GORTANIA - Atti Museo Friul. Storia Nat.	9('87)	47-56	Udine, 31.VII.1988	ISSN: 0391-5859

F. M. DALLA VECCHIA

FIRST RECORD OF A PETALODONT (*PETALODUS OHIOENSIS* SAFFORD, 1853) FROM THE ALPS

*PRIMA SEGNALAZIONE DI UN PETALODONTE (*PETALODUS OHIOENSIS *SAFFORD, 1853) DALLE ALPI*

Abstract — An almost complete tooth of *Petalodus ohioensis* SAFFORD, 1853 (Pisces, Chondrichthyes, Petalodontida) from the Upper Carboniferous of the Carnic Alps is described. It's the first record of a petalodont from the southern Europe and the Alps. Lithologic, stratigraphic and paleogeographic notes are given.
Key words: Petalodontida, Upper Carboniferous, Carnic Alps.

Riassunto breve — *Viene descritto un dente quasi completo di* Petalodus ohioensis SAFFORD, *1853 (Pesci, Condritti, Petalodontida) proveniente dal Carbonifero Superiore delle Alpi Carniche. Si tratta della prima segnalazione di un petalodonte dall'Europa meridionale e dalle Alpi. Vengono fornite note litologiche, stratigrafiche e paleogeografiche.*
Parole chiave: *Petalodontida, Carbonifero Superiore, Alpi Carniche.*

Introduction

Paleozoic rocks ranging in age from Late Ordovician (Caradoc) to Late Permian crop out in the northern part of the Carnic Alps (NE Italy) along the Austrian-Italian border.

These rocks contain important invertebrate faunas; however no vertebrate remains have been found and studied except tetrapod footprints from Dolce Valley and Auernig Mt. (Corona Formation) dated as Gzhelian (MIETTO, MUSCIO & VENTURINI, 1985) and from Ligosullo (Val Gardena Sandstones) dated as Upper Permian (MIETTO & MUSCIO, 1987).

Lithologic, stratigraphic and paleogeographic notes

The tooth was found by the author on the southern slope of Corona Mt., some tens of metres on the left of the treck Passo Pramollo-Pontebba, south of Casera For (fig. 1).

The rock containing the tooth was examined by thin- and polished sections as were other rock samples collected in the outcrop. In thin sections, large bioclasts constituted by single calcitic crystals (fragments of crinoids), carbonate intraclasts and fine grained dark matrix rich in opaque minerals can be recognized. In the polished sections it is possible to identify many small masses of pyrite in the dark matrix. In the rock samples there are also fragments, a few centimetres in length, of the stems of crinoids, shells of brachiopods and algae.

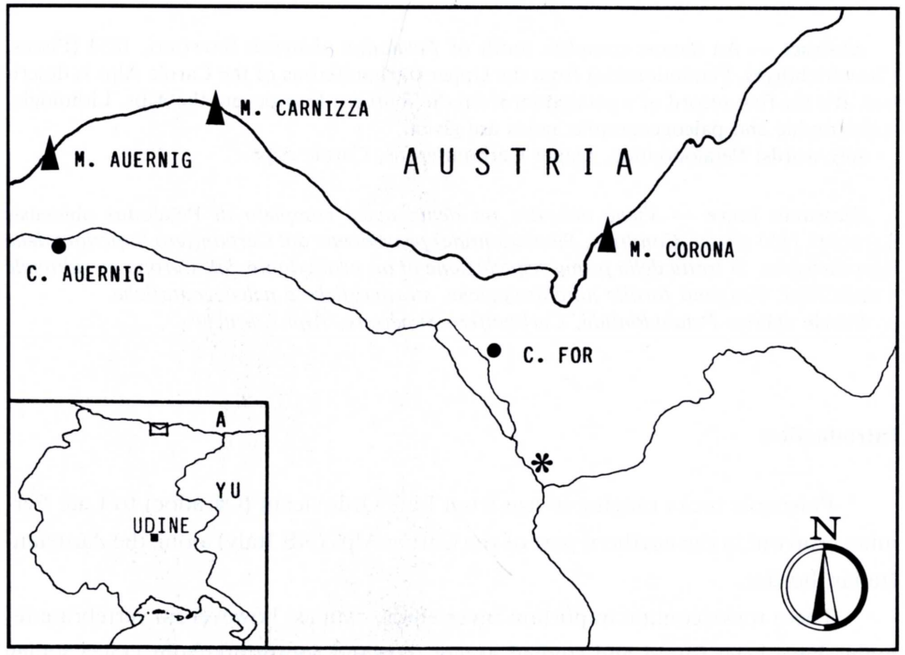

Fig. 1 - Map of the area of Passo Pramollo (Pontebba, Udine, NE Italy). The finding out place is marked by an asterisk.
- *Carta topografica dell'area di Passo Pramollo (Pontebba, Udine). La località di ritrovamento è segnata con un asterisco.*

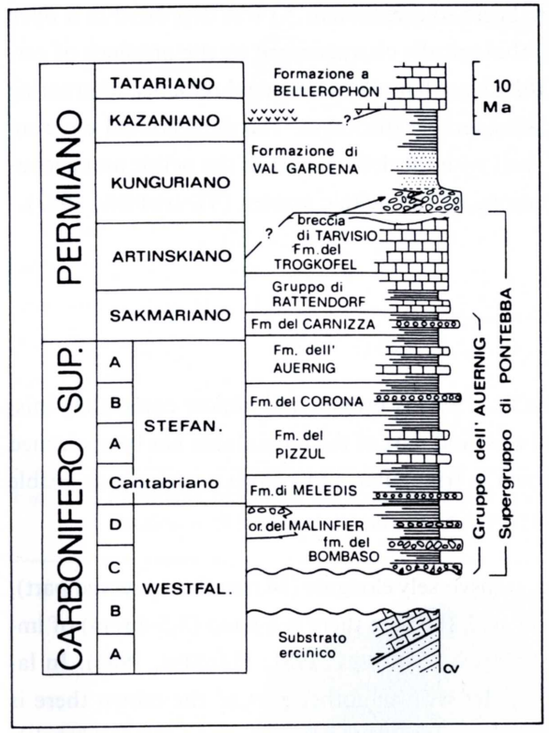

Fig. 2 - Schematic profile of the Permo-Carboniferous stratigraphic sequence in the Carnic Alps (from VENTURINI et al., 1982).
Schema della successione stratigrafica Permo-Carbonifera delle Alpi Carniche (da VENTURINI *et al., 1982).*

The outcrop, strongly tectonized and poorly bedded, belongs to the Pizzul Formation, Auernig Group (SELLI, 1963). This group is composed of six formations (fig. 2), which range in age from Westfalian ? C (VENTURINI, 1983) to Lower Autunian (PASINI, 1963). Sediments constituting these formations derived primarly from the erosion of the Hercynian mountain chain. The depositional environments range from deltaic plain to typical shelf and show repeated progradations and regressions of some deltaic sequences produced by synsedimentary tectonism (VENTURINI, 1983).

The Corona Formation and expecially Auernig Formation are locally very rich in plant remains belonging to the genera *Pecopteris, Annularia, Calamites, Alethopteris, Neuropteris, Cordaites* and others (FRANCAVILLA, 1974; FRITZ & BOERSMA, 1984).

During the deposition of the whole group, according to paleomagnetic data, the Carnic plate was situated close to the equator (MANZONI, VENTURINI & VIGLIOTTI, 1987).

The Pizzul Formation (Cantabrian to Stephanian A) was deposited in a open marine environment. This unit is lithologically characterized by the presence of carbonate banks up to ten metres in thickness that are rich in algal remains, alternating with pelitic-arenaceous levels of considerable thickness. The depositional environment is considered to be a typical shelf with the detritic part of the pelitic arenaceous levels produced by distal contributions of the deltaic system (VENTURINI, 1983).

Description of the specimen

The tooth base (sensu ZANGERL, 1981) is broken and almost completely missing. The tooth is exposed in labial view and part of the lingual side has been cleaned from rock. In lateral view the crown is triangular and convexo-concave as visible in the natural lateral section.

C r o w n: «Napoleon-hat» shaped, transversely elongate (34 mm the preserved part), slightly asymmetrical. At the border with the base there is a band (3,5-4 mm) of imbricated ridges («imbricated basal ridges» ZANGERL, 1981; HANSEN, 1985). In labial side above the ridges, at the border with the other part of the crown there is a blunt «keel» which appears somewhere vacuolar (emergence of vascular canals). Centrally on the coronal surface there is a notch parallel with the length due to the collapse of the osteodentine caused by diagenesis (Hansen, pers. com.). Towards the apex there is a decrease in inclination corresponding with a transverse vacuolar band. Here the vacuoles are at the beginnings more or less circular and, towards the top, they appear elonged giving to this area a fringed aspect. They are the distal ends of the large vascular canals which ascend from the osteodentine and were exposed by wear.

B a s e: A small part is preserved. The tissue presents a spongy aspect (trabecular dentine, RÖSE, 1898, osteodentine, ØRVIG, 1951)

M i c r o s c o p i c a n a t o m y: In the cleaned part where weathering has not reached the crown, the thin, shiny, external layer of vitrodentine (ZANGERL, 1981; HANSEN, 1985), called also enameloid (HANSEN, 1985), is preserved; in the other parts of crown surface the orthodentine (sensu PEYER, 1968) layer appears, which has been

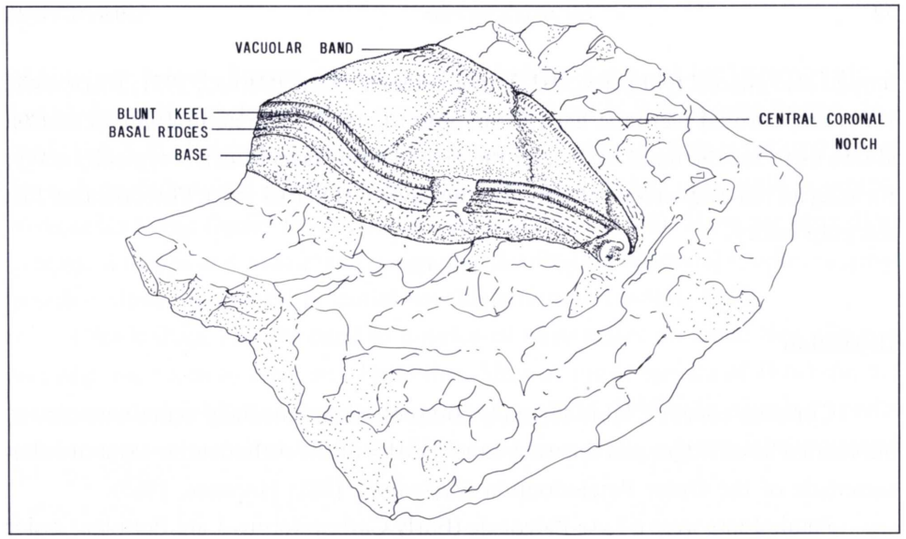

Fig. 3 - *Petalodus ohioensis* SAFFORD, 1853 (GP 1897 MFSNU). Labial aspect.
- Petalodus ohioensis SAFFORD, *1853 (GP 1897 MFSNU). Visione labiale.*

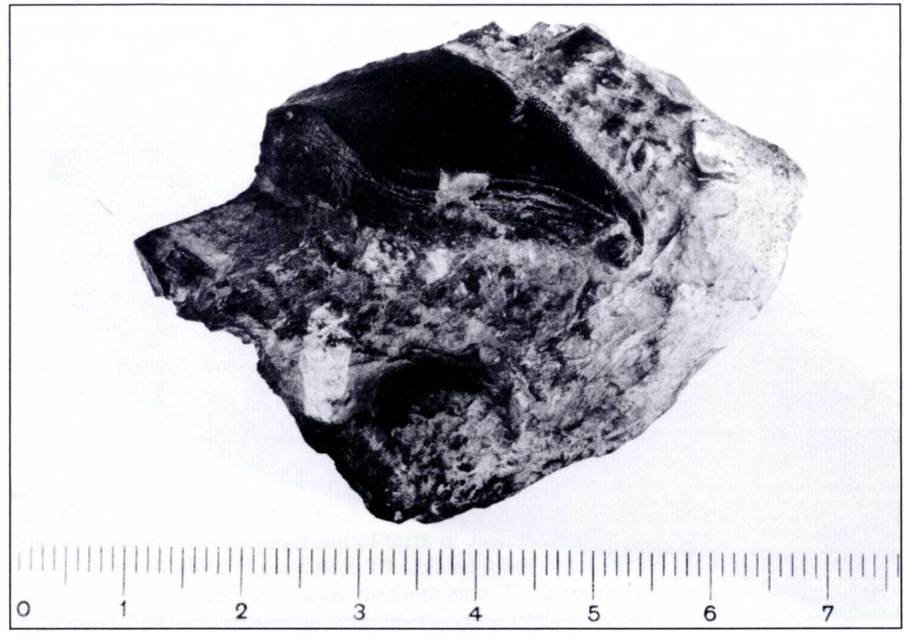

Fig. 4 - *Petalodus ohioensis* SAFFORD, 1853 (GP 1897 MFSNU). Labial aspect (photo Vallero).
- Petalodus ohioensis SAFFORD, *1853 (GP 1897 MFSNU). Visione labiale (foto Vallero).*

termed also enamel (NIELSEN, 1932), interosteonal tissue (ØRVIG, 1951; RADINSKY, 1961) and coronal pleromic hard tissue (ØRVIG, 1967). The natural lateral section allows us to see the inner surface of the orthodentine layer which is typically wavy, forming an hill-and-valley pattern; also this layer is thin (0.3 mm). Osteodentine fills the pulp cavity.

Discussion

Convexo-concave, labio-lingually compressed and medially acuminate crown, imbricated basal ridges and the wavy inner border of the orthodentine layer are characteristic of the Order Petalodontida (ZANGERL, 1981; HANSEN, 1985).

Petalodonts were a Late Paleozoic (Early Carboniferous-Late Permian) order

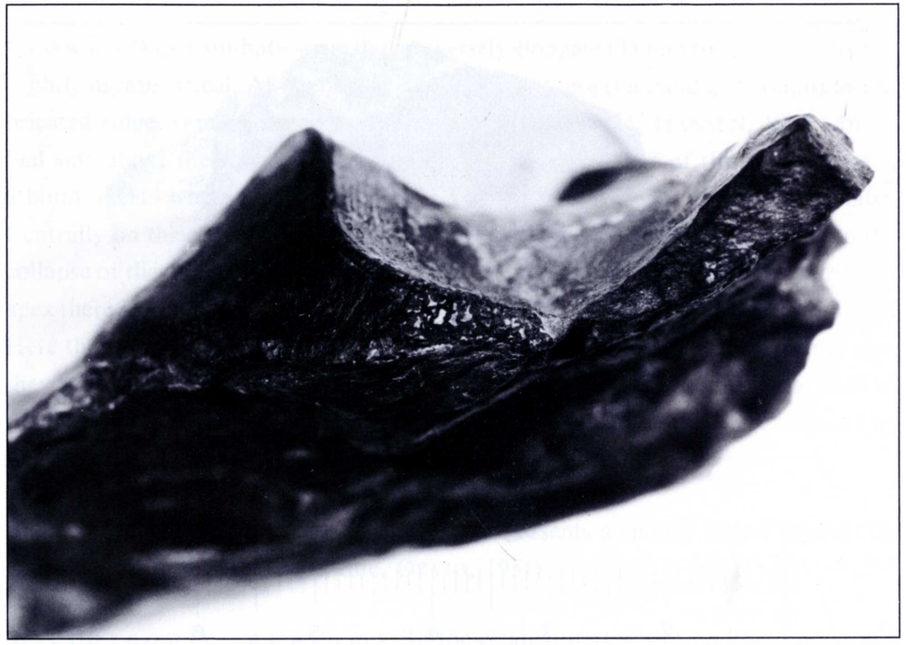

Fig. 5 - *Petalodus ohioensis* SAFFORD, 1853 (GP 1897 MFSNU). Lateral aspect (photo Vallero).
- Petalodus ohioensis SAFFORD, *1853 (GP 1897 MFSNU). Visione laterale (foto Vallero).*

of Chondrichthyes, known, above all, from isolated teeth. At the current state of knowledge it is constituted of 17 genera coming from U.S.A., Great Britain, Ireland, U.S.S.R., Belgium, France, China, Iran and Pakistan. This is the first report from Alps. Subordinal groupings have not been instituted or universally accepted, if we exclude the family Pristodontidae (WOODWARD, 1889). However «the short geological ranges and widespread geographic distribution of several species, suggests possible biostratigraphical potential for this group» (HANSEN, 1985).

Crown shape and the band of imbricated basal ridges on labial view allow us to assign the tooth to the genus *Petalodus*. Most of the 21 species of *Petalodus* are nominal or referable to other genera (HANSEN, 1985). The more common species are *Petalodus acuminatus* AGASSIZ, 1838 from Lower Carboniferous of Europe and

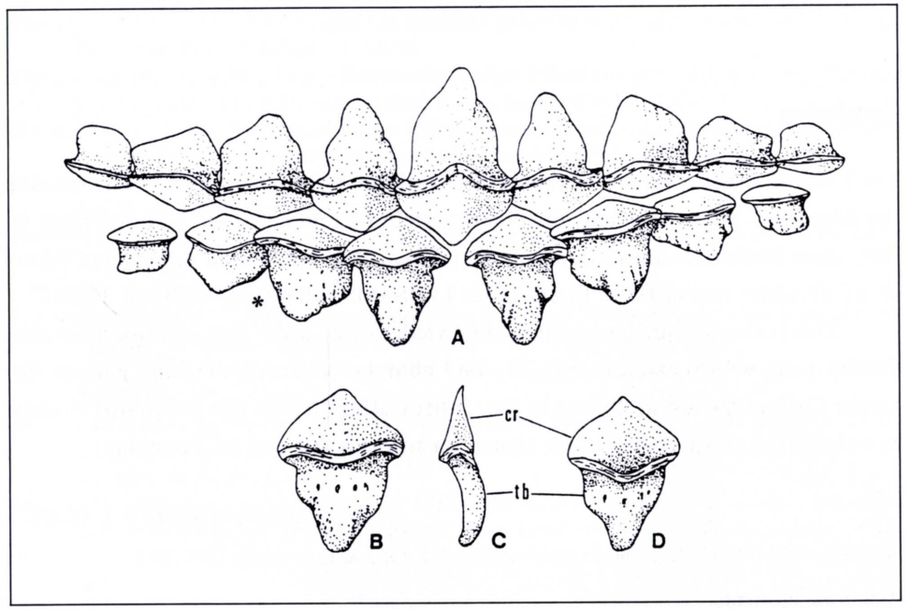

Fig. 6 - A) Possible arrangement of teeth of *Petalodus ohioensis* SAFFORD, 1853; B) isolated tooth in labial aspect; C) isolated tooth in lateral aspect; D) isolated tooth in lingual aspect; cr) crown; tb) tooth base. The asterisk indicates the possible position of the studied specimen (from HANSEN, 1986).
- *A) Possibile disposizione dei denti in* Petalodus ohioensis SAFFORD, *1853; B) dente isolato in visione labiale; C) dente isolato in visione laterale; D) dente isolato in visione linguale. cr) corona; tb) base. L'asterisco indica la possibile posizione dell'esemplare studiato (da HANSEN, 1986).*

U.S.A. and *Petalodus ohioensis* SAFFORD, 1853 from the Upper Carboniferous and Lower Permian of U.S.A. and Middle Carboniferous of the U.S.S.R. The characteristics used in differentiating the two species is the breadth of the band of imbricated ridges on the basolingual portion of the crown. Our tooth presents a narrow band so it belongs to *P. ohioensis*, the only species in Upper Carboniferous rocks.

Class *Chondrichthyes* HUXLEY, 1880
Order *Petalodontida* ZANGERL, 1981
Genus *Petalodus* OWEN, 1840
Species *Petalodus ohioensis* SAFFORD, 1853

Crown shape indicates it is from a medio-lateral portion of the dentition (fig. 6; Hansen pers. com.).

The specimen is stored in the Museo Friulano di Storia Naturale of Udine, with the n. 1897 GP.

Conclusion

This is the first record of the Order Petalodontida from southern Europe and the Alps, and, at the moment, the oldest vertebrate remain found and described in Italy since *Tridentinosaurus antiquus* DAL PIAZ, 1931 was found in Permian deposit of Trentino region (DAL PIAZ, 1932; LEONARDI, 1959; ALTICHIERI, 1980) (1).

This is also a contribution to the knowledge of an order that attained an evolutionary peak with maximum diversity and abundance during the final part of the Lower Carboniferous; at the end of the Upper Carboniferous this group was already in a declining phase that lead to extinction towards the end of Permian.

Manoscritto pervenuto il 4.XI.1987.

Acknowledgements

I wish to thank dr. Rupert Wild for allowing me to examine the material preserved in the Staatliches Museum für Naturkunde of Stuttgart and mr. Elido Turco for the drawing of the tooth.

(1) Tetrapods footprints have been recorded from the Upper Carboniferous of Sardinia (FONDI, 1979) and, as already told, from the Carnic Alps.

A special thank to dr. Michael C. Hansen of the Ohio Department of Natural Resources for his useful informations and the critical reading of the manuscript.

References

ALTICHIERI L., 1980 - Il *Tridentinosaurus*. In: AA. VV. - I vertebrati fossili italiani. Catalogo della Mostra. *Mus. Civ. St. Nat.*: 49-50, Verona.

DAL PIAZ G.B., 1932 - Scoperta degli avanzi di un rettile (Lacertide) nei tufi compresi entro i porfidi quarziferi permiani del Trentino. *Atti S.I.P.S.*, XX riun., 2, Milano.

FONDI R., 1979 - Orme di microsauri nel Carbonifero Superiore della Sardegna. *Mem. Soc. Geol. It.*, 20: 347-356, Roma.

FONDI R., 1980 - Le orme di tetrapodi più antiche. In: AA.VV. - I vertebrati fossili italiani. Catalogo della Mostra. *Mus. Civ. St. Nat.*: 41-45, Verona.

FRANCAVILLA F., 1974 - Stratigraphie de quelques paleoflores des Alpes Carniques. *7° Cong. Int. Strat. Geol. Carbon.*, 3: 89-96.

FRITZ A. & BOERSMA M., 1984 - Fundberichte über Pflanzefossilien aus Kärnten, Beiträge 9: Krone (Stefan), Karnische Alpen. *Carinthia II*, 174/94: 145-175.

HANSEN M.C., 1978 - A presumed lower dentition and a spine of a permian petalodontiform chondrichthyan, *Megactenopetalus kaibanus. Jour. Paleont.*, 52 (1): 55-60.

HANSEN M.C., 1985 - Systematic relationship of petalodontiform chondrichthyans. *9° Cong. Int. Strat. Geol. Carbon.*, 5: 523-541.

HANSEN M.C., 1986 - Microscopic chondrichthyan remains from Pennsylvanian marine rocks of Ohio and adjacent areas. Unpublished Ph. D. dissertation, *Ohio State Univ.*, pp. 536, Columbus.

LEONARDI P., 1959 - *Tridentinosaurus antiquus* DAL PIAZ, Rettile Protosauro permiano del Trentino orientale. *Mem. Ist. Geol. Min. Univ. Padova*, 21: 1-17.

MANZONI M., VENTURINI C. & VIGLIOTTI L., 1987 - Paleomagnetic data of Stefanian age from the Carnic Alps. *Terra Cognita*, 8: 127.

MIETTO P. & MUSCIO G., 1987 - *Prochirotherium permicum* LEONARDI, 1951 (Reptilia: ? Chirotheriidae) delle Arenarie di Val Gardena della Carnia. *Gortania-Atti del Mus. Friul. St. Nat.*, 8: 81-94, Udine.

MIETTO P., MUSCIO G. & VENTURINI C., 1985 - Impronte di tetrapodi nei terreni carboniferi delle Alpi Carniche. *Gortania-Atti del Mus. Friul. St. Nat.*, 7: 60-73, Udine.

NIELSEN E., 1932 - Permo-Carboniferous fishes from East Greenland. *Medd. Gronland,* 86: 565.

ØRVIG T., 1951 - Histologic studies of Placoderms and fossil Elasmobrachies. I. *Arch. Zool. Kungl. Sv. Vet. Akad.,* s. 2, 2: 321-454.

ØRVIG T., 1967 - Histological studies of Placoderms and fossil Elasmobrachies. II. *Arch. Zool. Kungl. Sv. Vet. Akad,* s. 2, 19: 1-39.

PASINI M., 1963 - Alcuni Fusulinida del M. Auernig (Alpi Carniche) ed il loro significato stratigrafico. *Riv. Ital. Paleont. Strat.,* 69 (3): 337-382.

PEYER B., 1968 - Comparative odontology. *Univ. Chicago Press.*, pp. XV + 347.

RADINSKY L., 1961 - Tooth histology as a taxonomic criterion for cartilagineous fishes. *Jour. Morphol.,* 109: 73-92.

RÖSE C., 1898 - Über die verschiedenen Abänderungen der Hartgewebe bei Niederen Wirbeltieren. *Anat. Anz.*, 14: 21-31; 33-69.

SAFFORD J.M, 1853 - Tooth of *Getalodus (Petalodus) ohioensis. Am. Journ. Science,* 2nd ser., 16 (46): 142.

SELLI R., 1963 - Carta geologica del Permo-Carbonifero Pontebbano alla scala 1:20.000. *Lit. Art. Cart.*, Firenze.

VENTURINI C., 1983 - Il bacino tardoercinico di Pramollo (Alpi Carniche): una evoluzione regolata dalla tettonica sinsedimentaria. *Mem. Soc. Geol. Ital.*, 24: 23-42.

VENTURINI C., FERRARI A., SPALLETTA C. & VAI G.B., 1982 - La discordanza ercinica, il tardorogeno ed il postorogeno nella geologia del Passo di Pramollo. In: *AA.VV.* - Guida alla Geologia del Sudalpino centro-orientale. *Guide Geol. Reg. S.G.I.*: 305-319.

WOODWARD A.S., 1889 - Catalogue of the fossil fishes in the British Museum. Part. I. *British Museum (N.H.),* London.

ZANGERL R., 1981 - Chondrichthyes I. Paleozoic Elasmobranchii. Handbook of Paleoichthyology, 3A. *Gustav Fischer Ver.*, pp. 115.

Author's address - Indirizzo dell'Autore:
— Fabio Marco DALLA VECCHIA
Museo Friulano di Storia Naturale
Via Grazzano 1, I-33100 UDINE