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First Sauropterygian remains from the Upper Muschelkalk (Middel Triassic) of the Wesergebirge in NW-Germany

Abstract

In the Upper Muschelkalk (Ladinian) of the Weser Mountains (NW-Germany) some rare isolated bones and teeth of sauropterygians were collected. *Simosaurus gaillardoti* H. v. MEYER 1842, *Nothosaurus mirabilis* MÜNSTER 1834, *Nothosaurus giganteus* MÜNSTER 1834, *Placodus gigas* AGASSIZ 1834, and *Neusticosaurus* sp. are represented. The sauropterygian remains occur in different facies types indicating different taphonomic processes or biotopes of the marine reptiles.

Zusammenfassung

Anhand aktueller Funde werden seltene isolierte Knochen- und Zahnrelikte von Sauropterygiern aus NW-Deutschland von verschiedenen Fundstellen vorgestellt. Sie stammen aus dem Oberen Muschelkalk (Ladin) des Weserberglandes. Die fünf Taxa *Simosaurus gaillardoti* H. v. MEYER 1842, *Nothosaurus mirabilis* MÜNSTER 1834, *Nothosaurus giganteus* MÜNSTER 1834 und *Placodus gigas* AGASSIZ 1834 sowie *Neusticosaurus* sp. konnten nachgewiesen werden. Die Sauropterygierreste treten faziesabhängig auf und deuten auf unterschiedliche taphonomische Bedingungen bzw. Lebensräume der marinen Reptilien.

Inhalt

1. Inroduction 151
2. Geology 152
2.1. Stratigraphy 152
3. Systematic description 154
4. Discussion 160
Acknowledgments 163
References 163

1. Introduction

A first monograph of saurian remains of the Germanic Triassic was published by MEYER (1847-55). Many descriptions of new sauropterygians were published in the last century. After a revision of these early sauropterygian findings (cf. RIEPPEL 1993, 1994a, b, 2001, RIEPPEL & WILD 1996) new prospections started to collect new material in Israel (RIEPPEL, MAZIN & TCHERNOW 1999), Italy (RIEPPEL & VECCHIA 2001), Germany (DIEDRICH 1996, 1998, and this paper) and the Netherlands (OOSTERINK 1986). New findings should give information of systematics, biostratigraphy, taphonomy and palaeoecology of Middle Triassic reptiles.

Sauropterygian remains are very rare in the Upper Muschelkalk of the Osnabrücker Bergland, Teutoburger Wald, and Weserbergland in northwest Germany. On the contrary, findings in southern Germany are more abundant and mostly enriched in widespread

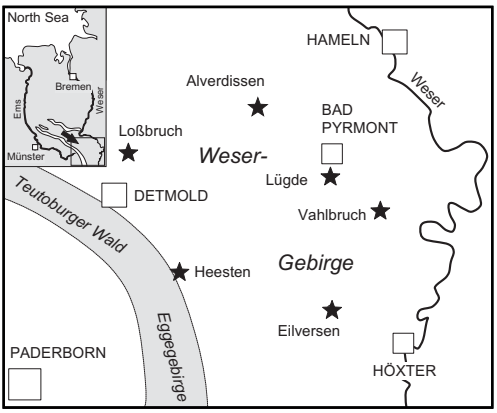


Fig. 1: Geographical position of sauropterygian localities in the Weser Mountains (NW Germany). (Graphics: PALEOLOGIC 2003).

bonebeds (e. g. Muschelkalk/Keuper boundary bonebed, MÜNSTER 1834, FRAAS 1896, SCHMIDT 1928, 1988, WESTPHAL 1988) or bioclastic chalks like the “Bayreuther Saurierkalk” (MÜNSTER 1834, GEISSLER 1895).

The locations of our sauropterygian prospections (fig. 1) are recent and old quarrys in the Teutoburger Wald and the Weserbergland (Northwest-Germany). They are to be found on the topographical maps 1 : 25 000 with the coordinates listed as following: Alverdissen (3920 Extertal, R 3509,20 H 5765,70); Bentrup (4019 Detmold, R 3492,50 H 5761,50); Eilversen (4222 Höxter, R 3518,30 H 5741,50); Erkeln (4221 Brakel, R 3515,90 H 5726,00); Heesten (4119 Horn Bad Meinberg, R 3499,50 H 5748,50); Luedge (4021 Bad Pyrmont, R 3519,50 H 5756,20), and Vahlbruch (4022 Ottenstein, R 3525,70 H 5754,30).

The material described in this study is stored in the Lippische Landesmuseum Detmold (= LLM) under the numbers: mo 505-556, and mo 947. A list of the sauropterygian remains and some photographs are presented on the website
http://www.lippisches.landesmuseum.de
of the Museum.

2. Geology

The Weser Mountains are characterized by Triassic sediments of the Germanic Basin consisting of Bunter, Muschelkalk and Keuper Formations. The Upper Muschelkalk in this region is built up of almost 60 m carbonates more or less in horizontal stratification and show different facies-types influenced by the palaeogeographical situation, such as the costal facies, the Egge Swell or the Brakel Muschelkalk Swell (KLEINSORGE 1935, WOLBURG 1969, EL-NOSHOKATY 1972). Sediment types are dolomitic yellow limestones, bioclastic limestones (terebratula limestone, trochitic limestone), ooliths, marls intercalated by storm shell beds (= Tonplatten), clays and rarely bonebeds (cf. fig. 2).

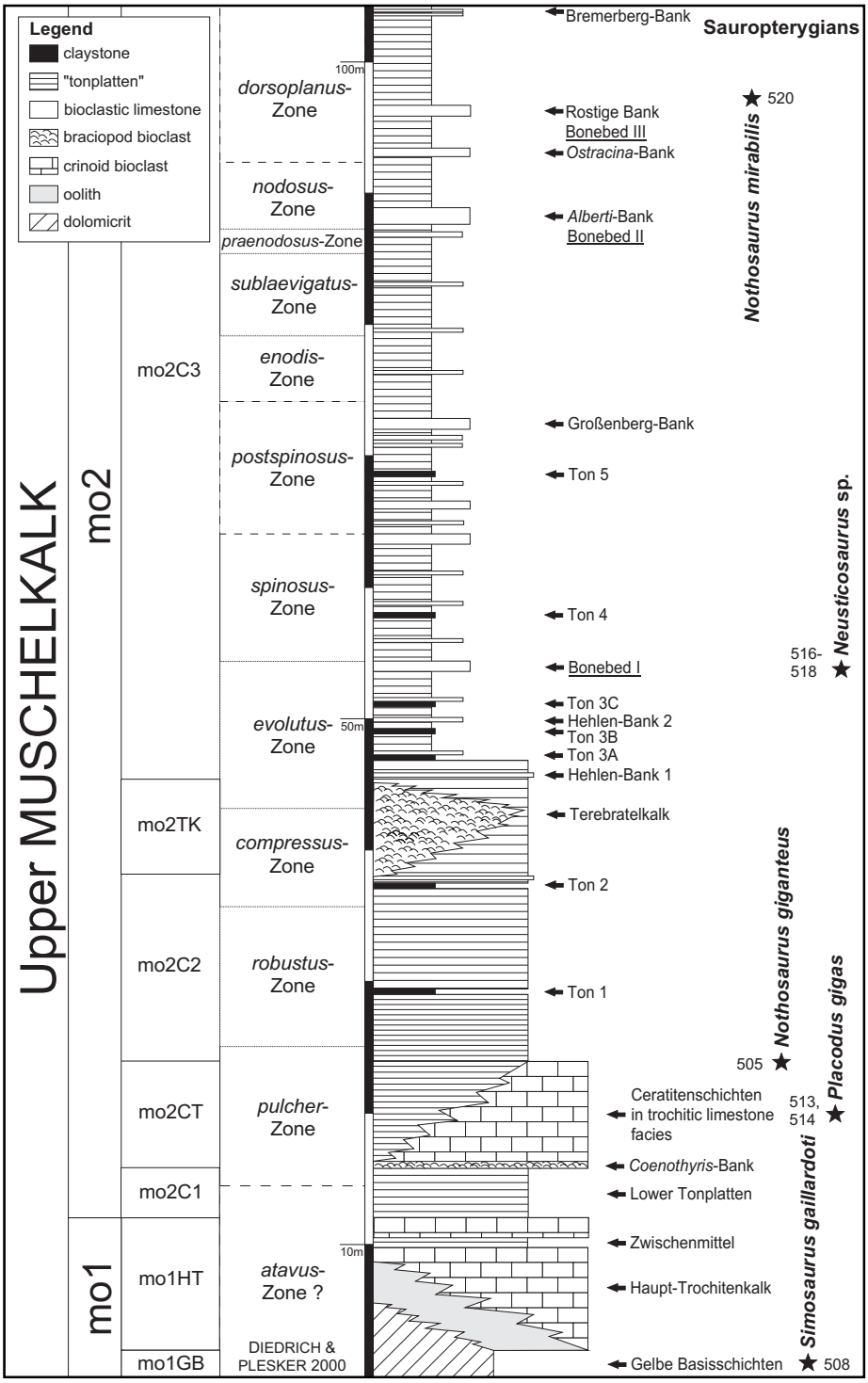
2.1. Stratigraphy

Previous research of stratigraphy (e.g. RHODE 1963, LORENZ 1967, DUCHROW & GROETZNER 1984, ROSE 1986 and others) and new own observations of multistratigraphy (litho- and biostratigraphy) are presented.

The Upper Muschelkalk of the Weser Mountains (fig. 2) is devided into the basal mo1 comprising the Gelbe Basisschichten (mo1GB), and Haupttrochitenkalk (mo1HT). The mo2 is devided into the Lower Tonplatten (mo2C1), the Upper Trochitenkalk (mo2CT), and the Upper Tonplatten (mo2C2/3) intercalated of the Terebratelkalk (mo2TK).

The yellow basic dolomites are followed by the Haupttrochitenkalk, built of carbonate types like dolomite, oolithe, and trochitic limestone depending on the palaeogeographical situation. In its upper part the mo1HT is interrupted by the Zwischenmittel developed as Tonplatten facies (RHODE 1963). The Zwischenmittel is regarded to be an isochron marker bed in the Weser Mountains. Above the mo1HT the Lower Tonplatten (mo2C1) follow. The pelagic

right site, fig. 2: Stratigraphy of the Upper Muschelkalk in the Weser Mountains and sauropterygian remain horizons. (Graphics: PALEOLOGIC 2003).


Legend
claystone
"tonplatten"
bioclastic limestone
braciopod bioclast
crinoid bioclast
oolith
dolomicrit
Upper MUSCHELKALK
mo2
mo1
mo2C3
mo2TK
mo2C2
mo2CT
mo2C1
mo1HT
mo1GB
dorsoplanus-Zone
nodosus-Zone
praenodosus-Zone
sublaevigatus-Zone
enodis-Zone
postspinosus-Zone
spinosus-Zone
evolutus-Zone
compressus-Zone
robustus-Zone
pulcher-Zone
atavus-Zone ?
DIEDRICH & PLESKER 2000
100m
50m
10m
Bremerberg-Bank
Rostige Bank
Bonebed III
Ostracina-Bank
Alberti-Bank
Bonebed II
Großenberg-Bank
Ton 5
Ton 4
Bonebed I
Ton 3C
Hehlen-Bank 2
Ton 3B
Ton 3A
Hehlen-Bank 1
Terebratelkalk
Ton 2
Ton 1
Ceratitenschichten in trochitic limestone facies
Coenothyris-Bank
Lower Tonplatten
Zwischenmittel
Haupt-Trochitenkalk
Gelbe Basisschichten
Sauropterygians
520
Nothosaurus mirabilis
516-518
Neusticosaurus sp.
505
Nothosaurus giganteus
513, 514
Placodus gigas
Simosaurus gaillardoti
508

Tonplatten facies close the Teutoburg Forest is almost interrupted by a second trochitic limestone facies, starting basally with a brachiopod dominated *Coenothyris*-Bank (Upper Trochitenkalk, LORENZ 1967). Where this Trochitenkalk (mo2CT) is missing, it is replaced by a brachiopod bed and some *Encrinus* beds (RHODE 1963, LORENZ 1967). In most quarries the stratigraphic position of the Trochitenkalk (mo2ß/mo2CT) is in the *pulcher* Zone.

Along the Teutoburg forest and close to the Brakel Muschelkalk Swell there is a Terebratelkalk developed between the *compressus*- and the *evolutus*-Zone of the mo2 (mo2TK, DUCHROW & GROETZNER 1984). The percentage of trochites in this facies type increases regionally. In this case it appears as another trochitic limestone facies (Upper Trochitenkalk, KLEINSORGE 1935). In the quarry of Bentrup/Loßbruch (Gretberg), it becomes evident that the mo2TK is an additional development to the mo2CT, although is was regarded to be identical with the mo2CT by NOLTE (1982).

In the Weser Mountains the Ceratitenschichten/Tonplattenfolge (mo2alpha/mo2C1) is almost starting in the *pulcher* Zone, reaching up into the *dorsoplanus* Zone, intercalated between the *ostracina*-Bank and the Bremerberg Bank. The youngest ceratite to be found is *Ceratites* (*Discoceratites*) *dorsoplanus* PHILIPPI, found 1.3 m above the Rostige Bank. On Top of the Bremerberg Bank the boundary to the Keuper formation is located.

There are also some well developed marker beds of tempestites, bonebeds, and clays or marlstones, showing a wide distribution in the Weser Mountains, helpful for event and marker bed correlation of different sections within the Upper Muschelkalk. They are depicted in the generalized section for the Weser Mountains given here (Fig. 2), according to ROSE (1986).

Bonebeds in the Upper Muschelkalk of the Weser Mountains have had none or only little regional significance for correlation. Especially in the upper part of the mo2C3, thin bonebeds become more abundant like in the Osnabrücker Bergland (DUCHROW & GROETZNER 1984) or southern Germany (HAGDORN 1991). The few bonebeds I-II contain small vertebrate bones like fish scales, fish and selachian teeth, almost sorted in size. One of these widespread bonebeds is the base of the Bonebed I. Another characteristic bonebed is developed at the base of the *Alberti* Bank. The Bremerberg Bank seems to correlate with the "Grenzbonebed" of South Germany. These bonebeds do not contain a rich amount of Sauropterygian remains like the Grenz-Bonebed of the Upper Muschelkalk/Lower Keuper boundary in South Germany (e. g. Crailsheim, Bayreuth, cf. e. g. SCHMIDT 1928, 1988, HAGDORN 1991).

The fossiliferous horizons of the described sauropterygian remains are marked in the generalized section except for those that were not found on a dump.

3. Systematic description

The material consists of isolated bones and teeth of sauropterygians. Isolated bones were found in concretions or bonebeds, teeth of *Placodus* in shill beds (bioclastic limestones like crinoid limestone or molluscan shell limestone). Two incomplete ribs, three vertebral centra, one vertebra, and some teeth could not be identified. An actual revision and synonyme lists of the described species are discussed by RIEPPEL (1994a,b) and RIEPPEL & WILD (1996).

Subclass Synaptosauria OWEN 1860
Order Sauropterygia OWEN 1860
Suborder Eusauropterygia TSCHANZ 1989
Suprafamily Nothosauria SEELEY 1882
Family Nothosauridae BAUR 1889
Genus *Simosaurus* H. v. MEYER 1842

***Simosaurus gaillardoti* H. v. MEYER 1842**

Figs. 3a-c, 8.7a-c

* 1842 *Simosaurus gaillardoti*. – H. v. MEYER: 184, 196.
1994 *Simosaurus gaillardoti* H. v. MEYER. – RIEPPEL: 4-36, Fig. 3A, 4-28, 30-37.

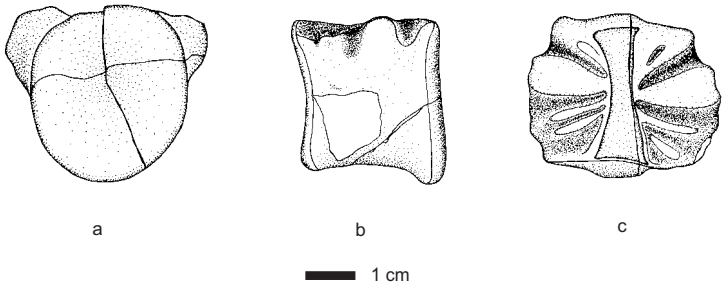


Fig. 3: *Simosaurus gaillardoti* H. v. MEYER, centrum of sacral vertebra, Bentrup, Gelbe Basisschichten (Upper Muschelkalk), LLM mo 508, a: frontal, b: lateral, c: dorsal. (Graphics: PALEOLOGIC 2003).

Material: 1. Centrum of sacral vertebra in a yellow dolomite (figs. 3a-c, 8.5a-c), Bentrup, Gelbe Basisschichten, Upper Muschelkalk, LLM mo 508. Measurements: length: 2,9 cm, width: 2,9 cm, height: 3,2 cm. 2. Neural arch in a grey carbonate concretion, Heesten, Ceratitenschichten, Upper Muschelkalk, Ladin, LLM mo 509. Measurements: length: 4,1 cm, width: no measurements, height: 5,2 cm.

Stratigraphy: The sacral vertebra centrum was found in the Gelbe Basisschichten (cf. fig. 2), the neural arch in a not clearly defined bed in the Ceratitenschichten. *S. gaillardoti* is known from the Ceratitenschichten (*nodosus* Zone to *semipartitus* Zone), Upper Muschelkalk to Middle Keuper (Lettenkohlenkeuper, Gipskeuper, RIEPPEL & WILD 1996).

Discussion: The centrum of a sacral vertebra has got the same sutures of the articulation surface as figured by RIEPPEL & WILD 1996 (cf. figs. 13, 14, 16) for cervical and dorsal vertebrae of *S. gaillardoti*.

Palaeobiogeography: *S. gaillardoti* is widely distributed in the Germanic Basin in Germany and eastern France (MEYER 1842, RIEPPEL & WILD 1996).

Genus *Neusticosaurus* BROILI 1927
***Neusticosaurus* sp.**
Figs. 4a-c, 8.6a-c

Material: 1. Thoracal vertebra centrum (figs. 4a-c, 8.6a-c), Eilversen, Bonebed I, *evolutus*-Zone, Ceratitenschichten, Upper Muschelkalk, Ladin. LLM mo 516. Measurements: length: 0,5 cm, width: 0,5 cm, height: 0,5 cm. 2. Incomplete thoracal vertebra centrum, Eilversen, Bonebed I, *evolutus* Zone, Ceratitenschichten, Upper Muschelkalk, Ladin. LLM mo 517. Measurements: length: 0,5 cm, width: 0,5 cm, height: 0,45 cm. 3. Incomplete thoracal vertebra centrum, Eilversen, Bonebed I, *evolutus* Zone, Ceratitenschichten, Upper Muschelkalk, Ladin. LLM mo 518. Measurements: length: 0,5 cm, width: 0,5 cm, height: 0,35 cm. 4. Incomplete thoracal vertebra centrum, Lügde, Rostige Bank, *nodosus* Zone, Ceratitenschichten, Upper Muschelkalk, Ladin. LLM mo 519. Measurements: length: 0,5 cm, width: 0,5 cm, height: 0,4 cm. 5. Thoracal vertebra centrum, Eilversen, Bonebed I, *evolutus* Zone, Ceratitenschichten, Upper Muschelkalk, Ladin. LLM mo 947. Measurements: length: 0,5 cm, width: 0,5 cm, height: 0,5 cm.

Stratigraphy: Most vertebra centra were taken from the Bonebed I at the top of the *evolutus* Zone, and seem to be a result of size fractioning. In this bonebed, only small pebbles and vertebrate remains of up to 0,5 cm are present. One centrum occurred in the Rostige Bank of the *nodosus* Zone. These small sauropterygians can be found in the Tonplatten of the Upper Muschelkalk (mo2C3) in North Germany. Different pachypleurosaurid species are typical in the Grenzbitumen Zone of the Monte San Giorgio (Anis/Ladin boundary, PEYER 1944, SANDER 1989).

Discussion: All vertebra centra show nearly identical dimensions. These small centra may belong to adult individuals. By comparison with the original skeletons in the Museum of

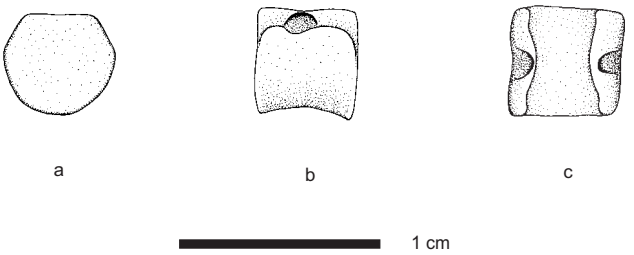


Fig. 4: *Neusticosaurus* sp., centrum of dorsal vertebra, Eilversen, Bonebed I, *evolutus* Zone, Ceratitenschichten (Upper Muschelkalk), LLM mo 516, a. frontal, b. lateral, c. dorsal. (Graphics: PALEOLOGIC 2003).

the University Zürich, and with figured skeletons (SANDER 1989), these small vertebrates seem to be clearly Pachypleurosaurid maybe from *P. pusillus*.

Palaeobiogeography: Pachypleurosaurids are distributed in the Germanic Basin and are only known from isolated bones. In the northern Tethys hundreds of well preserved skeletons of different size average were described by SANDER (1989).

Subfamily Nothosaurinae NOPCSA 1889
Genus *Nothosaurus* MÜNSTER 1923
***Nothosaurus giganteus* MÜNSTER 1834**
Figs. 5, 7.1, 8.8a-c

* 1834 *Nothosaurus giganteus*. – MÜNSTER: 525.
1839 *Nothosaurus andriani*. – MEYER: 559.
1844 *Nothosaurus angustifrons*. – MEYER & PLIENINGER: 47, pl. 10, figs. 2.
1847-55 *Nothosaurus aduncidens*. – MEYER: 85, pl. 67, figs. 1-3.
1847-55 *?Opeosaurus suevicus*. – MEYER: 82, pl. 14, figs. 7-9.
1895 *Nothosaurus baruthicus*. – GEISSLER: 333 ff., pl. 13, fig. 1.
1896 *Nothosaurus chelydrops*. – FRAAS: 12, pl. 4.
v 1939 *Paranothosaurus amsleri*. – PEYER: 1 ff., figs. 1-7, pls. 66-71.
1996 *Nothosaurus giganteus* MÜNSTER,1834. – RIEPPEL: 4-25, figs. 9-19, 21.

Material: 1. One incomplete skull in a dolomitic limestone bed (figs. 5, 7.1), Alverdissen, *robustus* Zone, Ceratitenschichten (mo2C2), Upper Muschelkalk, LLM mo 505. The praemaxilla was destroyed completely before embedding. The occipital region has fresh fractures. The skull, especially the postorbital region (parietal, frontal etc.) shows horizontal clefts produced by diagenesis. The posterior part of the skull is deformed by tectonic or diagenetic pressure. The cranial dorsal sutures are visible (fig. 5). There are no teeth in the alveoles. Measurements: total length: 24,9 cm, width in the middle of orbits: 7,5 cm, width in the middle of the nasars: 4,8 cm. Orbits: left, width: 2,6 cm, length: 3,9 cm, right, width: 2,6 cm, length: 4,1 cm. Nasals: left and right, width: 2,6 cm. Temporalforamen: right, length: 13,4 cm, width: 2,7 cm. Distance between nasars/orbits 2,35 cm. Parietal foramen diameter 0,9 cm.

2. One neural arch of a cervical vertebra in a carbonate concretion (figs. 8.8a-c), Alverdissen, Ceratitenschichten, LLM mo 510. Measurements: length: 4,1 cm, width: praezygapophyses: 6,0 cm, postzygapophyses: 6,5 cm, height: 6,0 cm. Height of vertical spine: 3,2 cm.

Stratigraphy: The skull was found in the Ceratitenschichten above the mo1HT at Alverdissen, where no mo2CT is developed. It was found in the *robustus* Zone of the Ceratitenschichten, where quarry work was in progress at that time. The stratigraphic position of the neural arch can only be given as Ceratitenschichten. *N. giganteus* occurs in the whole Upper Muschelkalk, e. g. in Bayreuth in the Trochitenkalk (MEYER 1847-1855), in Monte San Giorgio at the Anis/Ladin boundary (KUHN-SCHNYDER 1966, PEYER 1938, 1939, 1944).

Discussion: The incomplete skull was described by SPRINGHORN (1999) and first

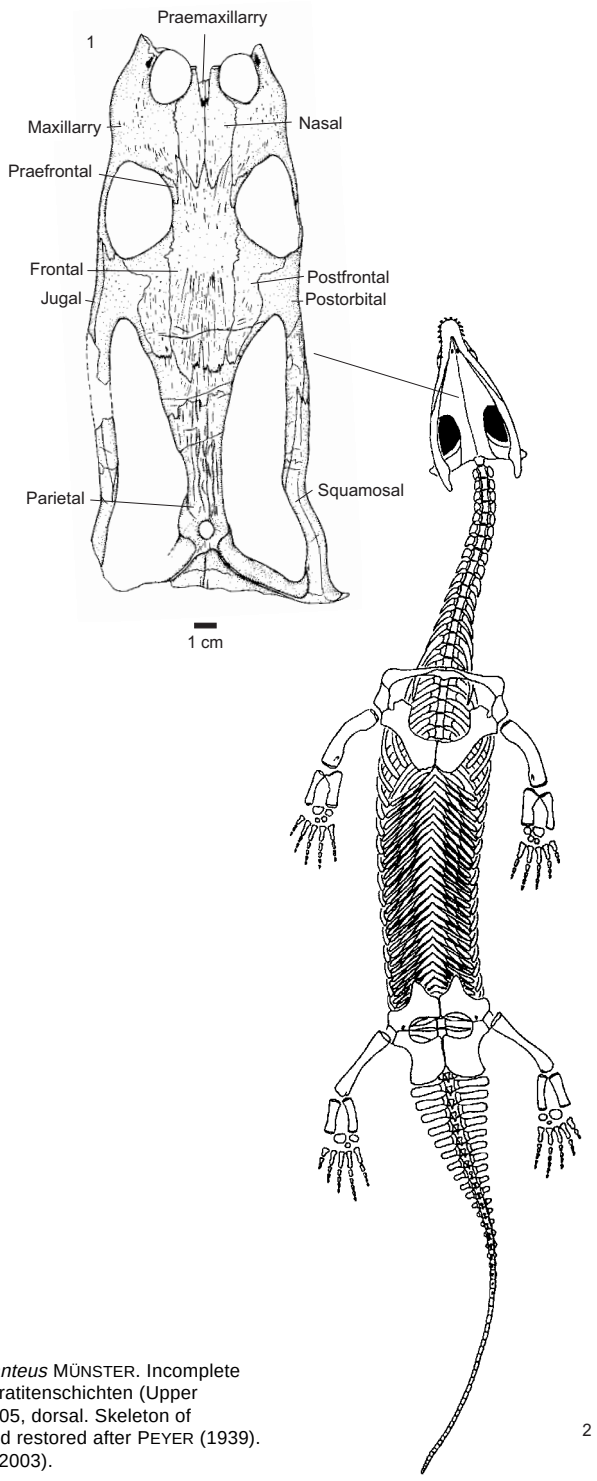


Fig. 5: *Nothosaurus giganteus* MÜNSTER. Incomplete skull, *robustus* Zone, Ceratitenschichten (Upper Muschelkalk), LLM mo 505, dorsal. Skeleton of *N. giganteus* redrawn and restored after PEYER (1939). (Graphics: PALEOLOGIC 2003).

thought to be *N. mirabilis*. A comparison with the original skull of "*Paranothosaurus amsleri* PEYER" (= *N. giganteus* MEYER after RIEPPEL & WILD 1996) in the Palaeontological Museum of the University of Zürich showed the similarities of facial sutures to *N. giganteus*. The measurements of the skull correspond to the variability of skull morphology and preservation of *N. giganteus* (cf. PEYER 1939, KUHN-SCHNYDER 1966, RIEPPEL & WILD 1996) and differ from all other species of *Nothosaurus*. The facial sutures are typical of *N. giganteus*. There is no articulation between the prefrontals and nasals. The distance between the orbits is much wider than in e. g. *N. mirabilis*.

The neural arch of a thoracal vertebra has very large and flat angled (3°) pre- and postzygapophyses. The neural arch could be compared with cervical vertebrae at the original of "*P. amsleri* PEYER" and has the typical measurements that PEYER (1939), and RIEPPEL & WILD (1996) described for *N. giganteus*.

Palaeobiogeography: *N. giganteus* is distributed in the Germanic Basin and the northern Tethys (Switzerland, "Jugoslawia") (RIEPPEL & WILD 1996), and is known from a complete skeleton of the Monte San Giorgio (Switzerland, PEYER 1939).

Nothosaurus mirabilis MÜNSTER 1834

Figs. 6.1-3, 8.1, 8.4-5

* 1834 *N. mirabilis*. – MÜNSTER: 525.
1847 *N. schimperi* MEYER. – MEYER: pl. 10, fig. 19.
1847 *N. adunciens* MEYER. – MEYER: pl. 67, fig. 1-3.
1847 *N. bergeri* MEYER. – MEYER: pl. 67, fig. 4-5.
1896 *N. blezingeri* FRAAS. – FRAAS: 11, fig. 4.
1957 *E. lelmensis* HUENE. – HUENE: 97.
1996 *N. cuvieri* MÜNSTER. – RIEPPEL & WILD: 56, fig. 51.
1996 *N.* cf. *mirabilis* MÜNSTER. – RIEPPEL & WILD: 56, fig. 56.

Material: 1. One complete right coracoid in a flat carbonate bed (figs. 6.1, 8.1), Vahlbruch, *dorsoplanus* Zone, Ceratitenschichten, Upper Muschelkalk, Ladin. LLM mo 520, is well preserved and has a few diagenetic fractures. Measurements: total lenght: 16, 0 cm, width of coracoid symphysis: 10 cm, width of smallest area: 4,8 cm, width of coracoid „foramen" incisura: 1,0 cm, thickness at coracoid scapula suture: 1,8 cm. The typical surface striation of nothosaurid bones begins in the centre of the coracoid radiating to the symphyses. A depression of 0,7 x 3,8 cm radiates from the coracoid "foramen" to the center. 2. One neural arch of a dorsal vertebra in a carbonate concretion (figs. 6.2, 8.4), Heesten, *spinosus* Zone, Ceratitenschichten, Upper Muschelkalk, Ladin. LLM mo 511. Measurements: complete height: 11,0 cm, transversal width: 7,5 cm, height of transversal processes: 2,3 cm, height of dorsal process: 7 cm, width of symphyses: 1 cm. 3. Centrum of thoracal vertebra (figs. 6.3, 8.5a-c), Eilversen, near to the Ton 3, *evolutus* Zone, Ceratitenschichten, Upper Muschelkalk, Ladin. LLM mo 512. Measurements: length: 3,3 cm, width: 3,7 cm, height: 4 cm. 4. Neural arch fragment, Heesten, Ceratitenschichten, Upper Muschelkalk, Ladin. LLM mo 538. 5. Neural arch fragment, Heiligenkirchen (Königsberg), Ceratitenschichten, Upper Muschelkalk, Ladin. LLM mo 551.

Stratigraphy: The coracoid was found just above the Rostige Bank in the *dorsoplanus* Zone, the neural arch in the *spinosus* Zone, and the centrum of a thoracal vertebra in the *evolutus* Zone. Therefore this species occurs in the complete Tonplatten (mo2C3) of the Weserbergland. *N. mirabilis* is one of the most common sauropterygian species known from the basal Upper Muschelkalk to the Lower Keuper (RIEPPEL 1993, RIEPPEL & WILD 1996), but no complete skeleton is known.

Discussion: MEYER (1847-55) depicted some coracoids of *N. mirabilis* of the Bayreuther Upper Muschelkalk, the complete pectoral girdle is shown by SCHMIDT (1987). The comparison to coracoids of *N. giganteus* and *N. marchicus* shows many differences in the outline (cf. figs. 5-6).

Neural arches of thoracal vertebrae from *N. mirabilis* (for comparison) are figured by

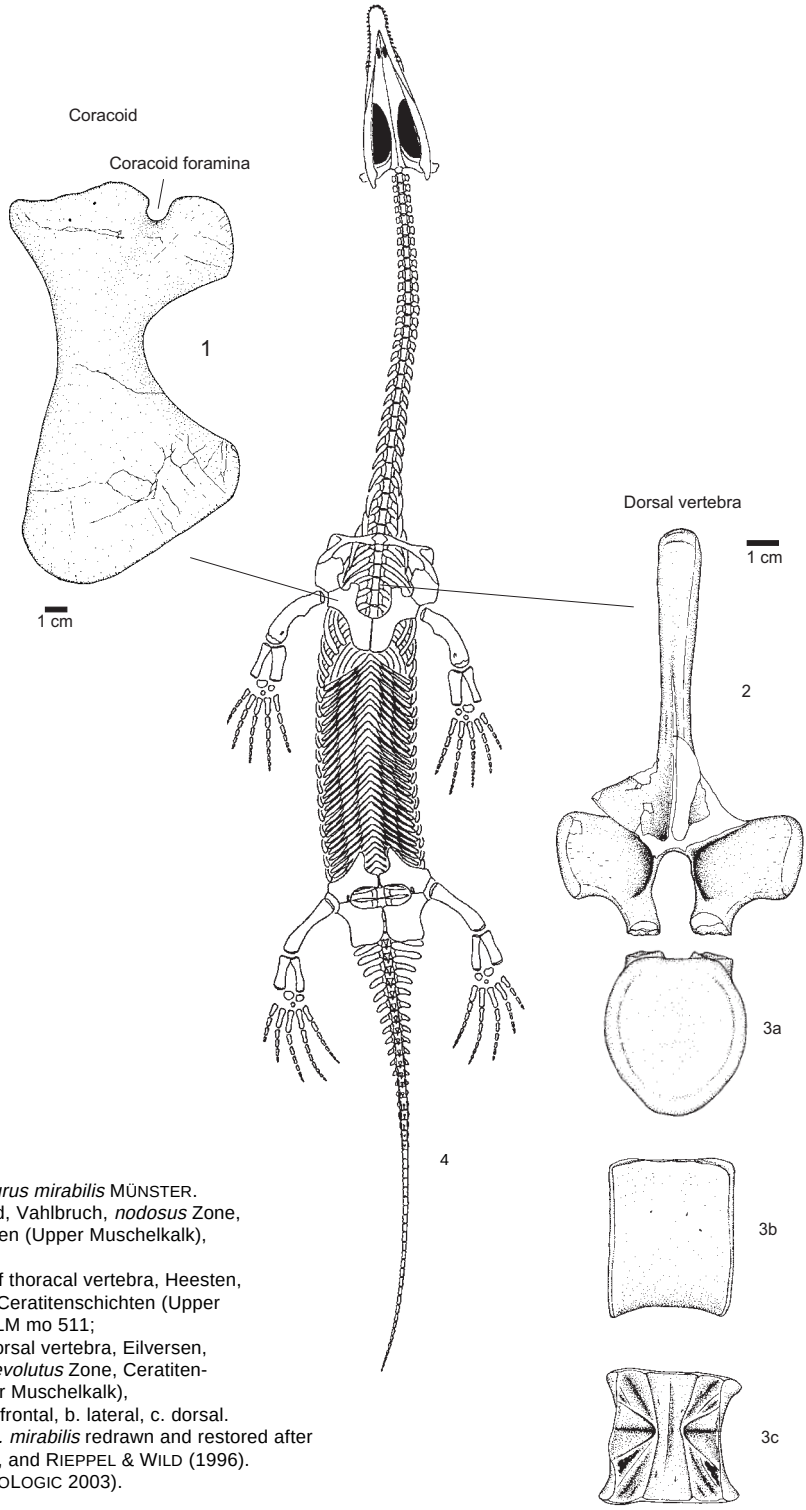


Fig. 6: *Nothosaurus mirabilis* MÜNSTER.
1: Right coracoid, Vahlbruch, *nodosus* Zone, Ceratitenschichten (Upper Muschelkalk), LLM mo 520;
2: Neural arch of thoracal vertebra, Heesten, *spinosus* Zone, Ceratitenschichten (Upper Muschelkalk), LLM mo 511;
3: Centrum of dorsal vertebra, Eilversen, Bereich Ton 3, *evolutus* Zone, Ceratitenschichten (Upper Muschelkalk), LLM mo 512, a. frontal, b. lateral, c. dorsal.
4: Skeleton of *N. mirabilis* redrawn and restored after SCHMIDT (1988), and RIEPPEL & WILD (1996). (Graphics: PALEOLOGIC 2003).

MÜNSTER (1834-55), MEYER (1847-55), GEISSLER (1895), SCHMIDT (1988), and RIEPPEL & WILD (1996).

Thoracal vertebrae of this species are well described and figured (see MEYER 1847, RIEPPEL & WILD 1996). The long dorsal spine is typical of thoracal vertebra of *N. mirabilis*, also the greater angle of the zygapophyses.

Palaeobiogeography: This species is the most common nothosaur in the Germanic Basin and known from many sites in South Germany like Bayreuth, Hoheneck, Molsdorf, Bindlach, Crailsheim, Weissach, Heldenmühle, Berlichingen and Hegnabrunn (see MEYER 1847, RIEPPEL & WILD 1996), and now known from the North-German sites Vahlbruch, Heesten and Eilversen.

Order Placodontia MEYER 1863
Suborder Placodontoidea NOPCSA 1923
Family Placodontidae NOPCSA 1923
Genus *Placodus* AGASSIZ 1833-43
***Placodus gigas* AGASSIZ 1833**
Figs. 7.2, 8.2-3

* 1833 *Placodus gigas*. – AGASSIZ: 15, pl. 13, fig. 13.
1994 *Placodus gigas* MÜNSTER, 1830. – RIEPPEL: figs. 41, 42B, 43, 45, 48C, 50C, 52, 59, 60B, C, 62B

Material: 1. Tooth, Bentrup, (fig. 8.2), Upper Trochitenkalk, LLM mo 513. Measurements: length: 2,8 cm, largest width: 1,9 cm, height: 1 cm. 2. Tooth, Bentrup, (fig. 8.3), Upper Trochitenkalk, LLM mo 514. Measurements: length: 2,2 cm, largest width: 1,5 cm, height: 0,7 cm. 3. Incomplete Tooth, Heesten, Upper Muschelkalk, LLM mo 515. 4. Incomplete Tooth, Heesten, Upper Muschelkalk, LLM mo 521. 5. Right dental with one toothplate, Hiddesen (Hiddeser Berg), Upper Muschelkalk, LLM mo 530. Measurements: length: 12,2 cm. 6. Tooth, Oerlinghausen, Upper Muschelkalk, LLM mo 544.

Stratigraphy: Both teeth of Bentrup came from the Upper Trochitenkalk. The exact stratigraphic position of all other findings cannot be given, but must be Upper Muschelkalk as well. *P. gigas* is distributed in the Germanic Basin from Lower (OOSTERINK 1986) to Upper Muschelkalk (RIEPPEL 1994).

Discussion: Teeth of *P. gigas* are well described and figured in many papers, e.g. by AGASSIZ (1833-43), BROILI (1912), DREVERMANN (1933), and WESTPHAL (1967, 1988). The tooth morphology is very variable, depending on position. The tooth figured on fig. 5.2 seems to be a lower jaw tooth, the other one (fig. 5.3) an upper jaw tooth.

Palaeobiogeography: *P. gigas* is widely distributed in the Germanic Basin and known from many localities (cf. AGASSIZ 1833-43, BROILI 1912, DREVERMANN 1933, WESTPHAL 1967, 1988, OOSTERINK 1986, SCHMIDT 1988, and RIEPPEL 1994).

4. Discussion

The material available gives further biostratigraphic, biogeographic, taphonomic and palaeoecologic information for sauropterygian remains in NW Germany, but does not provide new taxonomic data.

In the Upper Muschelkalk taphonomic processes seem to be responsible for, the fractionation and faunal sorting of vertebrate remains in bonebeds. For this reason the bonebeds known in the *spinosus* zone of the Weser Mountains contain only small bones up to 0,5 cm, teeth of *Hybodus*, *Acrodus, Palaeobates, Saurichthys*, and the described Sauropterygians, and also dermal denticles of fishes like *Colebodus*, *Dollopterus* etc. Therefore only small pachypleurosaurid remains are typical of these bonebeds in the Tonplatten (mo2C3). Large sauropterygians occur only rarely as isolated bones in other beds or carbonate concretions.

The Bremerberg Bank seems to be similar to the very well known “Grenz-Bonebed” of South Germany (e.g. in Crailsheim). If the Bremerberg Bank correlates to the Grenzbonebed of South Germany, the boundary to the Lower Keuper can be determined in NW-

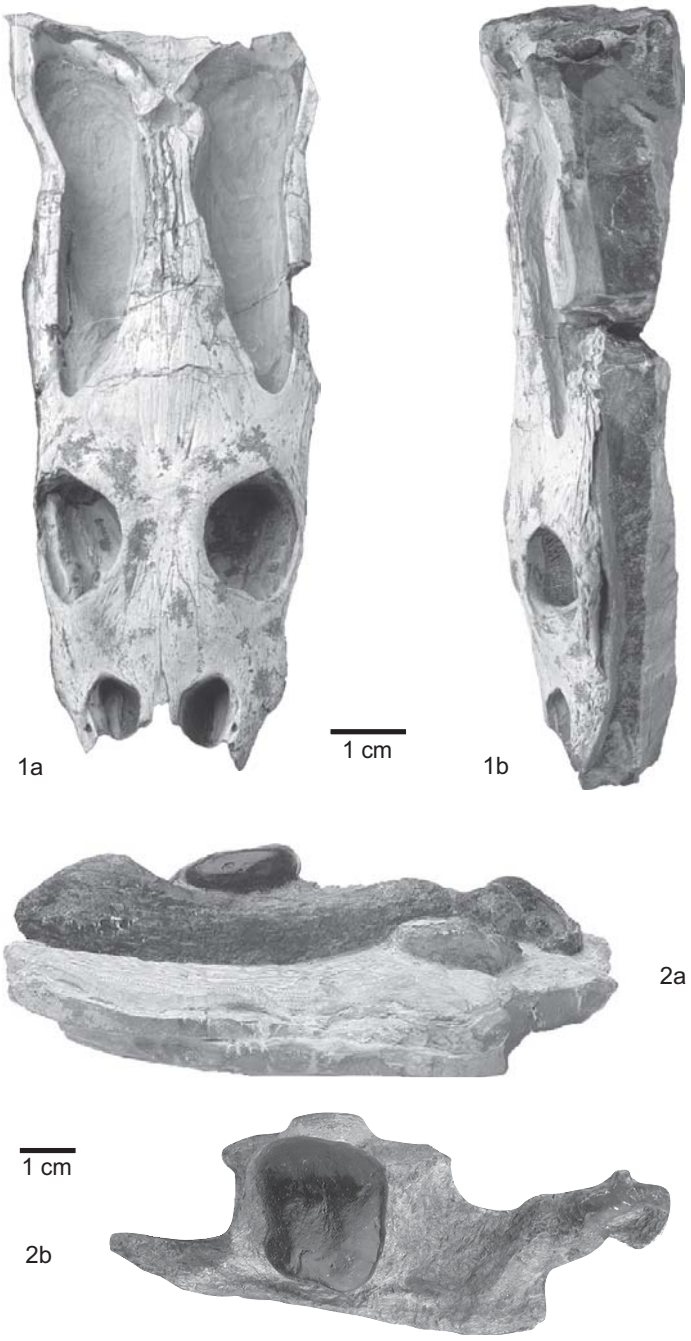
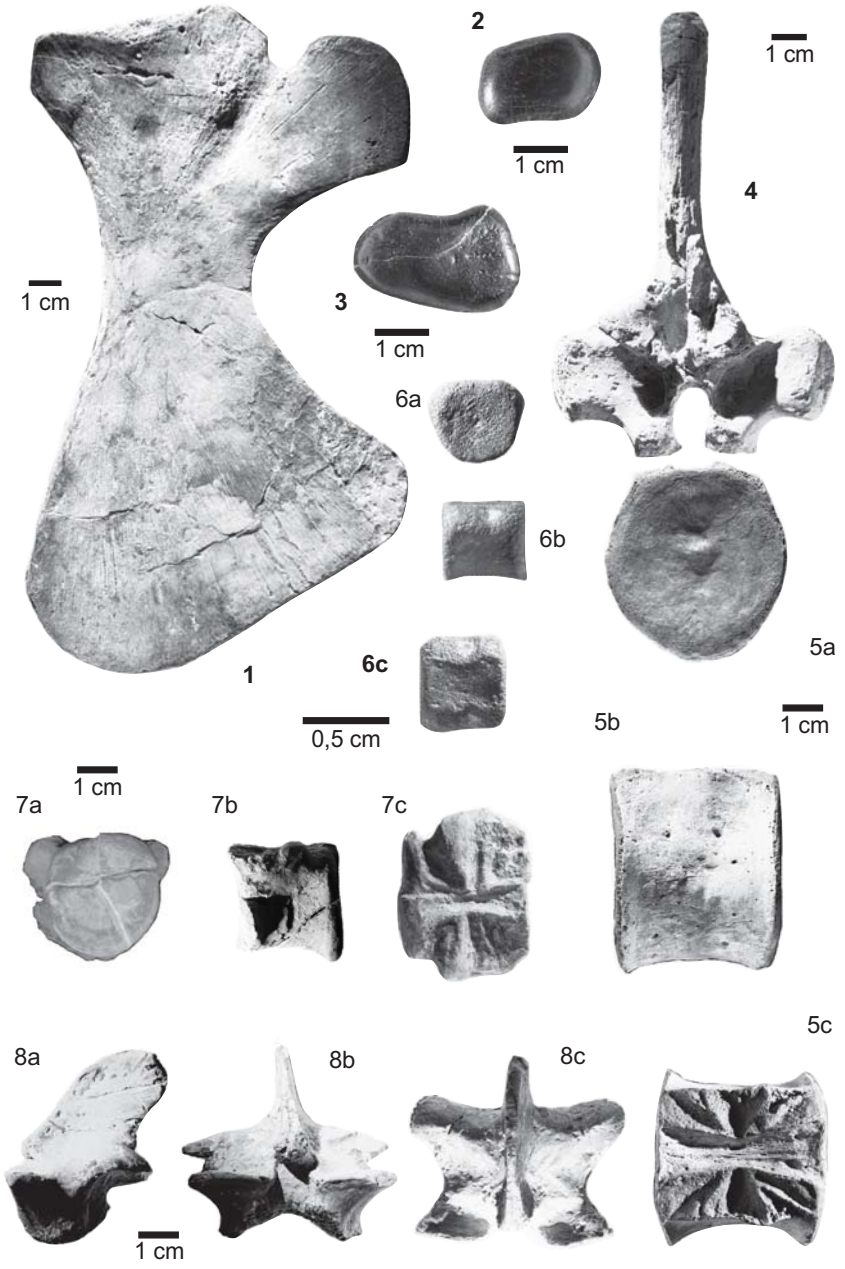


Fig. 7.1: *Nothosaurus giganteus* MÜNSTER, incomplete Skull (without praemaxillary and occipital region), *robustus* Zone, Ceratitenschichten (Upper Muschelkalk), LLM mo 505, a: dorsal, b: lateral. 2: *Placodus gigas* AGASSIZ, right dental with one tooth, Hiddesen (Hiddeser Berg), Upper Muschelkalk, LLM mo 530, a: lateral, b: dorsal. (Photos: PALEOLOGIC 2003).


1
1 cm
2
1 cm
3
1 cm
4
1 cm
5a
5b
1 cm
5c
6a
6b
6c
0,5 cm
7a
1 cm
7b
7c
8a
1 cm
8b
8c

Germany for the first time. Larger undescribed bones (ribs, vertebrate centra etc.) and fragments are numerous in the Bremerberg Bank, but difficult to collect because of a strong cementation. The Bremerberg Bank is exposed in the outcrop of Lügde in the Weserbergland, also in Lamerden (North Hesse). The vertebrate remains of this marker bed will be further studied and published in detail.

At the moment there are not enough findings of bones in the Weserbergland for a statistic analysis, but the occurrence of different sauropterygians in different stratigraphic horizons and bonebeds correlates to different facies types. *Neusticosaurus* sp. and *N. mirabilis* are common in the Tonplatten (mo2C3) in lower ramp facies conditions. *N. giganteus* appears near to the bar facies (mo2C2). *P. gigas,* especially teeth, are common in the trochitic limestone facies of the Upper Trochitenkalk (moT), deposited in the bar facies, too. New material of the Bremerberg Bank will give further information on sauropterygian remains of the "Grenzbonebed" in NW Germany after new collecting activities.

The occurrence of sauropterygian remains in NW Germany in different facies types suggest different palaoenvironments and biotopes of sauropterygians. *Neusticosaurus* sp. and *N. mirabilis* are common in the open basin sediments of the Tonplatten in contrast to *N. giganteus*, *P. gigas*, and *S. gaillardoti* being typical of the lagoon and bar sediments.

left site, fig. 8.1: *Nothosaurus mirabilis* MÜNSTER, right coracoid, Vahlbruch, *nodosus* Zone, Ceratitenschichten (Upper Muschelkalk), LLM mo 520; 2: *Placodus gigas* MÜNSTER, tooth, Bentrup, Upper Trochitenkalk (Upper Muschelkalk), LLM mo 513; 3: *Placodus gigas* MÜNSTER, tooth, Bentrup, Upper Trochitenkalk (Upper Muschelkalk), LLM mo 514; 4: *Nothosaurus mirabilis* MÜNSTER, neural arch of thoracal vertebra, Heesten, *spinosus* Zone, Ceratitenschichten (Upper Muschelkalk), LLM mo 511; 5: *Nothosaurus mirabilis* MÜNSTER, centrum of thoracal vertebra, Eilversen, Bereich Ton 3, *evolutus* Zone, Ceratitenschichten (Upper Muschelkalk), LLM mo 512, a: frontal, b: lateral, c: dorsal; 6: *Neusticosaurus* sp., centrum of thoracal vertebra, Eilversen, Bonebed I, *evolutus* Zone, Ceratitenschichten (Upper Muschelkalk), LLM mo 516, a: frontal, b: lateral, c: dorsal; 7: *Simosaurus gaillardoti* H. v. MEYER, centrum of sacral vertebra, Bentrup, Gelbe Basisschichten (Upper Muschelkalk), LLM mo 508, a: frontal, b: lateral, c: dorsal; 8: *Nothosaurus giganteus* MÜNSTER, neural arch of cervical vertebra, Heesten, Ceratitenschichten (Upper Muschelkalk), LLM mo 510, a: frontal, b: lateral, c: dorsal.
(Photos: PALEOLOGIC 2003).

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