

Discovery of Ichthyosaur Remains (Reptilia) in the Upper Cenomanian of Bavaria

By NATHALIE BARDET, PETER WELLNHOFER & DIETRICH HERM *)

With 2 figures in the text and 1 plate

Abstract

For the first time ichthyosaur remains from the Upper Cenomanian Regensburger Grünsandstein of Bavaria are recorded and assigned to *Platypterygius* sp.. It is the stratigraphically latest ichthyosaur known in the fossil record. During the Cretaceous ichthyosaurs become rare, and their extinction probably came about during the Cenomanian-Turonian transition.

Kurzfassung

Es werden erstmals aus dem Regensburger Grünsandstein (Obercenoman) von Saal a. d. Donau (Niederbayern) Fossilreste eines Ichthyosauriers bekannt gemacht und als *Platypterygius* sp. beschrieben. Es handelt sich um die stratigraphisch jüngsten Ichthyosaurierfunde, die bisher bekannt sind. Während der Kreide werden Ichthyosaurier selten und ihr Aussterben erfolgte wahrscheinlich an der Cenoman/Turon-Grenze.

Résumé

Des restes d'ichthyosaures trouvés dans le Cénomanien supérieur (Regensburger Grünsandstein) de Bavière sont décrits pour la première fois et rapprochés de *Platypterygius* sp.. Il s'agit des restes d'ichthyosaures les plus récents trouvés à ce jour. Durant le Crétacé, les ichthyosaures deviennent rares et leur extinction se situe probablement durant la transition Cénomanien-Turonien.

Introduction

Ichthyosaurs are a group of Mesozoic reptiles with very pronounced adaptations to marine life. They are known as early as the Smithian (late Lower Triassic) (COX & SMITH, 1973; CALLWAY & BRINKMAN, 1989) up to the Cenomanian (base of Upper Cretaceous) (BAIRD, 1984;

*) Dr. N. BARDET, Laboratoire de Paléontologie des Vertébrés, Université Pierre et Marie Curie, URA 1761 du CNRS, case 106, 4 place Jussieu, F-75252 Paris cedex 05, Frankreich; Prof. Dr. D. HERM and Dr. P. WELLNHOFER, Bayerische Staatssammlung für Paläontologie und historische Geologie, Richard-Wagner-Straße 10, D-80333 München.

BARDET, 1992). During the Triassic, ichthyosaurs are represented by mainly coastal forms but since the end of this period and during Jurassic and Cretaceous times, they are known by only pelagic forms.

Contrary to the Triassic and Jurassic members of the order which were greatly diversified, the ichthyosaurs become scarce during the Cretaceous and are only represented by the cosmopolitan genus *Platypterygius* v. HUENE (McGOWAN, 1972). In the Albian and Cenomanian, four species are currently recognized: in North America, *P. americanus* ranging from the Upper Albian to the Lower Cenomanian (NACE, 1939, 1941; McGOWAN, 1972); in Australia, *P. longmanni* reported from up to the Upper Albian (WADE, 1990); in Russia, *P. kiprijanoffi* known from Upper Albian and Cenomanian deposits (NESSOV et al., 1988); and finally, in Western Europe, *P. campylodon* to which most of the specimens commonly have been assigned. It should be noted, however, that this species is only poorly defined (McGOWAN, 1972), and has been based on material which is not diagnostic (BARDET, 1990). On the other hand, new material recently found could be used to define the species more adequately (BARDET, in prep.). The specimens from Western Europe known to date range from the Albian to possibly the Middle Cenomanian and have represented the youngest occurrence of ichthyosaurs in the fossil record (BARDET, 1992).

This report of ichthyosaur remains from the Upper Cenomanian of Bavaria is thus of particular interest, because it is evidence of the most recent and accurately identified ichthyosaur currently known.

Locality and Stratigraphy

The material, probably all part of a single individual, has been discovered in the eastern part of the large limestone quarry of the Süddeutsche Kalkstickstoff-Werke (SKW quarry) near Saal a.d. Donau, about 4 km southeast of Kelheim (Niederbayern) (fig. 1). The ichthyosaur remains were recovered from the upper part of the Regensburger Grünsandstein, a glauconitic block sandstone discordantly overlying the Upper Jurassic Kelheimer Kalke and the Lower Cretaceous

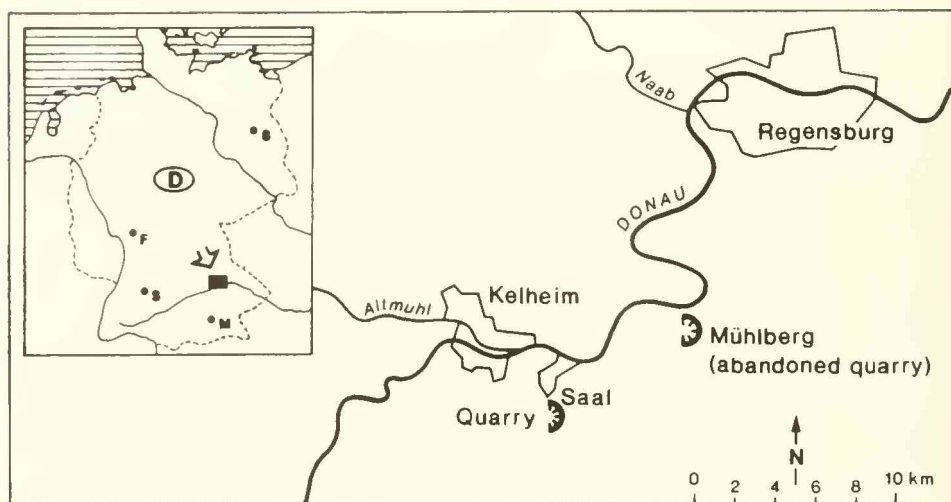


Fig. 1: Location map of the SKW quarry at Saal a. d. Donau with transgressive Upper Cenomanian Grünsandstein and Mühlberg quarry with transgressive culmination during Early Turonian.

(? Valanginian) Schuttfels-Schichten. The Regensburger Grünsandstein is covered by the Eibrunner Mergel (latest Cenomanian to early Turonian) as exposed in the abandoned quarry of Mühlberg, 7,5 km NE of Saal a. d. D. near Bad Abbach (fig. 2).

The age of the Regensburger Grünsandstein is Upper Cenomanian, according to WEISS (1982) and STEIGER et al. (1985), equivalent to the *Rotalipora cushmani-greenhornensis* zone of the planctonic foraminifera zonation scheme. Recently, a detailed analysis of the Cretaceous series exposed in the quarry at Saal was published by HERM & HOFING (1994). According to these authors the so-called Quadersandstein facies from which the ichthyosaur remains originate has been deposited as a glauconitic sandstone with cross-bedded layers of pectinid and inoceramid shell at the base and intercalated siliceous sponge biostromes and lithistid

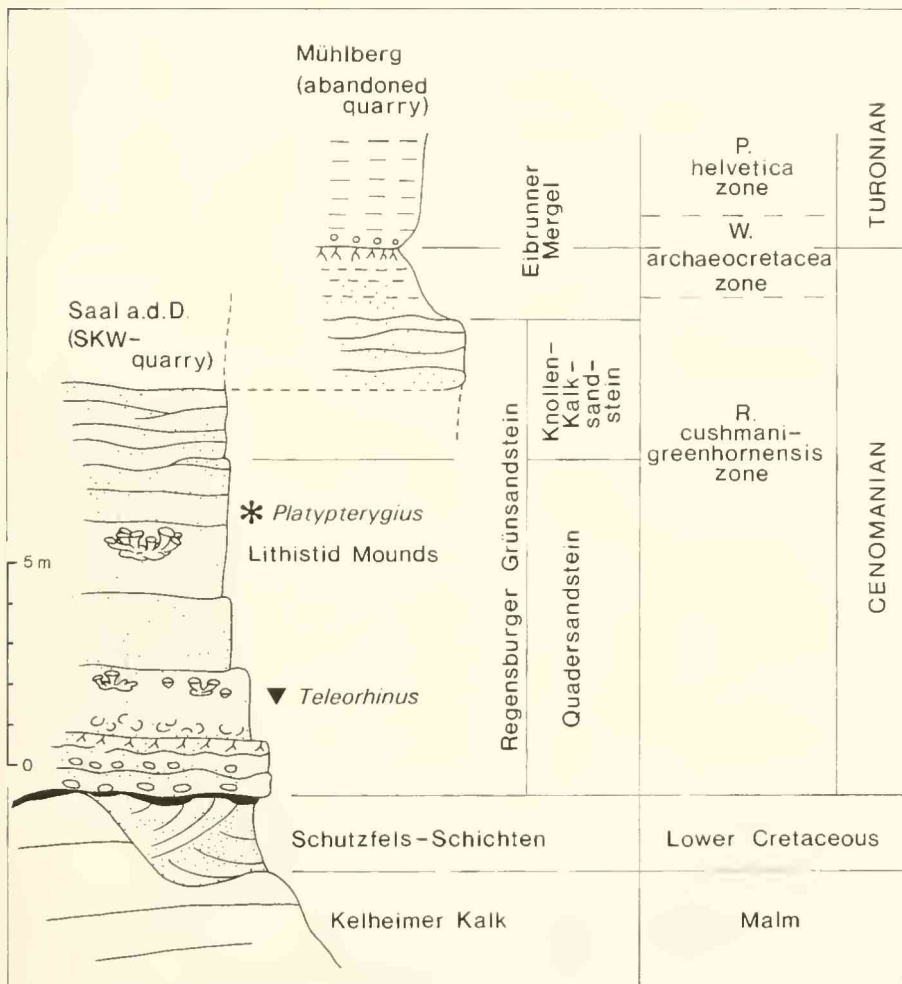


Fig. 2: Lithological section of the upper part of the SKW quarry at Saal a. d. D. with location of the ichthyosaur remains of *Platypterygius* (this paper) and of the crocodilian *Teleorhinus* (BUFFETAUT & WELLNHOFER, 1980). The section exposed in the Mühlberg quarry (7,5 km NE of Saal a. d. D.) is added showing its relative position to the sequence in the SKW quarry at Saal a. d. D..

mounds in a water depth of 20 to 40 m. The Regensburger Grünsandstein is a testimony of the great Albian-Cenomanian marine transgression of the Tethys from the South to the North and Northeast into the Regensburg Gulf (HERM, 1979). At the Mühlberg quarry the Cenomanian/Turonian boundary is 2,2 m above the top of the Regensburger Grünsandstein within the sequence of clays and marls of the Eibrunner Mergel (HERM & HOFLING, 1994). This boundary is recognized worldwide as a marked environmental change of marine life as consequence of a global ecological crisis (FORSTER et al., 1983), which could also have brought about the extinction of the ichthyosaurs (BARDET, 1994).

According to DAC QUE (1939) the Regensburger Grünsandstein has yielded a diverse marine invertebrate fauna, but also a few marine vertebrate remains. Especially isolated teeth of fishes (*Oxyrhina*, *Otodus*, *Corax*, *Ptychodus*, *Anomocodus*, *Protosphyraena*), of a pliosaur (*Polyptychodon*), and of a mosasaurid (*Liodon*) have been reported (MEYER, 1856; WAGNER, 1853). Also a jaw fragment of a pholidosaurid crocodilian, *Teleosaurus* cf. *browni*, has been described from the same quarry at Saal, but from a slightly lower horizon than the ichthyosaur remains (BUFFETAUT & WEIHNHOFER, 1980). DAC QUE (1939) also mentioned large jaw fragments with longitudinal grooves which he attributed to ichthyosaurs. However, this material, originally housed in the Bavarian State Collections, was lost during World War II.

Systematic Description

Ichthyopterygia

Temnodontosauridae GODEFROIT, 1994

Platypterygius v. HUFNE, 1922

Platypterygius sp.

Plate I

Material: Incomplete, fragmentary skeletal remains of a large ichthyosaur including parts of the skull (jugal and undetermined bones) and jaws, numerous teeth, vertebrae, ribs and phalanges. Most of the bones, except the teeth, are flattened because of post mortem diagenetic processes which caused compression and crushing. The material is housed in the Bayerische Staatssammlung für Paläontologie und historische Geologie, München, under the catalogue number BSP 1991 I 111.

Skull (Pl. I, Fig. A): The only skull bone which could be indentified is the jugal. It lacks the proximal part of the ascending ramus. The jugal appears to be robust and is about 40 cm long. The horizontal ramus is divided into a laterally compressed anterior and a dorsoventrally flattened posterior part. The vertical ramus is laterally compressed.

Other fragmentary remains could possibly belong to the skull or jaws but are inadequate for description.

Jaws and teeth (Pl. I, Figs. B, C): Upper and lower portions of the jaws are preserved in close contact (plate I, figure C). The jaws are elongated and robust with a longitudinal groove on the lateral surface. The insertion of the teeth is of „aulacodont“ type (MAZIN, 1983) which explains that several teeth were removed from the alveolar rows.

Numerous well preserved teeth of different sizes (2 to 5 cm high) have been collected (plate I, figure B). They are globally stout and slightly curved. The crown occupies one fourth to one third of the total length and is rounded in cross section. The enamel is sculptured by several regularly spaced, longitudinal ridges. The upper part of the root is smooth and oval in cross

section, whereas the lower part is quadrangular in cross section and covered by rough longitudinal ridges. At the base there is an internal rounded replacement opening developed.

V e r t e b r a e a n d r i b s (Pl. 1, Figs. D, E, G): The vertebrae (plate 1, figures D, E), 8 to 10 cm in diameter, are mostly flattened (length: 2 cm). One vertebra imbedded in a block of matrix remained uncrushed and is 4 cm thick with deeply excavated biconcave articular surfaces. No neural arches are preserved. One vertebra bears two rib facets indicating a dorsal position within the vertebral column.

Numerous rib fragments are preserved (plate 1, figure G). They are very thick and flattened antero-posteriorly, compressed medially, resulting in an almost reniform cross section.

L i m b b o n e s (Pl. 1, Fig. F): Two phalanges are preserved being typical small flattened disks with a diameter of less than 2 cm.

Systematics

The relatively great size and robustness of the bones suggest an ichthyosaurus of large size (about 8 to 10 m long). The bones which could be used for comparison (i. e. jugal, teeth, jaws) resemble, both in size and general morphology, those of specimens assigned to *Platypterygius* from the Albian of Normandy (BUFFETAUT, 1977), the Cenomanian of the Boulonnais (BARDET, 1989) and the Albian-Cenomanian of England (OWEN, 1851). On the basis of the general proportions and robustness of the bones, the teeth divided into three distinct areas and the jugal morphology, the Bavarian ichthyosaurus is here referred to as *Platypterygius* sp..

Implications

As mentioned above, „*Ichthyosaurus*“ *campylodon* was originally established on the basis of material from the Chalk of England (CARTER, 1846a, 1846b). Commonly, ichthyosaurus remains from the Albian-Cenomanian of Western Europe have subsequently been referred to this species. Later, „*I.*“ *campylodon* has been referred to *Myopterygius* (HUENE, 1922), and finally to *Platypterygius* (KUHN, 1946). However, it has remained a poorly defined species (Mc GOWAN, 1972). A review of the characters indicated by CARTER (1846a) to define „*I.*“ *campylodon* shows that they are not diagnostic because they are also present in other Cretaceous ichthyosaurus species as well as in the Upper Jurassic genus *Grendelius* (BARDET, 1990). Thus, as already suggested by Mc GOWAN (1972) and despite the familiarity of the name, the type specimen of *P. campylodon* is rather poor and the species name must be regarded as nomen dubium (BARDET, 1990). Finally, further diagnostic material from the Albian-Cenomanian of Northern France is currently under study (BARDET, in prep.).

During the Cretaceous, ichthyosaurs are considered to have declined well before the Cenomanian, although several fragmentary remains have been reported from younger formations (RUSSEL, 1977; SULLIVAN, 1987). Reports of presumed ichthyosaurus fossils from the Campanian and Maastrichtian of North America (Mc GOWAN, 1973, 1978) have recently strengthened the classical view arguing that ichthyosaurs reached the end of the Cretaceous to fall victim to the K/T crisis (RUSSEL, 1977). According to SULLIVAN (1987), the last occurrence of ichthyosaurs in the fossil record was probably in the Campanian. On the other hand, BAIRD (1984) has recently noted that the material described by Mc GOWAN (1973, 1978) is in fact plesiosaurian and has suggested that the occurrence of ichthyosaurs after the Cenomanian remains to be demonstrated.

Recently, a review of post-Cenomanian presumed ichthyosaurus remains has shown that they are too poorly defined both systematically and stratigraphically in order to permit a valid

extension of the stratigraphical range of ichthyosaurs into post-Cenomanian times (BARDET, 1992). Thus, the youngest ichthyosaur specimens were previously known from the top of the Lower Cenomanian of Northern France (BARDET, 1989) and possibly from the Middle Cenomanian of England (BARDET, 1992). In this context, the specimen from the Upper Cenomanian of Bavaria, described in this paper, currently represents the youngest safely dated and identified ichthyosaur in the fossil record. It also supports the view of an ichthyosaur extinction during the Cenomanian-Turonian environmental perturbations (BARDET, 1994).

Acknowledgements

The ichthyosaur skeletal material was discovered during a field trip with students guided by one of us (D.H.) on 30 July 1991. Very helpful was stud. geol. Peter Rüdel, one of the participants of this excursion, who also attended one of the subsequent excavations carried out by Ernst Schmiejka, Peter Veit and one of us (P.W.). E. Schmiejka also prepared the material. The artwork for figures 1 and 2 has been prepared by Klaus Dossow. The photos of the plate have been made by Claude Abrial. We are also obliged to the officials of the quarry company, the Süddeutsche Kalkstickstoffwerke Trostberg, for permission to excavate the fossil material and to transfer it into the Bavarian State Collections.

References

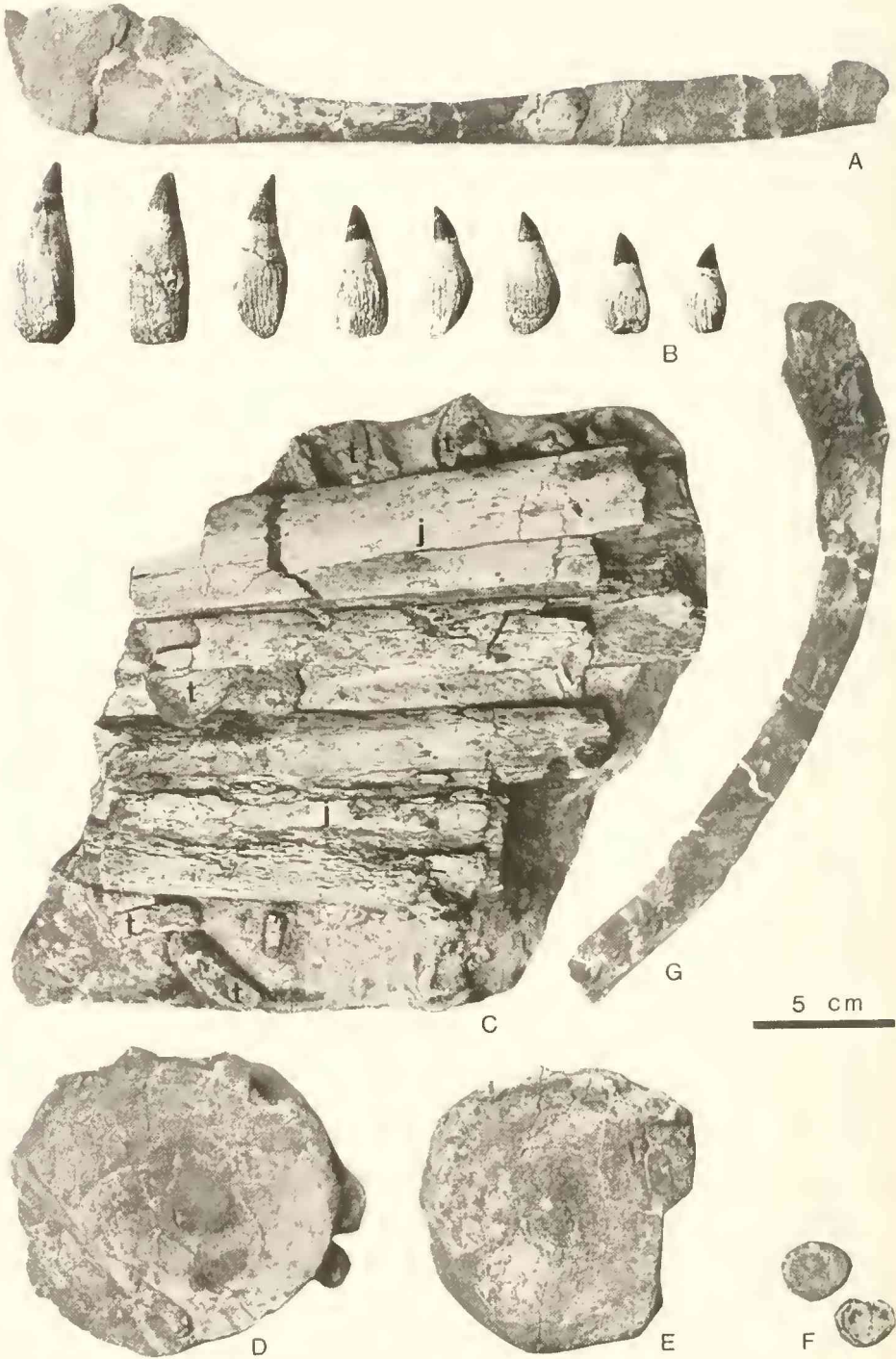
- BAIRD, D. (1984): No ichthyosaurs in the Upper Cretaceous of New Jersey or Saskatchewan. - *The Mosasaur*, 2: 129-133; Philadelphia.
- BARDET, N. (1989): Un crâne d'Ichthyopterygia dans le Cénomanien du Boulonnais. - *Mém. Soc. Acad. Boul.*, 6 (1): 1-32; Boulogne-sur-Mer.
- BARDET, N. (1990): Dental cross-sections in Cretaceous Ichthyopterygia: systematic implications. - *Geobios*, 23 (2): 169-172; Lyon.
- BARDET, N. (1992): Stratigraphic evidence for the extinction of the ichthyosaurs. - *Terra Nova*, 4: 649-656; Oxford.
- BARDET, N. (1994): Extinction events among Mesozoic marine reptiles. - *Hist. Biol.*, 7 (4): 313-324.
- BUFFETAUT, E. (1977): Remarques préliminaires sur l'Ichtyosaure de Saint-Jouin. - *Bull. Soc. Géol. Norm. & Amis Mus. Havre*, 64 (1): 17-19; Le Havre.
- BUFFETAUT, E. & WILLINGER, P. (1980): Der Krokodilier *Teleorhynchus* OSBORN, 1904 (Mesosuchia, Pholidosauridae) im Regensburger Grünsandstein (Obercenoman). - *Mitt. Bayer. Staatsslg. Paläont. hist. Geol.*, 20: 83-94; München.
- CALLAWAY, J. M. & BRINKMAN, D. B. (1989): Ichthyosaurs (Reptilia, Ichthyosauria) from the Lower and Middle Triassic Sulphur Mountain Formation, Wapiti Lake Area, British Columbia, Canada. - *Can. J. Earth Sci.*, 26: 1491-1500; Ottawa.
- CARTER, J. (1946a): Notice of the jaws of an *Ichthyosaurus* from the Chalk in the neighbourhood of Cambridge. - *Trans. Sect. Brit. Ass. Adv. Sci. Rep. 15. meet.*, 1845: 60; London.
- CARTER, J. (1846b): On the occurrence of a new species of *Ichthyosaurus* in the Chalk. - *London Geol. J.*, 1: 7-9; London.
- COX, C. B. & SMITH, D. G. (1973): A review of the Triassic vertebrate faunas of Svalbard. - *Geol. Mag.*, 110 (5): 405-418; Cambridge.
- DACQUÉ, E. (1939): Die Fauna der Regensburg-Kelheimer Oberkreide (mit Ausschluß der Spongien und Bryozoen). - *Abh. Bayer. Akad. Wiss., math.-naturwiss. Abt.*, N. F. 45: 218 p.; München.
- FORSTER, R., MEYER, R. & RISCH, H. (1983): Ammoniten und planktonische Foraminiferen aus den Eibrunner Mergeln (Regensburger Kreide, Nordostbayern). - *ZITTELIANA*, 10: 123-141; München.
- GODEFROID, P. (1994): Les reptiles marins du Jurassique inférieur en Lorraine Belgo-Luxembourgeoise. - Thèse de l'Université catholique de Louvain-la-Neuve, 359 pp. (inédit).

- HERM, D. (1979): Die süddeutsche Kreide ein Überblick. - IUGS, Ser. A., 6: 85-106; Stuttgart (Schweizerbart).
- HERM, D. & HOFLING, R. (1994): Kieselschwämme als Riffbildner in der Oberkreide des Regensburger Golfes. - Jahresber. Mitt. Freunde Bayer. Staatsslg. Paläont. hist. Geol., 22: 34-46; München.
- HUENE, F. v. (1922): Die Ichthyosaurier des Lias und ihre Zusammenhänge. - Monogr. Geol. Paläont., 114 p.; Berlin (Gebr. Bornträger).
- KUHN, O. (1946): Ein Skelett von *Ichthyosaurus (Platypterygius) bercynicus* n. sp. aus dem Aptium von Gitter. - Ber. Naturf. Ges. Bamberg, 29: 69-82; Bamberg.
- MAZIN, J. M. (1983): L'implantation dentaire chez les Ichthyopterygia (Reptilia). - N. Jb. Geol. Paläont. Mh., 7: 406-418; Stuttgart.
- McGOWAN, C. (1972): The systematics of Cretaceous ichthyosaurs with particular reference to the material from North America. - Contr. Geol., 11 (1): 9-29; Laramie.
- McGOWAN, C. (1973): A note on the most recent ichthyosaur known: an isolated coracoid from the Upper Campanian of Saskatchewan (Reptilia, Ichthyosauria). - Can. J. Earth Sci., 10: 1346-1349; Ottawa.
- McGOWAN, C. (1978): An isolated ichthyosaur coracoid from the Maastrichtian of New Jersey. - Can. J. Earth Sci., 15: 169-171; Ottawa.
- MEYER, H. v. (1856): Saurier aus der Kreide-Gruppe in Deutschland und der Schweiz. - Palaeontographica, 6: 3-13; Stuttgart.
- NACE, R. L. (1939): A new ichthyosaur from the Upper Cretaceous Mowry Formation of Wyoming. - Amer. J. Sci., 237: 637-686; New Haven.
- NACE, R. L. (1941): A new ichthyosaur from the Late Cretaceous, northeast Wyoming. - Amer. J. Sci., 239: 908-914; New Haven.
- NESSOV, L. A., IVANOV, A. O. & HOZACKY, L. I. (1988): On findings of the remnants of ichthyosaurs in the USSR and problem of faunal turnover in the Middle Cretaceous. - Vestnik Leningrad Univ., 7(1): 15-26; St. Petersburg (in Russian).
- OWEN, R. (1851): Monograph on the fossil Reptilia of the Cretaceous Formation. - Palaeont. Soc. Monogr., 5 (11): 68-80; London.
- RUSSEL, D. A. (1977): The biotic crisis at the end of the Cretaceous period. - Syllogeus, 12: 11-23; Ottawa.
- STEIGER, T., WEIDICH, K. & KASTLE, B. (1985): Exkursion B1: Fränkischer Jura - Regensburger Kreide. - Exkursionsführer B. Paläont. Ges. 55. Jahrestag.: 1-54; München.
- SULLIVAN, R. M. (1987): A reassessment of reptilian diversity across the Cretaceous-Tertiary boundary. - Contr. Sci. Nat. Hist. Mus. Los Angeles Co., 391: 1-26; Los Angeles.
- WADE, M. (1990): A review of the Australian Cretaceous longipinnate ichthyosaur *Platypterygius* (Ichthyosauria, Ichthyopterygia). - Mem. Queensld. Mus., 28 (1): 115-137; Brisbane.
- WAGNER, A. (1853): Die Charakteristik einer neuen Art von *Ichthyosaurus* aus den lithographischen Schiefer und eines Zahnes von *Polyptychodon* aus dem Grünsandsteine von Kelheim. - Gel. Anz. Bayer. Akad. Wiss., 3-4: 25-36; München.
- WEISS, W. (1982): Planktonische Foraminiferen aus dem Cenoman und Turon von Nordwest- und Süddeutschland. - Palaeontographica, A, 178: 49-108; Stuttgart.

Plate 1

Platypterygius sp., Regensburger Grünsandstein, Upper Cenomanian, Saal a.d. Donau (Niederbayern). BSP 1991 1 111.

A. right jugal, lateral view; B. teeth; C. fragment of the jaws (j) with teeth (t); D-E. vertebrae; F. phalanges; G. rib.



ZOBODAT - www.zobodat.at

Zoologisch-Botanische Datenbank/Zoological-Botanical Database

Digitale Literatur/Digital Literature

Zeitschrift/Journal: [Mitteilungen der Bayerischen Staatssammlung für Paläontologie und Histor. Geologie](#)

Jahr/Year: 1994

Band/Volume: [34](#)

Autor(en)/Author(s): Bardet Nathalie, Wellnhofer Peter, Herm Dietrich

Artikel/Article: [Discovery of Ichthyosaur Remains \(Reptilia\) in the Upper Cenomanian of Bavaria 213-220](#)