BELEMNITELLA PROPINQUA PROPINQUA (MOBERG, 1885) FROM SCANDINAVIA

WALTER KEGEL CHRISTENSEN

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A study of the type material of *Belemnitella propinqua propinqua* (Moberg, 1885) from the Eriksdal Marl and *Belemnitella propinqua ravni* (Birkelund, 1957) from the Bavnodde Greensand has shown that the two subspecies are identical. On the basis of a biometric analysis of *Gonioteuthis westfalica* from the Bavnodde Greensand and *Gonioteuthis westfalicagranulata* from the Eriksdal Marl, the stratigraphic range of *Belemnitella propinqua propinqua* in Scandinavia is discussed, and the palaeogeographic distribution of the species commented upon.

Moberg (1885) described *Belemnitella propinqua propinqua* from the Eriksdal Marl in Scania, Sweden, and according to Birkelund (1957) this subspecies is the ancestor of *Belemnitella propinqua ravni* from the Bavnodde Greensand on the island of Bornholm. According to Stolley (1930) the Eriksdal Marl represents a stratigraphically younger horizon than the Bavnodde Greensand. Stolley (1930) referred the Eriksdal Marl to the "Untere Granulatensenon" and the lower part of the "Mittlere Granulatensenon" and the Bavnodde Greensand to the "Obere-Emscher" (cf. table 2). These contradicting conclusions led the author to examine the specimens of *B. propinqua propinqua* from the Eriksdal Marl, and the specimens of *B. propinqua ravni* from the Bavnodde Greensand. Furthermore, a sample of the genus *Gonioteuthis* Bayle from each of the two localities has been examined to check the stratigraphic horizon given by Stolley (1930).

Material has been placed at the author's disposal by the following institutions: Geological Survey of Sweden, Stockholm (SGU), Swedish Museum of Natural History, Stockholm (RM), and the Mineralogical Museum, Copenhagen (MMH). Furthermore, Mr. S. B. Andersen, Copenhagen (SBA) has kindly given the author belemnites from his private collections.

The author wishes to thank Dr. V. Jaanusson (RM), Dr. R. Skoglund (SGU), S. Floris, M.Sc. (MMH), and Mr. S. B. Andersen for the loan of the

investigated belemnite material. Thanks are also due to Mr. J. Sommer, who prepared the photographs, Mrs. G. Nielsen, who made the drawings, and Dr. A. Lord, who corrected the English manuscript.

Preparation of the material

To examine the internal characters it is necessary to split the guard. This can be done very easily after boiling the guard in water for one or two minutes. When the guard is cooling in the air a natural fracture occurs ventrally, and the guard can be split with a little chisel along this fracture without damage.

Photographed specimens have been coated with ammonium chloride.

Belemnitella propinqua propinqua (Moberg, 1885)

Pl. 1, figs. 1–2; pl. 2, figs. 1–3; pl. 3, figs. 1–3

1885 *Actinocamax propinquus* Moberg: p. 53, pl. 5, fig. 25.
1885 *Actinocamax propinquus?* Moberg: p. 53, pl. 6, fig. 22.
1897 *Belemnitella mucronata* mut. *anterior* Stolley: p. 296.
non 1912 *Actinocamax propinquus* Moberg. – Arkhangelsky: p. 585, pl. 10, figs. 14–15, 23–27, 34–36.
1921 *Actinocamax propinquus* Moberg. – Ravn: p. 38, pl. 3, figs. 2a–c.
non 1948 *Belemnitella propinqua* (Moberg). – Jeletzky: p. 594.
1948 *Belemnitella* ex gr. *mirabilis* Arkhangelsky. – Jeletzky: p. 594.
non 1949b *Belemnitella propinqua* (Moberg). – Jeletzky: p. 416, text-figs. 1, 2, 4.
1949b *Belemnitella propinqua* (Moberg). – Jeletzky: p. 417, text-fig. 3.
1949b *Belemnitella* ex gr. *mirabilis* Arkhangelsky. – Jeletzky: p. 422.
1955 *Belemnitella* ex gr. *mirabilis* Arkhangelsky. – Jeletzky: p. 481, pl. 58, figs. 5a–d.
pars 1957 *Actinocamax propinquus propinquus* Moberg. – Birkelund: p. 20.
1957 *Actinocamax propinquus ravni* Birkelund: p. 21, pl. 2, figs. 5a–d.
non 1958 *Belemnitella propinqua* (Moberg). – Jeletzky: p. 24, p. 28.
1958 *Belemnitella* ex gr. *mirabilis* Arkhangelsky. – Jeletzky: p. 28
non 1962 *"Belemnitella" propinqua* (Moberg). – Kongiel: p. 127.
1962 *Gonioteuthis jeletzkyi* Kongiel: p. 127, footnote.
1964a *Belemnitella propinqua propinqua* (Moberg). – Naidin: p. 85.
non 1964b *Belemnitella propinqua propinqua* (Moberg). – Naidin: p. 167.
1964b *Belemnitella propinqua rylskiana* Nikitin. – Naidin: p. 167.

Type

The specimen figured by Moberg, 1885, pl. 5, fig. 25 is the holotype. The specimen is in the collections of SGU.

Table 1

Measurements of *Belemnitella propinqua propinqua* (Moberg, 1885) from the Bavnodde Greensand and the Eriksdal Marl.

Specimens of *B. propinqua propinqua*	Total length of the guard (mm)	Depth of the pseudo-alveolus (mm)	Length from apex to protoconch (mm)	Dorso-ventral diameter at the protoconch (mm)	Lateral diameter at the protoconch (mm)	Length of the ventral fissure (mm)	"Schatzky-Index" (mm)	Fissure-angle	"Riedel-Quotient"
1	80.3	22.3	58.0	13.7	13.9	5.5	3.1	11.5	3.60
2	–	–	53.7	11.7	12.0	–	5.1	6*	–
3	–	–	–	13.5	14.0	–	5**	10*	–
4	–	–	–	–	–	18.7	–	–	–
5	84.6	26.0	58.6	14.5	14.8	–	4.9	7.5	3.25
6	75.2	26.2	50.0	12.8	13.3	12.5	4.5	11.5	2.87
7	–	–	50.5	11.6	11.6	–	3.7	18.0	–
8	–	–	74.5	14.6	15.0	–	–	–	–
9	–	–	–	–	–	–	5.1	–	–
10	–	–	68.8	15.8	16.8	–	–	–	–
11	–	–	41.6	10.0	–	–	–	–	–
12	84.3	25.8	58.5	15.7	16.9	–	–	–	3.27
13	–	–	44.2	12.5	13.3	–	–	–	–

1. Holotype of *B. propinqua propinqua.*
2. *Actinocamax propinquus?* (Moberg 1885, pl. 6, fig. 22).
3. *B. propinqua propinqua* (RM Mo 151004).
4. Holotype of *B. propinqua ravni* (MMH 1807).
5. *B. propinqua propinqua* (MMH 7845), figured in Birkelund 1957 (pl. 2, fig. 5).
6. *B. propinqua propinqua* (MMH 11161) from the Bavnodde Greensand.
7. *B. propinqua propinqua* (MMH 11162) from the Bavnodde Greensand.

8–13. *B. propinqua propinqua* from the Bavnodde Greensand.

* The fissure-angle can not be measured with certainty as the anterior part of the guard is broken off.

** Estimated.

Emended diagnosis

A *Belemnitella* with a rather sturdy guard, lanceolate in ventral view and slightly lanceolate or subcylindrical in lateral view. Vascular imprints and longitudinal striae are fully developed. The guard is provided with a mucro. The cross-section of the pseudoalveolus in subtriangular to oval. The depth of the pseudoalveolus is about 1/3–1/4 of the entire length of the guard ("Riedel-Quotient" between 3 to 4). The walls of the pseudoalveolus are covered by conellae. The "Schatzky-Index" is 3 to 8 mm.

Material

The Eriksdal Marl: 1. The holotype of *B. propinqua propinqua.* 2. *Actinocamax propinquus?* (Moberg, 1885, pl. 6, fig. 22). The specimen is in the collections of SGU. 3. One specimen collected and labelled *Belemnitella mucronata?* by Dr. A. Lundegren in 1931. The specimen is from an exposure at Moberg's locality "Eriksdal-B" (Moberg, 1884), which was excavated by Dr. A. Lundegren. The specimen belongs to RM (No Mo 151004).

The Bavnodde Greensand: 10 specimens, which are in the collections of MMH. These specimens are described in Birkelund (1957, p. 22), and include the holotype of *B. propinqua ravni,* figured in Ravn (1921, pl. 3, figs. 2a-c) (MMH 1807), and the specimen figured in Birkelund (1957, pl. 2, fig. 5a-d) (MMH 7845). Three specimens from Mr. S. B. Andersen's private collections were also examined.

Measurements and definitions

The measurements of the examined specimens of *Belemnitella propinqua propinqua* are given in table 1.

The term "Riedel-Quotient" was introduced by Ernst (1964, p. 122), and is defined as the ratio between the length of the guard and the depth of the pseudoalveolus.

The term "Schatzky-Index" was introduced by Jeletzky (1949a, p. 260, footnote 2), and is defined as the distance from the protoconch to the beginning of the bottom of the ventral fissure measured along the longitudinal axis.

The term conella is used for the cone-shaped tubercle in the pseudoalveolus of belemnites (Hölder, 1955).

Description

The guard may reach a length of 90 mm. In ventral view the guard is lanceolate; in lateral view it is subcylindrical, slightly lanceolate or slightly cone-shaped. The ratio between the distance from apex to the protoconch and the dorso-ventral diameter at the protoconch varies from 3.5 to 5 (text-fig. 1). The guard is ventrally flattened along its entire length. The posterior part of the guard is flattened dorsally and the anterior part of the guard is flattened laterally. In the anterior part the dorso-ventral diameter exceeds the lateral diameter. At the protoconch the lateral diameter is always larger or equal to the dorso-ventral diameter. The posterior end of the guard is provided with a mucro which is only indistinctly separated from the guard.

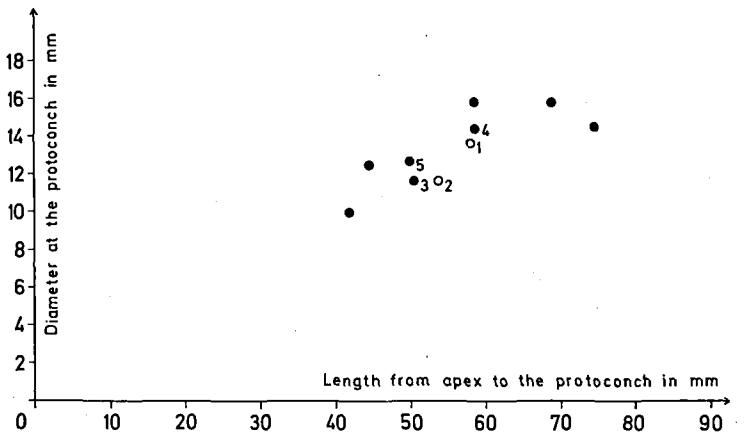


Fig. 1. Scatter diagram showing relationship between the length from the apex to the protoconch and the dorso-ventral diameter at the protoconch of specimens of *Belemnitella propinqua propinqua* (Moberg, 1885) from the Bavnodde Greensand and the Eriksdal Marl. *1:* Holotype of *B. propinqua propinqua. 2: Actinocamax propinquus?* (Moberg, 1885, pl. 6, fig. 22). *3: B. propinqua propinqua* from the Bavnodde Greensand (MMH 11162). *4: B. propinqua propinqua* from the Bavnodde Greensand (MHH 7845). *5: B. propinqua propinqua* from the Bavnodde Greensand (MMH 11161). The other specimens are from the Bavnodde Greensand.

The vascular imprints are most strongly and densely developed around the ventral fissure, and over the entire surface of the guard there is a longitudinal striation. The dorso-lateral longitudinal depressions are distinct and limit the dorsal field. The dorso-lateral double furrows are fully developed, and can be traced to the apex. The angle between the dorso-lateral furrows and the main vascular imprints on the posterior part of the guard is less than 30°.

The cross-section of the pseudoalveolus is subtriangular to oval. The "Riedel-Quotient" varies from about three to about four. The walls of the pseudoalveolus are straight or slightly convex, and carry conellae, which are small in the posterior part of the pseudoalveolus and become larger towards the anterior end. The ventral fissure varies from 5 to 20 mm in length, and at the bottom is straight or slightly bent. The fissure angle varies from 6° to 18°. The "Schatzky Index" varies from 3 to 5 mm. A specimen figured by Jeletzky (1955, pl. 58, figs. 5a-d, p. 506) as *Belemnitella* ex gr. *mirabilis* Arkhangelsky has a "Schatzky-Index" which is 7 to 8 mm.

Discussion

Moberg (1885) referred *Belemnitella propinqua* to the genus *Actinocamax,* but stated that the species showed affinity both to the genus *Actinocamax*

and the genus *Belemnitella*. Jeletzky (1949b) emphasised the belemnitelloid characters and referred the species to *Belemnitella*. Birkelund (1957, p. 23) placed the species in *Actinocamax*, but stated "... it must be a matter of opinion whether it is to be referred to one or the other genus.". The present author shares this view but assigns the species to *Belemnitella* because he considers it preferable to restrict the genus *Actinocamax* to species without a pseudoalveolus or with only a very shallow one, e.g. *Actinocamax* ex gr. *primus* and *A.* ex gr. *verus*.

Jeletzky (1949b, p. 422), after a personal study of Arkhangelsky's specimens of *Belemnitella mirabilis* Arkhangelsky, 1912, in the Geological Museum in Leningrad, and several photographs of the holotype of *Belemnitella propinqua propinqua* stated that *B. propinqua propinqua* and *B. mirabilis* were identical. Therefore, *B. mirabilis* was considered as a junior synonym of *B. propinqua propinqua* which has priority. Nevertheless, Jeletzky (op. cit. pp. 422–423) distinguished between *B. propinqua propinqua* (Moberg) from the lower part of the Santonian, which has a "Riedel-Quotient" from 5 to 6, and *Belemnitella* ex gr. *mirabilis* Arkhangelsky from the middle and upper part of the Santonian, which has a "Riedel-Quotient" of about 4. According to Jeletzky (1958, p. 28) *B. propinqua propinqua* is characterised by a "Riedel-Quotient" of 5 to 6 and a "Schatzky-Index" from 2.5 to 3.5 mm, while in *Belemnitella* ex gr. *mirabilis* the "Riedel-Quotient" is 3 to 5, and the "Schatzky-Index" is 6 to 8 mm.

Birkelund (1957) followed, on the whole, the concept of *B. propinqua propinqua* sensu Jeletzky. The specimens of *B. propinqua* from the Bavnodde Greensand were referred to a new subspecies, *B. propinqua ravni*, characterised by a "Riedel-Quotient" of 3 to 4, a "Schatzky-Index" of 4 to 8 mm, and small and close-set conellae almost covering the walls of the pseudoalveolus. This subspecies was thought to differ from *B. propinqua propinqua* by a smaller "Riedel-Quotient", a greater "Schatzky-Index", and in the development of the conellae.

A closer investigation of the split holotype of *B. propinqua propinqua* (pl. 1, figs. 1D, 1E) shows, however, that the "Riedel-Quotient" of the holotype is 3.60. The reason why Moberg (1885) indicated too shallow a depth for the pseudoalveolus (17 mm in stead of 22.3) is that the lower part of the pseudoalveolus is filled up. Furthermore, it can be seen that the conellae are rather small and cover the walls of the pseudoalveolus entirely.

The specimen figured on pl. 2, fig. 1 was referred by Stolley (1897) to *Belemnitella mucronata* mut. *anterior* Stolley. According to Jeletzky (1955, p. 481) this is the only figured specimen of *B. mucronata* mut. *anterior*, and this species is considered by Jeletzky to be synonymous with *Belemnitella* ex gr. *mirabilis* Arkhangelsky. Since the figured specimen of *B. mucronata* mut. *anterior* originates from the same locality as the holotype of *B. pro-*

pinqua propinqua and only differs from other specimens of *B. propinqua propinqua* from Eriksdal in possessing smaller conellae, this specimen is referred to *B. propinqua propinqua,* and *B. mucronata* mut. *anterior* is considered to be a junior synonym of *B. propinqua propinqua.*

From the measurements given in table 1, it can be seen that there are no differences in the "Riedel-Quotient" and the "Schatzky-Index" for the specimens of *B. propinqua propinqua* and *B. propinqua ravni.* Furthermore, it can be seen from the figured specimens that there is no difference in the dimensions and distribution of the conellae between the two subspecies.

It is therefore concluded that *B. propinqua propinqua* and *B. propinqua ravni* are identical, and that *B. propinqua ravni* is a junior synonym of *B. propinqua propinqua,* which has priority.

The systematic position of *Belemnitella mirabilis* Arkhangelsky (= *Belemnitella propinqua* (Moberg) sensu Jeletzky 1949b) is uncertain. The holotype of *B. mirabilis,* figured by Arkhangelsky (1912, pl. 10, figs. 28–30) and by Jeletzky (1949b, text-fig. 4), is referred by Naidin (1964a, 1964b) to *Belemnitella propinqua mirabilis.* The two specimens figured as *B. propinqua* by Jeletzky (1949b, text-figs. 1,2) was tentatively referred to *Goniocamax lundgreni postexcavata* by Naidin (1964b, p. 168, footnote).

Stratigraphy

The Bavnodde Greensand was referred by Stolley (1930) to the "Obere-Emscher", which according to Ernst (1968, table 1 = table 2 in the present paper) corresponds to the Lower Santonian and the lower part of the Middle Santonian. On the basis of *Gonioteuthis westfalica* and *B. propinqua ravni,* Birkelund (1957, p. 29) placed the Bavnodde Greensand in the uppermost part of the *Inoceramus cordiformis* Zone (cf. table 2). Douglas & Rankin (1969) did not add any new information about the age of the Bavnodde Greensand.

On the basis of ammonites, belemnites, *Inoceramus,* and the crinoid, *Uintacrinus,* Stolley (1930) assigned the Eriksdal Marl to the "Untere Granulatensenon" and the lower part of the "Mittlere Granulatensenon". Hägg (1930) considered the Eriksdal Marl to belong to the *Inoceramus pinniformis* Zone sensu Heinz. It should be noted that Heinz used the *pinniformis* Zone in a more restricted sense than Ernst. The *pinniformis* Zone sensu Heinz corresponds to the lower part of the upper Middle Santonian. Lundegren (1930) opposed the conclusion reached by Hägg (1930) and supported the views of Stolley (1930). On the basis of foraminifera, Brotzen (1936) referred the Eriksdal Marl to the boundary between the "Emscher" and the "Granulatensenon". Brotzen's samples from the Eriksdal

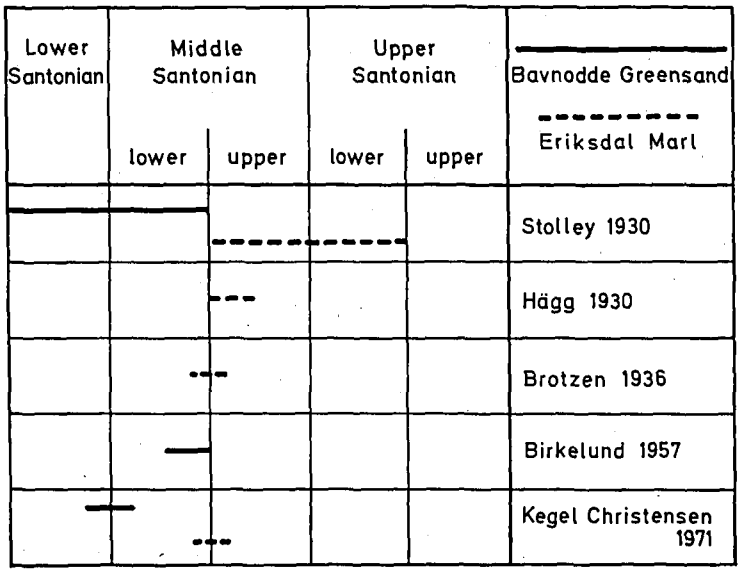
Table 2

Stratigraphic diagram of the Santonian, after Ernst 1968. RQ corresponds to the "Riedel-Quotient" and the figures are the mean value of the "Riedel-Quotient" of samples of *Gonioteuthis*.

ERNST 1968			Belemnite Zones	Echinoderm Zones	*Inoceramus* Zones	STOLLEY 1930	
UPPER SANTONIAN	upper	*Marsupites* Zone	*G. granulata* RQ = 6.0–7.0	*Marsupites testudinarius*		Mittlere	Granulatensenon
	lower	*Uintacrinus* Zone	*G. granulata* RQ = 7.0–8.0	*Uintacrinus westfalicus*	*I. pinniformis*		
MIDDLE SANTONIAN	upper	*westfalicagranulata* Zone	*G. westfalicagranulata* RQ = 8.0–9.5			Untere	
	lower	*cordiformis-westfalica* Zone	*G. westfalica* RQ = 9.5–11.5 / RQ > 11.5		*I. cordiformis*	Obere	Emscher
LOWER SANTONIAN		*undulatoplicatus* Zone			*I. undulatoplicatus*		

Table 3

Outline of the different views of the stratigraphic age of the Bavnodde Greensand and the Eriksdal Marl.



Marl was collected by Dr. A. Lundegren in 1931 at Moberg's locality "Eriksdal-B", (Brotzen, 1936, p. 7).

It can be seen, that many diverging points of view have been put forward on the stratigraphic age of the Bavnodde Greensand and the Eriksdal Marl, but there has been a tendency to place the Eriksdal Marl at a stratigraphically younger level than the Bavnodde Greensand.

To check the stratigraphic location of the two deposits, it was decided to make a biometric analysis of a sample of the genus *Gonioteuthis* from the Bavnodde Greensand, and from the Eriksdal Marl (see p. 378). The genus *Gonioteuthis* from northern Germany has been carefully studied in recent years by Ernst (1963a, 1963b, 1964, 1966, 1968), and provides a good framework for stratigraphic use.

As shown in the biometric section, the Bavnodde Greensand can on the basis of the population of *G. westfalica* be referred to the uppermost part of the Lower Santonian and the lowermost part of the Middle Santonian, whereas the Eriksdal Marl can, on the basis of the sample of *G. westfalica-granulata,* be assigned to the boundary between the lower and upper part of the Middle Santonian. This corresponds to the boundary between the "Emscher" and the "Granulatensenon", and is thus in agreement with Brotzen's (1936) correlation using foraminifera.

According to Stolley (1930, p. 168) and Hägg (1930, p. 70) a few specimens of *Uintacrinus* have been collected in the Eriksdal Marl. This may indicate that the *Uintacrinus* occurs earlier in Sweden than in Germany or that more zones may be present at Eriksdal.

It can be concluded that the stratigraphic range of *B. propinqua propinqua* in Scandinavia is from the uppermost part of the Lower Santonian to the boundary between the lower and upper part of the Middle Santonian.

Biometric study on samples of *Gonioteuthis*

The analysed samples of *Gonioteuthis* originate from the Eriksdal Marl and the Bavnodde Greensand.

The sample of *Gonioteuthis* from the Eriksdal Marl was collected by Dr. A. Lundegren in 1931 and originates from the locality "Eriksdal-B". The sample of *Gonioteuthis* from the Bavnodde Greensand was collected by Mr. S. B. Andersen.

The distributions of the length of the guard of the two samples are given in text-fig. 2, and the estimates of the statistical parameters are given below:

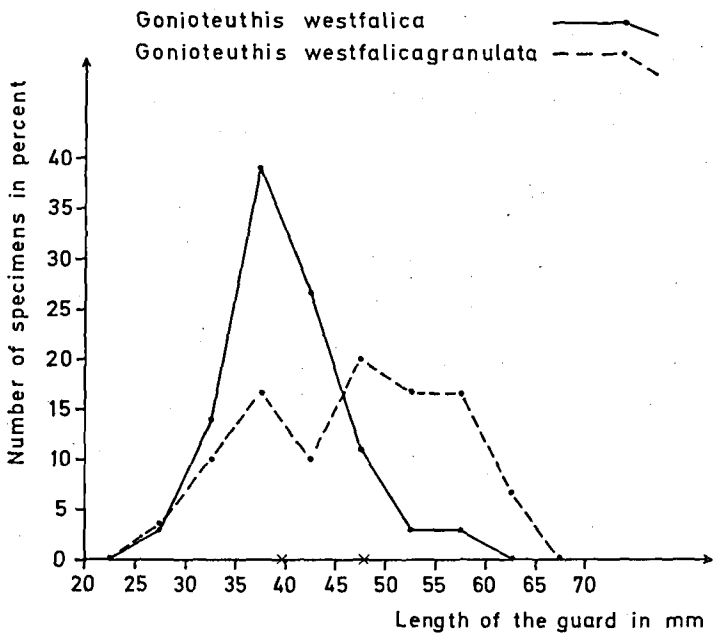


Fig. 2. Distribution of the length of the guard of *Gonioteuthis westfalica* from the Bavnodde Greensand and *Gonioteuthis westfalicagranulata* from the Eriksdal Marl.

	N	$\bar{X}$	S. D.	O. R
Gonioteuthis westfalica, (Bavnodde Greensand)	64	39.9	6.1	29.0–58.3
Goniotcuthis westfalicagranulata, (Eriksdal Marl)	30	46.8	9.3	28.8–61.3

N = number of specimens; $\bar{X}$ = mean length of the guard in mm; S. D. = standard deviation in mm; O. R. = observed range of the length of the guard in mm.

It is, unfortunately, not possible to compare the mean length of the guard of the two samples of *Gonioteuthis* with samples of *Gonioteuthis* from northern Germany on the basis of Ernst (1964), because he has sorted out specimens less than 40 mm in length.

The size-frequency curves of the two samples have been tested for normality by a "Goodness-of-fit"-test. The "Goodness-of-fit"-test of the sample from the Bavnodde Greensand gave $\chi^2 = 12.1$ with 4 degrees of freedom, which is significant at the 5% level, (2% > P > 1%). The "Goodness-of-fit"-test of the sample from the Eriksdal Marl gave $\chi^2 = 3.2$ with 5 degrees of freedom, which is not significant (70% > P > 50%). As the size-frequency distribution of the sample from the Bavnodde Greensand is not normal, the mean length of the two samples have not been compared with a t-test. Since the observed ranges of the length of the guard in the two samples are of the same magnitude, it can be concluded that juvenile guards dominate in the sample from the Bavnodde Greensand.

Regression analysis of the depth of the pseudoalveolus on the length of the guard have been made for each of the two samples (text-fig. 3). Different methods for fitting of a straight line exist, and in the recent years many authors (e.g. Kermack & Haldane, 1950; Kermack, 1954; Imbrie, 1956; Miller & Kahn, 1960) have preferred the reduced major axis. As pointed out by Miller & Kahn (1960, p. 206, footnotes 1 and 2) this

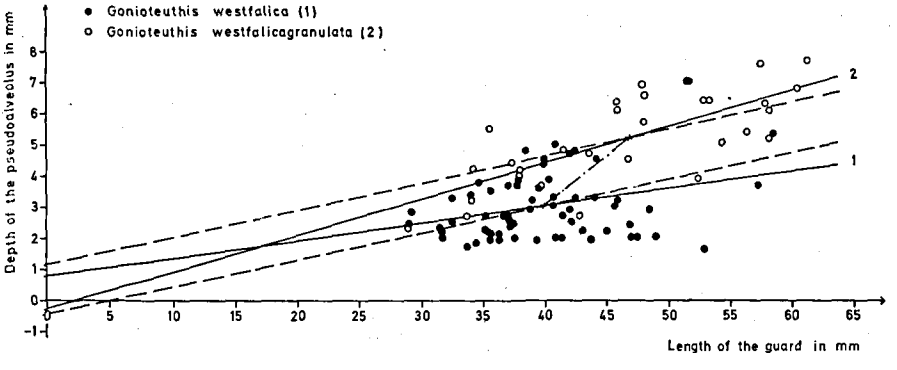


Fig. 3. Scatter diagram and regression lines, fitted by the method of least square, for *Gonioteuthis westfalica* from the Bavnodde Greensand and *Gonioteuthis westfalica-granulata* from the Eriksdal Marl.

method seems to have some drawbacks, and the standard (least square) method is preferred in the present case. The estimates of the statistical parameters of the regression analysis are given below. N is the number of specimens, r is the correlation coefficient, and the regression line is written $y = a + bx$, (x = the length of the guard; y = the depth of the pseudoalveolus).

Gonioteuthis westfalicagranulata from the Eriksdal Marl:

$y = \div 0.2783 + 0.1171x; \quad r = 0.7511; \quad N = 30$

The correlation coefficient with 28 degrees of freedom is highly significant, as $P < 0.1\%$.

Gonioteuthis westfalica from the Bavnodde Greensand:

$y = 0.8633 + 0.0527x; \quad r = 0.3017; \quad N = 64$

The correlation coefficient with 62 degrees of freedom is significant, as $2\% > P > 1\%$.

The two regression-lines have been compared in the way described by Hald (1957, § 18.8. p. 571–579).

The test for equality of the variances gave $F = 1.1149$, with 62 and 28 degrees of freedom, which is not significant, ($P > 20\%$).

The next step in this method is to compare the slopes of the regression-lines. The t-test gave $t = 2.2191$, with 90 degrees of freedom, which is significant at 5% level, ($5\% > P > 2.5\%$). As the difference between the slopes is not highly significant, it was decided to continue and test the position of the regression-lines. The computed common slope of the regression-lines is $\bar{b} = 0.08588$, and the two parallel regression-lines can now be written (cf. text-fig. 3):

G. westfalica from the Bavnodde Greensand: $y = -0.4596 + 0.08588x$
G. westfalicagranulata from the Eriksdal Marl: $y = 1.1855 + 0.008588x$

The identity of the two regression-lines is tested by a t-test, which gave $t = 6.6387$, with 90 degrees of freedom, which is highly significant, ($P < 0.1\%$). This means, that the two regression-lines can not be considered equal.

The relationship between the length of the guard and the depth of the pseudoalveolus in the two samples can be considered as isometric (t-tests have been made on the intercepts on the y-axis), and it is therefore legal to compute the mean "Riedel-Quotient". The mean "Riedel-Quotient" of the sample from the Bavnodde Greensand is 14.8, and the observed range is

7.4 to 33.0. The mean "Riedel-Quotient" of the sample from the Eriksdal Marl is 9.5, and the observed range is 6.5 to 15.9.

The correlation between the length of the guard and the dorso-ventral diameter at the alveolar end is very strong in the two samples, ($r = 0.917$ in the sample from the Eriksdal Marl, and $r = 0.930$ in the sample from the Bavnodde Greensand). The relationship between the length of the guard and the dorso-ventral diameter is allometric, and the mean values of the "Schlankheits-Quotient" (Ernst, 1964, table 2) of the two samples have therefore not been computed.

The comparison of the two samples of *Gonioteuthis* from the Eriksdal Marl and the Bavnodde Greensand with samples of *Gonioteuthis* from Germany are therefore only based on the mean "Riedel-Quotient". The sample of *Gonioteuthis* from the Bavnodde Greensand is, on the basis of Ernst (1968), referred to *G. westfalica,* and the stratigraphic horizon is the uppermost part of the Lower Santonian and the lowermost part of the Middle Santonian, (cf. table 2). The sample of *Gonioteuthis* from the Eriksdal Marl with the mean "Riedel-Quotient" 9.5 can, according to Ernst (1968), be referred to *G. westfalicagranulata,* and the stratigraphic horizon is the boundary between the lower and upper part of the Middle Santonian.

Paleogeographic distribution

Belemnitella propinqua has up to now only been found in the northern part of the Upper Cretaceous boreal sea, viz. on the northeastern part of the Russian Platform (Naidin, 1954, 1960, 1969) and in Scandinavia.

Dansk sammendrag

På grundlag af en undersøgelse af *Belemnitella propinqua propinqua* (Moberg, 1885) fra Eriksdal-merglen i Skåne og *B. propinqua ravni* (Birkelund, 1957) fra Bavnoddegrønsandet på Bornholm konkluderes, at de to underarter ikke kan adskilles.

På basis af variations-statistiske undersøgelser af en population af *Gonioteuthis westfalica* fra Bavnodde-grønsandet og en population af *G. westfalicagranulata* fra Eriksdal-merglen vises, at *B. propinqua propinqua* fra Skandinavien findes i aflejringer fra den øverste del af Nedre Santonien til grænsen mellem den nedre og øvre del af Mellem Santonien.

Til slut nævnes, at *B. propinqua* hidtil kun er fundet i den nordlige del af det boreale øvre kretaciske hav.

Geologisk Institut
Aarhus Universitet
Universitetsparken
DK-8000 Aarhus C, Denmark

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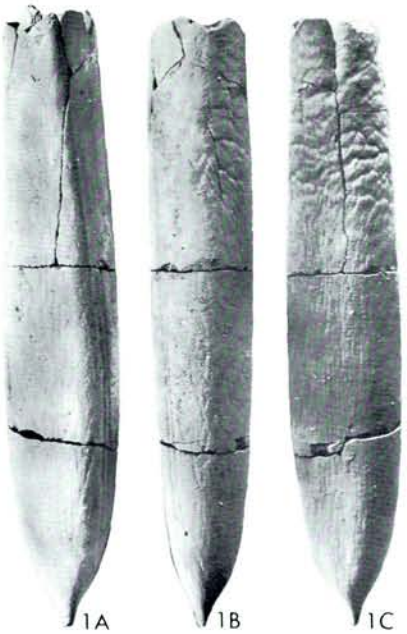
Plate 1

Fig. 1. *Belemnitella propinqua propinqua* (Moberg, 1885) from the Eriksdal Marl. Holotype. A: Dorsal view. – B: Lateral view. – C: Ventral view. × 1. – D: View of half the split anterior end. × 3. – E: View of the other half of the split anterior end. × 3.

Fig. 2. *Belemnitella propinqua propinqua* (Moberg, 1885) from the Bavnodde Greensand (MMH 1807). Holotype of *B. propinqua ravni*. A: Dorsal view. – B: Lateral view. – C: Ventral view. × 1.



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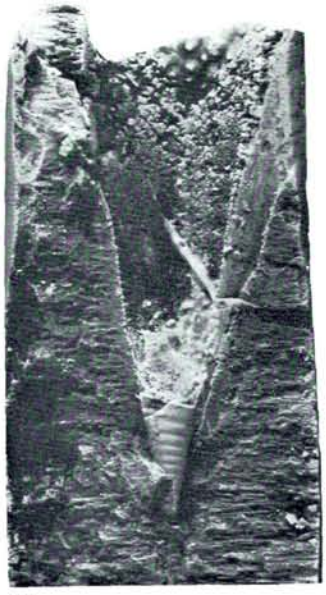

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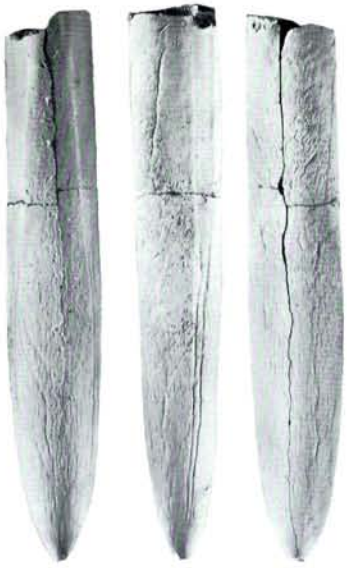
Plate 2

Fig. 1. *Belemnitella propinqua propinqua* (Moberg, 1885) from the Eriksdal Marl. The specimen was figured as *Actinocamax propinquus?* by Moberg (1885, pl. 6, fig. 22). A: Dorsal view. – B: Lateral view. – C: Ventral view. × 1. – D: View of the split anterior end showing internal characters. × 3.

Fig. 2. *Belemnitella propinqua propinqua* (Moberg, 1885) from the Bavnodde Greensand (MMH 11162). A: Dorsal view. – B: Lateral view. – C: ventral view. × 1. – D: View of the split anterior end showing the internal characters. × 3.

Fig. 3. *Belemnitella propinqua propinqua* (Moberg, 1885) from the Eriksdal Marl (RM Mo 151004). The specimen was referred to as *Belemnitella mucronata?* by Dr. A. Lundegren. View of the split anterior end. × 3.



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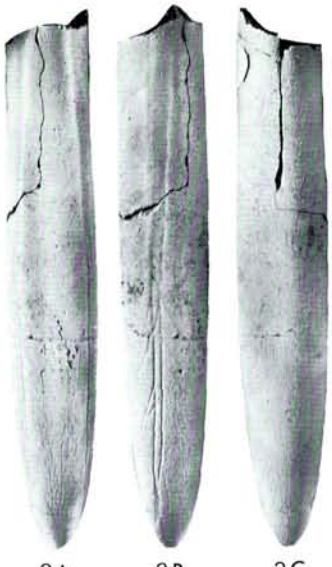

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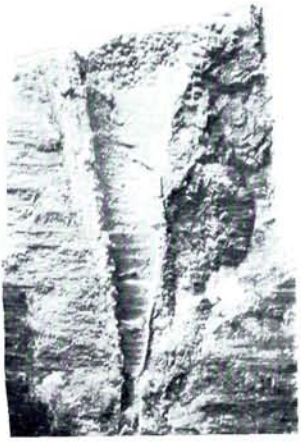


3

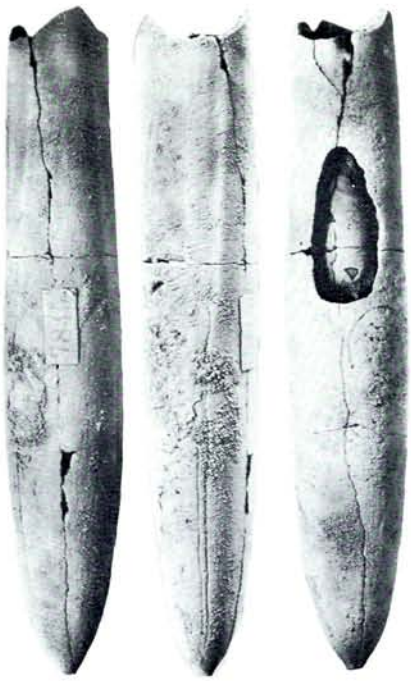
2D

Plate 3

Fig. 1. *Belemnitella propinqua propinqua* (Moberg, 1885) from the Bavnodde Greensand (MMH 7845). The specimen was figured in Birkelund 1957 (pl. 2, fig. 5) as *B. propinqua ravni.* A: Dorsal view. – B: Lateral view. – C: Ventral view. × 1. – D: View of the split anterior end. × 3.

Fig. 2. *Belemnitella propinqua propinqua* (Moberg, 1885) from the Bavnodde Greensand (MMH 11161). View of the split anterior end showing internal characters. × 3.

Fig. 3. *Belemnitella propinqua propinqua* (Moberg, 1885) from the Bavnodde Greensand (MMH 11163). Internal mould of the pseudoalveolus showing impressions of the conellae. × 3.



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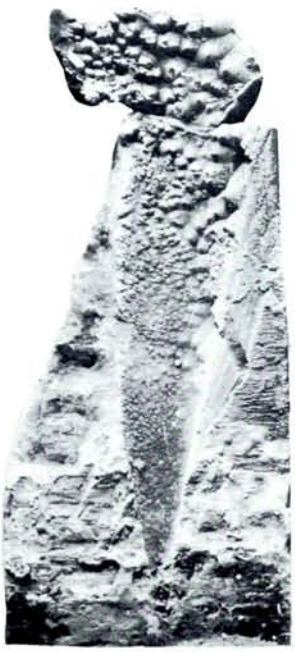

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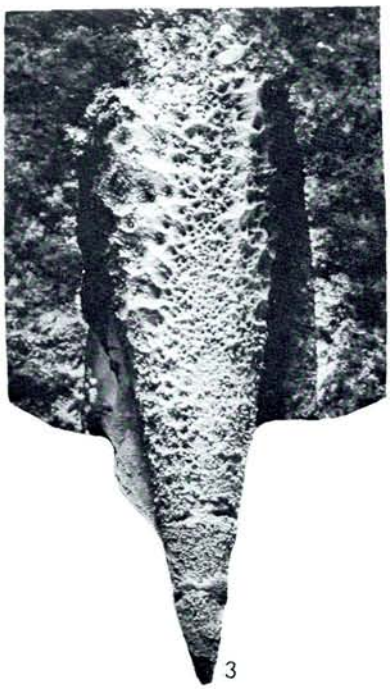

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