

New *Nothosaurus* skulls from the Lower Muschelkalk of the western Lower Saxony Basin (Winterswijk, the Netherlands) shed new light on the status of *Nothosaurus winterswijkensis*

P.C.H. Albers

Netherlands Centre for Biodiversity Naturalis, P.O. Box 9517, 2300 RA Leiden, the Netherlands. Email: palbers@xs4all.nl.

Manuscript received: January 2011, accepted: March 2011

Abstract

Three nothosaur skulls from the Lower Muschelkalk (Lower Anisian) locality of Winterswijk, the Netherlands, were recently acquired by museum Twentse Welle (Enschede) and have thereby become available for scientific description. Thus, these skulls had been identified as *Nothosaurus winterswijkensis*, but upon examination these skulls challenge the status of this *Nothosaurus* species. All diagnostic characters are somehow discredited, but the material can also not be unequivocally be considered as *Nothosaurus marchicus*, which is the only other obvious candidate. As these fossils originate from the same strata as the type of *Nothosaurus winterswijkensis* and there is no reason to assume that the animals occupied different ecological niches they are more plausibly considered one species, and *Nothosaurus winterswijkensis* therefore becomes a junior synonym of *Nothosaurus marchicus*. The diagnosis of *Nothosaurus marchicus* is enlarged to include all finds.

Keywords: *Nothosaurus winterswijkensis*, *Nothosaurus marchicus*, revision.

Introduction

The Winterswijk locality has become an increasingly more important site where good quality fossils of Triassic reptiles and their fauna are being unearthed (e.g. Albers & Rieppel, 2003; Albers, 2005a, b, Bickelmann & Sander, 2008, Klein & Albers, 2009, Sander et al., submitted). Finds of *Nothosaurus* date back to the description in 1959 of *Nothosaurus raabi* (Hooijer, 1959) which since has been synonymised with *Nothosaurus marchicus* (Rieppel & Wild, 1996).

Recently the large and important private collection of Gerben Diepenbroek, a true treasure trove of fossils from the Winterswijk quarries, has been acquired by the museum Twentse Welle, Enschede, and has thus become available for scientific research. This collection contains four nothosaur skulls of which three are sufficiently complete to allow a scientific description. Two of these skulls have already been depicted in Oosterink & Diepenbroek (1990) and again in Oosterink et al. (2003) but were not critically examined and summarily depicted and also they were not prepared (eg the right temporal arch of one of the skulls was left completely covered with matrix). This warrants a new description of these skulls.

Up to now three species of nothosaur have been described from the Lower Muschelkalk locality of Winterswijk: the very similar *Nothosaurus winterswijkensis* (Albers & Rieppel, 2003) and *Nothosaurus marchicus* (Albers, 2005a) and the distinctively smaller *Nothosaurus winkelhorsti* (Klein & Albers, 2010). The skull assigned to *Nothosaurus marchicus* could be disregarded considering *Nothosaurus winterswijkensis* as it was found in an older layer of the quarry, but as its morphology hinted to a somewhat intermediate position between *Nothosaurus winterswijkensis* and *Nothosaurus marchicus*, it thus already questioned, to some extent, the status of *Nothosaurus winterswijkensis* (Albers, 2005a).

The three skulls described in this study are a welcome addition to our knowledge of variation of nothosaur skulls as the intraspecific variation, size range and ontogenetic diversity remain not well known (Rieppel 1994a; Rieppel & Wild 1996; Rieppel & Werneburg 1998).

Description

Institutional abbreviations

TW = Museum Twentse Welle, Enschede

Described material

Four nothosaur skulls from the Diepenbroek collection in the museum 'Twentse Welle', Enschede, with collection numbers: TW480000375, TW480000376, TW480000377, and TW480000378. (Photographs in addendum online: www.njgonline.nl).

Referred material

Two additional skulls described as *Nothosaurus winterswijkensis* (Albers & Rieppel, 2003), one skull attributed to *Nothosaurus marchicus* (Albers, 2005a) and one skull described as *Nothosaurus winkelhorsti* (Klein & Albers, 2009).

Stratum typicum

The skulls were found in the Lower Wellenkalk layer 9 (Oosterink, 1986), Vossenveld Formation (lower Anisian, lowermost Middle Triassic) in the 'Winterswijkse Steen- en Kalkgroeve, Winterswijk, Netherlands', a quarry of the Ankerpoort consortium; see also the tectonic map and geological profiles of Harsveldt (1973). Gauss-Krüger coordinates: R 2252,6/H 5758,6.

General remarks and measurements

All four skulls are relatively small sized. Two skulls, are complete, one prepared in dorsal view (TW480000375) and one prepared in ventral view (TW480000376). The third skull is very incomplete and not diagnostic, its right temporal fenestra is intact and the corresponding frontal and parietal skull table and the medial outline of the orbits with the front broken off just posterior to the external naris. A small part of the left side of the skull is present but below elements belonging to the palate e.g. the pterygoid and the basisoccipital are or appear to be completely missing. (see photograph in addendum online: www.njgonline.nl). The fourth skull (TW480000378) is complete except for most of the premaxilla. For estimation of sizes the missing premaxilla was considered to be of about equal size as that of TW480000375. See Table 1 for general measurements and Table 2 for derived measures and dentition. Unless specifically mentioned otherwise the descriptions below refer to skulls TW480000375 and TW480000378 when features in dorsal view are described and refer to TW480000376 when features in ventral view are described (see Fig. 1).

Premaxilla

The paired premaxillas have long and slender tapering posterior processes, which reach far back along the skull midline, extending beyond the external naris. In dorsal view the anterior medial margin of the external naris is bordered by the premaxilla. Their posterior medial margin, however, is separated from the premaxilla by an anterior lateral tapering process of the nasal. The suture between premaxilla and maxilla is located slightly posterior to the anteroventral corner of the external naris, from where it extends in anterolateral direction. In ventral view it curves around the alveolus of the anteriormost maxillary tooth until about the height of the anterior margin of the internal naris, but remains excluded therefrom by a contact of the maxilla with the vomer at the anterior margin of the latter. The premaxilla carry five tooth positions, comprising four premaxillary fangs followed by a distinctly smaller premaxillary tooth. Several teeth remain in situ (see figure) as well as one replacement visible in the alveolus of the fourth position on the left side of TW480000376.

Maxilla

From posterior to the anteroventral corner of the external naris the maxilla reaches backwards carrying the tooth row until about 10-15% of the length of the longitudinal diameter of the upper temporal fenestra. The maxilla has a foramen at the anterior part along the lateral margin of the external naris, serving the exit of a lateral branch of the superior alveolar nerve, as is common in most species of *Nothosaurus* (Rieppel & Wild, 1996). Laterally the maxilla shows a slight bulge just behind the level of the posterior margin of the external naris, accommodating the roots of the maxillary fangs. Behind the external naris, the maxilla meets the lateral margin of the nasal in a posteromedially trending suture, until it meets the frontal, as is common for *Nothosaurus marchicus* (Rieppel & Wild, 1996), except for the left maxilla of TW480000375 where the maxilla is excluded from the frontal by a small anteromedial process of the prefrontal, as typical of *Nothosaurus winterswijkensis* (Albers & Rieppel, 2003).

In ventral view the maxilla forms the lateral margin of the internal naris and extends posteriorly lateral to the palatine and the ectopterygoid. The suture between the premaxilla and the maxilla is clearly identifiable on both sides of the skull of TW480000376 and indicates four tooth positions (2 teeth in situ) before the maxillary fangs on the left side of the skull and five tooth positions (3 teeth in situ) before the maxillary fangs on the right side of the skull. Five tooth positions before the maxillary fangs are diagnostic for *Nothosaurus marchicus* (Rieppel & Wild, 1996). Lateral views of both other skulls (TW480000375 and TW480000378) do not seem to accommodate more room than three tooth positions (with either 1 or 2 teeth

Table 1. General measurements of nothosaur skulls from Winterswijk.

	Nothosaur skulls from the Winterswijk locality					
	<i>winterswijkensis</i> ¹	<i>marchicus</i> ²	TW480000375	TW480000376	TW480000378	<i>winkelhorsti</i> ³
Tip of the snout to occipital condyle	126.7	130*	101.4	107	94*	46
Tip of the snout to posterior margin of supraoccipital	122.8	-	98.3	-	93*	45
Tip of the snout to posterior margin of parietal skull table	113.3	116*	89.3	-	83*	41.8
Tip of the snout to anterior margin of upper temporal fossa	71.8-73	67.2*	56	-	55*	26.3-27
Tip of the snout to anterior margin of the orbit	41.8-43.7	41.3	31-31.2	-	33*	13.5-15
Tip of the snout to anterior margin of the pineal foramen	94.8	-	72.4	-	70*	33.1
Tip of the snout to anterior margin of external naris	22.5-23.2	20.9	16.6-16.7	-	18*	6.25-7
Tip of the snout to the anterior margin of internal naris	26.3	26.7	19.7	20.4	-	-
Width of skull across postorbital arches	49.2	46*	44.4	43.7	34.2	-
Width of skull at anterior margin of orbits	35	36.2*	28.1	25	24.3	-
Width of skull at roots of maxillary fangs	33.9-37	32.1*	26.4	25.9	21.1	-
Width of skull at rostral constriction	19.6-22.4	19.3*	14.6	14.9	13.3	-
Maximum width of premaxillary rostrum	22.5-23.2	20.7*	15.2	16.9	-	-
Longitudinal diameter of external naris	10.4-12.8	10.4	7.5-8	-	7.1-8.4	2-2.2
Transverse diameter of external naris	7.5-9.4	9.7	6.2-6.4	-	3.4-5.2	1.25-1.3
Longitudinal diameter of orbit	21.9-22.8	21.2	18.1-19.4	-	15.8-16.3	2-10.5
Transverse diameter of orbit	13.7-14.7	13.2	12.2	-	8.8-10.7	3.3
Longitudinal diameter of upper temporal fossa	46.3	48*	38.5-39.2	-	32.4-34	14-16
Transverse diameter of upper temporal fossa	16	17	13.3	-	9.9-10.6	-
Longitudinal width of the pineal foramen	4.6	-	2.9	-	2.3	1.7
Transverse width of the pineal foramen	2.9	-	2.2	-	1.7	0.5
Longitudinal diameter of internal naris	10.8-11.4	11.7	-	8.7-9.2	-	-
Transverse diameter of internal naris	4.1-4.4	4.5*	-	3.6-3.9	-	-
Distance from posterior margin of external naris to anterior margin of orbit	10.2-10.3	10	7.2-7.6	-	6.6-8.9	5.25-5.3
Distance from posterior margin of orbit to anterior margin of upper temporal fossa	8.8-9.1	8	7.5-7.8	-	6.5-6.8	3.8-3.5
Middorsal bridge between external nares	6.2	3.9*	3.9	-	3.8	2.5
Middorsal bridge between orbits (minimum width)	8.1-10	13*	8.6	-	6.7	3.5
Middorsal bridge between upper temporal fossae (behind the pineal foramen)	2.9	-	4.8	-	2.8	3.4

* Estimation based on extrapolation of the material at hand.

1 (Albers & Rieppel, 2003).

2 (Albers, 2005a).

3 (Klein & Albers, 2009).

preserved in situ), which is diagnostic for *Nothosaurus winterswijkensis* (Albers & Rieppel, 2003). Behind the two maxillary fang positions 13 to 19 tooth positions can be estimated, but neither skull is sufficiently well prepared to give an exact number of tooth positions. As to the description

of tooth elements from both premaxilla and maxilla: the fangs are conical, pointed and recurved. The enamel surface of the fangs is covered with longitudinal striations. The 'normal' teeth are also pointed but not re-curved, and their surface is smooth. The tooth implantation is thecodont.

Table 2. Skull proportion and dentition.

	<i>Nothosaurus</i>					
	<i>winterswijkensis</i> ¹	<i>marchicus</i> ²	TW480000375	TW480000376	TW480000378	<i>winkelhorsti</i> ³
Snout – external naris						
Rostral constriction	1.08	1.04-1.15	1.14	1.17*	1.35*	1.1-1.4
Snout – orbit						
Snout – external naris	1.98	1.86-1.88	1.87	-	1.83*	1.8-2
Snout – upper temporal fossa						
Snout – external naris	3.25	3.15-3.19	3.36	-	3.05*	2.9-3.4
Longitudinal ∅ external naris						
Transverse ∅ external naris	1.07	1.33-1.40	1.23	-	1.89	1-1.4
Premaxillary dentition	?(5)/4 + 1	4+1	4+1	4+1	?	5
Maxillary dentition	5+2+(21-?)	3+2+(19-21)	3+2+(13-?)	4/5+2+(18+?)	3+2+(10+?)	5+2+23

1 From the Winterswijk locality (Albers, 2005a).

2 (Albers & Rieppel, 2003).

3 In general (Rieppel & Wild, 1996).

Nasal

The nasals form most of the posterior margin of the external nares and are carrying slender anteromedial processes which line the entire medial margin of the external nares. As described above the nasals laterally contact the maxillae and posteriorly they contact the frontal, except for TW480000375 where the left nasal also contacts the prefrontal excluding the maxilla from the frontal.

Prefrontal

The prefrontals are short and slender elements, lining the anteriomedial third of the dorsal orbit. Noticable is that, as the previously mentioned, only on the left side of TW480000375 a small anteromedial process of the prefrontal, as typical of *Nothosaurus winterswijkensis* (Albers & Rieppel, 2003) excludes the maxilla from the frontal.

Jugal

In *Nothosaurus winterswijkensis* the jugal separates the posterior part of the maxilla from the postorbital and enters into the orbit completely excluding the maxilla from the postorbital (Albers & Rieppel, 2003). In *Nothosaurus marchicus* the maxilla and the postorbital meet close to the edge and thereby excluding the jugal from the orbit (Rieppel & Wild, 1996; Albers & Rieppel, 2003). In TW480000378 however the jugal does not enter the orbit on the left side but does enter the orbit on the right side. In TW480000375 the jugal clearly enters the orbit on both sides and in TW480000378 the jugal seems to enter the orbit on the right side when the skull is examined in lateral view (but due to the solely ventral preparation the view is not optimal; on the left side the orbit is not visible).

Frontal

The contacts between the frontals and maxilla and prefrontal have been extensively ascribed above. Their medial margins meet the antero-lateral margin of the nasals, and their lateral margins run parallel to the medial prefrontal. The body of the fused frontals forms an interorbital bridge and therefore separates the posterior prefrontal from the anterior part of the postfrontal. The medial processes of the frontals contact the parietal in a interdigitating suture.

Postfrontal

The postfrontal defines the posteromedial margin of the orbit. The posterior tip of the postfrontal is excluded from the anteromedial margin of the upper temporal fossa by a contact between postorbital and parietal.

Postorbital

The postorbital has a broad medial process that forms almost the entire postorbital arch and thus defines the anterior margin of the upper temporal fossa as well as the posterolateral margin of the orbit. Anteriorly, the postorbital contacts the jugal, and posteriorly the postorbital enters the upper temporal arch.

Parietal

The parietal is unpaired (fused). The parietal diverges posteriorly to meet the squamosal at the posterior margin of the upper temporal fossa. Sutures in the occipital area are not very clear but the parietal does not seem to markedly deviate from *Nothosaurus winterswijkensis* or *Nothosaurus marchicus*, which do not differ in this respect. The position of the pineal foramen of TW480000375 is almost at the center of the parietal

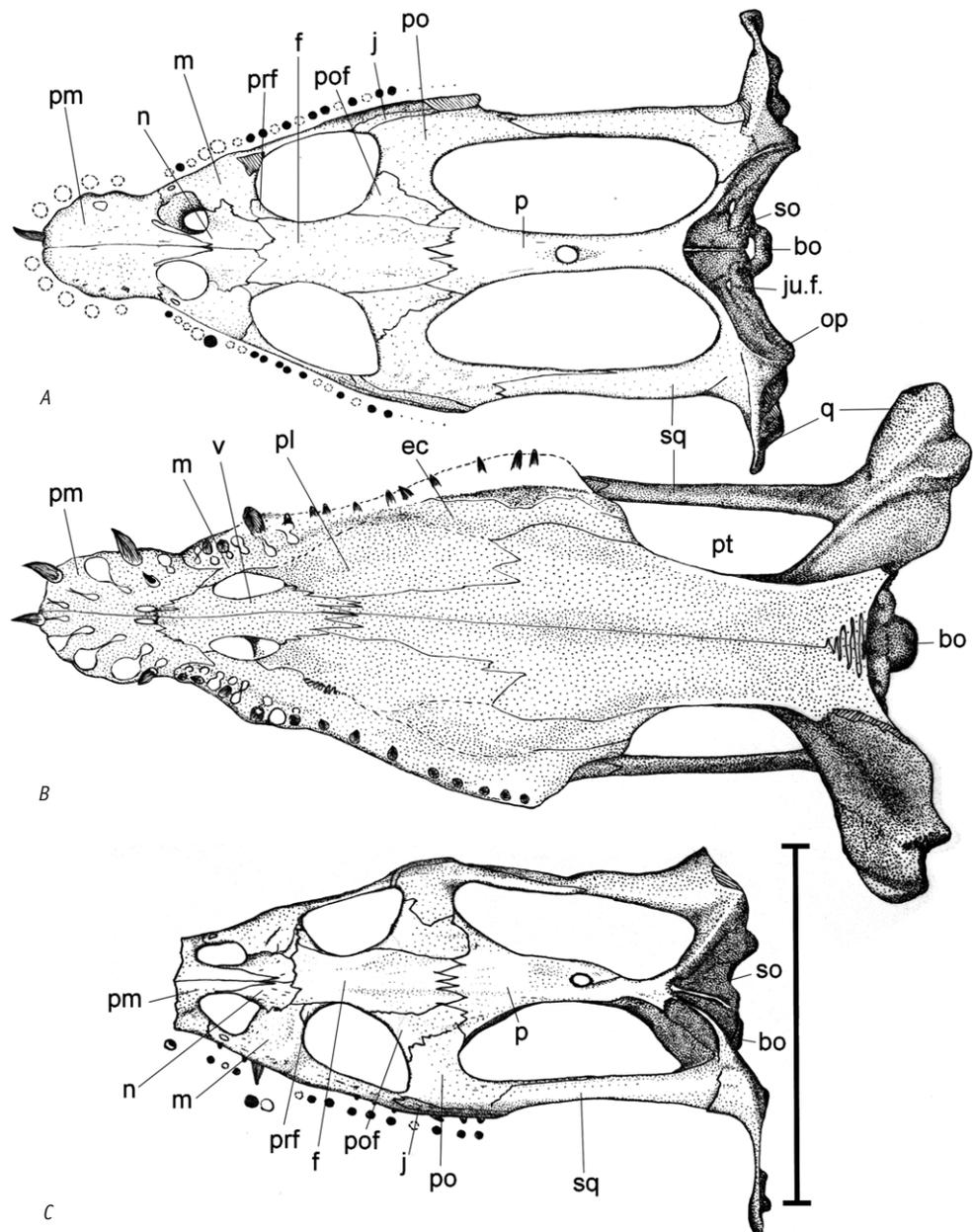


Fig. 1. Three skulls of *Nothosaurus marchicus*. A – TW480000375 in dorsal view; B – TW480000376 in ventral view; C – TW480000378 in dorsal view. bo, basisoccipital; eo, exoccipital; ec, ectopterygoid; f, frontal; j, jugal; ju.f., jugular foramen; m, maxilla; n, nasal; op, opisthotic; p, parietal; pmx, premaxilla; po, postorbital; pof, postfrontal; prf, prefrontal; pt, pterygoid; q, quadrate; sq, squamosal. Filled in circles next to the skull represent tooth elements visible in lateral view, open circles represent assumed tooth positions. Scale bar represents 5 cm.

(plesiomorphic position) whereas in TW480000378 this position is somewhat shifted backward closer to the posterior margin of the parietal skull table.

Squamosal

The squamosal defines most of the posterior margin of the upper temporal fossa. Its anterior extent within the upper temporal reaches almost until the anterior margin of the temporal fossa where it meets the postorbital. On the left side of TW480000378 however it even seems to contact the posteromedial part of the jugal, but sutures in that area are not clear.

Posteriorly, sutures are not very clear but the squamosal does again not seem to markedly deviate from *Nothosaurus winterswijkensis* or *Nothosaurus marchicus*, which do not differ in this respect.

Vomer

The paired vomers are elongate elements, which separate the internal nares from one another. The tapering anterior end of the vomer enters between the premaxillae, forming two clear grooves. Behind the internal nares, the broad body of the vomer extends between the pterygoids for a distance that slightly exceeds the longitudinal diameter of the internal nares.

Posteriorly the vomer sutures with the palatine and with more deeply interdigitating sutures contacts the anterior end of the pterygoid.

Palatine

The palatine forms the posterior margin of the internal naris with a shallow choanal groove.

Posteriorly the palatine is embraced by the maxilla, ectopterygoid, and pterygoid.

Ectopterygoid

The sutures of the ectopterygoid are not clearly identifiable but seem to stretch anteriorly along half the length of the palatine.

Pterygoid

The pterygoid seems to form a weakly developed transverse process that, together with the ectopterygoid, forms a ventrally projecting (ecto)pterygoid flange. The shape of the pterygoid itself corresponds to the characteristic nothosaurian pattern (Rieppel & Wild, 1996). At their posterior extremity the pterygoids meet in an interdigitating suture common to all *Nothosaurus* species.

Quadrate and occipital area

The quadrate and the occipital area are difficult to ascertain exactly as sutures are not always very clear and/or preparation has not been optimal. However what can be seen is that the general plan does not markedly deviate from what is known *Nothosaurus winterswijkensis* or *Nothosaurus marchicus*, nor are these characters considered important diagnostic features for these species. I therefore will forego detailed descriptions on elements as quadrate, basoccipital, basisphenoid, exoccipital, jugular foramen, opisthotic, supraoccipital and sagittal crest.

Discussion

The proportions and descriptions of the newly described skulls suggest them to be either *Nothosaurus winterswijkensis* or *Nothosaurus marchicus* (see Tables 1 and 2). However none of the skulls presented here can unequivocally be fitted to the diagnostic characters of neither *Nothosaurus winterswijkensis* nor *Nothosaurus marchicus*. But tending more towards *Nothosaurus marchicus*, a new problem arises as these were all found in the same 'layer 9'. The presence of *Nothosaurus marchicus* in the Winterswijk locality could so far be explained as the only find came from a different (older) layer and therefore the species would not coincide with *Nothosaurus winterswijkensis* (Albers, 2005a). But naming any of the new skulls *Nothosaurus marchicus* would no longer leave room for the assumption that the two nothosaurs occupied different ecological niches. The most parsimonious conclusion therefore is to consider *Nothosaurus winterswijkensis* synonymous with *Nothosaurus marchicus* and widen the description of the characters of *Nothosaurus marchicus*. In particular whether or not the jugal enters the orbit has been shown to be variable even within one skull (TW480000378 left no, right yes) and the

number of maxillary teeth preceding the maxillary fangs can also variate within one skull (TW480000376, 4 left, 5 right) as can the maxilla reaching the frontal (TW480000375, left no, right yes). Rieppel and Wild (1996) already mentioned a *Nothosaurus marchicus*-like skull from Mühlhausen depicted in Jaekel (1911; the fossil can no longer be located) that also has the jugal entering the orbit as well as the more forward (plesiomorphic) position of the pineal foramen, which further underlines the large variability possible with regard to the skull sutures. Furthermore, the jugal entering the orbit is also known to be a variable character in the genotypical species *Nothosaurus mirabilis* Rieppel, 1994; Rieppel & Wild, 1996).

N. marchicus is very common in the entire Lower Muschelkalk of the Germanic Basin and has a large geographic distribution in the Anisian of Central Europe (Rieppel & Wild, 1996; Rieppel, 2000). With regard to the phylogenetical position of the *Nothosaurus marchicus* no big change is to be expected as *Nothosaurus marchicus* and *Nothosaurus winterswijkensis* were already much more similar to each other than to any other nothosaur, and therefore very closely linked. But given the large variability within *Nothosaurus marchicus*, some of the other species, which only rest on very few specimens, may well become questionable in the future if more specimens become available.

Concluding systematic palaeontology

Specimens TW480000375, TW480000376, and TW480000378 belong to:

- Order Sauropterygia OWEN, 1860
- Suborder Eosauropterygia RIEPPEL, 1994
- Family Nothosauridae BAUR, 1889
- Genus *Nothosaurus* MÜNSTER, 1834
- Species *Nothosaurus marchicus* KOKEN, 1893

Type species and specimen as stated in the revision of Rieppel & Wild (1996: 34):

Holotype: The specimen figured by Koken (1893, text figs 1, 2, 3A: Pl. 10, figs 1-3) can no longer be located today. The counterslab, showing the impressions of the dorsal aspect of the skull, is kept at the Natural History Museum, Humboldt University, Berlin (MB R. 2). [...]

Synonymy

Nothosaurus winterswijkensis, Albers & Rieppel, 2003.

Acknowledgements

Bert Boekschoten and Constanze Bickelmann are greatly acknowledged for their constructive reviews.

References

- Albers, P.**, 2005a. A new specimen of *Nothosaurus marchicus* with features that relate the taxon to *Nothosaurus winterswijkensis*. www.PalArch.nl, Vertebrate Palaeontology, 3, (1): 1-7.
- Albers, P.**, 2005b. A placodontoid jaw fragment from the Lower Muschelkalk of Winterswijk (the Netherlands). www.PalArch.nl, Vertebrate Palaeontology 3 (5): 34-36.
- Albers, P. & Rieppel, O.**, 2003. A new species of the sauropterygian genus *Nothosaurus* from the Lower Muschelkalk of Winterswijk, the Netherlands. *Journal of Paleontology* 77: 738-774.
- Bickelmann, C. & Sander, M.**, 2008. A partial skeleton and isolated humeri of *Nothosaurus* (Reptilia: Eosauropterygia) from Winterswijk, the Netherlands. *Journal of Vertebrate Paleontology* 28(2): 326-338.
- Baur, G.**, 1889. *Palaeohatteria* Credner, and the Proganosauria. *American Journal of Science* 3(37): 310-313.
- Harsveldt, H.M.**, 1973. The middle Triassic Limestone (Muschelkalk) in the Achterhoek (E Gelderland) *Verhandelingen van het Koninklijk Nederlands Geologisch Genootschap* 29: 43-50.
- Hooijer, D.A.**, 1959. Records of nothosaurians from the Muschelkalk of Winterswijk, the Netherlands. *Geologie en Mijnbouw* 21: 37-39.
- Jaekel, O.**, 1911. Die Wirbeltiere. Eine Übersicht über die fossilen und lebende Formen. Gebr. Borntraeger, Berlin.
- Klein, N. & Albers, P.C.H.**, 2009. A new species of the sauropterygian reptile *Nothosaurus* from the Lower Muschelkalk of the western Germanic Basin, Winterswijk, the Netherlands. *Acta Palaeontologica Polonica* 54: 589-598.
- Koken, E.**, 1893. Beiträge zur Kenntnis der Gattung *Nothosaurus*. *Zeitschrift der deutschen geologischen Gesellschaft*, 45: 337-377.
- Münster, G.**, 1834. Vorläufige Nachricht über einige neue Reptilien im Muschelkalk von Baiern. *Neues Jahrbuch für Mineralogie, Geognosie, Geologie und Petrefaktenkunde* 1834: 521-527.
- Oosterink, H.W.**, 1986. Winterswijk, Geologie deel II. De Trias-periode (geologie, mineralen en fossielen) Wetenschappelijke Mededeling van de Koninklijke Nederlandse Natuurhistorische Vereniging 178:1-120.
- Oosterink, H., Berkelder, W., De Jong, C., Lankamp, J. & Winkelhorst, H.**, 2003. Sauriers uit de Onder-Muschelkalk van Winterswijk. In: Vereniging, N.G. (ed.): *Staringia* 11, Volume Jahrgang 57, Nummer 1a, Grondboor & Hamer, 146 pp.
- Oosterink, H. & Diepenbroek, G.H.**, 1990. Nieuwe vondsten uit de Winterswijkse Trias. *Grondboor & Hamer* 44(6): 150-154.
- Owen, R.**, 1860. *Paleontology; or a systematic summary of extinct animals and their geologic remains*. Adam and Charles Black, Edinburgh, XV + 420p.
- Rieppel, O.**, 1994. Braincases of *Simosaurus* and *Nothosaurus*: monophyly of the Nothosauridae (Reptilia, Sauropterygia). *Journal of Vertebrate Paleontology* 14: 9-23.
- Rieppel, O.**, 2000. Sauropterygia I. In: Wellnhofer, P. (ed.): *Encyclopedia of Paleoheteroptology*, Volume 12A, Friedrich Pfeil (München), 134 pp.
- Rieppel, O. & Werneburg, R.**, 1998. A new species of the sauropterygian *Cymatosaurus* from the Lower Muschelkalk of Thuringia, Germany. *Palaeontology* 41: 575-589.
- Rieppel, O. & Wild, R.**, 1996. A revision of the genus *Nothosaurus* (Reptilia, Sauropterygia) from the Germanic Triassic, with comments on the status of *Conchiosaurus clavatus*. *Fieldiana: Geology* 40: 1-85.
- Sander, M., Klein, N., Albers, P.C.H., Bickelmann, C. & Winkelhorst, H.** (submitted). Postcranial morphology of a basal Pistosauroida from the Lower Muschelkalk of Winterswijk, the Netherlands and a revised and extended phylogenetic analysis of Triassic Sauropterygia.

Addendum



Photo 1. TW480000375 in dorsal view.



Photo 3. TW480000377 partial skull in dorsal view.



Photo 2. TW480000376 in ventral view.



Photo 4. TW480000378 in dorsal view.