.9
MDVD	10*	5.6
LVF	8.0	3.6
RQ	9.1	5.8
RI	11.0	17.2
SQ	20.8**	10.0
BI	–	8.3
L/MLD	8.3**	8.7

L, length of guard; LAP, length from apex to protoconch; D, depth of alveolus; DVDAE, dorsoventral diameter at alveolar end; LDAE, lateral diameter at alveolar end; DVDP, dorsoventral diameter at protoconch; LDP, lateral diameter at protoconch; MLD, maximum lateral diameter; MDVD, maximum dorsoventral diameter; LVF, length of ventral fissure; RQ, Riedel Quotient (L/D); RI, Riedel Index (D×100/L); SQ, Slenderness Quotient (L/DVDAE); BI, Birkelund Index (LAP/DVDP). Measurements marked * are obtained from the figures of Kongiel (1962: pl. 1: 1–3) and quotients marked ** are based on these measurements.

The age of the greensand has been the subject of much discussion previously (see review by Machalski 1998), and it has been placed either in the uppermost Maastrichtian or in the Danian. Some authors have placed the Cretaceous–Palaeogene boundary in the middle of the greensand (Machalski and Walaszczyk 1987, 1988).

Machalski (1998) considered the greensand as a transgressive horizon of Danian age, that contains both indigenous and reworked Danian fossils, as well as reworked Maastrichtian fossils. Reworked Maastrichtian fossils include specimens of the Upper Maastrichtian belemnitellid *Belemnella kazimiroviensis* (Skołozdrówna) and the Maastrichtian ammonite *Hoploscaphites constrictus* (Sowerby) (Machalski and Walaszczyk 1988), as well as the holotype of *F. polonica*. Machalski and Walaszczyk (1988) recorded *B. kazimiroviensis* from throughout the greensand and two specimens of *H. constrictus* from phosphatized nodules in the upper part of the greensand.

Machalski (1998) suggested that the reworked Maastrichtian fossils from the greensand may have come from two sources: 1) the top of the Kazimierz Opoka, which is of late Late, but not latest, Maastrichtian age (see below), or 2) a glauconitic chalk unit of late Late, possibly latest, Maastrichtian age, which was removed by erosion during the early Danian. Machalski (1996) placed the upper part of the Opoka of Bochotnica quarry in the upper Upper Maastrichtian *Belemnella kazimiroviensis* Zone of the northwest European belem-

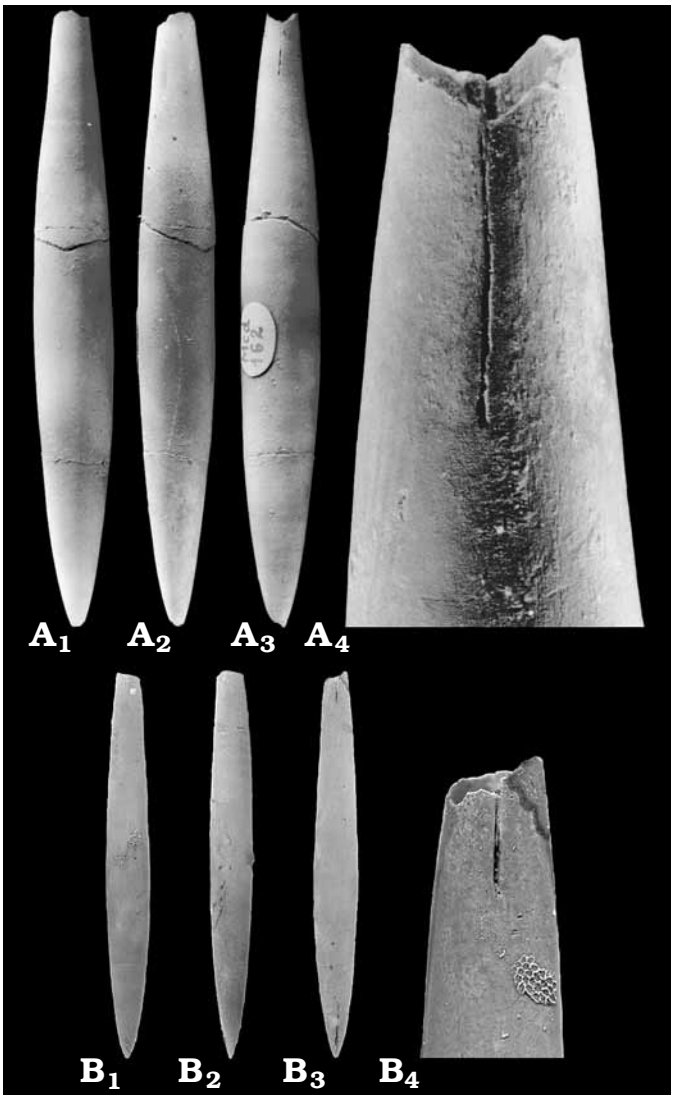

Fig. 2. *Fusiteuthis polonica* Kongiel, 1962. **A**. Holotype MZ VIII Med 162 in dorsal (A_1), lateral (A_2), ventral (A_3) views, and view of the ventral anterior end of the guard, showing the ventral fissure (A_4), approximately × 5. **B**. MGUH 26406, "Saturn" chalk pit at Kronsmoor, uppermost part of the *Belemnella lanceolata* Zone, ca. 3.5 m below marker horizon G 610 in dorsal (B_1), lateral (B_2), ventral (B_3) views, and view of the ventral anterior end of the guard, showing the ventral fissure (B_4), × 4. MGUH 26406 is registered in the Type Collection of the Geological Museum, University of Copenhagen. All figures are coated with ammonium chloride and are natural size unless otherwise stated.

nite zonal scale (Fig. 3). Moreover, he showed on ammonite evidence that this part of the Opoka equates with the lower part of the *B. kazimiroviensis* Zone of Denmark. Thus, it seems that the holotype of *F. polonica* came from the upper Upper, possibly uppermost, Maastrichtian.

Naidin (1973, 1975; Fig. 2) recorded two specimens of *Fusiteuthis* sp. from the uppermost Maastrichtian of Crimea, but he did neither describe nor figure these specimens. The specimen of *F. polonica* described here came from the basal Maastrichtian, uppermost part of the *Belemnella lanceolata* Zone (see below).

In conclusion, the genus was very rare but had a wide palaeogeographical range, extending from northwest Germany, across Poland to Crimea, and it has been recorded only from the basal and uppermost Maastrichtian. The Maastrichtian Stage lasted about 6 myr (Obradovich 1994) and the longevity of the genus, therefore, was a little less than 6 myr. On the basis of the geographical and stratigraphical distribution of *Fusiteuthis* it may be suggested that the few specimens recorded so far were occasional migrants from an unknown area.

Affinities of *Fusiteuthis*

Kongiel (1962: p. 28) noted that *Fusiteuthis* "is nearest to the genus *Actinocamax* but differs in its well developed alveolus (eualveolus with preserved conotheca) and the lack of dorso-lateral double furrows, also in complete lack of ornamentation".

Naidin (1964) erected two new subgenera of *Actinocamax*: *A.* (*Praeactinocamax*), type species *Belemnites plenus* Blainville, and *A.* (*Paractinocamax*), type species *Actinocamax grossouvrei* Janet, in addition to the nominotypical subgenus. Moreover, he established one new genus, *Belemnellocamax*, type species *Belemnites mammillatus* Nilsson. *A.* (*Paractinocamax*) was placed in synonymy with *Belemnellocamax* by Christensen (1986) and *A.* (*Praeactinocamax*) was elevated to full generic rank by Christensen (1997). Species placed in *Belemnellocamax* were assigned to *Actinocamax* before 1964.

With respect to the size and shape of the guard the holotype of *F. polonica* somewhat resembles some species of *Praeactinocamax*, e.g., adolescent specimens of the Cenomanian *P. plenus* (see Christensen 1974), and the Santonian *Belemnellocamax toucasi* (Janet), but it differs in the structure of the alveolar end. *Praeactinocamax* generally has a low cone-shaped alveolar fracture anteriorly, or more rarely a very shallow pseudoalveolus, and *B. toucasi* has a very shallow pseudoalveolus, in contrast to *Fusiteuthis* which has a shallow alveolus.

With regard to the shape of the guard MGUH 26406 is somewhat similar to juvenile specimens of the Cenomanian *Praeactinocamax primus* (Arkhangelsky) (see Christensen 1990) and *P. plenus* (see Christensen 1974), but, again, it differs in possessing a shallow alveolus rather than a shallow pseudoalveolus. Moreover, the maximum lateral diameter is situated in the middle part of the guard in MGUH 26406, and generally in the lower third in the two species of *Praeactinocamax*.

MGUH 26406 is also somewhat similar to juvenile specimens of the uppermost Lower Campanian *Belemnellocamax mammillatus* and the lowermost Upper Campanian *B. balsvikensis* (Brotzen) (cf. Christensen and Schulz 1976, Figs. 1A–E), but it differs in possessing a shallow alveolus rather

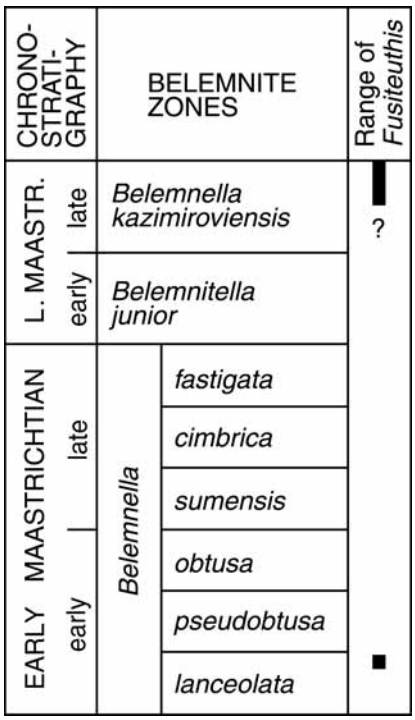

Fig. 3. Stratigraphical diagram, showing the range of *Fusiteuthis* Kongiel on the north European belemnite zonal scale. This scale was critically assessed by Christensen (1996), who noted that the Early Maastrichtian *Belemnella* zones are either interval or total range zones. Moreover, he showed that the base of the *B. kazimiroviensis* Zone is highly diachronous and becomes progressively younger from the eastern part of the Russian Platform in the east to the Netherlands in the west. The zone is Late Maastrichtian in the east, late Late Maastrichtian in Denmark and latest Maastrichtian in the Netherlands.

than a shallow pseudoalveolus and more lanceolate shape of the guard in ventral view.

According to Schulz (1979, 1982) the upper half of the *Belemnella lanceolata* Zone of the "Saturn" pit has yielded *Belemnella lanceolata* (Schlotheim), *Belemnella inflata* (Arkhangelsky), and *Belemnitella pulchra* Schulz. *B. pulchra* differs from *F. polonica* in its deeper alveolus, stouter guard and conspicuous vascular markings, among other characters. Juvenile specimens of *B. lanceolata* and *B. inflata* are very slender and have weakly developed or no vascular markings. MGUH 26406 differs from these in its markedly more shallow alveolus.

The Campanian–Maastrichtian Stage boundary

The first occurrence of *Belemnella lanceolata* has been widely used for the definition of the base of the Maastrichtian, first in Russia (Arkhangelsky 1912) and later in Europe (Jeletzky 1951). At the Copenhagen Symposium on Cretaceous Stage Boundaries in 1983, the lowest occurrence of *B. lanceolata* at the base of flint bed F600 in the "Saturn" pit at Kronsmoor was proposed as the boundary stratotype for the base of the Maastrichtian (Birkelund et al. 1984). A new multidisciplinary definition of the base of the Maastrichtian confirms, however, that the first appearance of *B. lanceolata* remains a reliable marker for the base of the stage (see below).

The proposal by Odin (2001; see also Odin and Lamaurelle 2001) for a Global Stratotype Section and Point (GSSP) for the base of the Maastrichtian to be placed at level 115.2 m on platform IV in the abandoned quarry at Tercis near Dax in the Landes region, southwestern France, was voted on by the Subcommission on Cretaceous Stratigraphy and the International Commission on Stratigraphy in 2000, and ratified by the International Union of Geological Sciences in February 2001. Level 115.2 m at Tercis was defined in terms of a combination of 12 bioevents, including the first occurence (FO) or last occurrence (LO) of four macrofossils and eight microfossils. The level is the arithmetical mean value of the first and last occurrences of these fossils.

The FO of the ammonite *Pachydiscus neubergicus* (Hauer) is at level 116.1 m, that is 0.9 m above the base of the Maastrichtian. The LO of the ammonite *Nostoceras hyatti* Stephenson is at level 114.1 m, that is 1.1 m below the base of the Maastrichtian. Previously, the Maastrichtian Working Group recommended the level of the lowest occurrence of *P. neubergicus* at Tercis as the GSSP for the base of the Maastrichtian at the Brussels Symposium on Cretaceous Stage Boundaries (Odin 1996).

It is worthy of note, that the FO of *P. neubergicus* in the Maastrichtian of Europe is highly diachronous (Christensen et al. 2000) and that Küchler (2000) and Küchler et al. (2001) recorded *N. hyatti* from the basal Lower Maastrichtian of Navarra in northern Spain, where it co-occurs with *P. neubergicus*. Navarra is situated only ca. 80 km south of Tercis.

Christensen et al. (2000) discussed the *P. neubergicus* and *B. lanceolata* standards for the base of the Maastrichtian Stage and tentatively concluded that these are not separated by more than about 0.2 myr, *B. lanceolata* occurring slightly earlier than *P. neubergicus*. This is a relatively small discrepancy in terms of current limits of biostratigraphical precision, but may imply that the *B. lanceolata* Zone or lower part of the zone at least, is Upper Campanian. However, the conclusion by Christensen et al. (2000) was based on the assumption that the base of the Maastrichtian was defined at the level of the lowest occurrence of *P. neubergicus* at Tercis, which was considered to be at level 115.7 m. Christensen (2001) suggested, therefore, that the belemnite standard for the base of the Maastrichtian, as defined by the FO of *Belemnella lanceolata* at Kronsmoor, virtually corresponds to the Campanian–Maastrichtian Stage boundary at level 115.2 m at Tercis, as defined by a multi-bioevents approach. Odin and Lamaurelle (2001) arrived at the same conclusion and noted that the belemnite standard can be used as a boreal proxy for the stage boundary.

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References

Arkhangelsky, A.D. [Arhangelskij, A.D.] 1912. The Upper Cretaceous deposits in the eastern part of the European Russia [in Russian]. *Materialy dlâ Geologii Rossii* 25: 1–631.

Birkelund, T., Hancock, J.M., Hart, M.B., Rawson, P.F., Remane, J., Robaszynski, F., Schmid, F., and Surlyk, F. 1984. Cretaceous stage boundaries Proposals. *Bulletin of the Geological Society of Denmark* 33: 3–20.

Christensen, W.K. 1974. Morphometric analysis of *Actinocamax plenus* from England. *Bulletin of the Geological Society of Denmark* 23: 1–26.

Christensen, W.K. 1986. Upper Cretaceous belemnites from the Vomb Trough in Scania, Sweden. *Sveriges Geologiska Undersökning Ca* 57: 1–57.

Christensen, W.K. 1990. *Actinocamax primus* Arkhangelsky (Belemnitellidae; Upper Cretaceous): Biometry, comparison and biostratigraphy. *Paläontologische Zeitschrift* 64: 75–90.

Christensen, W.K. 1993. *Belemnocamax boweri* Crick, an unusual belemnite from the Cenomanian of northwest Germany and eastern England. *Bulletin of the Geological Society of Denmark* 40: 157–166.

Christensen, W.K. 1996. A review of the Upper Campanian and Maastrichtian belemnite biostratigraphy of Europe. *Cretaceous Research* 17: 751–766.

Christensen, W.K. 1997. The Late Cretaceous belemnite family Belemnitellidae: Taxonomy and evolutionary history. *Bulletin of the Geological Society of Denmark* 44: 59–88.

Christensen, W.K. 2001. The Campanian–Maastrichtian Stage boundary. *Bulletin of the Geological Society of Denmark* 48: 208 only.

Christensen, W.K., Hancock, J.M., Peake, N.B., and Kennedy, W.J. 2000. The base of the Maastrichtian. *Bulletin of the Geological Society of Denmark* 47: 81–85.

Christensen, W.K. and Schulz, M.-G. 1976. First record of *Belemnellocamax balsvikensis* (Brotzen, 1960) from NW Germany. *Neues Jahrbuch für Geologie und Paläontologie, Monatshefte* 9: 522–531.

Hansen, H.J., Rasmussen, K.L., Gwozdz, R., Hansen, J.M., and Radwański, A. 1989. The Cretaceous/Tertiary boundary in Central Poland. *Acta Geologica Polonica* 39: 1–12.

Jeletzky, J.A. 1946. Zur Kenntnis der Oberkretazischen Belemniten. *Geologiska Föreningens i Stockholm Förhandlingar* 68: 87–105.

Jeletzky, J.A. 1951. Die Stratigraphie und Belemnitenfauna des Obercampan und Maastricht Westfalens, Nordwestdeutschlands und Dänemark, sowie einige allgemeine Gliederungs-Probleme der jüngeren borealen Oberkreide Eurasiens. *Beihefte Geologisches Jahrbuch* 1: 1–142.

Kongiel, R. 1962. On belemnites from the Maastrichtian, Campanian and Santonian sediments in the Middle Vistula Valley (Central Poland). *Prace Muzeum Ziemi* 5: 1–148.

Küchler, T. 2000. Upper Cretaceous of the Barranca (Navarra, northern Spain): integrated litho-, bio- and event stratigraphy. Part II: Campanian and Maastrichtian. *Acta Geologica Polonica* 50: 441–499.

Küchler, T., Kutz, A., and Wagreich, M. 2001. The Campanian–Maastrichtian boundary in northern Spain (Navarra province): the Imiscoz and Erro sections. *In*: G.S. Odin (ed.), The Campanian–Maastrichtian Stage Boundary. *Developments in Palaeontology and Stratigraphy* 19: 723–744.

Machalski, M. 1996. Scaphitid ammonite correlation of the Late Maastrichtian deposits in Poland and Denmark. *Acta Palaeontologica Polonica* 41: 369–383.

Machalski, M. 1998. The Cretaceous–Tertiary boundary in Central Poland [in Polish with English summary]. *Przegląd Geologiczny* 46: 1153–1161.

Machalski, M. and Walaszczyk, I. 1987. Faunal condensation and mixing in the uppermost Maastrichtian/Danian Greensand (Middle Vistula Valley, Central Poland). *Acta Geologica Polonica* 37: 75–91.

Machalski, M. and Walaszczyk, I. 1988. The youngest (uppermost Maastrichtian) ammonites in the middle Vistula Valley, central Poland. *Bulletin of the Polish Academy of Sciences, Earth Sciences* 36: 67–70.

Naidin, D.P. [Najdin, D.P.] 1964. *Verhnemelovye belemnity Russkoj Platfromy i sopredel'nyh oblastej*. 190 pp. Izdatel'stvo Moskovskogo Universiteta, Moskva.

Naidin, D.P. [Najdin, D.P.] 1973. On the relationship betweeen lower rank biostratigraphical and palaeobiogeographgical subdivision [in Russian]. *Bûlletin' Moskovskogo Obŝestva Ispytatelej Prirody, Otdel Geologičeskij* 48: 50–63.

Naidin, D.P. [Najdin, D.P.] 1975. Late Maastrichtian belemnitellids of Eurasia [in Russian]. *In:* V.V. Menner, M.M. Moskvin, D.P. Najdin, A.N. Solov'ev, and V.N. Šimanskij (eds.), *Razvitie i smena organičeskogo mira na rubeže mezozoâ i kajnozoâ*, 91–108. Nauka, Moskva.

Obradovich, J.D. 1994. A Cretaceous time scale. *In*: W.G.E Caldwell and E.G. Kauffman (eds.), Evolution of the Western Interior Basin. *Geological Association of Canada, Special Paper* 39: 379–396. [Misdated 1993].

Odin, G.S. (compiler) 1996. Definition of a Global Boundary Stratotype Section and Point for the Campanian/Maastrichtian boundary. *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Sciences de la Terre* 66 (Supplement): 111–117.

Odin, G.S. (compiler) 2001. The Campanian–Maastrichtian boundary: definition at Tercis (Landes, France), principle, procedure and proposal. *In*: G.S. Odin (ed.), The Campanian–Maastrichtian Stage Boundary. *Developments in Palaeontology and Stratigraphy* 19: 820–833.

Odin, G.S. and Lamaurelle, M.A. 2001. The global Campanian–Maastrichtian stage boundary. *Episodes* 24: 229–238.

Schulz, M.-G. 1979. Morphometrisch-variationsstatistische Untersuchungen zur Phylogenie der Belemniten-Gattung *Belemnella* im Untermaastricht NW-Europas. *Geologisches Jahrbuch A* 47: 1–157.

Schulz, M.-G. 1982. Erster Nachweis der Belemnitengattung *Belemnitella* (*B. pulchra* n. sp.) im mittleren Untermaastricht NW-Deutschlands. *Geologisches Jahrbuch A* 61: 279–293.

Stolley, E. 1919. Die Systematik der Belemniten. *Jahresbericht des Niedersächsischen geologischen Vereins* 11: 1–59.