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# A SYSTEMATIC REVISION OF *STRAMENTUM* (*STRAMENTUM*) *PULCHELLUM* (G.B. SOWERBY JR., 1843) (CIRRIPEDIA, THORACICA, STRAMENTIDAE) FROM THE BOHEMIAN CRETACEOUS BASIN, THE CZECH REPUBLIC

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Abstract. We review the single species within the genus *Stramentum* Logan, 1897, *Stramentum* (*Stramentum*) *pulchellum*, from the Lower to Upper Turonian strata in the Bohemian Cretaceous Basin (BCB). Only seven specimens are known to date; one is housed at Krupka Museum (Teplice), the others are held in the palaeontological collections of the National Museum in Prague. These specimens were first described in 1887 by Fritsch and Kafka, but have not received attention since. Despite the fact that stramentids are rare within the BCB, all individuals available are articulated and very well preserved and, without exception, belong to *S.* (*S.*) *pulchellum*. The Krupka Museum specimen differs in the shape of both the scuta and the upper latera, but this is interpreted as a result of slight disarticulation. Varying numbers of peduncular scales amongst individuals are indicative of several age groups and small, juvenile stramentids occur as external moulds in one lot at the National Museum. Most Czech stramentids have been found attached to shells of the ammonite genera *Lewesiceras* and *Collignoniceras*.

■ Cirripedia, *Stramentum*, Late Cretaceous, Lower to Upper Turonian, Bohemian Cretaceous Basin

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## Introduction

Cirripede assemblages from the Bohemian Cretaceous Basin (BCB) comprise representatives of six families, Zeugmatolepadidae Newman, 2004, Calanticidae Zevina, 1978, Scalpellidae Pilsbry, 1907, Stramentidae Withers, 1920, Brachylepadidae Woodward, 1901 and Verrucidae Darwin, 1854. Dissociated capitular plates of cirripedes are relatively common in this area (see Kafka 1885; Fritsch and Kafka 1887; Kočí and Kočová Veselská 2012). In contrast, articulated specimens of the genus *Stramentum*, all collected near the end of the nineteenth century and now housed in Czech museums, are rare. All of them are well preserved and probably were epizoic on ammonite shells. The first scientists to study *Stramentum* from the BCB were Frič (1878, 1880), Kafka (1885), and Fritsch and Kafka (1887), who assigned the material to *Loricula pulchella* Sowerby, 1843 and distinguished two morphotypes, var. *gigas* Frič, 1878 and var. *minor* Frič, 1878. These authors also compiled lists of all cirripede taxa then known from the BCB, with indications of their stratigraphic and geographic provenance (Fritsch and Kafka 1887). All specimens except one are deposited in the palaeontological collections of the National Museum (Prague); a single individual is housed at Krupka Museum in northern Bohemia. Later, Withers (1920, 1935) revised the family Stramentidae Withers, 1920, distinguishing three genera: *Stramentum*, *Loriculina* Dames, 1885 and *Squama* Logan, 1897. Withers (*loc. cit.*) also mentioned stramentids from the BCB, including a single scutum of *Loriculina laevissima* (Zittel, 1885) from the out-quarried and now overgrown locality of 'Na Vinici', northeast of Kolín, an outcrop some 237 meters above sea level. Unfortunately, he did not describe or illustrate this scutum; the original (NHM 31672) forms part of the collections of the Natural History Museum, Department of Palaeontology (London). Consequently, it is uncertain whether this scutum really belongs to *Loriculina*. Frič (1878) and Fritsch and Kafka (1887) neither recorded nor described any dissociated plates of *Loriculina*. Recent authors (Jagt and Collins 1989; Hauschke 1994; Hauschke et al. 2011; Ifrim et al. 2011; Schöllmann and Hauschke 2012), have also referred to stramentids from the BCB, but

have not discussed these in any detail. *Stramentum* from the area was mentioned briefly by Kočová Veselská and Kočí (2012).

## Stratigraphic and geographic setting

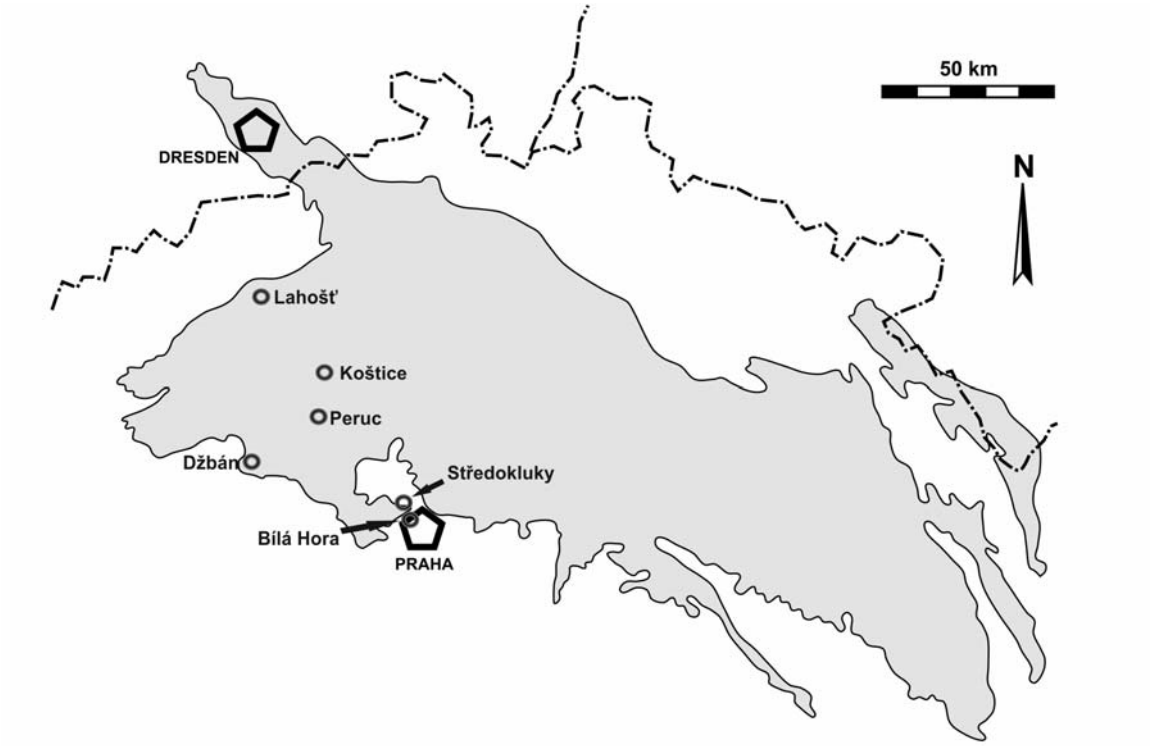
The exact provenance of *Stramentum* in the BCB is problematic, because all material known to date comprises old museum collections. In addition, some of the localities that yielded stramentids have long been excavated, eroded or are inaccessible. In all, eight specimens of *Stramentum* are available from six localities within the area (see text-fig. 1). Five of these originate from the Lower-Middle Turonian (Bílá Hora Formation, *Mytiloides labiatus/Mytiloides hercynicus* Zone) at Bílá Hora in Prague (now overgrown quarries), Středokluky (now overgrown outcrops), Peruc vicinity near Louny (one of several overgrown quarries) and probably an old disused quarry in the Džbán Plateau (Hředle vicinity near Rakovník; see below). Three others are from the Upper Turonian (Teplice Formation, *Mytiloides labiatoidiformis*/*striatoconcentricus-Cremnoceramus erectus* Zone) at Koštice and Lahošť. All localities are situated in the western part of the basin and the strata exposed mainly reflect shallow-water marine (hemipelagic) settings.

Although it is not known precisely from what lithologic horizons stramentids originate, it is very likely that they were epizoic on shells of the ammonites *Collignoniceras woollgari* and *Lewesiceras peramplum*. The former ammonite species helps date stramentids because its first appearance datum (FAD) is at the Lower-Middle Turonian boundary. *Lewesiceras peramplum* may occur first in the uppermost Cenomanian, as based on putative records from the Dölzschen Formation in Saxony, eastern Germany (Wilmsen and Nagm 2013). Otherwise, this species is common in the Lower to lower Upper Turonian of Germany, the Czech Republic, Poland, France, Tunisia and Morocco (see Wright and Kennedy 1981).

The Bílá Hora Formation consists mainly of shallow-water marine marlstones. Glauconite occurs in horizons at both the base and in the upper part of the formation. Typical of most rocks of this unit is the high admixture of sponge spicules; spongilites are commonly present. In the western and northern ranges of the BCB, the formation is developed as quartzose sandstones. Along the southern margin of the basin, a surf facies, consisting of conglomerates and biomicritic and biosparitic limestones, is developed. Across most of the BCB, strata assigned to this formation show coarsening-up cycles (for summary see Čech et al. 1980).

The locality of Bílá Hora was Frič's standard section, where "marlite" (calcareous marlstone) was quarried. From here, Frič (1878, 1880) described inoceramids (*Mytiloides labiatus*, *M. hercynicus*), ammonites (*Mammites nodosoides*, *Collignoniceras woollgari*), echinoids (*Epiaster michelini*), decapod crustaceans (*Enoploclytia leachi*, *Glyphea bohemica*, *Paraclytia nephropica*, species of *Hoploparia* and *Thalassinoides* burrows) and other biotic groups.

Frič's (1878) original sample of *Stramentum*, which comprises juveniles only, was collected from the Lower-Middle Turonian sediments of an old overgrown quarry in the Džbán Plateau (its precise geographical position is unknown). These juveniles are preserved as external moulds on a shell of the ammonite *Collignoniceras woollgari* Mantell, 1822. Unfortunately, the original specimen and its label have been replaced by other juveniles, in the same state of preservation, but from an unknown locality. However the nature of the matrix suggests that these have come from similar horizons; in all probability, they were recovered from the same locality as the misplaced (lost) original. Strata at the Džbán Plateau comprise mainly silty, sandy marlstones, spongilitic




**Text-fig. 1. Simplified map of the Bohemian Cretaceous Basin (grey) showing the occurrence of *Stramentum* (*Stramentum*) *pulchellum* (G. B. Sowerby jr., 1843).**

sandstones and siltstones with spongilite cavities (15– 20 cm in diameter) with an abundant molluscan fauna containing bivalves e.g. *Mytiloides labiatus* (Schlotheim) and ammonites, e.g. *Mammites nodosoides* (Schlotheim). A diverse assemblage, dominated by *Protocallianassa bohemica* (Fritsch), occurs in the upper part of the spongilitic sandstone (Váně 1999; Svoboda 2003).

The lower part of the Teplice Formation is characterized by shallow-water, marine biomicritic limestones. Calcareous claystones to marlstones, with limestone intercalations occur higher in the sequence. This formation differs from both underlying and overlying units in comprising fewer psammitic sediments. At the base of Teplice Formation, a 'coprolite layer' is developed, with a high glauconite content, phosphatic nodules, casts of shells and coprolites (Čech et al. 1980). Macrofossils from this unit include mainly inoceramids (*Inoceramus costellatus*, *I. cuvieri*), ammonites (*Lewesiceras peramplum*, *Scaphites geinitzii*, *Helicoceras reussianum*, *Baculites undulatus*), gastropods (*Natica*, *Pleurotomaria*, *Turbo*), non-inoceramid bivalves (*Isocardia cretacea*, *Cardium bipartitum*, *Nucula semilunaris*, *Syncyclonema nilsoni, Spondylus spinosus*) and other groups.

Two stramentids are known from the Teplice Formation at Koštice (GPS co-ordinates: 50°23'59.680''N, 13°57'47. 190''E) and Lahošť (GPS co-ordinates: 50°37'52.999''N, 13°45'50.894''E) in the northwest of the basin. At Koštice exposures are mainly of clayey limestones and calcareous marlstones; at present this locality is covered by scree and is much overgrown. Koštice is the site of Frič's sample locality and is now referred to as the Teplice Formation. Accumulations of comminuted mollusc and ostracod shells, vertebrate bones and large benthic foraminifera known as 'Koštice plates' occur at the base of this formation. Below this and close to the surface of the River Ohře, a coprolite bed occurs. Above the 'Koštice plates' horizon, is a compact horizon of clayey limestones also known as 'Hundorf limestone' with ammonites (*Lewesiceras peramplum*) or their body chambers (Váně 1999). From these, Frič (1889a, 1889b) described a specimen of *Stramentum* (*S.*) *pulchellum*.

Outcrops at Lahošť near Teplice expose very compact quartzites at the base with glauconitic sandstones above. The upper part has clayey and calcareous marlstones, which yield most of the fauna, and probably is the source of a single individual of *Stramentum*.

## Methods

All stramentids known from the BCB were examined. Ammonium chloride sublimate was used, hoping to achieve a higher contrast when photographing the specimens from the collections of the National Museum in Prague (NM). However, with the exception of NM O3449, the results were not satisfactory. Photographs of NM O3448 and NM O3449 were taken using the microphotography setting Olympus DP70 and photographs of additional material deposited in NM (O3445 – O3447 and O7132) were taken using the microphotography setting Keyence VHX-2000. Specimen PA 1476 was photographed by museum curator Miroslav Radoň from Krupka Museum where material is deposited. Plates were made using Corel Graphic Suite X4.

## Systematic palaeontology

In terminology and taxonomy, we follow Fritsch and Kafka (1887), Logan (1897), Withers (1920, 1935), Hattin (1977), Stevenson (1979), Collins (1986), Breton and Boiné (1993), Hauschke (1994), Hauschke et al. (2011) and Wittler (1996).

Subclass **Cirripedia Burmeister, 1834**

Superorder **Thoracica Darwin, 1854**

Order **Scalpelliformes Buckeridge et Newman, 2006**

Family **Stramentidae Withers, 1920**

Genus and subgenus ***Stramentum* Logan, 1897**

Type species. *Pollicipes haworthi* Williston, 1897; Late Santonian of Kansas.

***Stramentum* (*Stramentum*) *pulchellum* (G.B. Sowerby jr., 1843)**

Pl. 1, figs 1–9

1843 *Loricula pulchella*; G. B. Sowerby jr., p. 260.
1851 *Loricula pulchella*; Darwin, p. 81.
1878 *Loricula gigas* Fr.; Frič, p. 147.
1880 *Loricula gigas* Fr.; Frič, p. 137.
1885 *Loricula gigas* Frič; Kafka, p. 21, pl. 3, fig. 5.
1886 *Loricula gigas* Frič.; Kafka, p. 573.
1887 *Loricula pulchella*, Sow.; Fritsch and Kafka, p. 1 (including var. *minor* and var. *gigas*).
1889a *Loricula pulchella*, Sow. var. *gigas*, Fr.; Frič, p. 96.
1889b *Loricula pulchella*, Sow. var. *gigas*, Fr; Frič, p. 90.
1920 *Stramentum pulchellum*, G. B. Sowerby, jun., sp.; Withers, p. 70.
1935 *Stramentum pulchellum* (G. B. Sowerby, jun.); Withers, p. 316.
1977 *Stramentum pulchellum* (Sowerby); Hattin, p. 812.
1986 *S. pulchellum* (G. B. Sowerby jr); Collins, p. 130.
1989 *Stramentum pulchellum* (Sowerby); Oekentorp, p. 134, pl. 1, fig. 1; pl. 2, figs. 3– 4; pl. 4, figs. 1, 4.
1993 *Stramentum pulchellum* (G.B. Sowerby jun., 1843); Breton and Boiné, p. 20.
1994 *Stramentum* (*Stramentum*) *pulchellum* (Sowerby); Hauschke, p. 15, pls. 1– 5.
1996 *Stramentum (S.) pulchellum* (Sowerby 1843); Wittler, p. 94.
2011 *Stramentum* (*Stramentum*) *pulchellum* (Sowerby, 1843); Ifrim et al., p. 527.
2011 *Stramentum* (*Stramentum*) *pulchellum* (Sowerby); Hauschke et al., p. 202, figs. 3– 5.
2012 *Stramentum* (*Stramentum*) *pulchellum* (Sowerby); Schöllmann and Hauschke, p. 64, fig. 5; taf. 1, figs. 1– 7.

H o l o t y p e . A specimen from the Turonian (Upper Chalk) at Rochester, England; described and illustrated by G. B. Sowerby jr. (1843); in the collections of the Natural History Museum (London), registration number NHM 59150.

M a t e r i a l . A total of eight specimens; NM O3445 – O3449, NM O4255 and NM O7132 in the palaeontological collections of the National Museum (Prague) and PA 1476 at Krupka Museum. With the exception of NM O3448, NM O7132 and PA 1476, these represent Fritsch's (1877) and Fritsch and Kafka's (1887) originals. NM O3445 – O3447,

NM O3449, NM O4255 and NM O7132 were recorded as epizoans on shells of *Lewesiceras* or *Collignoniceras*. The original substrate of NM O3448 and PA 1476 is uncertain. All ontogenetic stages, from juvenile to adult, are presented and all individuals are (semi-) articulated.

D i s t r i b u t i o n . Cenomanian of England, France and northwest Germany; Turonian of northern Ireland, England, northwest Germany and the Czech Republic; Coniacian of Mexico; ?lower Campanian of northern Germany (Jagt 2013). For summaries of geographical and stratigraphical distribution, reference is made to Hauschke (1994), Nomura et al. (2009), Ifrim et al. (2011), Hauschke et al. (2011) and Schöllmann and Hauschke (2012). Specimens from the BCB originate from the Lower-Upper Turonian, as follows: Lower to Middle Turonian (Bílá Hora, Prague: NM O3446, NM O3447; Středokluky: NM O3449; Peruc vicinity NM O7132; Džbán: NM O3448, see below), Upper Turonian (Koštice: NM O3445, with negative imprint NM O4255; Lahošť: PA 1476).

D i a g n o s i s . Tergum triangular with growth lines sharply upturned (near occludent margin); scutum triangular with umbo removed from apex by between one quarter to one third the length of the plate; ventro-apical (occludent) margin straight or gently convex; carinolatus with growth lines sharply upturned along tergal margin; upper latus triangular; peduncular plates arranged in eight vertical imbricating rows: six broad rows aligned beneath and of about the same width as the carinolatera, upper latera and scuta; two narrower rows aligned beneath the carina and rostrum; rostrum is not preserved.

D e s c r i p t i o n . All specimens conform broadly to the species; PA 1476 differs slightly in scutal and upper lateral outline. Individuals expose external surfaces of capitular and peduncular plates, representing either left-hand (NM O3445, NM O3446) or right-hand sides (NM O3447 – O3449, NM O7132, PA 1476). NM O4255 represents an internal mould of NM O3445. Rostrum not preserved (it may seem that a rostral fragment is preserved in NM O7132, but a small piece placed on the connection of the occludent and basal margin is only a broken part of a scutum).

Capitulum about one third length of peduncle. Scutum subtriangular with convex occludent margin, growth-lines sub-parallel to basal margin, then sharply upcurving to parallel upper lateral margin; scutal umbo removed from apex by about one quarter to a third the length of occludent margin. Upper latus almost isosceles-triangular in outline, length comparable to scutum; growth-lines parallel to basal margin. Tergum broadly triangular with acute occludent-upper lateral angle, carinolateral margin straight to slightly convex, apex acute and level with that of carinolatus; growth-lines parallel upper lateral margin, but upturn sharply to run sub-parallel to occludent margin; basal angle of tergum extends to just above the capitulum-peduncle boundary. Carinolatus obliquely triangular with growth lines parallel to a straight or gently convex basal margin. Carina narrow and long triangular slightly convex with length comparable to carinolatus.

Peduncle. Heavily calcified, joining capitulum obliquely and sloping gradually towards rostral side, widest at one third of length (measured from base of capitulum) narrowing towards base and capitulum, with size of single plates decreasing. Arranged with three broad vertical rows aligned with paired scuta, upper latera and carinolatera and two narrower, unpaired outer rows (rostral and carinal). All plates with fine growth lines parallel to plate outline; plates of scutal, upper lateral and carinolateral columns of similar size, becoming narrower, towards both capitulum and the base. Shape of scutal and carinolateral columns broadly sub-trapezoidal, straight or gently convex on rostral and carinal sides, plates of upper lateral column broadly sub-hexangular with convex upper margin and concave lower margin (more markedly than in adjacent columns), plates narrower just below capitulum and with near-straight upper margins; width about four times height. Carinal plates almost quadrangular, slightly higher than wide and slightly less than four times width of corresponding plates in adjacent column. Plates of rostral column rather subtrapezoidal; of similar size to carinal row, but broader in width; towards base, plates become narrower and scutal margin straightens. Outer plates overlap neighboring inner plates; row of plates corresponding to upper latus overlapped from both sides. Within each row, overlapping occurs from base to top. Basal plates of peduncle not preserved.

Lot NM O3445 contains two specimens, the upper one preserving only scutum, upper latus and a deformed tergum; occludent margin in both capitula straight, peduncle is almost complete, lacking solely lower part of carinal column, lower specimen lacks rostrum, carina and lower half of peduncle, uppermost plates of carinolateral and scutal columns are sub-hexangular as in upper lateral column; plates of rostral column have convex upper margins and heavier growth lines.

NM O3446 has a fragmentary part of the right-hand side scutum exposed; tergum longer than carinolatus and carina and tergum exceeding both; plates in rostral column about twice width of those in carinal column; peduncle almost complete, lacking only lowest part of each column.

NM O3447 lacks rostrum, carina and apex of a rounded and deformed tergum, occludent margin straight; three main columns of peduncle complete, rostral column and most of carinal column not preserved.

Lot NM O3448 represents some juvenile individuals as external moulds; very small juveniles have about 6-8 plates in peduncular columns, most of them preserved only as fragments of capitulum or peduncle; a single specimen almost complete, capitulum without carina and rostrum and peduncle with three main columns (scutal, upper lateral, carinolateral) corresponding to description above; occludent margin of capitulum straight.

NM O3449 capitulum incomplete (rostrum, scutum and rostral and scutal column of peduncle lost); scutal margin of upper latus broken; remaining part of occludent margin straight, only upper lateral, carinolateral and carinal columns preserved, all lacking lower parts; size and shape of two main columns similar, upper plates narrowest; towards base, plates of carinolateral column rather broadly subtrapezoidal as in other specimens, lower plates of carinal column with spurs on both sides and with convex upper and lower margins (rhomboidal outline), connection of upper lateral and carinolateral columns disarticulated; slight

deformation displaced upper lateral margin towards carinolateral row.

Lot PA 1476 comprises two specimens, the upper (smaller and younger) lacking rostrum, tergum and upper parts of scutum and upper latus; peduncle almost complete, lacking only lower part; rostral column disarticulated; the lower specimen (larger and more mature) lacking only rostrum and apex of tergum; specimen retaining part of second scutum from left-hand side as in NM O3446; scutum and upper latus slightly deformed, scutum with strongly convex upper lateral margin (*vs* straight in other specimens) and outline less rounded-triangular and upper latus with concave scutal margin. This results from slight disarticulation of some peduncular plates (N. Hauschke, pers. comm., 2012). Occludent margin convex (because of lack of uppermost part of tergum and almost rounded scutum), upper lateral and rostral columns nearly complete, only few plates of carinal column and upper half of carinolateral and scutal columns present; upper and lower margins of scutal and carinolateral plates almost straight, towards base, plates of rostral column rhomboidal (with spur on both sides) rather than subtrapezoidal.

R e m a r k s . All material, collected near the end of the nineteenth century, is articulated or semi-articulated (e.g., PA 1476) and well preserved. NM O3445 (and counterpart NM O4255), NM O3446, NM O3447, NM O3449 and NM O7132 were found as epizoans of body chambers of ammonite shells. We are not certain about the original substrate of NM O3448 and PA 1476. NM O3448, which represents external moulds of juvenile individuals and was recorded by Fritsch and Kafka (1887) as an epizoan of *Collignoniceras woollgari*. As noted, the original has been replaced with other juveniles in a similar state of preservation. Fritsch's original stems from the Lower-Middle Turonian calcareous marlstones from a defunct quarry in the Džbán Plateau; he differentiated three growth stages – on the basis of the number of peduncular plates; all individuals have four capitular plates preserved: scutum, upper latus, tergum and carinolatus. NM O3448 also comprises juveniles, but unfortunately, information on either the substrate or provenance area is lacking, but we assume them to have come from Džbán as well. One of the juveniles is nearly complete, having four capitular plates and 6-8 plates in each peduncular column. Others also have four capitular plates, but due to their fragmentary preservation it is impossible to distinguish growth stages. It cannot be determined whether specimens in lot NM O3448 were attached or not, but in view of the good state of preservation, it is most likely that these juveniles were also attached to some shell. A similar case is PA 1476, which also comprises two well-preserved stramentids, although it is not clear what were originally attached to. Only small pieces of matrix survive with these collections.

Fritsch and Kafka (1887) described two varieties of *Stramentum pulchellum* from the BCB, namely *minor* and *gigas*, on the basis of differences in peduncular plates and overall body size. Var. *gigas* was recorded to have pointed plates in the carinal column (reflecting rapid growth of the body), with plates of the carinolateral and scutal columns broadly subtrapezoidal and produced into a spur on the upper lateral sides, and plates of the upper lateral column equally developed on the upper lateral and scutal sides and all plates of the three main columns have rounded margins. However, these features are typical of all Czech stramentids. Individuals of var. *gigas* are also larger, reflecting older age and these have a greater number of peduncular plates. Fritsch's var. *minor* comprised six specimens of 15 to 20 mm in size, all from the Lower-Middle Turonian; unfortunately, only three of these survive (NM O3446, NM O3447 and NM O3449). NM O3446 was described as an epizoan of the body chamber of a juvenile *Lewesiceras peramplum*; it is the largest and best preserved of individuals of var. *minor.* The substrate of NM O3447 was *Collignoniceras woollgari*, while the deformed NM O3449 was fixed on *L. peramplum*. All individuals are from the Lower-Middle Turonian. NM O3445 comprises two stramentids, originally described by Fritsch and Kafka (1887) as var. *gigas*, as epizoans on the body chamber of a large *L. peramplum*. PA 1476 is of the Upper Turonian age. In short, any preferred orientation and position of attached stramentids cannot be recognised, contrary to other Cretaceous stramentids described by Breton and Boiné (1993), Hauschke (1994), Wittler (1996), Hauschke et al. (2011), Ifrim et al. (2011) and Schöllmann and Hauschke (2012).

Finally, it should be stressed that the figures and animal restorations (drawings) presented in works by Fritsch (notably in Fritsch and Kafka 1887) often do not fully correspond with the original specimens (pers. obs. MKV, TK) as in many cases his reconstructions are idealised. This is especially true for stramentids NM O3446 (figured in Fritsch and Kafka 1887: pl. 1, fig. 2) or NM O3449 (figured in Fritsch and Kafka 1887: pl. 1, fig. 4). Thus, caution must be taken when dealing with Frič's taxa on the basis of published figures only.

## Palaeoecology and taphonomy

Stalked barnacles, a highly successful group of crustaceans, most often occur in the fossil record as dissociated plates of capitulum and peduncle, because soon after death plates tend to disarticulate and become scattered, similar to modern lepadids and scalpellids (Hauschke et al. 2011). The Cretaceous genus *Stramentum* provides some notable exceptions, because under certain conditions, individual plates of heavily calcified stramentids have remained articulated during fossilisation. Unfortunately, finds of articulated stramentids are rather rare and their occurrence appears to be restricted to three exceptional circumstances: when their cypris larvae attached directly to a substrate (e. g. ammonite shells); when cirripedes were embedded in black shales; or when cirripedes were rapidly buried. Examples of completely articulated stramentids, often in groups, on shells of ammonites or inoceramid bivalves, are commoner than finds from anoxic settings exemplified by black shales. Attachment was by the uncalcified basal part of the peduncle. In the majority of cases, attachment occured on live ammonites, and a few generations are occasionally represented (Ifrim et al. 2011). Stramentids appear to have preferred rather smooth planispiral ammonite morphotypes with widely spaced, shallow ribs, such as members of the genera *Collignoniceras*

Breistroffer, 1947 and *Lewesiceras* Spath, 1939. However, there is a single case of attachment to heteromorph ammonites of the genus *Sciponoceras* Hyatt, 1894 from northwest Germany (Hauschke et al. 2011). Schöllmann and Hauschke (2012: table 1) presented a highly detailed picture of palaeoecological and palaeogeographical relationships and of preservational and taphonomical implications of *Stramentum*.

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## Explanations of the plate

## PLATE 1

***Stramentum* (*Stramentum*) *pulchellum* (G. B. SOWERBY JR., 1843)**

1, 2. NM O3446 from the Lower-Middle Turonian, Bílá Hora (Prague); nearly complete specimen and detail of capitulum, respectively. Frič's original (figured in Fritsch and Kafka 1887: pl. 1, fig. 2). Explanation of names of capitular plates: c = carina, cl = carinolatus, t = tergum, ul = upper latus, sc = scutum. Scale bars 2 mm.

3. NM O3447 from the Lower-Middle Turonian, Bílá Hora (Prague). Frič's original (figured in Fritsch and Kafka 1887: pl. 1, fig. 3). Scale bar 2 mm.

4, 5. NM O3449 from the Lower-Middle Turonian, Středokluky; fragmentary specimen and detail of capitulum, respectively. Frič's original (figured in Fritsch and Kafka 1887: pl. 1, fig. 4). Scale bars 2 mm.

6. NM O7132 from the Lower-Middle Turonian, Peruc vicinity (one of several overgrown outcrops), collected by Mr. Daneš. Scale bar 2 mm.

7. NM O3445 from the Upper Turonian, Koštice. Frič's original (figured in Fritsch and Kafka 1887: pl. 1, fig. 1). Scale bar 1 cm.

8. PA 1476 from the Upper Turonian, Lahošť, which is deposited in Krupka Museum (North Bohemia). Scale bar 1 cm.

9. NM O3448, external mould of juvenile specimens from the Lower-Middle Turonian, old overgrown quarry in the Džbán Plateau. Scale bar 5 mm.

**PLATE 1**