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### *Rhynchoteuthis minima* VON DER MARCK, 1858 (Rhyncholite, Cephalopod Jaw) from the Latest Campanian (Cretaceous) of Westphalia (NW Germany)

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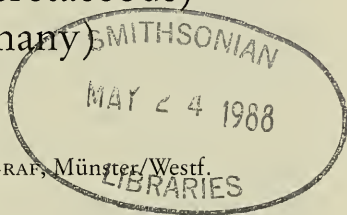
With 7 plates and 8 figures

#### Abstract

About 220 calcified upper and lower jaws of *Rhynchoteuthis minima* VON DER MARCK, 1858, have been washed from microfossil samples of the Upper Campanian of Westphalia. A neotype is established because all type material is lost. The species seems to be endemic, but rhynchoteuthids are always Tethyan elements as it is deduced by the correspondence of their worldwide distribution pattern with that of contemporaneous larger and other Tethyan foraminifers. At present, our knowledge does not allow the assignment of *Rhynchoteuthis minima* VON DER MARCK to any known cephalopod group with certainty. Various preservational stages in this species demonstrate that the taxonomy strongly depends on the preservation of finds. Rhynchoteuthids are distributed from the Pliensbachian to the Maastrichtian. In the epicontinental deposits of Germany, they only occur during the Pliensbachian and Campanian. The first Maastrichtian record of *Rhynchoteuthis* is presented from the Bavarian Alps, and also rare upper jaws of nautiloids occurring in the Campanian of the Lower Saxony Basin.

#### Zusammenfassung

Circa 220 calcitische Ober- und Unterkiefer von *Rhynchoteuthis minima* VON DER MARCK, 1858, wurden aus Mikroproben des westfälischen Obercampaniums geschlämmt. Ein Neotyp wird aufgestellt, da das gesamte Typusmaterial dieser Art nicht mehr aufzufinden ist. Die Art scheint endemisch zu sein, aber Rhynchoteuthiden sind immer Tethys-Elemente. Dies zeigt ihre weltweite Verteilung, die deckungsgleich mit dem gleichzeitigen Auftreten von Groß- und anderen Tethys-Foraminiferen ist. Unser Kenntnisstand erlaubt zur Zeit nicht, *Rhynchoteuthis minima* VON DER MARCK mit Sicherheit irgendeiner bekannten Cephalopodengruppe zuzuordnen. Unterschiedliche Erhaltungszustände bei dieser Art zeigen die starke Abhängigkeit der Taxonomie von der Erhaltung der Funde. Die Rhynchoteuthiden sind vom Pliensbachium bis zum Maastrichtium bekannt, in epikontinentalen Sedimenten Deutschlands nur aus dem Pliens-



bachium und Campanium. Der erste *Rhynchoteuthis*-Fund aus dem Maastrichtium überhaupt wird aus den Bayerischen Alpen vorgestellt, ebenso seltene Nautiliden-Oberkiefer aus dem Campanium des Niedersächsischen Beckens.

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## 1. Introduction

In 1855, VON DER MARCK reported belemnites and rhyncholites from Westphalia which were partly redeposited in Pleistocene marl deposits, partly from autochthonous Campanian ("Senonian") marls of the southern Münster Basin. Afterwards (1858 a; 1858 b), he described these cephalopod upper jaws as "*Rhynchoteuthis minima*" and "*Rhynchoteuthis monasteriensis*". Subsequently, TILL (1907, p. 614) mentioned this species and assigned it to his new established genus *Hadrocheilus* TILL, although he did not possess clear information about them. He demanded a redescription of this species:

„Allerdings eignet sich die rohe Zeichnung nicht, um nähere Vergleiche anzustellen, aber man sieht immerhin, daß dieser Schnabel durch einen auffallend großen Schaft mit tiefem, V-förmigem Sillon, durch eine relativ kleine, sehr stumpfe Kapuze und eine eigentümlich skulptierte Unterseite charakterisiert ist (vergl. die soeben beschriebene Art [*Rhynchoteuthis britannicus* TILL, 1907]. Soviel ist auch sicher, daß es sich um einen Vertreter der Compressi-Gruppe handelt. Eine Beschreibung und Neuabbildung dieser Art wäre sehr wünschenswert, zumal da aus solch hohem geologischen Horizont keine andere Form beschrieben und abgebildet ist. Leider weiß ich nicht, wo das betreffende Fossil gegenwärtig aufbewahrt ist.“

No subsequent worker on Mesozoic rhyncholites could give a precise description of these poorly characterized rhyncholites, although two papers describing or figuring these rhyncholites briefly (VOIGT & HÄNTZSCHEL, 1964; GIERS, 1964) have been neglected.

In 1986, during work on Campanian microfaunas, about 220 specimens of *Rhynchoteuthis minima* VON DER MARCK were found in washed residues from several samples. About 110 kg of marls were economically washed through 0,125 mesh sieves with the recently developed "Gievenbach Method" which will subsequently be described in another journal. The rhyncholites were found in fractions coarser than 0.2 mm and reach a maximum length up to 6.3 mm.

There are few reports of rhynchoteuthid jaws in the Cenomanian to Maastrichtian deposits from Northern Germany (TILL, 1907, p.601, pl. 12, fig. 17 a-c; p. 609, pl. 12, figs. 18 a-c) and India (LAKSHIMINARAYANA & SAHA, 1979; SAHNI & JAIN, 1962; SASTRY, MAMGAIM & RAO, 1965; TILL, 1910, p. 425, textfigs. 1-2). The other finds mentioned in the systematic part under "*Rhyncholites* sp." have to be assigned to nautiloids.

The material examined is deposited in the palaeontological collections of the Staatliches Museum für Naturkunde, Stuttgart, Germany, if not stated otherwise.

Abbreviations:

SGPIMH = Geologisch-Paläontologisches Institut und Museum, University of Hamburg

PMUM = Paläontologisches Museum, University of Münster  
 RME = Ruhrlandmuseum Essen  
 SMNS = Staatliches Museum für Naturkunde, Stuttgart.

### Acknowledgments

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### 2. Localities

The following exposures of Campanian beds in or around the town of Münster were investigated (grid references referred to are from the topographic map of Germany, scale 1/25 000, sheet no. 4011 Münster):

1. Former strontianite marl pit at the Ramertsweg in Münster-Gievenbeck, NW-Germany; r34 01 300, h 5760470.
2. Gievenbecker Reihe in Münster-Gievenbeck; r34 01 820, h 5760080.
3. Eastern banks of the Gievenbach between the Roxeler Straße and the Arnheimweg, Münster-Gievenbeck, NW-Germany; r34 02 400 to 34 02 280, h 5760750 to 59950.
4. Excavation at the Ludgeriplatz in the centre of the town of Münster; r34 05 700, h 5758760 [sample kindly provided by C. RODRIGUEZ].
5. Germania quarry near Neubeckum, southern part of the Münster Basin [material of VOIGT & HÄNTZSCHEL, 1964].
6. Anneliese quarry, Werk I, at Ennigerloh, south of Münster [kindly provided by F. ALBAT].

### 3. Lithology and Fossil Content

Since the beginning of the last century, the famous Campanian "Fossil-Lagerstätten" (after SEILACHER & WESTPHAL, 1971, p. 327, an English term does not exist for such fossiliferous beds) of the Münster Basin (textfig. 1) have locally delivered in the carbonaceous and bioclastic, clayey "Baumberger Sandstein" ("Baumberge Sandstone"), the "Sendenhorster Plattenkalke" ("Sendenhorster Lithographic Stone"), and also the early Campanian beds, a number of plants, cephalopods [for example the largest ammonite of the world, *Parapuzosia seppenradensis* (LANDOIS)], well preserved crustaceans, and a pelagic fish fauna (ERNST, 1964a; 1964b; GIERS, 1964; HOSIUS & VON DER MARCK, 1885; KAEVER, OEKENTORP, & SIEGFRIED, 1974; JELETZKY, 1951; KÖPLITZ, 1920; VON DER MARCK, 1858a; 1858b; 1863; 1885; VON DER MARCK & SCHLÜTER, 1868; OEKENTORP, 1985; SCHLÜTER, 1876; SIEGFRIED, 1954). Monographs of the rich foraminiferal faunas were published by REUSS (1860), FRANKE (1928), JORDAN & GASSE (1987), and RODRIGUEZ (1987), while WIEDMANN (1979) suggested a new Campanian ammonite biostratigraphy.

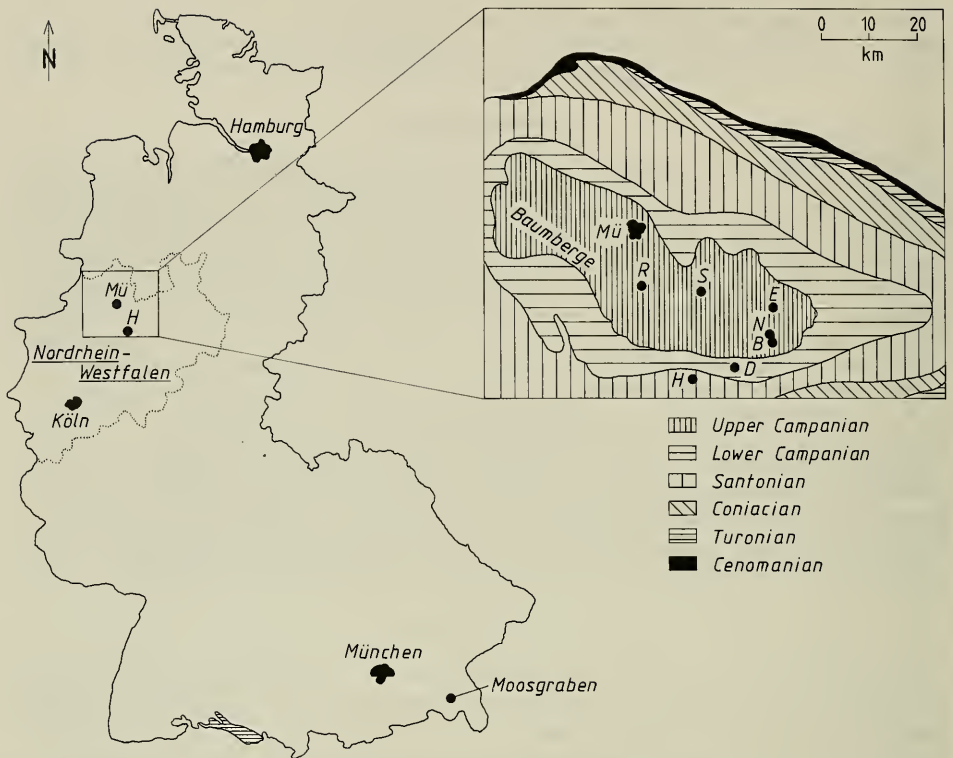


Fig. 1. Map of Germany showing the localities investigated and mentioned in the text. A detailed map on the right shows the geological situation of the Late Cretaceous in the Münster Basin. The abbreviations mean: B = Beckum, E = Ennigerloh, H = Hamm, Mü = Münster, N = Neubeckum, R = Rinkerode, S = Sendenhorst.

The Late Campanian beds (krca<sub>3-4</sub>) investigated in the present paper consist of bioturbated, clayey limestones, glauconitic marlstones, and marly claystones, somewhat sandy, rich in calcisphaerulids, foraminifers, and silica sponge spicules, which were deposited in a shallow epicontinental basin. They have been called “Mucronatenkreide”, “Coesfelder Schichten I–II” (FRIEG, 1977), “Beckumer Schichten” and “Vorhelmer Schichten” (GIERS, 1958; 1964). In the centre of the basin, these beds are mostly covered by some metres of Pleistocene sands, marls, and erratic boulders. Natural exposures of these Cretaceous strata are generally rare. Quarries are most frequent in the area around Beckum (textfig. 1). More lithologic or faunistic details are given in ALBAT (1987), ARNOLD (1955; 1964 a; 1964 b; 1964 c), ARNOLD & WOLANSKY (1964), FRIEG (1977), GIERS (1958), GUTHEIL (1968), HESEMANN (1975), MASRI (1970), OTTO (1981), ROEMER (1854), VOIGT & HÄNTZSCHEL (1964), and WEGNER (1905; 1926).

In the Beckum area, rhyncholites are frequently found at the base of bioclastic, redeposited beds with graded bedding (early Upper Campanian, “Bärsteine”; VOIGT & HÄNTZSCHEL, 1964, p. 524, pl. 7, fig. 3; material of GIERS, 1964, studied by the present authors), or in marly claystones from Ennigerloh (textfig. 2). In both cases, rhyncholites are enriched in the coarser-grained bioclastic sediments which were deposited first.

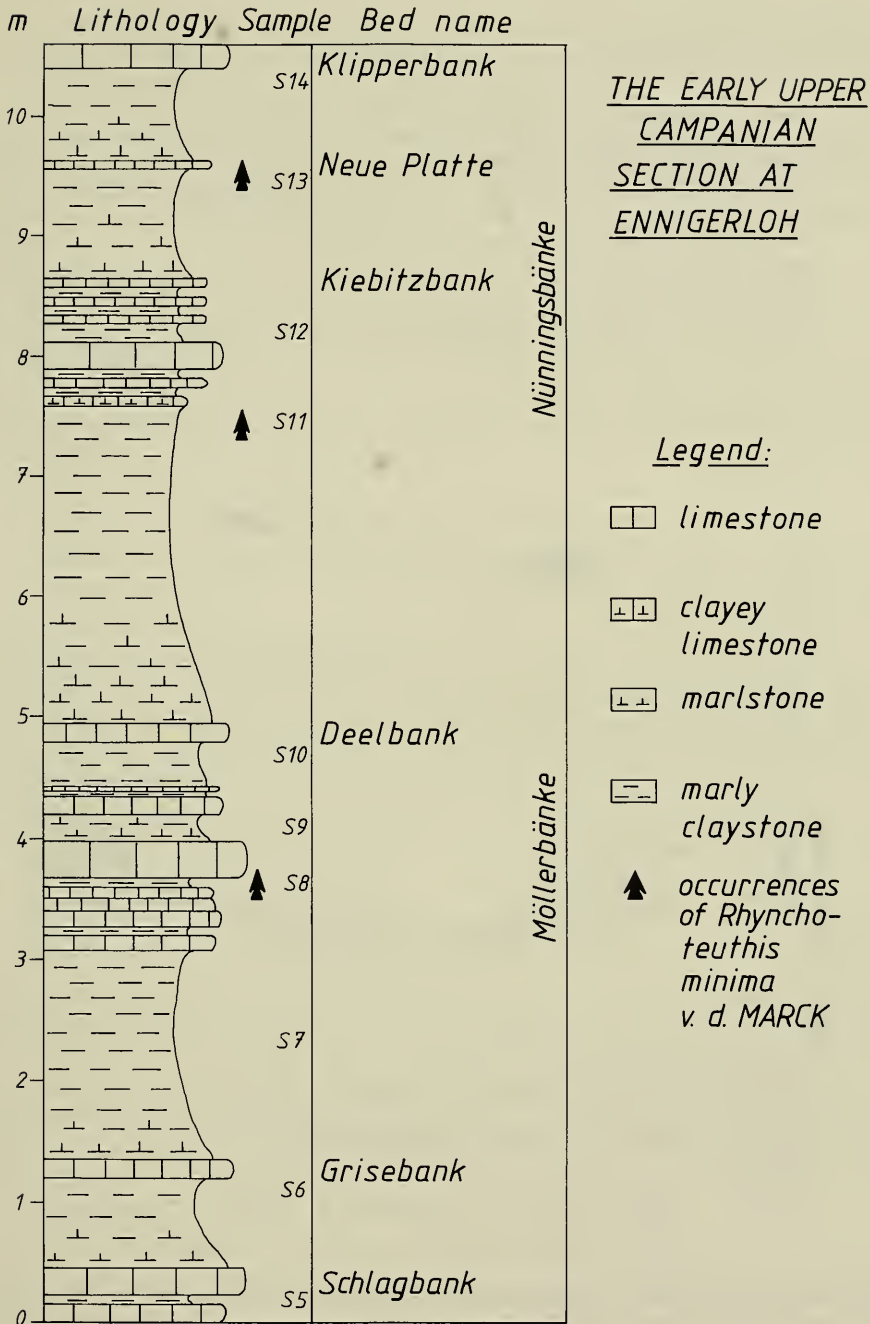


Fig. 2 The lower part of the early Upper Campanian section at Ennigerloh, quarry Anneliese I, with the occurrences of *Rhyrchoteuthis minima* VON DER MARCK (kindly supplied by F. ALBAT, Münster). The German names of important limestone beds are given for comparison with other near-by quarry sections. The samples S5–S8, S9–S10, S12, and S14 did not yield rhyrchoteuthids. The full section is drawn in ALBAT (1987, encl. 1).

The small early Upper Campanian exposure (former strontianite open-cast mine) at the Ramertsweg in Münster-Gievenbeck (textfig. 3) shows a prominent limestone bed as follows:

- >30 cm marly claystone to clayey marlstone, light grey, often with schlieren caused by slumping; yielding dark *Thalassinoides* burrows, frequent *Inoceramus* shell debris, and rare small regular (pseudoplanktonic?) sea-urchins, scattered small silica sponges, *Baculites* fragments and aptychi (rhyncholite-bearing bed; sample Mü. 500 D);
- 20–25 cm bioclastic, sparitic, clayey, medium grey limestone, somewhat shaley, with abundant sponge spicules, and sometimes with graded bedding at the base; the base contains frequently large reworked clay pebbles, fish debris (teeth, scales, bones), frequent bivalves, abundant bryozoans and ostracodes, rare larger foraminifers, *Lenticulina* (diameter up to 4 mm), pieces of irregular sea-urchins and aptychi, pieces of flattened sponges, plant debris; this typical turbiditic bed of allochthonous origin has most

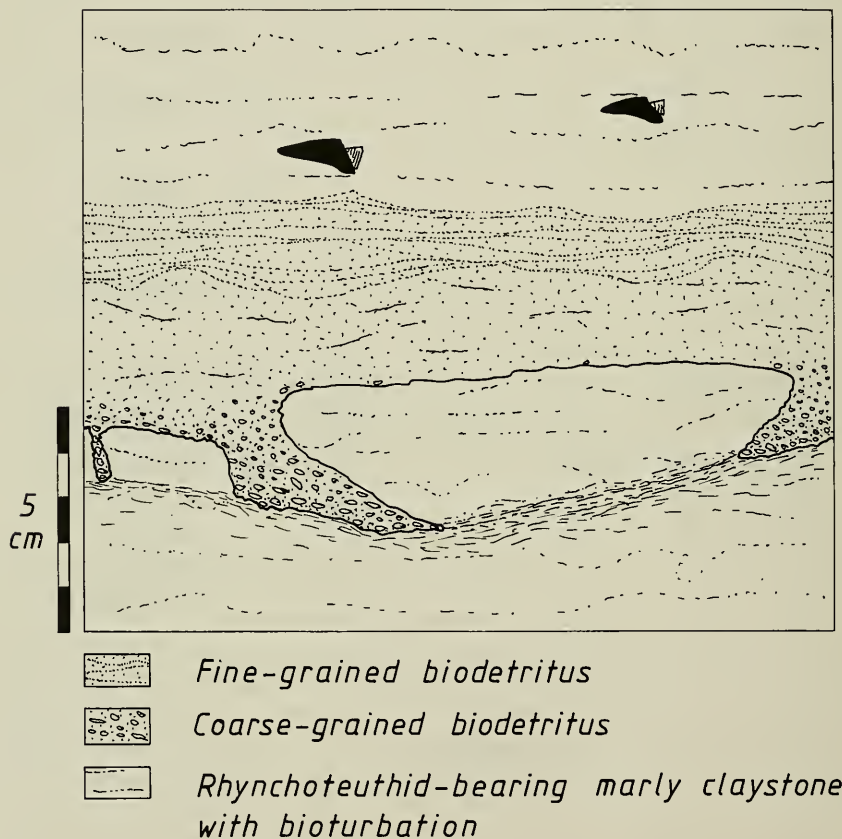


Fig. 3. Detail of a section at the small exposure of early Upper Campanian at the strontianite marl pit at Münster-Gievenbeck. On the rough, eroded surface of a marly claystone locally showing slumping and load-casts, coarse-grained redeposited sediments with graded bedding and clay pebbles were deposited consisting largely of abundant bryozoans, ostracodes, foraminifers, aptychi, bivalve shells, and sponge spicules, all probably derived from shallower water. In the upper part of the bioclastic, redeposited beds, the rock becomes more and more fine-grained. The contents of bioclastic material decreased until the onset of deposition of marly claystone. Rhynchoteuthids have only been found above and below, but not within these bioclastic redeposited sediments.

probably to be derived from shallow-water deposits and corresponds to the "Plattenkalke von Sendenhorst"; in former times it had been used to build houses; 30 cm marly claystone to clayey marlstone, light grey, sometimes with slumping and load-casts by the overlying beds, above with an irregular, eroded surface.

In contrast to some quarries of the Beckum area, rhynchoteuthids have only been found above and below, but not in, or enriched at the base of this bioclastic, carbonaceous bed at Münster-Gievenbeck.

#### 4. Biostratigraphy

In the area around Beckum, the rhyncholite-bearing beds were dated as "early Upper Campanian" by former workers. The exposures around Münster have biostratigraphically been dated by the present authors in 1986–1987. The few rare and, in general, badly preserved cephalopods include:

*Belemnitella* sp. (3 fragments)

*Neophylloceras velledaeforme* (SCHLÜTER) [PMUM]

*Baculites* cf. *vertebralis* LAMARCK (SMNS number 29417/1–4)

*Hoploscaphites gibbus* (SCHLÜTER), inclusive of a few horny lower jaws (SMNS number 29418/1–5)

indicating an early Late Campanian age.

Fortunately, the worldwide subdivision of the Campanian-Maestrichtian foraminiferal biostratigraphy is well established. The following diagnostic important species have been found in the well-preserved, abundant foraminiferal faunas from Münster (Samples Mü. 500 A–G):

*Bolivinooides laevigatus* (MARIE)

*Bolivinooides decoratus decoratus* (JONES)

*Neoflabellina buticula* HILTERMANN

*Neoflabellina numismalis* (WEDEKIND)

*Neoflabellina rugosa* (D'ORBIGNY) with subspecies

*Stensioeina pommerana* (BROTZEN).

This assemblage points to an age of early Upper Campanian (HILTERMANN, 1963; HILTERMANN & KOCH, 1962; KOCH, 1977; HART, BAILEY, FLETCHER, PRICE & SWEICICKI, (1981), as was given for the rhyncholite beds in the southern part of the Münster Basin by GIERS (1964). Scattered individuals of the long-ranging *Globotruncana lapparenti lapparenti* BROTZEN and *Globotruncana paraventricosa* HOFKER in some washed residues are stratigraphically worthless (KOCH, 1977, table 1). Further, the occurrence of

*Neoflabellina permutata* KOCH

*Bolivina incrassata incrassata* (REUSS)

in few samples indicates the transition beds of early/late Upper Campanian. Summarizing cephalopod and foraminiferal biostratigraphy, the rhyncholite-bearing beds belong to the zone of *Trachyscaphites spiniger* (SCHLÜTER) (WIEDMANN, 1979, p. 343, table 5), possibly corresponding to the zone of *Belemnitella mucronata minor* JELETZKY (JELETZKY, 1951), and the *vulgaris*- or *conicus-senior* zone (ARNOLD, 1964 a). Probably, *Rhynchoteuthis minima* VON DER MARCK range into the lowermost part of the zone of *Bostrychoceras polyplacum* (ROEMER) (WIEDMANN, 1979) which has been found at Havixbeck, west of Münster (ROEMER, 1854, p. 139).

## 5. Systematic Descriptions

Class Cephalopoda CUVIER, 1798  
Incertae SedisGenus *Rhynchoteuthis* D'ORBIGNY, 1847Type species: *Rhynchoteuthis asteriana* D'ORBIGNY, 1847.*Rhynchoteuthis minima* VON DER MARCK, 1858

Pls. 1–3; pl. 4, figs. 1–12; pls. 5–6; pl. 7, fig. 7; textfig. 5

- \*1858 *Rhynchoteuthis minima* m. – VON DER MARCK, p. 67, pl. 3, no. 38–39 (Campanian, Westphalia). – [1858 a]
- 1858 *Rhyncholithes* sp. (cfr. *Rhynchoteuthis asteriana* D'ORB). – VON DER MARCK, p. 67, pl. 3, no. 36–37 (Campanian, Pleistocene, Westphalia). – [1858 a]
- 1858 *Rhynchoteuthis minima*. – VON DER MARCK, p. 266, pl. 7, fig. 13–14 (Campanian, Pleistocene, Westphalia). – [1858 b]
- 1858 *Rhynchoteuthis monasteriensis*. – VON DER MARCK, p. 265, pl. 7, fig. 12 (Campanian, Westphalia). – [1858 b]
- non 1858 *Rhyncholithes pusillus* KADE. – VON DER MARCK, p. 67, pl. 3, no. 35; and not: *Rhyncholithes* sp., p. 68, pl. 3, no. 40 (Senonian and Pleistocene, Westphalia). – [Both specimens not identifiable] – [1858 a]
- non 1861 *Rhyncholithes minimus*, Nobis. – BINCKHORST VAN DEN BINCKHORST, p. 19, pl. 5 c, fig. 5 a–d (Campanian-Maestrichtian, Netherlands). – [A nautiloid jaw, not a *Rhynchoteuthis*]
- 1863 *Rhynchoteuthis monasteriensis* m. – VON DER MARCK, p. 5 (Campanian, Westphalia).
- 1907 *Hadrocheilus exseccatus* n. sp. – TILL, p. 601, pl. 12, fig. 17 a–c (Campanian, Westphalia).
- 1907 *Hadrocheilus(?) Hercynicus* n. sp. – TILL, p. 609, pl. 12, figs. 18 a–c (Campanian, Westphalia).
- 1907 *Hadrocheilus monasteriensis* (v. D. MARCK/MÜNSTER). – TILL, pp. 614, 680 (Campanian, Westphalia).
- v 1964 *Rhyncholithes*. – GIERS, p. 286 (Campanian, Westphalia).
- v 1964 *Rhyncholithes* (*Hadrocheilus monasteriensis* [v. D. MARCK]). – VOIGT & HÄNTZSCHEL, p. 524, pl. 7, fig. 3 (Campanian, Westphalia).
- 1973 *Hadrocheilus monasteriensis* MARCK. – GASIOROWSKI, p. 183 (Campanian, Westphalia).
- non 1973 *Rhyncholithes minimus* (BINCKHORST). – GASIOROWSKI, p. 183 (Campanian, Netherlands). – [A nautiloid jaw, not a *Rhynchoteuthis*]
- 1985 *Rhynchoteuthis monasteriensis* VON DER MARCK. – HARDETERT, p. 45 (Campanian, Westphalia).

Holotype: lost (see remarks below).

Neotype: pl. 1, figs. 1–3, from the Campanian, “Beckumer Schichten” (krca<sub>3–4</sub>) of the “Zeche Westfalen”, Dolberg, Westphalia (Material of GIERS, 1964); deposited in the RME, Germany, collection number RE 551.763.333.A2033.

Locus typicus: “Dolberg”, “Herrensteinberg”, “Umgebung von [surroundings of] Hamm” [near Beckum in the southern part of the Münster Basin].

Stratum typicum: “Obere Senon-Kreidemergel”, and “Diluvium” [now determined as early Upper Campanian (krca<sub>3–4</sub>), “Coesfelder Schichten” (= “Beckumer and Vorhelmer Schichten”), or redeposited in Pleistocene marls and sands].Emended diagnosis. – A *Rhynchoteuthis* species (upper jaw), similar to the type of the genus, with a large, smooth hood enclosing an angle of 50–55°, largely covering the lateral areas of the shaft. The less developed ventral median ridge does not reach the posterior margin of the shaft. This is an important difference from similar early to late Cretaceous species. In lateral view, the upper jaw is distinctly incurved towards the ventral side and very thick. The shaft and the dorsal median profile form an angle of about 120–125°. Both lateral areas of the shaft enclose an angle of about 45–50°.



The simple lower jaw lacks all dorsal median and lateral ridges, but has a slightly developed ventral ridge. Its anterior part is also calcified, not horny. Its apex laterally shows small processes.

**Description of the upper jaw.** – The terminology of the upper jaw is shown in textfig. 4. Its length varies between 0.6 and 6.3 mm. On the dorsal side, the smooth hood and the wings enclose an angle of 50–55°. They cover the largest part of the shaft and the median furrow. In the neotype (pl. 1, figs. 1–3) muscular tissue preserved as the carbonate-apatite francolite covers those free parts of the shaft which can be seen in other specimens. The dorsal median ridge is less developed and rounded. A crest is not observed. The anterior margins are straight to somewhat incurved, converging towards the apex. The posterior margins enclose an angle of about 30°, but the tiny parts of the wings are mostly damaged or broken off. The shaft consists of two lateral margins enclosing the median areas and the distinct median furrow. The whole shaft, including the lateral areas, shows straight growth lines. In rare cases, parts of the horny layer which covered the shaft are preserved (pl. 1, fig. 1–3). The apex is sharp, but sometimes seems to be blunt by the usage of the rhyncholite bearer itself (pl. 1, fig. 4–6).

The ventral view shows a distinct, but rounded ventral median ridge without crest. It diminishes towards the posterior edge changing into a slight shaft depression. The posterior lateral points are distinctly developed. The posterior edge ends in an arc in each lateral area surrounded by a rim. In the neotype, the posterior margin of the left lateral area is abnormally grown together with the lateral areas of the hood.

The lateral view offers a slightly incurved (sinus-shaped) ventral median longitudinal profile. The dorsal median profile and the shaft dorsally form an angle of about 120–125°. The dorsal median longitudinal profile is slightly incurved towards the apex. Both profiles enclose a more or less thick upper jaw – depending from the degree of mechanical abrasion, chemical dissolution, and compaction (pls. 1–3). The dorsal margin of the shaft is straight to slightly incurved, often encrusted by sediment, and shows distinct growth lines. The wing processes are rarely preserved (pl. 1, figs. 1–3; pl., 2, figs. 4–6). The vertex is mostly damaged because there the hood is very fragile.

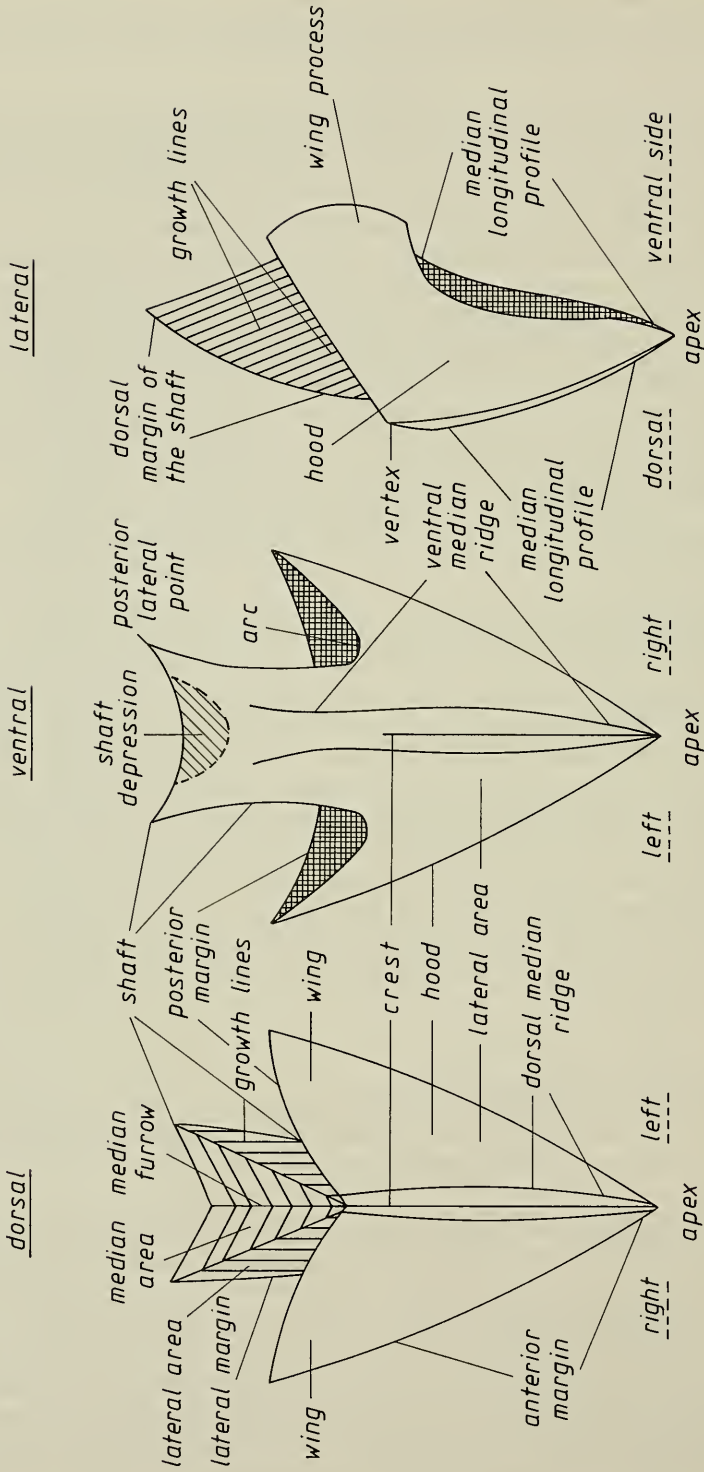
These rhyncholites have been found in quite different preservational stages: in some cases, the hood is broken off or dissolved, and the shaft partly dissolved (pl. 1, fig. 7–9; pl. 2, figs. 16–18; pl. 3, figs. 4–9); some individuals look like as they have been treated with weak acetic acid; a few have been crushed by the sedimentary compaction (pl. 1, figs. 7–9; pl. 2, figs. 1–3); while others have been mechanically damaged, possibly by transportation on the sea floor.

17 upper jaws have been dissolved in 2-percent acetic acid. As a result, a thin, dark brown, horny membrane remained in a few cases which is also described by SEPTFONTAINE (1970, p. 124, fig. 12). This organic remain resembles somewhat that of ammonite upper jaws.

The distribution graph of 180 measured upper jaws from the Münster Basin (textfig. 5) shows that the bearer of *Rhynchoteuthis minima* VON DER MARCK lived in the Münster Basin. No size sorting by currents or transportation in stomachs of fishes as known from living species (CLARKE, 1962), or in fish coprolites is observed.

**Lower jaw.** – The 20 calcitic lower jaws available at present vary between 0.9 and 1.8 mm in length and show a bivalve-like habit. In rare cases, remains of the organic tissue are ventrally preserved on lateral parts near the apex. There, in one case even a wing-like process is observed (pl. 4, fig. 4–6). The ventral side shows longitudinal growth lines near the margins (pl. 4, fig. 12). Near the apex, a sharp anterior process is

p o s t e r i o r



a n t e r i o r

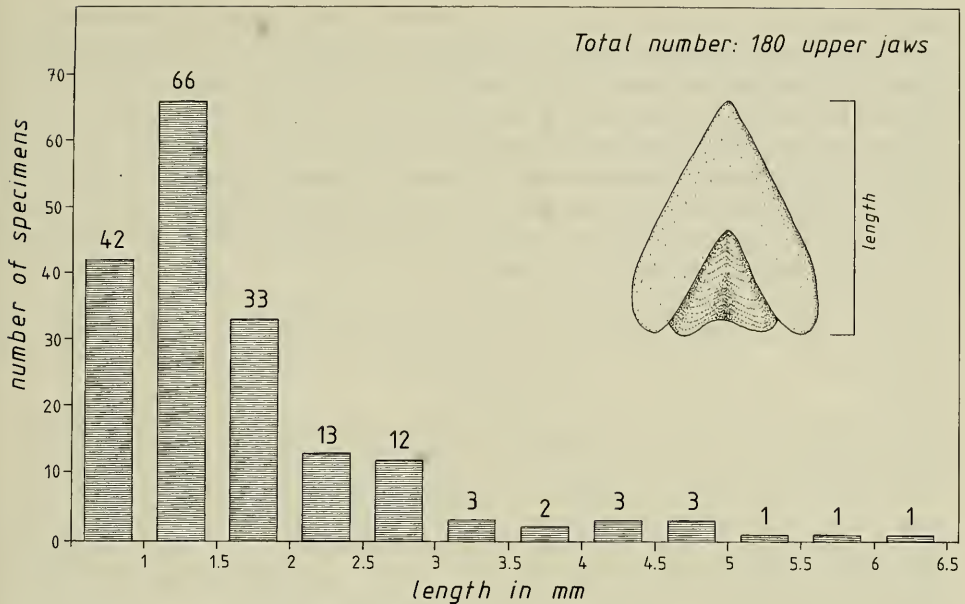


Fig. 5. Size distribution of 180 selected upper jaws of *Rhynchoteuthis minima* VON DER MARCK from the early Upper Campanian of Westphalia, mostly from Münster-Gievenbeck.

observable. The following characteristics were also found in the Upper Jurassic *Rhynchocameratus ionicus* RENZ, 1978 (a lower jaw, probably of cephalopods): a slight ventral keel and the outlines in ventral and dorsal view. But RENZ's species shows differences in lateral aspect. A similar lower jaw from the early Cretaceous of Silesia (Poland) is named "*Rhyncholithes obtusus* nov. sp. (Eigener Typus)" in TILL (1906, p. 121, pl. 4, figs. 25–28). It is not useful to distinguish the lower jaws as a "*Conchorhynchus*" species because there are no doubts that they belong to the same organism which upper jaws are named "*Rhynchoteuthis minima* VON DER MARCK".

**Discussion.** – A neotype is established because there are a lot of quite similar *Rhynchoteuthis* species and because VON DER MARCK's (1858 a) description and figures do not allow distinction from them. Investigations in the Paläontologisches Museum, University of Münster, Westfälisches Landesmuseum für Naturkunde, Münster, in the Ruhrland-Museum Essen, in the Geologisches Institut, University of Köln, in the Geologisch-Paläontologisches Institut, University of Bonn, the Naturhistorischer Verein at Bonn (collections destroyed during World War II, communicated by Prof. H. BICK, 1987), the Senckenberg-Museum at Frankfurt, and the kind communications of many colleagues reveal that VON DER MARCK's type material of the rhyncholithes is lost.

VON DER MARCK originally published *Rhynchoteuthis minima* as a new species in two papers both appearing in 1858. In the second one, he (1858 b, p. 266) gave a foot-

Fig. 4. Terminology of a rhynchoteuthid upper jaw to explain the terms used in the descriptive part of the present paper. Modified after DIENI (1975). The terminology given by TEICHERT, MOORE & NODINE ZELLER (1964) is insufficient for lacking most of the important terms. In contrast to common usage, the upper jaw is here shown in life position. All authors are used to figure rhyncholithes as in plates 1–7 of the present paper, although this contradicts their anatomical position in the animal's dentition.

note pointing to the earlier published work (1858 a). "*Rhynchoteuthis monasteriensis*" VON DER MARCK (1858 b), often used by subsequent authors, is a junior subjective synonym of "*Rhynchoteuthis minima*" VON DER MARCK, as both forms are conspecific and represent only different ontogenetic and preservational stages of the same species. This is best demonstrated in the present specimens (pls. 1–3). For example, VON DER MARCK's "*Rhynchoteuthis monasteriensis*" represent larger specimens (pl. 1, figs. 4–6), while "*Rhynchoteuthis minima*" was used for smaller ones (pl. 1, figs. 10–12; pl. 2, figs. 4–6, 13–16). As VON DER MARCK (1858 b, p. 266) distinguished both species by the absolute size only, this hypothesis is most likely.

Except VON DER MARCK (1858 a; 1858 b), VOIGT & HÄNTZSCHEL (1964), and GIERS (1964) which have obtained Campanian *Rhynchoteuthis* material from Westphalia, all other authors have referred to VON DER MARCK's (1858 a; 1858 b) and TILL's (1907) papers.

TILL (1907) described two species, *Hadrocheilus exseccatus* sp. nov., and *Hadrocheilus(?) Hercynicus* sp. nov. from the "Cretaceous of Rinkerode, Harz Mountains", Northern Germany, but no "Rinkerode" is known near the Harz Mountains in Lower Saxony, Federal Republic of Germany, or in the German Democratic Republic. The only "Rinkerode" existing in Germany is a part of Drensteinfurt, a village in the southern part of the Münster Basin. As there are early Upper Campanian deposits there, too, TILL's finds came most likely from Rinkerode in Westphalia.

The similar form *Rhynchoteuthis kossmati* (TILL, 1910, p. 425, textfigs. 1–2) from the Cenomanian of Southern India has a longer ventral ridge which reaches the posterior margin. Similar features are known in *Rhynchoteuthis vaucclusensis* (TILL, 1907, p. 361, fig. 2) from the Aptian of Southeastern France, in *Rhynchoteuthis dibrarenensis* (ALIEV, 1961), and in *Rhynchoteuthis asteriana* D'ORBIGNY (1847). The type material of the latter species could not be found in the D'ORBIGNY collection at the Muséum National d'Histoire Naturelle, Paris, and seems to be lost (personal communication J. C. FISCHER, 1987). For this reason and because D'ORBIGNY's type figure is schématic, D'ORBIGNY's species and *Rhynchoteuthis minima* VON DER MARCK cannot be compared in detail.

Other localities found: Beckum, Dolberg, Ennigerloh, Hamm, Münster, Neu-beckum, and Rinkerode (near Drensteinfurt in Westphalia).

Geological range: Known only from the early to middle Upper Campanian of Westphalia. There are no reports at all from the Cretaceous Basin of Lower Saxony and from the Lower Campanian and Maestrichtian of Europe and elsewhere. The total range of the genus in the Boreal and Tethyan realm is: Pliensbachian to Maestrichtian. The only Maestrichtian find known until now is described below (pl. 4, figs. 13–14).

Material: From 199 specimens, 170 upper jaws and 19 lower jaws are from Münster-Gievenbeck (SMNS numbers 29415/1–201), 5 upper jaws from Ennigerloh (kindly supplied by F. ALBAT, Münster), deposited in the SMNS, collection numbers 29416/1–5; 6 upper jaws and 1 lower jaw from Neu-Beckum (Material of VOIGT & HÄNTZSCHEL, 1964, SGPIMH, number 2834), 2 upper jaws from Beckum (material of GIERS, 1964, RME, numbers RE 551.763.333 A 2032 and A 2031), and 1 upper jaw (Neotype) from Dolberg (material of GIERS, 1964, RME, numbers RE 551.763.333 A 2033). One of the 8 specimens mentioned by GIERS (1964) is a cast only (RME, numbers RE 551.763.333 A 2034), 4 other ones seem to be lost (kindly communicated by U. STOTTROP, Essen).

#### *Rhynchoteuthis* sp.

Pl. 4, figs. 13–14

There is a small, incomplete upper jaw from the late Lower Maestrichtian of the Moosgraben section, Oberbayern, Bavarian Alps, from a sample which is kindly pro-

vided by K.-H. KIRSCH (München). The locality is described in HAGN & HERM (1983). It differs from *Rhynchoteuthis minima* VON DER MARCK in having a more acute hood (enclosed angle about 40°) and a more prominent, thicker, rounded ventral ridge. The anterior margins of the hood are damaged. In lateral view, the median longitudinal profiles of both, dorsal and ventral, sides is only slight incurved. The shaft is broken off, but has a more acute angle than in the previous species and prominent ridges which enclose a narrow median furrow. *Rhynchoteuthis* sp. is very similar to "*Mesocheilus*" *proceroides* TILL (1909, p. 601, pl. 20, figs. 21 a-c) and "*Mesocheilus*" cf. *hastatus* TILL (1909, p. 602, pl. 20, figs. 22 a-c). Unfortunately, after drawing, it has been lost.

### Genus *Rhyncolites* FAURE-BIGUET, 1819

#### *Rhyncolites* sp.

Pl. 7, figs. 1-6

1896 Rhyncolite, the upper mandible of *Bel. lanceolata*.; BLACKMORE, p. 531, pl. 16, figs. 6-7.  
 v 1978 "Rhyncholith (BIGUET 1819)". - POCKRANDT, p. 14, figs. 28 a, b.

*Rhyncolites* sp. is also described in one well preserved specimen from the early Campanian, "*Belemnitella lanceolata*" band, of England (BLACKMORE, 1896). Two incomplete specimens (SMNS number 29998/1-2) were known from the early Campanian, Subzone of *Galeola senonensis*, Alemannia Quarry, Höver near Hannover, Lower Saxony (plate 7, figs. 1-6; POCKRANDT, 1978). The present species is a typical nautiloid upper jaw. Similar, mostly larger Cenomanian to Maestrichtian rhyncolite species are known from Northern to Eastern Germany (MÜLLER, 1851; HAGENOW, 1842; HOLZAPFEL, 1887-88; RÜGER, 1926), Czechoslovakia (FRITSCH, 1911; FRITSCH & SCHLOENBACH, 1872), The Netherlands (TUUK, 1980), England (FOORD, 1891), Southern Poland (LEONHARD, 1897), USSR (SHIMANSKY, 1969), and the southeastern part of the USA (TEICHERT & SPINOSA, 1971).

The present species is described for comparison and to indicate the presence of real nautilid beaks in the Campanian of Northern Germany. *Rhyncolites* sp. is not known from Westphalia although nautilid shells, for example of *Eutrephoceras darupense* (SCHLÜTER), are well-known. The proportions of *Rhynchoteuthis minima* VON DER MARCK and *Rhyncolites* sp. (plate 7, fig. 7) demonstrate the large differences between rhynchoteuthids ("not-nautiloid jaws") and rhyncolites (nautiloid jaws).

### 6. Hypothetical Assignment of *Rhynchoteuthis minima* VON DER MARCK

In order to search for a hypothetical rhynchoteuthid-bearer, we have to discuss following late Campanian cephalopods, although some of them are unknown from Northern Germany.

i) Diplobeliniid coleoid cephalopods which have thin aragonitic tests around a medium-sized phragmocone, e. g. *Conoteuthis dupiniana* D'ORBIGNY, 1842, from the Aptian-Cenomanian of the Anglo-Paris Basin (JELETZKY, 1966, pl. 18, fig. 2; 1981), *Naefia neogaeia* WETZEL, 1930 from the Campanian-Maestrichtian of Southern Chile and Southern India (DOYLE, 1986), and *Groenlandibelus rosenkrantzi* (BIRKELUND, 1956) from the Maestrichtian of Western Greenland (JELETZKY, 1966, pl. 18, fig. 3). In the Late Cretaceous marls of Westphalia and Lower Saxony, where aragonitic tests are commonly dissolved during diagenesis, the fossilization potential of *Naefia* and *Groenlandibelus* would be very low. In this context it should be mentioned that GIERS (1964)

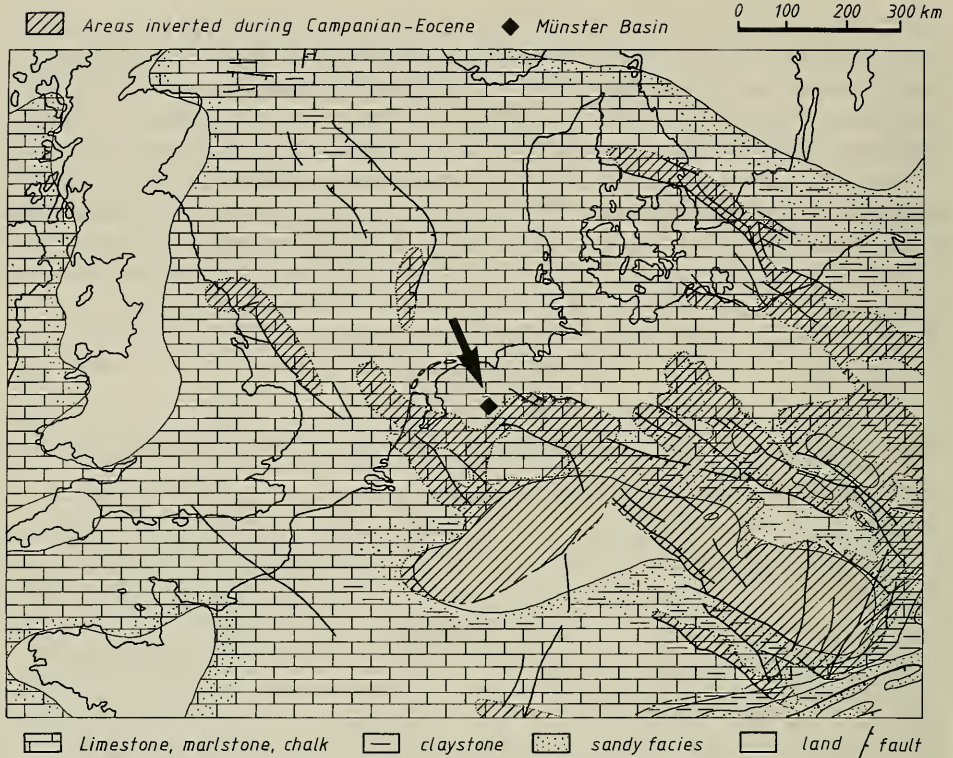


Fig. 6. Paleogeographic map of the Late Cretaceous (Cenomanian-Maestrichtian) in Europe showing the possibilities of faunal exchange of the Münster Basin with that of Lower Saxony, the North Sea Basin, the Atlantic Ocean, and Eastern Europe. The calcareous (chalk) facies is widespread at this time. Modified after ZIEGLER (1982).

reported some Tethyan ammonite species from the southern part of the Münster Basin which closely resemble their counterparts of Patagonia, Southern Chile, where *Naefia* has been discovered. He concluded that there have been faunal relations to the Southern Hemisphere.

ii) The frequency of Westphalian *Rhynchoteuthis* discoveries does not correspond with the number of finds of the rare ammonites and belemnites mentioned in the chapter "Biostratigraphy". In-situ discoveries of calcitic (formerly aragonitic?) and horny ammonite jaws in Jurassic and Late Cretaceous ammonites (KAISER & LEHMANN, 1971; KANIE, 1982; LEHMANN, 1970; LEHMANN, TANABE, KANIE & FUKUDA, 1980; TANABE, 1983; TANABE, FUKUDA, KANIE & LEHMANN, 1980; TANABE, HIRANO, & KANIE, 1980; RIEGRAF, WERNER & LÖRCHER, 1984, p. 144, fig. 41 i) have shown that ammonite jaws have a different morphology, although they can be similar in mineralogy. Ammonite genera with in-situ jaws that occur in the Cretaceous of Japan (e. g. *Gaudryceras*, *Neophylloceras*, *Phyllopachyceras*, *Scalarites*, *Tetragonites*, *Zelandites*) are not known from the late Cretaceous of Northern Germany (except *Neophylloceras* and *Gaudryceras*). In the Cretaceous Basin of Westphalia *Rhynchoteuthis minima* VON DER MARCK is accompanied by frequent *Baculites* sp., rare finds of *Hoploscaphites gibbus* (SCHLÜTER), *Phylloceras velledaeforme* (SCHLÜTER), the nautiloid *Eutrephoceras darupense* (SCHLÜTER), and *Belemnitella mucronata* (SCHLOTHEIM). In the contemporane-

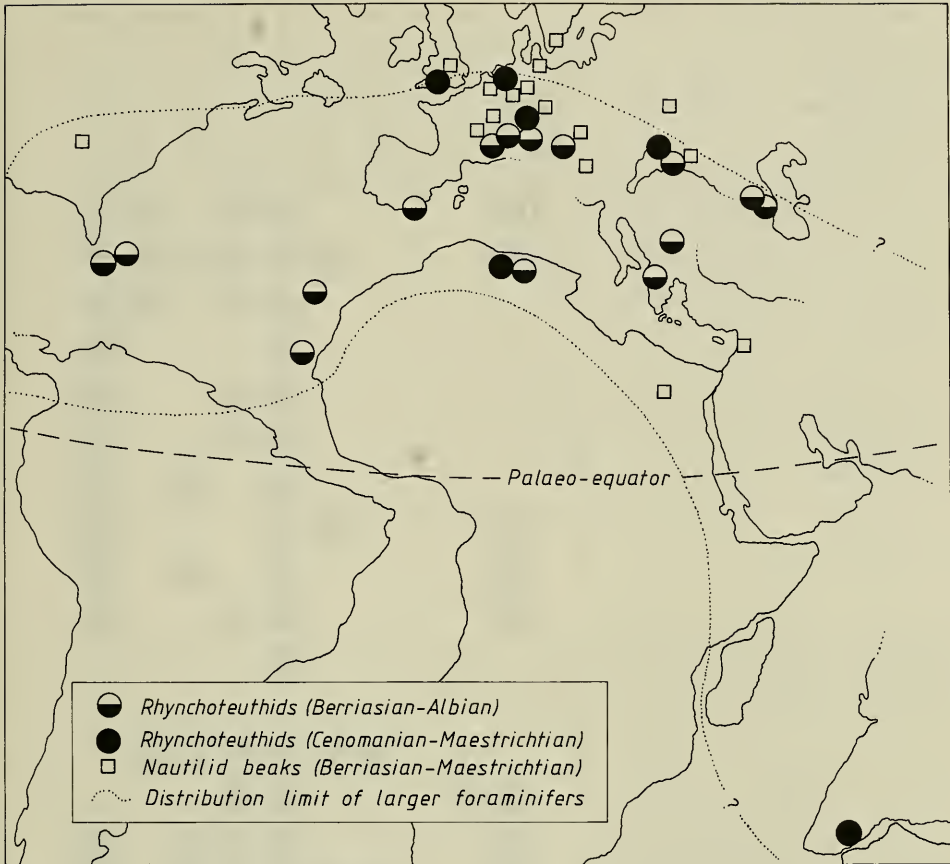


Fig. 7. Berriasian-Maestrichtian distribution of all published rhynchoteuthids (not-nautiloid upper jaws) and rhyncholites (nautiloid upper jaws) in the early and late Cretaceous in comparison with the spread of larger foraminifers. Palaeolatitudes after HABICHT (1979), paleocontinental situation after a Cenomanian map (Mercator projection) in SMITH & BRIDEN (1977).

ously deposited "Plattenkalke" of Sendenhorst (early Upper Campanian), three specimens of *Plesioteuthis arcuata* (VON DER MARCK, 1873) are known (Coll. PMUM, numbers 8362 and 8504) which will be revised in a separate article (RIEGRAF, 1987). Two types of belemnoid (belemnite?) arm hooks have been found in washed residues together with the rhynchoteuthids, but they cannot be assigned to any cephalopod because in-situ whole body discoveries are lacking. One type is figured (pl. 5, figs. 15–16), the other is more acute and belemnite-like (now destroyed).

Rhynchoteuthids (genera *Gonatocheilus*, *Leptocheilus*, *Palaeoteuthis*, and *Rhynchoteuthis*) are distributed between palaeolatitudes of 10°–25° N during the Jurassic, and between 10°–35° N and around 40° S during the Cretaceous. This corresponds with the distribution limits of larger foraminifers (textfig. 7). Further, there are some Tethyan genera of foraminifers, e. g. *Lockhartia* (larger foraminifer), *Archaeoglobigerina*, *Rugoglobigerina*, *Globotruncana*, *Schackoia*, *Pseudotextularia* (planktonic foraminifers), *Bolivinooides*, and *Reussella* (benthonic foraminifers) which underline the Tethyan influence in the Campanian of Northern Germany (textfig. 8).

System	Stage	Rhynchoteut.	Phyllocerat.	Lytoceratids	Chitinoteuth.	Belemnoteut.	Teuthids	Belemnites	Nautil. beaks	Radiolarians	Larger Foram.	Planktonic Fo.
CRETACEOUS	Maestrichtian		●					●	●		■	■
	Campanian	▲	●				●	●	●	■	■	■
	Santonian							●	●		■	■
	Coniacian							●				■
	Turonian							●	●			■
	Cenomanian							●	●			■
	Albian							●		■		■
	Aptian		●				●	●				■
	Barremian		●					●		■		■
	Hauterivian		●					●	●			■
	Valanginian							●				
	Berriasian											
JURASSIC	Tithonian					●	●	●	●	■	■	
	Kimmeridgian		●	●				●	●			
	Oxfordian		●					●	●	■		■
	Callovian		●			●	●	●	●	■		■
	Bathonian			●		●		●				
	Bajocian			●				●				
	Aalenian			●				●	●			
	Toarcian		●	●		●	●	●	●	■		
	Pliensbachian	▲	●	●	●			●	●	■		
	Sinemurian					●	●	●	●			
	Hettangian					●		●				

world-wide unknown

Distribution of selected invertebrates in epicontinental deposits of Germany

Fig. 8. Stratigraphic occurrences of rhynchoteuthids in epicontinental Mesozoic deposits of Germany (except the Bavarian-Alps) compared with that of Mediterranean ammonite groups (Phylloceratids, Lytoceratids), dibranchiate cephalopods (*Chitinoteuthis*, belemnoteuthids, teuthids, and belemnites), nautiloid beaks, radiolarians, larger and planktonic foraminifers.



In the German epicontinental deposit, rhynchoteuthids (genus *Rhynchoteuthis* only) are known from the Pliensbachian of Southwest Germany (BESSLER, 1938; RÜGER, 1921; TILL, 1909, p. 583, pl. 19, figs. 1a–c; author's own finds) accompanied by frequent Phylloceratidae (*Phylloceras*, *Tragophylloceras*) and Lytoceratidae (*Lytoceras*, *Trachylytoceras*) and from the Campanian of Westphalia (textfig. 8) where only scattered *Neophylloceras* are present. In both cases belemnites are also found. In the Pliensbachian the archaic dibranchiate cephalopod *Chitinoteuthis* MÜLLER-STOLL accompanies *Rhynchoteuthis*. But the whole group of *Atractites* and its relatives diminished worldwide during the late Lower Jurassic. Well-preserved horny cephalopod jaws of the coleoid type were described, for example, from the Callovian of Poland (DZIK, 1986, figs. 2A–E) and could partly belong to *Belemnoteuthis polonica* MAKOWSKI, 1952. If it would be so the belemnoteuthids would not have calcified upper jaws, too. The assignment of rhynchoteuthid jaws therefore remains unsolved.

In the future the present authors will expand their investigations on *Rhynchoteuthis minima* VON DER MARCK over all parts of the Upper Campanian outcrop in the Münster Basin, and also into the Santonian, Lower Campanian, and uppermost Campanian. A subsequent paper dealing with new finds is in preparation.

## 7. Results

1. *Rhynchoteuthis minima* VON DER MARCK, 1858, have been washed from microfossil samples collected from the early Upper Campanian (zone of *Trachyscaphtes spiniger*) of the Münster Basin in Westphalia. This species is very similar to the type of the genus, *Rhynchoteuthis asteriana* D'ORBIGNY, 1847.
2. A neotype is established for *Rhynchoteuthis minima* VON DER MARCK, 1858, because all type material is lost.
3. About 200 upper and 20 lower jaws between 0.6 and 6.3 mm in length were investigated and show a normal size distribution, no size-sorting by sedimentological or biological effects.
4. Both the simple lower jaw and the upper jaw were calcified.
5. The species observed has been found in all preservational stages from rare cases with preservation of organic tissue to highly corroded and damaged specimens. The latter demonstrates well that a successful rhyncholite taxonomy strongly depends from the preservation of the finds.
6. The genus *Rhynchoteuthis* is long-ranging: Pliensbachian – Maestrichtian. In Germany, it occurred only twice, during the Pliensbachian and during the Campanian. So far as it is known, *Rhynchoteuthis minima* VON DER MARCK was the stratigraphically last representative of the rhynchoteuthids.
7. The first Maestrichtian rhynchoteuthid known is described herein from the Bavarian Alps.
8. *Rhynchoteuthis minima* VON DER MARCK seems to be endemic in the Münster Basin, but rhynchoteuthids are typical Mediterranean elements. This is also evident by the co-occurrence of some larger and other Mediterranean foraminiferal genera (planktonic and benthonic) in that region indicating warm currents and/or warm climate. Additionally, the world-wide distribution pattern of larger foraminifers exactly corresponds with that of rhynchoteuthids.
9. Until now, our knowledge does not allow the assignment of *Rhynchoteuthis minima* VON DER MARCK to any known cephalopod group, e.g. Mediterranean

ammonites, belemnites, or other dibranchiate cephalopods (Groenlandibelidae, Belemnoteuthidae, teuthids). The reasons are discussed.

10. Rare nautiloid upper jaws from the Campanian of the Lower Saxony Basin are also described herein, but are much thicker and considerably larger than the contemporaneous rhynchoteuthids from the near-by Münster Basin.

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Plate 1

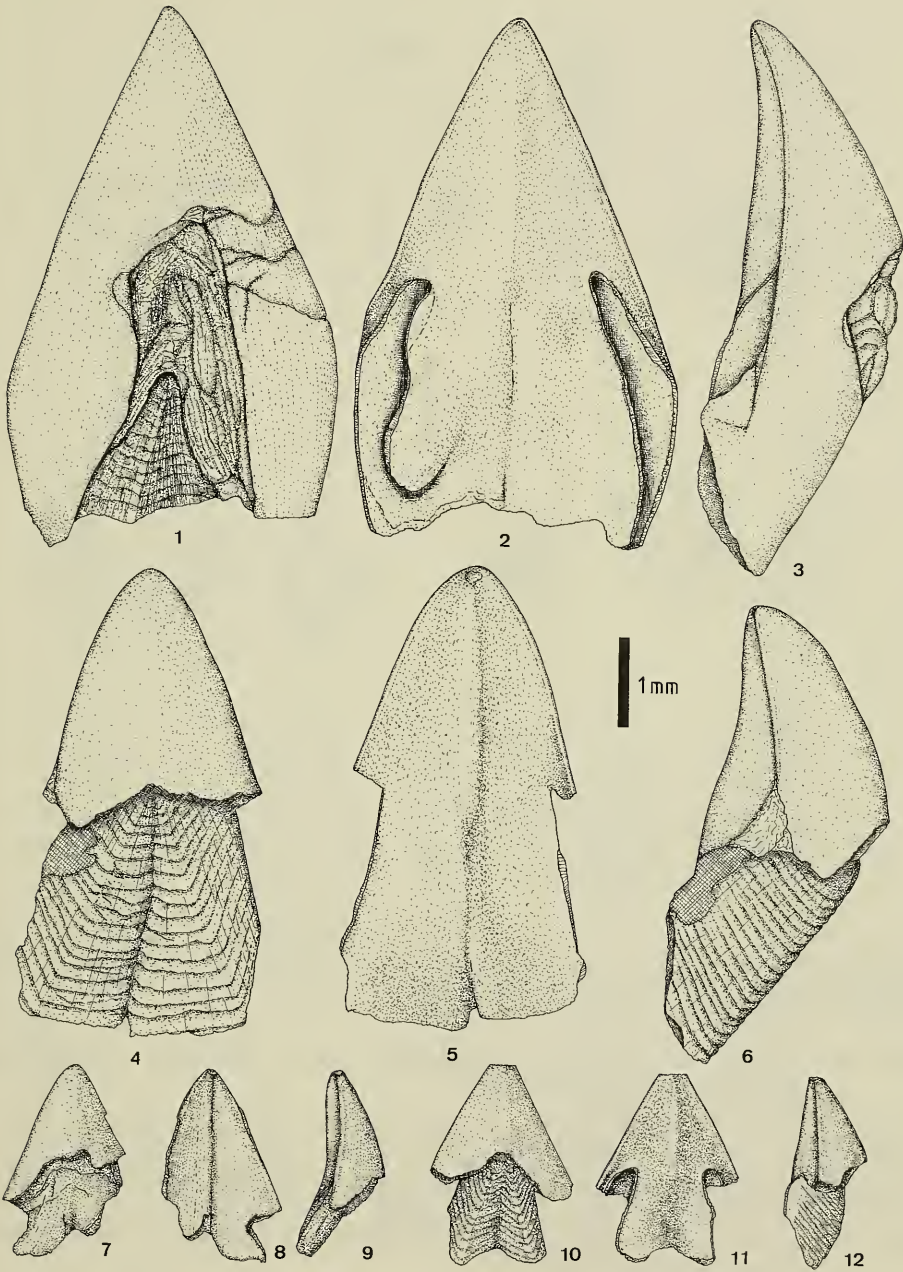
*Rhynchoteuthis minima* VON DER MARCK. Upper jaws in dorsal, ventral, and lateral views, respectively. Early Upper Campanian, Coesfelder (= Beckumer and Vorhelmer) Schichten, krca<sub>3-4</sub>, zone of *Trachyscaphites spinninger*. Westphalia.

Figs. 1–3. Neotype. Dolberg. Material of GIERS (1964, p. 286; RME, no. RE 551.763.333.A2033).

Figs. 4–6. Large specimen with organic tissue on the right lateral area and broken-off wings. Münster-Gievenbeck. SMNS 29415/1.

Figs. 7–9. Small specimen, partly dissolved. Münster-Gievenbeck. SMNS 29415/2.

Figs. 10–12. Small, well-preserved specimen. Münster-Gievenbeck. SMNS 29415/3.

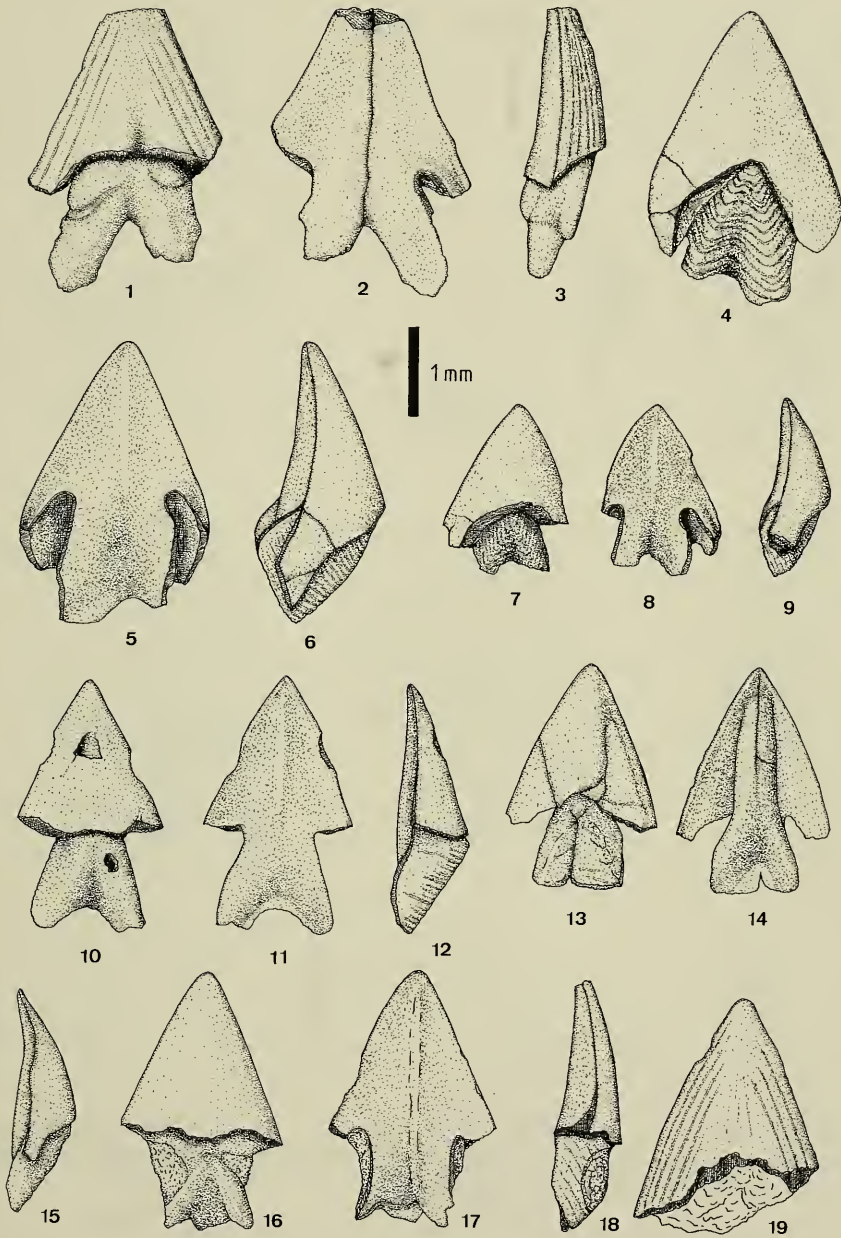


## Plate 2

*Rhynchoteuthis minima* VON DER MARCK. Upper jaws in dorsal, ventral, and lateral views, respectively. Early Upper Campanian, Coesfelder (= Beckumer and Vorhelmer) Schichten, krca<sub>3-4</sub>, zone of *Trachyscaphites spinninger*. Westphalia.

- Figs. 1-3. Larger, somewhat dissolved specimen with lacking cover layer of the hood. Münster-Gievenbeck. SMNS 29415/4.
- Figs. 4-6. Small, well-preserved specimen. Münster-Gievenbeck. SMNS 29415/5.
- Figs. 7-9. One of the smallest specimens. Münster-Gievenbeck. SMNS 29415/6.
- Figs. 10-12. Damaged specimen. Germania quarry, Neubeckum. Material of VOIGT & HÄNTZSCHEL (1964). SGPIMH 2834.
- Figs. 13-15. Misshaped and slightly crushed specimen. Figured by VOIGT & HÄNTZSCHEL (1964, pl. 7, fig. 3). SGPIMH 2834.
- Figs. 16-18. Smaller, misshaped specimen. Münster-Gievenbeck. SMNS 29415/7.
- Fig. 19. Isolated hood fragment lacking cover layer. Münster-Gievenbeck. SMNS 29415/8.





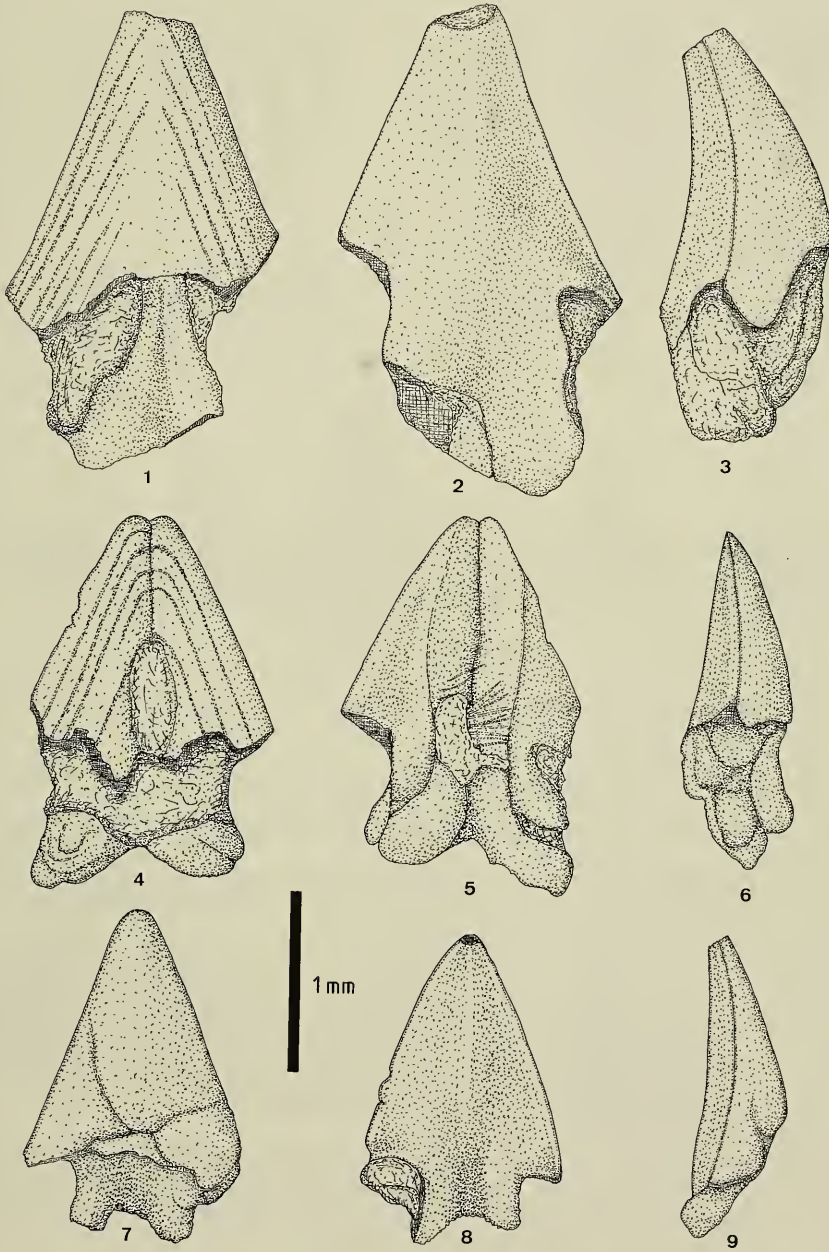
### Plate 3

*Rhynchoteuthis minima* VON DER MARCK. Upper jaws in dorsal, ventral, and lateral views, respectively. Early Upper Campanian, Coesfelder (= Beckumer and Vorhelmer) Schichten, krca<sub>3-4</sub>, zone of *Trachyscaphites spiniger*. Westphalia.

Figs. 1-3. Large, corroded specimen with lacking cover layer of the hood. Münster-Gievenbeck. SMNS 29415/9.

Figs. 4-6. Large, corroded specimen with regular scratches (bites of a fish?) on the ventral side. Münster-Gievenbeck. SMNS 29415/10.

Figs. 7-9. Larger, corroded (on the dorsal side) and somewhat misshaped specimen (damaged during growth?). Münster-Gievenbeck. SMNS 29415/11.



#### Plate 4

*Rhynchoteuthis minima* VON DER MARCK. Calcitic parts of the lower jaws in ventral, dorsal, and lateral views, respectively. Early Upper Campanian, Coesfelder (= Beckumer and Vorhelmer) Schichten, krca<sub>3-4</sub>, zone of *Trachyscaphites spiniger*. Münster-Gievenbeck, Westphalia.

Figs. 1–3. Damaged specimen. SMNS number 29415/12.

Figs. 4–6. Specimen with organic tissue and a lateral process on the left of the apex. SMNS number 29415/13.

Figs. 7–9. Fragment of a broader specimen. SMNS number 29415/14.

Figs. 10–12. Best-preserved, larger specimen showing the growth lines. SMNS 29415/15.

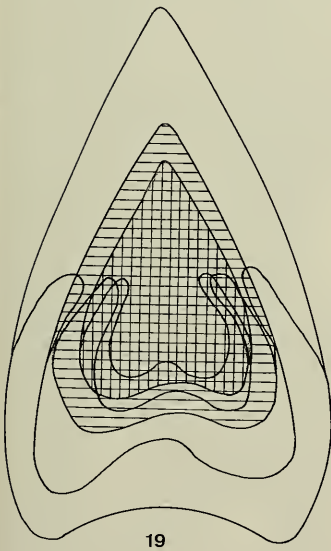
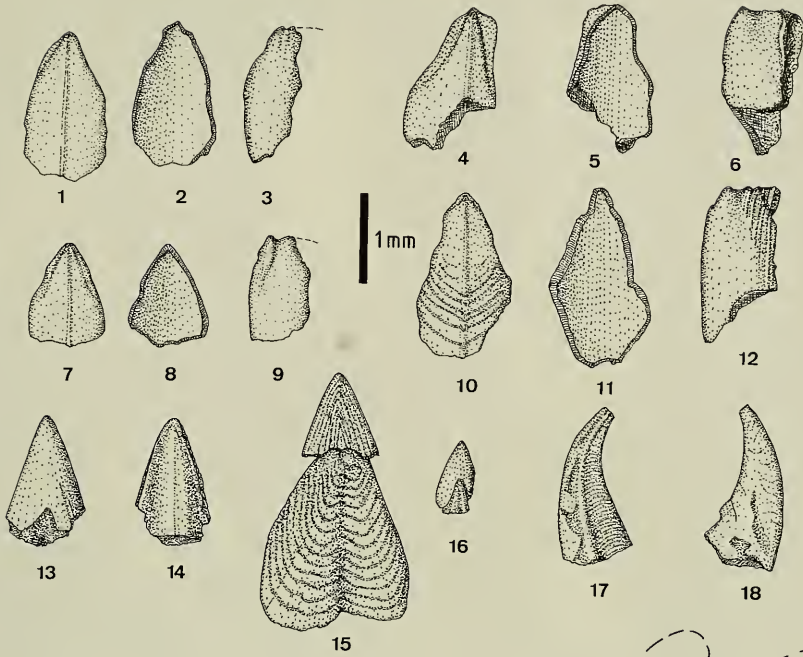
Figs. 13–14. *Rhynchoteuthis* sp. Late Lower Maestrichtian. Moosgraben section, Bavarian Alps. Dorsal and ventral view of a single, incomplete specimen (lost during drawing).

Figs. 15–16. *Rhynchoteuthis minima* VON DER MARCK. (Upper jaws. Early Upper Campanian, Coesfelder (= Beckumer and Vorhelmer) Schichten, krca<sub>3-4</sub>, zone of *Trachyscaphites spiniger*. Münster-Gievenbeck, Westphalia. – Fig. 15: Somewhat dissolved specimen showing an “*Erlangericheilus*” – like habit. Dorsal views. SMNS 29415/26. – Fig. 16: The smallest specimen of all material examined, figured for comparison with pl. 1, figs. 1–3. Dorsal view. SMNS 29415/27.

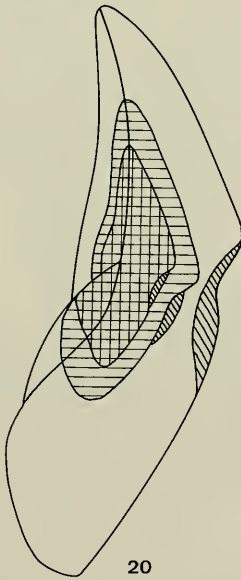
Figs. 17–18. Lateral views of a belemnite (belemnite?) arm hook. Early Upper Campanian, Münster-Gievenbeck. The lateral impressions on the hook are caused by diagenetic pressure of other calcareous microfossils. Fig. 19 show laterally growth lines beneath a longitudinal ridge. SMNS 29415/16.

Figs. 19–20. Growth stages of *Rhynchoteuthis minima* VON DER MARCK in dorsal and lateral view, reconstructed after all material available.

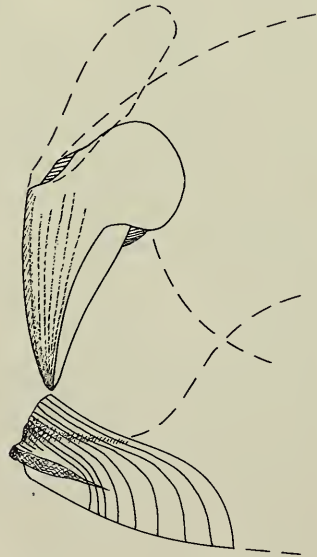
Fig. 21. Reconstruction of the calcitic dentition of an unknown rhynchoteuthid-bearing cephalopod using upper and lower jaw of *Rhynchoteuthis minima* VON DER MARCK. The outlines of the horny parts are dashed.



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### Plate 5

*Rhynchoteuthis minima* VON DER MARCK. Upper jaws in dorsal, ventral, and lateral views, respectively. Early Upper Campanian, Coesfelder (= Beckumer and Vorhelmer) Schichten, krca<sub>3-4</sub>, zone of *Trachyscaphites spiniger*. Münster-Gievenbeck.

Figs. 1–3. Same as in plate 3, figs. 1–3. SMNS 29415/9.

Figs. 4. Specimen, longitudinally split before embedding. SMNS 29415/17.

Figs. 5–7. Small, somewhat dissolved specimen. SMNS 29415/18.

Figs. 8–10. Same as in pl. 3, figs. 4–6. SMNS 29415/10.

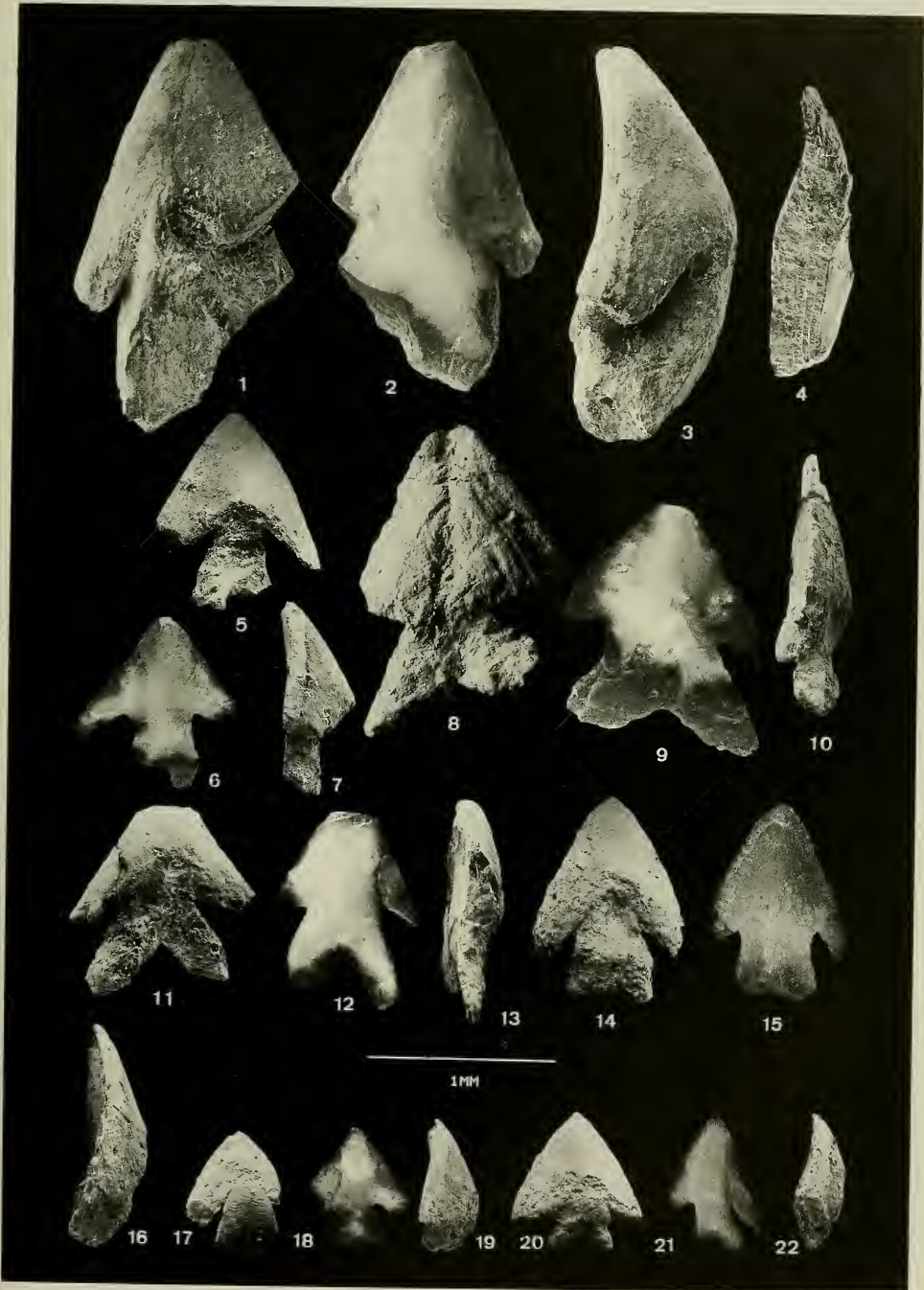
Figs. 11–13. Same as in pl. 2, figs. 1–3. SMNS 29415/4.

Figs. 14–16. Small specimen with overcrusted shaft. SMNS 29415/19.

Figs. 17–19. One of the smallest specimen. SMNS 29415/20.

Figs. 20–22. Small specimen with preserved wings. SMNS 29415/21.

The stereoscan micrographs were carried out with a Cambridge Stereoscan 250 Mk 2 at the “Institut für Geologie und Paläontologie”, University of Münster. The rhyncholites have been coated with carbon or gold.



### Plate 6

*Rhynchoteuthis minima* VON DER MARCK. Upper jaws (figs. 1–12) and lower jaws (figs. 16–21) in dorsal, ventral, and lateral views, respectively, and problematicum (figs. 13–15). Early Upper Campanian, Coesfelder (= Beckumer and Vorhelmer) Schichten, krca<sub>3–4</sub>, zone of *Trachyscapites spiniger*, Münster-Gievenbeck.

Figs. 1–3. Same as in pl. 3, figs. 7–9. SMNS 29415/11.

Figs. 4–6. Smaller specimen. SMNS 29415/22.

Figs. 7–9. Larger specimen. SMNS 29415/23.

Figs. 10–12. Same as in pl. 2, figs. 16–18. SMNS 29415/7.

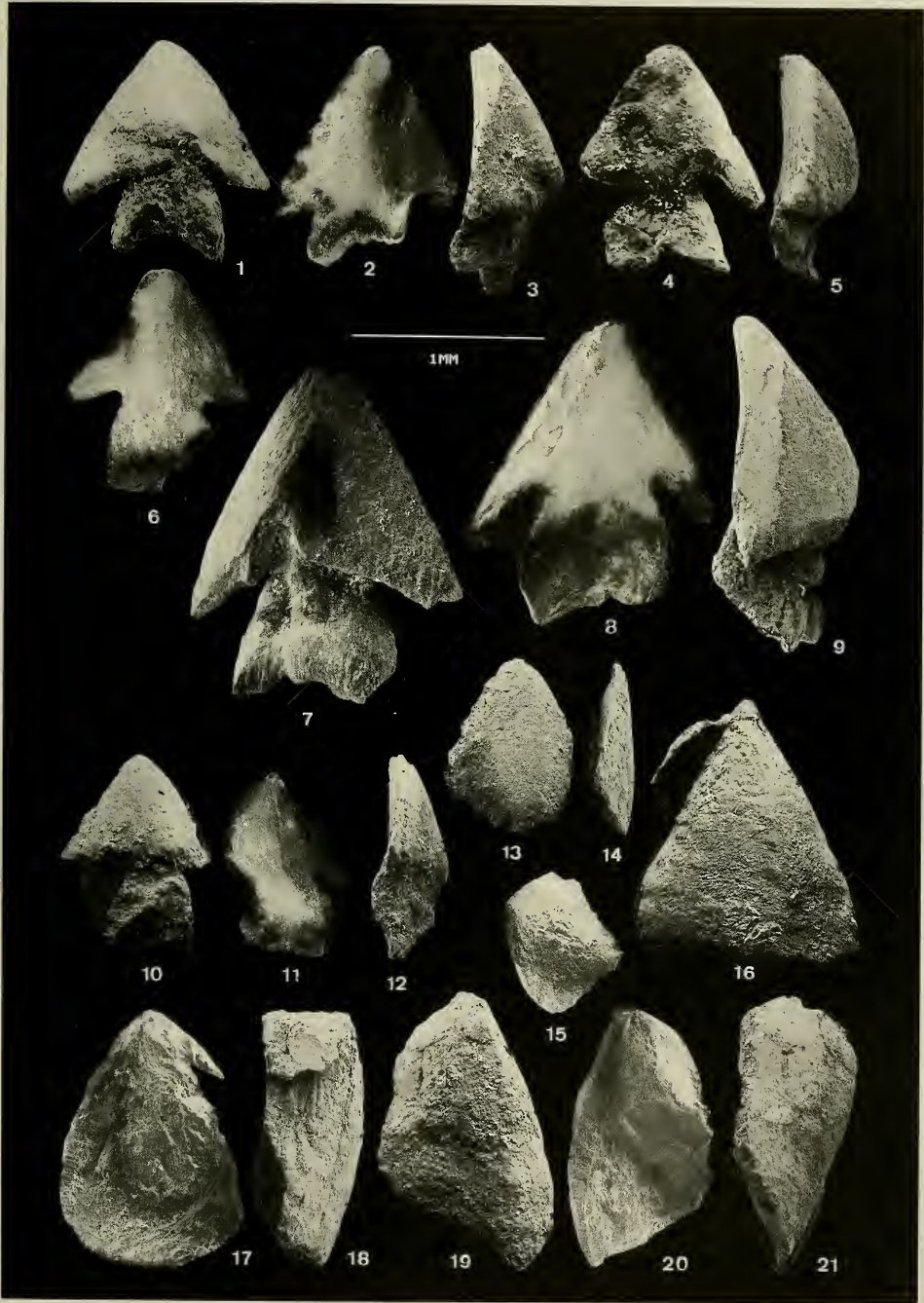
Figs. 13–15. Problematicum, as also figured by VON DER MARCK (1858 b, pl. 3, figs. 9–11); possibly a *Scalpellum* sp. SMNS 29415/24.

Figs. 16–18. Lower jaw with organic tissue at the lateral process (“wing”). SMNS 29415/25.

Figs. 19–21. Lower jaw without lateral process. Lost after having been photographed.

The stereoscan micrographs were carried out with a Cambridge Stereoscan 250 Mk 2 at the “Institut für Geologie und Paläontologie”, University of Münster. The rhyncholites have been coated with carbon or gold.





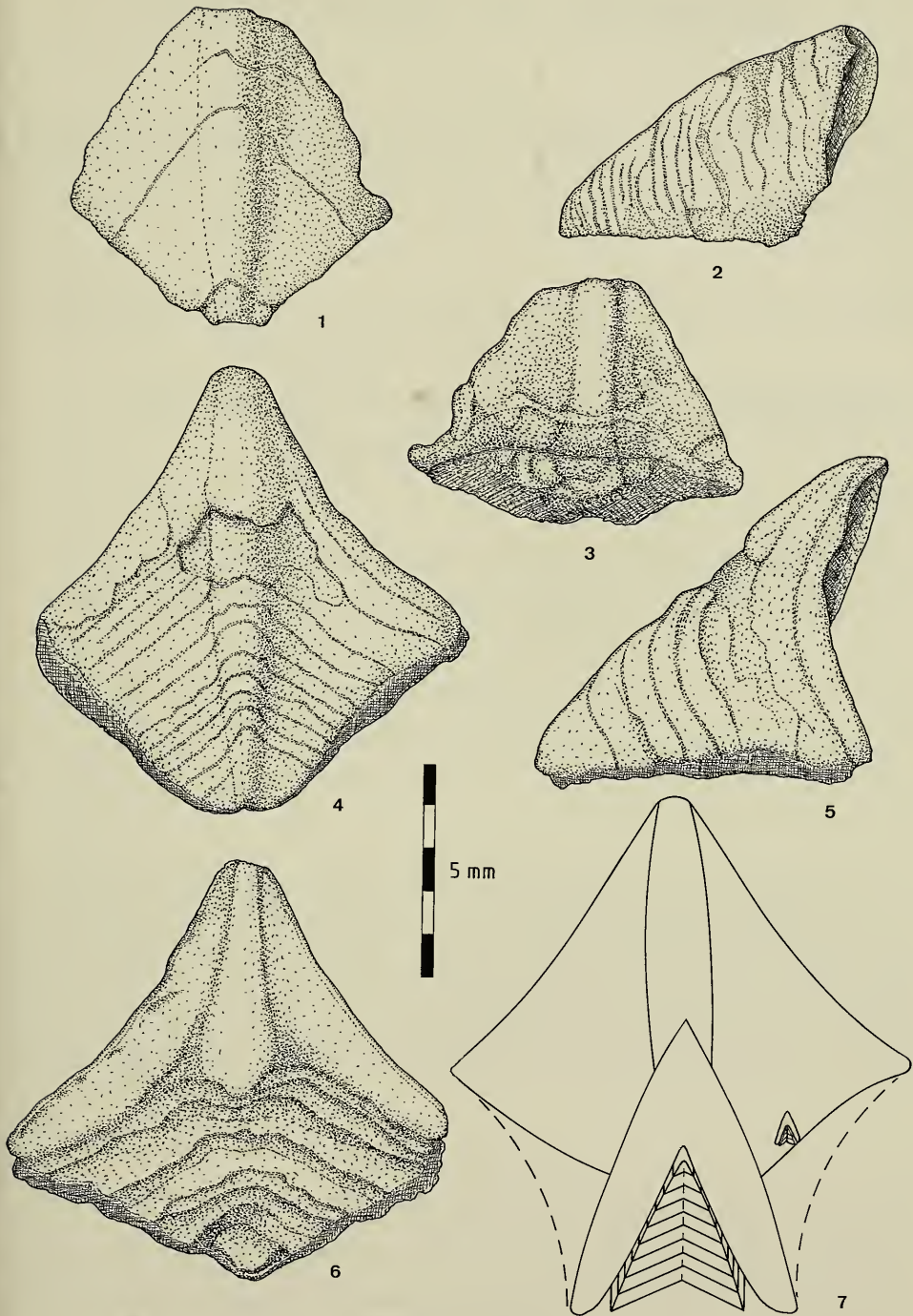
### Plate 7

*Rhyncolites* sp. Early Campanian, Subzone of *Galeola senonensis*, Alemannia quarry, Höver near Hannover, Lower Saxony. Two incomplete specimens lacking the shaft (kindly provided by W. POCKRANDT, Hannover).

Figs. 1–3. Smaller, bad preserved specimen. Dorsal, lateral, and ventral view. SMNS 29998/2.

Fig. 4–6. Specimen figured in POCKRANDT (1978, p. 14, figs. 28a, b) as “Rhyncholith (BIGUET 1819)”, in dorsal, lateral, and ventral view. SMNS 29998/1.

Fig. 7. Comparison of a complete *Rhynchoteuthis minima* VON DER MARCK (smallest and largest specimen) with *Rhyncolites* sp. showing the size differences in their natural proportions.



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Artikel/Article: [Rhynchoteuthis minima von DER MARCK, 1858 \(rhyncholite, Cephalopod Jaw\) from the Latest Campanian \(Cretaceous\) of Westphalia \(NW Germany\) 1-35](#)