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TAXONOMY OF THE EARLY CRETACEOUS BELEMNITE SPECIES *AULACOTEUTHIS ABSOLUTIFORMIS* (SINZOW, 1877) AND ITS TYPE STATUS

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ABSTRACT

Recent field work in the Early Cretaceous succession of the Ulyanovsk – Syzran – Saratov region, Volga River, Russia has shown that the belemnite species *Aulacoteuthis absolutiformis* occurs in the lower part of the Upper Hauterivian *Speetoniceras versicolor* ammonite Zone. These findings are in accordance with the original species assignment by Sinzow (1875, 1877). *A. absolutiformis* was lateron misidentified by Stolley (1911) and taken as the type species of the genus *Aulacoteuthis* common only in the late Early Barremian of northwest Europe (England, northwest Germany). Since the genus *Aulacoteuthis* is a well accepted belemnite genus of late Early Barremian age, we suggest *Aulacoteuthis ernsti* nov. sp. as the new type species of *Aulacoteuthis*.

Keywords: Belemnites, systematics, *Aulacoteuthis absolutiformis*, palaeobiogeography, north Europe, early Cretaceous

1. INTRODUCTION

Based on the belemnite species *Belemnites absolutiformis* the stratigraphically important belemnite genus *Aulacoteuthis* was introduced by Stolley (1911) as an index genus for the 'lower part of the Upper Neocomian' (= Barremian) in northwest Europe. *Aulacoteuthis* was included in the belemnite family Oxyteuthididae (suborder Belemnitina), a group which is restricted to the Boreal Realm (*sensu* Mutterlose 1988). The Oxyteuthididae, which include the genera *Praeoxyteuthis*, *Aulacoteuthis* and *Oxyteuthis*, are extremely common and the most useful index fossils in the Barremian of northwest Europe (Mutterlose 1990). They underwent an endemic evolution in the North Sea area. The species succession of the Oxyteuthididae both at Speeton (northeast England) and in northwest Germany clearly shows an evolutionary lineage: *Praeoxyteuthis jasikofiana* (Hauterivian - Barremian boundary interval) - *Praeoxyteuthis pugio* (earliest Barremian) - *Aulacoteuthis* spp. (late Early Barremian) - *Oxyteuthis brunsvicensis* (early Late Barremian) - *Oxyteuthis germanica* (mid Late Barremian) - *Oxyteuthis depressa* (latest Barremian). Various species of the *Aulacoteuthis* plexus form an evolutionary lineage, which characterises a distinctive level in the upper Lower Barremian without any other belemnites. Consequently Stolley (1925) and subsequent workers (e.g. Mutterlose 1983) used *Aulacoteuthis* as an index for the late Early Barremian *Aulacoteuthis* beds. In addition, *Aulacoteuthis* was used as the marker for the Lower/Upper Barremian boundary in the north of Europe (e.g. Mutterlose 1983, 1992, 1998), and the first occurrence of its successor *Oxyteuthis* occurs at the base of the Upper Barremian.

The type species of the genus *Aulacoteuthis*, *Belemnites absolutiformis* was, however, originally described by Sinzow (1875, nom. nud.; figured in 1877) from the basal part of the Upper Hauterivian of the Lower Cretaceous ('dark Simbirsk Clay') succession of the Volga River (Russian Platform). Then Pavlow (1892, 1901) recognised *B. absolutiformis* in the Barremian of the Speeton

succession (Fig. 1). Following him, Stolley (1911, 1925) and later Russian palaeontologists considered *Aulacoteuthis* mainly to be of Barremian age, but also mentioned it from the Upper Hauterivian (e.g. Milanovsky 1940, Chernova 1951, Glasunova 1969, Ivanova 1969). According to Kabanov (1959), however, *Aulacoteuthis absolutiformis* is clearly limited to the Upper Hauterivian.

From 1995-2000 extensive field studies have been carried out in beds of Hauterivian age, which are exposed along the Volga River (Russia) between the towns of Ulyanovsk in the north and Saratov in the south (Fig. 1). In the course of this project belemnites have been collected and subsequently been studied in detail, in order to resolve the stratigraphic occurrence of *Aulacoteuthis absolutiformis*. It is the purpose of this paper to examine the stratigraphic position of *A. absolutiformis* in Russia and northwest Europe, to discuss the taxonomic implications in the light of the new findings in Russia and to point out possible taxonomic consequences.

The figured material is deposited in the Museum of the Earth (Moscow State University, Russia) and in the Department for Geology and Palaeontology (University of Hannover, Germany = SGPI).

2. DISTRIBUTION OF *AULACOTEUTHIS* – TYPE BELEMNITES

Aulacoteuthis-type belemnites are characterised by (1) a well developed ventral groove extending from the apex in adoral direction, (2) a typical divergent course of the two lateral lines and (3) by an overall slender to elongate guard (e.g. Stolley 1925, Mutterlose 1983). Specimens of this genus have been described from two different stratigraphic intervals and three regions of northwest Europe: the late Early Barremian of England and northwest Germany and the early Late Hauterivian and mid-Barremian of European Russia. In order not to anticipate future new generic assignments, both, the Russian early Late Hauterivian and the northwest European late Early Barremian grooved belemnite groups will here be referred to as *Aulacoteuthis*.

The cephalopods of the Barremian of northwest Europe (England, northwest Germany) are dominated by the belemnite genera *Praeoxyteuthis*, *Aulacoteuthis* and *Oxyteuthis*. All three genera are very common and consequently they have been used as index fossils in the Barremian of northwest Europe (Mutterlose 1990; Fig. 2). The ventrally grooved genus *Aulacoteuthis* (in the sense of Stolley, 1911) which is clearly to be derived from ungrooved *Praeoxyteuthis*, passes at the top of its occurrence into the ungrooved *Oxyteuthis*. *Aulacoteuthis* seems to be restricted to a specific level in the upper Lower Barremian, which is characterised by laminated sediments rich in organic carbon (Hauptblätterton). Four species of *Aulacoteuthis* do occur in these late Early Barremian *Aulacoteuthis* beds, forming an evolutionary lineage: *Aulacoteuthis speetonensis* (Pavlow, 1892), *Aulacoteuthis compressa* Mutterlose, 1983, *Aulacoteuthis ernsti* n. sp. (= *Aulacoteuthis absolutiformis* sensu Stolley, 1911 (non Sinzow, 1877), *Aulacoteuthis descendens* Stolley, 1925; the diversity of the late Barremian *Oxyteuthis* is lower.

Fig. 1 Locality map showing the studied areas

In Russia the *Aulacoteuthis absolutiformis* group (Fig. 3A, B) has been recorded from the Ulyanovsk area, the Syzran area and the Saratov area of the Russian Platform (e.g. Moskvin 1986-1987, Baraboshkin 2001; Fig. 2). All three areas are located along the Volga River and are here jointly addressed as the Povolzhie region. *Aulacoteuthis* has also been reported from the Peri-Caspian region (Moskvin 1986-1987) further south, but was not figured. So far only specimens from the Ulyanovsk area have been figured. During recent fieldwork in the Povolzhie region the presence of *Aulacoteuthis* was confirmed only for localities of the Ulyanovsk area. About 20 specimens were collected both bed-by-bed from river sections and loose from the Volga beach.

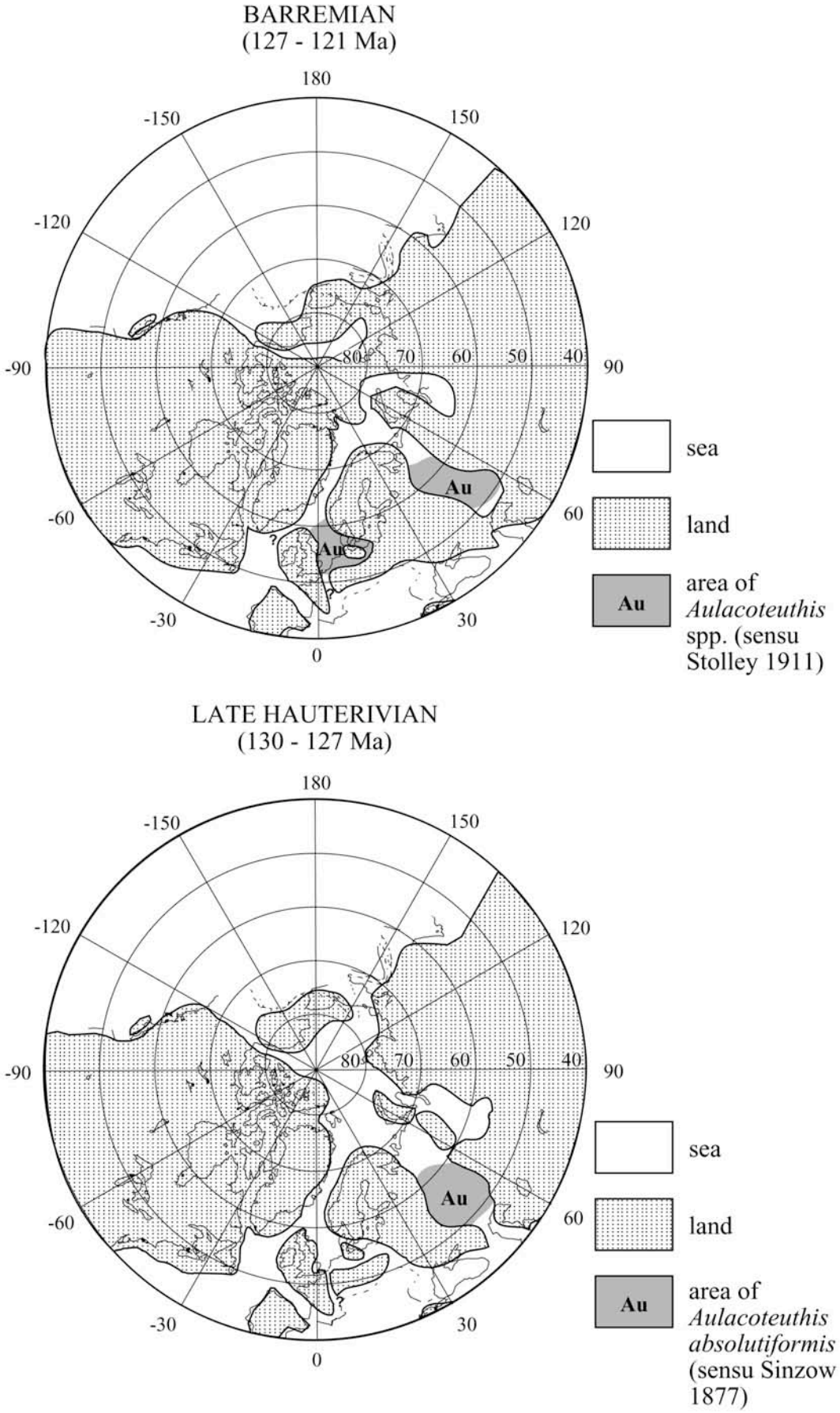

Fig. 2 Palaeogeographic map showing the geographic distribution pattern of *Aulacoteuthis* spp. *sensu* Stolley (1911) for the Barremian and *Aulacoteuthis absolutiformis* (Sinzow, 1877) for the Hauterivian

Specimens of *Aulacoteuthis* have also been recognised in the collection from the Volga River. They occur in the mid-Barremian like those of northwest Europe. The assemblage of the mid-Barremian *Aulacoteuthis* beds in Russia, however, is much less diverse. Only *Aulacoteuthis speetonensis* (Pavlow, 1892; Fig. 3E) and *A*. cf. *descendens* (Stolley, 1925) were identified.

3. SYSTEMATIC PALAEONTOLOGY

Order Belemnitida Zittel, 1895
Suborder Belemnitina Zittel, 1895
Genus *Aulacoteuthis* Stolley, 1911

pars	1877	*Belemnites* Sinzow, p.4
pars	1901	*Belemnites* Pavlow, p.83
	1911	*Oxyteuthis* (*Aulacoteuthis*) Stolley, p.218
	1925	*Aulacoteuthis* Stolley p.189
	1947	*Belemnites (Oxyteuthis)* Kamysheva-Elpatievskaya & Ivanova, p.73
	1948	*Aulacoteuthis* Swinnerton, p.44
	1959	*Aulacoteuthis* Ivanova, p.381
	1969	*Aulacoteuthis* Glasunova, p.231
	1969	*Aulacoteuthis* Ivanova, p.135
	1983	*Aulacoteuthis* Mutterlose, p.66

Type species. *Belemnites absolutiformis* Sinzow 1877 from the Upper Hauterivian of the Volga River, Russia. Following Pavlow (1901) *B. absolutiformis* was misidentified by Stolley (1911), who regarded a late Early Barremian belemnite species from northwest European as identical to the species of Sinzow (1877). Stolley (1911) used his *Aulacoteuthis absolutiformis* for defining the belemnite genus *Aulacoteuthis* of late Early Barremian age. Thus the genus *Aulacoteuthis* is based on a misidentified type species. In this case "… the author may select, and thereby fix as type species, the species that will, in his or her judgment, best serve stability and universality …" (article 70.3 of the International Code of Zoological Nomenclature 2000). Thus we suggest *Aulacoteuthis ernsti* n. sp. as the new type species for the genus *Aulacoteuthis.*

***Diagnosis*.** Slender and elongate ventrally flattened guards. Ventrally an apical groove is developed. This definition includes both the Russian early Late Hauterivian and the northwest European late Early Barremian ventrally grooved belemnites.

Remarks. The belemnite genus *Aulacoteuthis* in this definition is a heterogeneous taxon consisting of two different stock groups. An application is to be prepared to the commission on zoological nomenclature to use plenary powers to designate a type species for *Aulacoteuthis*.

Aulacoteuthis absolutiformis (Sinzow, 1877)
Fig. 3A, B

	1877	*Belemnites absolutiformis* Sinzow, pl. 5, figs 3-7
non	1892	*Belemnites absolutiformis* Sinzow, 1877; Pavlow, p. 266, pl. 4 (7), fig. 11, 12
non	1925	*Aulacoteuthis absolutiformis* Sinzow, 1877; Stolley, p. 27, pl. 4, figs 13-23
non	1948	*Aulacoteuthis absolutiformis* Sinzow, 1877; Swinnerton, p. 44, pl. 12, figs 10-16
	1969	*Aulacoteuthis cymbulus* Glasunova, p. 234, pl. 1, fig. 2
non	1925	*Aulacoteuthis absolutiformis* Sinzow, 1877; Stolley, p. 27, pl. 4, figs 13-23
non	1980	*Aulacoteuthis absolutiformis* Sinzow, 1877; Immel & Mutterlose, p. 258, Fig. 9.2
non	1983	*Aulacoteuthis absolutiformis* Sinzow, 1877; Mutterlose, p. 68, pl. 4, figs 9, 10; pl. 5, figs 1-6

Lectotype. The whereabouts of the specimens figured by Sinzow (1877) is currently unknown.

Material. Twenty specimens from the Volga River. Nos. MSU 99/1, 99/2, 99/4 to 99/21.

Diagnosis. Both in ventral and lateral view club-shaped, relatively small guards. A well-developed apical groove extends from the apex into adoral direction. The groove occupies a central position on the ventral side, it flattens and expands to the apex. The cross-section of the guard is subelliptical to subrectangular, compressed in dorso-ventral direction. The apical line is extremely displaced to the venter, following a curved course throughout the guard from the protoconch to the apex. The distance apical line – venter is about one third to one fourth of the complete

diameter of the guard. The poorly developed lateral lines have often been removed by corrasion. They consist of two flat lateral depressions, that lie close together at the apex but broaden anteriorly.

Differential diagnosis. *Aulacoteuthis absolutiformis* sensu Sinzow differs from *A. ernsti* n. sp. (= *A. absolutiformis* sensu Stolley) by its shorter, markedly club shaped guard and its wider and deeper ventral groove. The courses of the axial line and of the lateral lines differs between both species. *A. absolutiformis* sensu Sinzow has a ventrally extremely displaced curved axial line, *A. ernsti* n. sp. has a central to slightly ventrally displaced straight axial line.

Distribution. Upper Hauterivian, *Speetoniceras versicolor* ammonite Zone of the Ulyanovsk area.

Aulacoteuthis ernsti n. sp.
Fig. 3C, D, F

1906 *Belemnites absolutiformis* Sinzow, 1877; Sheppard, pl. 2, fig. 6.
1925 *Aulacoteuthis absolutiformis* (Sinzow, 1877); Stolley, p. 27, pl. 4, figs 13-23.
1948 *Aulacoteuthis absolutiformis* (Sinzow, 1877); Swinnerton, p. 44, pl. 12, figs 10-16.
1958 *Aulacoteuthis absolutiformis* (Sinzow, 1877); Krymgolt's, pl. 67, fig. 7.
1968 *Aulacoteuthis absolutiformis* (Sinzow, 1877); Glasunova, p. 231, pl. 2, fig. 1.
1980 *Aulacoteuthis absolutiformis* (Sinzow, 1877); Immel & Mutterlose, p. 258, Abb. 9, fig. 2.
1983 *Aulacoteuthis absolutiformis* (Sinzow, 1877); Mutterlose, p. 68, pl. 4, figs 1-6, 9-10.

Derivation of name. ernsti named in honour of the late Prof. Dr. Gundolf Ernst, German palaeontologist.

Type species. Figured as *Aulacoteuthis absolutiformis* (Sinzow, 1877) by Mutterlose (1983), pl. 4, fig. 6; No. SGPI Han. 1981 II 45 (Department for Geology and Palaeontology, University of Hannover, FRG).

Type horizon and locality. Gott section (north Germany), 25.80m above base of section, *Aulacoteuthis* Zone, bed 100 top (Mutterlose 1983).

Material. 17 specimens from north Germany, 25 specimens from Speeton (England).

Diagnosis. See Mutterlose (1983: p. 69). Guard elongated and conical in ventral view. A deep ventral apical groove is well developed. It extends from the apex into adoral direction at least up to the position of the protoconch. The apical line is central to slightly ventrally displaced. The lateral lines which are clearly apart from one another in the alveolar part, converge in the apical part of the guard.

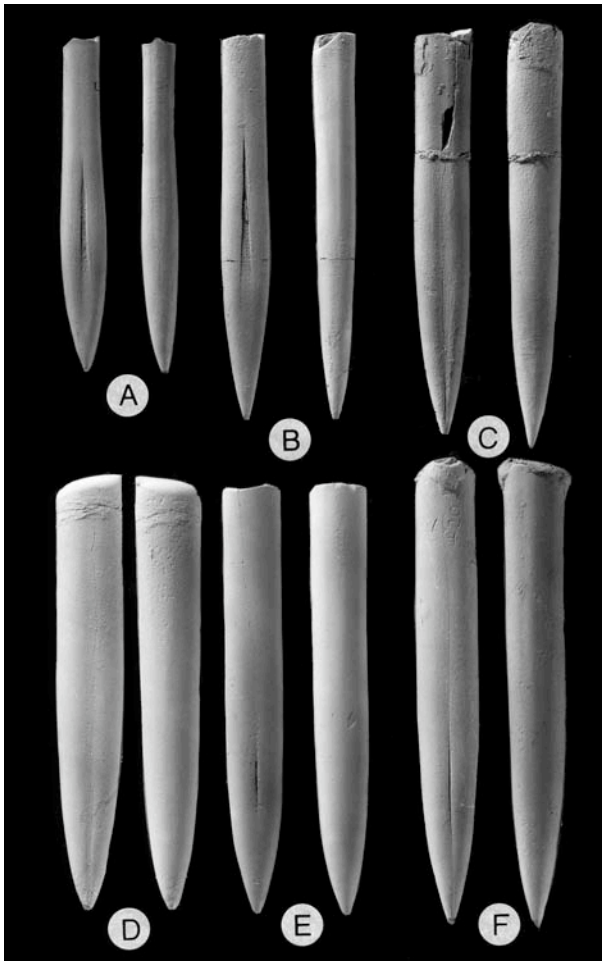

Fig. 3 Ventrally grooved belemnites from north Europe. All guards have been coated with NH4Cl and are figured in their natural size. The ventral side is always on the left, the lateral side is on the right hand.
A, **B**, *Aulacoteuthis absolutiformis* (Sinzow, 1877); right bank of the Volga River, near Zakharievsky Rudnik (Ulyanovsk area); Upper Hauterivian, *Speetoniceras versicolor* Zone. **A**, MSU 99/1; **B**, MSU 99/2.
C, **D**, **F** *Aulacoteuthis ernsti* n. sp.; Roklum pit, north-west Germany; Lower Barremian; *Aulacoteuthis* belemnite Zone. **C**, GPI RK-200; **D**, gypsum cast, GPI RK-240; **F**, gypsum cast, GPI RK+20.
E *Aulacoteuthis speetonensis* (Pavlow, 1892); right bank of the Volga River, near Buraki Village (Ulyanovsk area); Barremian. MSU 99/3

Differential diagnosis. *Aulacoteuthis ernsti* n. sp. (= *A. absolutiformis* sensu Stolley) differs from *A.*

absolutiformis sensu Sinzow by its longer, conically shaped guard and its shallower ventral groove. The courses of the axial line and of the lateral lines in *A. ernsti* n. sp. are different from those of *A. absolutiformis* sensu Sinzow. *A. ernsti* n. sp. has a central to slightly ventrally displaced axial line, *A. absolutiformis* sensu Sinzow has a ventrally extremely displaced axial line.

Remarks. The ventral groove of *A. ernsti* n. sp. varies in length considerably, some specimens closely approach *A. speetonensis* from which *A. ernsti* n. sp. evolved.

Distribution. *A. ernsti* n. sp. is known from Speeton (northeast England) and northwest Germany, where it occurs in the upper part of the *Aulacoteuthis* Zone.

4. PHYLOGENY AND MIGRATION PATTERNS OF THE BELEMNITINA

The suborder Belemnitina is interpreted here as a group of belemnites being characterised by the absence of alveolar grooves. The new, well dated findings of *Aulacoteuthis absolutiformis* sensu Sinzow from the early Late Hauterivian of the Russian Volga region confirm earlier reports. They shed light on the discussion of the evolutionary pattern of the belemnite families Cylindroteuthididae and Oxyteuthididae. The ventrally extremely displaced apical line of *Aulacoteuthis absolutiformis* sensu Sinzow suggests that this species should be included in the Cylindroteuthididae. The Cylindroteuthididae are characterised by ventrally displaced curved axial lines, while the Oxyteuthididae have a central to slightly ventrally displaced straight axial line. *Aulacoteuthis ernsti* n. sp. on the other hand has an axial line typical of the Oxyteuthididae; this implies that *A. ernsti* n. sp. should be included in a different belemnite family than the Cylindroteuthididae. The course of the lateral lines, another feature which allows an attribution either to the Cylindroteuthididae or to the Oxyteuthididae is less obvious. From our specimens of *Aulacoteuthis absolutiformis* sensu Sinzow the course of the lateral lines is not absolutely clear.

While the Cylindroteuthididae became extinct in the Barremian, the Oxyteuthididae are the last representatives of the suborder Belemnitina. The Belemnitina made their first occurrence in the earliest Jurassic and became extinct in the Aptian. Both the Cylindroteuthididae and Oxyteuthididae are belemnite families endemic to the Late Jurassic and early Late Cretaceous of the Boreal seas, being absent from the Tethys. Both groups show convergent evolution with relatively slender ventrally grooved genera evolving in the early Late Hauterivian (*Aulacoteuthis absolutiformis* sensu Sinzow) and in the early Late Barremian (*Aulacoteuthis* spp.).

The Hauterivian *Aulacoteuthis absolutiformis* sensu Sinzow, which is here thought to be part of the Cylindroteuthididae, developed from *Acroteuthis*; this assumption is based on the course of the apical line. *A. absolutiformis* sensu Sinzow is restricted to the Russian Platform and has not been recorded from northwest Europe. The late Early Barremian *Aulacoteuthis ernsti* n. sp., also showing a distinctive ventral groove, is included in the Oxyteuthididae. It is restricted to a relatively short interval of the late Early Barremian and has been observed both in northwest Europe and on the Russian Platform (Fig. 3E). Grooved Barremian *Aulacoteuthis* developed from ungrooved *Praeoxyteuthis*, and the genera form a phylogenetic lineage linked by intermittent forms. The Barremian *Aulacoteuthis* showed rapid speciation, and during a period of several 100.000 years four species evolved successively (Mutterlose 1998): *A. speetonensis* - *A. compressa* - *A. ernsti* n. sp. - *A. descendens*. The most obvious feature is the evolution of a ventral groove, culminating in *A. ernsti* n. sp. Subsequently the ventral groove became shallow (*A. descendens*) and disappeared finally. The newly evolving ungrooved taxa are assigned to the genus *Oxyteuthis* (Fig. 4).

Both the Hauterivian *Aulacoteuthis absolutiformis* sensu Sinzow and the late Early Barremian *Aulacoteuthis ernsti* n. sp. are clearly endemic lineages limited to the palaeogeographically restricted seas of Russia and northwest Europe (Fig. 4). The evolution of a ventral groove is thus viewed as a convergent feature repeating itself at least twice during the evolution of the suborder Belemnitina. Similar ventral grooves characterize the boreal belemnite taxa *Holcobelus* and *Holcobeloides*, both of which are not related to either of the *Aulacoteuthis* discussed here.

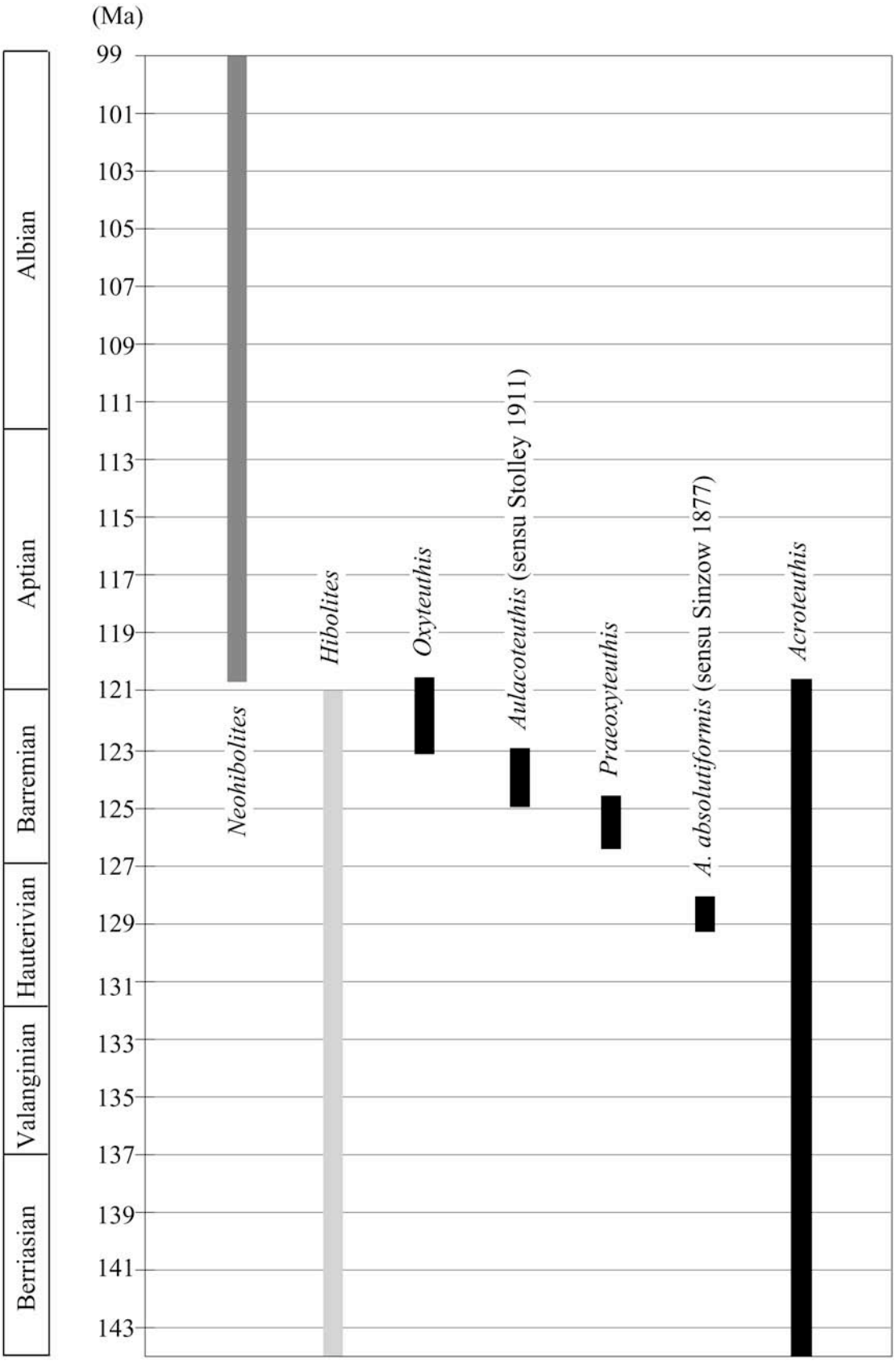

Fig. 4 Stratigraphic ranges of Early Cretaceous belemnites in the northern hemisphere. Black = boreal taxa (*Acroteuthis*, *Aulacoteuthis*, *Praeoxyteuthis*, *Oxyteuthis*); pale grey = tethyan taxa (*Hibolites*); medium grey = cosmopolitan taxa (*Neohibolites*)

5. CONCLUSIONS

Based on *Belemnites absolutiformis* Sinzow (1877) from the early Late Hauterivian of Russia, the type species *Aulacoteuthis absolutiformis* has been misidentified by Stolley (1911) and used for late Early Barremian belemnites of northwest Europe. Since *Aulacoteuthis*, as used by Stolley (1911, 1925) and subsequent workers, is a well defined late Early Barremian indicator that is in the use in numerous stratigraphic papers the replacement of the genus *Aulacoteuthis* would not serve any value for stratigraphy or palaeontology. We therefore rename the late Early Barremian type species of the genus *Aulacoteuthis*, *Aulacoteuthis absolutiformis* sensu Stolley, as *Aulacoteuthis ernsti* n. sp. Subsequently we will apply to the Commission of Zoological Nomenclature to make *A. ernsti* n. sp. the new type species of *Aulacoteuthis*. In a subsequent step it will be necessary to erect a new genus for the original *Aulacoteuthis absolutiformis* sensu Sinzow (1877).

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