

A ptychodontid (Chondrichthyes, Elasmobranchii) from the Upper Cretaceous of South America

Paulo M. BRITO

Departamento de Biologia Animal e Vegetal,
Universidade do Estado do Rio de Janeiro,
rua São Francisco Xavier, 524, Rio de Janeiro (Brazil)
pmbrito@uerj.br

Philippe JANVIER

UMR 8569 du CNRS, Département Histoire de la Terre,
Muséum national d'Histoire naturelle,
8 rue Buffon, F-75231 Paris cedex 05 (France)
janvier@mnhn.fr

Brito P. M. & Janvier P. 2002. — A ptychodontid (Chondrichthyes, Elasmobranchii) from the Upper Cretaceous of South America. *Geodiversitas* 24 (4) : 785-790.

ABSTRACT

An articulated assemblage of chondrichthyan teeth remain, previously described by Larrazet (1886) as selachian dermal scutes from the Carboniferous of New Granada, is re-described as a *Ptychodus* sp. and turns out to be Cretaceous in age, presumably from the La Luna Formation of Colombia or Venezuela. This *Ptychodus* species seems to differ from all the other known ptychodontids by its homodontous dentition, tooth morphology and ornamentation, however we prefer not to erect a new taxon here until tooth morphology morphoclines become better known and help in the understanding of the phylogenetic relationships among chondrichthyans.

KEY WORDS

Chondrichthyes,
Ptychodontidae,
Upper Cretaceous,
South America.

RÉSUMÉ

Un ptychodontidé (Chondrichthyes, Elasmobranchii) du Crétacé supérieur d'Amérique du Sud.

Une plaque dentaire de Chondrichthyes, précédemment décrite par Larrazet (1886) comme des plaques dermiques d'un Sélacien du Carbonifère de la Nouvelle Grenade, est redécrite comme étant un *Ptychodus* sp. et semble être d'âge Crétacé, probablement de la Formation La Luna, de Colombie et du Venezuela. Cette espèce de *Ptychodus* semble différer de toutes les autres espèces de Ptychodontidae par sa dentition homodonte, sa morphologie dentaire et son ornementation ; cependant nous préférons ne pas créer un nouveau taxon jusqu'à ce que la morphologie dentaire soit mieux connue et puisse aider à la compréhension des relations phylogénétiques au sein des chondrichthyens.

MOTS CLÉS

Chondrichthyes,
Ptychodontidae,
Crétacé supérieur,
Amérique du Sud.

INTRODUCTION

In a note on the dermal denticles of the chondrichthyan skin, Larrazet (1886: pl. 16, fig. 2) described a peculiar specimen, which consists of an assemblage of conical, tooth-like elements, and was said to come from the “Carboniferous of New Granada”; that is, now Colombia, Ecuador, Panama and Venezuela. Apparently, the specimen had been given to Paul Gervais, Professor of Comparative Anatomy at the Muséum national d’Histoire naturelle, Paris, in the mid-19th century. Paul Gervais and Ernest Munier-Chalmas, then Assistant Professor in Geology at the Sorbonne, made a thin section through this specimen, but never published it. Strangely, Larrazet never saw the original specimen, and described it from a cast. But the original specimen has been registered 12 years after Larrazet’s (1886) description in the collection of the Paleontology Department of the Muséum national d’Histoire naturelle, with the number 1898-3, and is mentioned as “presented by H. Gervais”, that is, Henri Gervais, the son of Paul Gervais. Until 1853, when Alcide d’Orbigny became the first Professor of Paleontology in the Paris Museum, most of the paleontological collections of vertebrates were deposited in the Department of Comparative Anatomy (and some in the Department of Geology). The hazards of the transfer of the fossil vertebrate collections to the newly created Paleontology Department in 1879, after P. Gervais’ death, are one possible cause of the temporary loss of the specimen. However, the specimen bears no Comparative Anatomy number and is not registered in the old catalogue of this department. Another possibility is thus that the specimen had been given to P. Gervais privately, and that he kept it in his own collection, as it was frequently done by these times. Therefore, we consider that it may be interesting to re-describe this historical and elusive specimen which, in addition, belongs to a ptychodontid. There is no precise indication about the locality and formation where this specimen has been collected in “New Granada”. It is possible that the specimen was brought back by one of the French

“voyageurs naturalistes” who explored South America and who passed it on to either Gervais or one of his predecessors (among which is Cuvier). In the 1850s, Gervais received and studied large collections of fossil mammals from South America, through F. de Castelnau, and this specimen may have reached him by this way. Yet, such collections were usually duly registered in the respective departments of the Museum. It should also be noted that, although the completion of independence of New Granada occurred by 1823, the name “Estado de Nueva Granada” was retained for Colombia alone between 1830 and 1858, that is, the period during which the specimen is supposed to have been collected. This strongly suggests that it comes from Colombia and not any of the other countries of the former New Granada. Nevertheless, the name “New Granada” was still commonly used in Europe for Colombia until the beginning of the 20th century. Thus, the fact that this name appears on the label of our specimen does not necessarily mean that it has been found before 1858.

The specimen is embedded in a gray, slightly sandy and fine-grained calcareous matrix (possibly part of a larger concretion) which, when etched with formic acid, yields a strong smell of oil. This type of sediment strongly recalls the matrix of the Turonian fishes of the La Luna Formation. The La Luna Formation is diachronous but mainly of middle Cenomanian to Turonian age, although it can locally include Albian sediments, which consist of characteristically laminated, oil-bearing black shales and limestones (Julivert 1968; Macellari & De Vries 1987; Jaillard pers. comm.). Another formation with fish concretions in western Venezuela, the Apon Formation, presents similar diagenetic characteristics. However its lower age (Aptian) argues against the presence of this taxon. In any case, the sediment left on the specimen does not match that of any Carboniferous formation in northern South America. Its attribution to the Carboniferous by the unknown collector may be due to its dark color and high oil content.

DESCRIPTION

The fossil described here is interesting because of the scarcity of ptychodontid remains in South America. For a long time, the only records from this continent were those of *Ptychodus chappelli* Reinhart, 1951, from the Turonian of Colombia (Reinhart 1951) and the ?Cenomanian of Ecuador (Wenz 1972) as well as a mention of *Ptychodus* sp., from the Senonian of Brazil (Cappetta 1987).

The family Ptychodontidae Jaekel, 1898 was formerly considered as belonging to the Teleostei (Mantell 1822), but it is now consensually regarded as a clade of chondrichthyans. However, there have been a number of divergent opinions as to the position of the Ptychodontidae within the chondrichthyans. They have been variously referred to the batomorphs (Woodward 1887; Williston 1900; Leriche 1902; Dibey 1911; White 1937; Romer 1945), the neoselachians in general (Stewart 1980), the heterodontids (Agassiz 1839; Owen 1840; Casier 1947, 1953; Herman 1977), and the hybodontoids, this assignment based on a single synapomorphy: the presence of a primary anaulacorhizous root (Patterson 1966; Cappetta 1987). Therefore, the affinities of the ptychodontids remain to be elucidated (for discussion see Maisey 1982).

The Ptychodontidae include two genera: *Ptychodus* Agassiz, 1835, with a known range from the Albian to the Campanian of Europe, Asia, North America, South America and Africa (Herman 1977; Cappetta 1987), and *Hylaeobatis* Woodward, 1916, from the Lower Cretaceous of England (Woodward 1916; Patterson 1966). However the position of this family within the elasmobranchs, as well as the interrelationships between the diverse nominal taxa are far from being resolved, due principally to the scarcity of semi-articulated material and the poor knowledge of the polarity of the dental characters.

DESCRIPTION OF THE SPECIMEN

The specimen consists of an articulated assemblage of teeth, housed in the Paleontology Department of the Muséum national d'Histoire naturelle, Paris (No. MNHN 1898-3). The

assemblage has 73 conical teeth with a pointed but blunt tip, forming a pavement type of dentition arranged in nine, tightly imbricated, parallel rows (Fig. 1A). The teeth decrease in size toward the lateral rows (Fig. 1A, B). No symphyseal teeth are preserved.

The teeth can be categorized as homodont, belonging to a high-crowned, uniscupid form (Fig. 1C). The crown of the largest teeth is 9 to 12 mm in medio-distal width and its maximal height is 9 mm.

The teeth differ markedly from those of all known ptychodontids in having the center of the crown raised into a conical apex and their marginal area is only moderately expanded. In occlusal view, many vertical striae diverge from the summit, and frequently become dichotomous as they approach the margin of the crown, turning into an almost uniformly rugose surface.

The crown is larger than the root and expands over it on all sides (Fig. 1C, D). The labial edge of the crown is straight to concave, whereas the lingual edge is convex. The labial edge overlaps the lingual edge of the precedent tooth, and thereby interlocks with the adjacent teeth of the same row. Such a structure is commonly observed in other ptychodontids, some hybodonts, and batomorphs. The apices of the teeth are not abraded but some of the teeth show lateral wear facets probably due to opposing tooth rows.

The root is narrower than the crown, being one third as high as the crown. It is labially reclined and forms an angle with the vertical axis of the crown. It projects out in the lingual region, but not on the labial side. The root bears no expanded lingual torus. All teeth have a massive, anaulacorhizous root, pierced by many foramina all around the collar (Fig. 1D).

COMPARISON AND DISCUSSION

Although the specimen described here is restricted to a single tooth assemblage, it can readily be referred to the genus *Ptychodus* by the pattern of arrangement of the teeth rows, interlocking mechanism of articulation of the teeth, crown

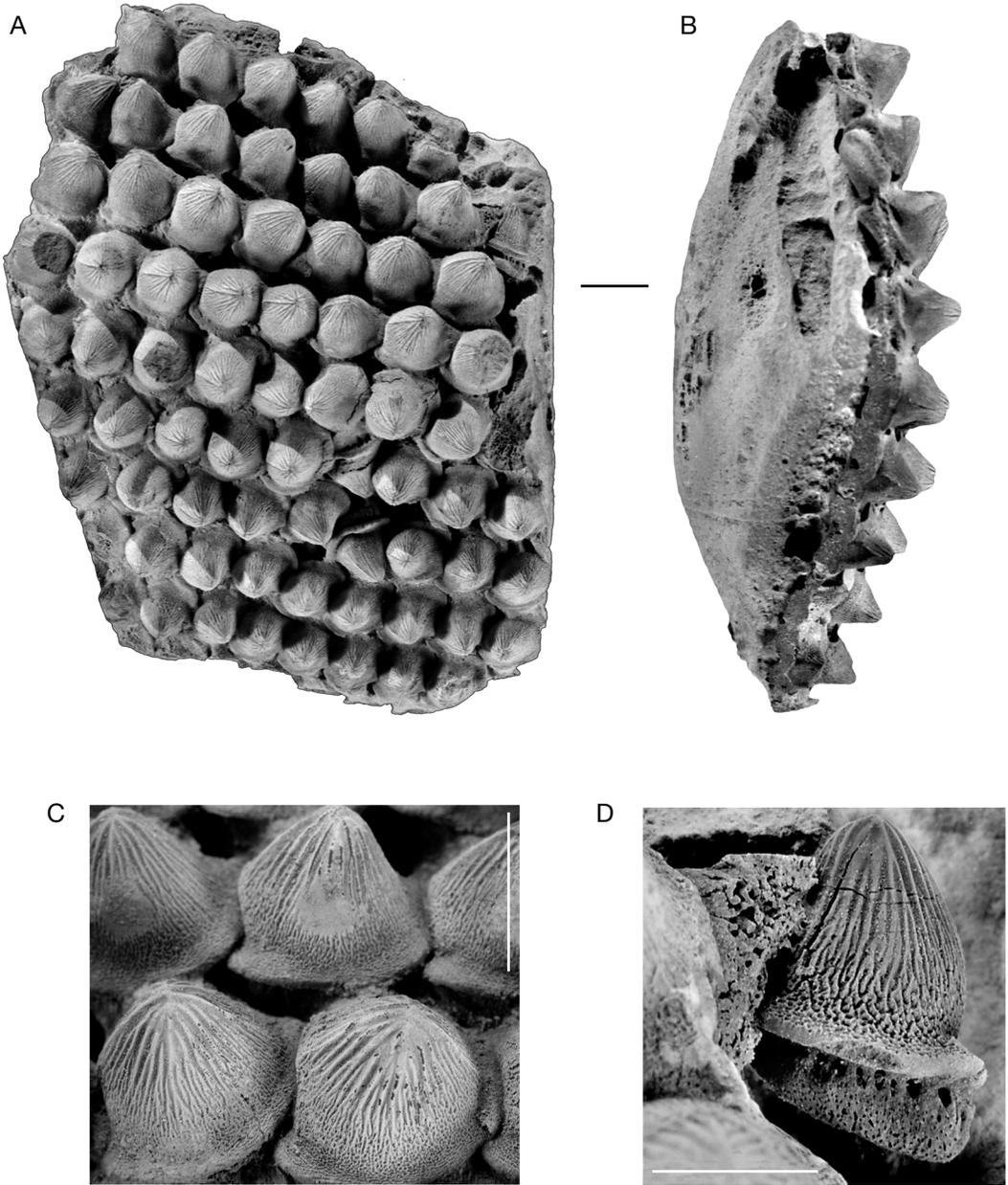


FIG. 1. — *Ptychodus* sp. (MNHN 1898-3); **A**, tooth assemblage in occlusal view; **B**, tooth assemblage in lateral view; **C**, detail of teeth; **D**, tooth in lateral view showing the anaulacorhizous root. Scale bars: 1 cm.

expanded over the root, as well as the presence of an anaulacorhizous root (an hybodontoid synapomorphy).

Although some ptychodontid species are known from some semi-articulated tooth assemblages (Williston 1900; Canavari 1916; Williamson *et al.* 1991), as well as from some vertebrae doubtfully referred to this taxon (see Welton & Zinneister 1980), the great majority of species are based on isolated teeth (Cappetta 1987). The diagnostic characters of the species are basically based on shape, arrangement and ornamentation of the most symmetrical teeth, located in the centralmost rows of the jaws (Welton & Farish 1993). No synapomorphy had hitherto been proposed for this family, and its included genera.

Cappetta (1987) proposed three different specialised patterns for the ptychodontid dentition: a first tooth type characterized by a widened and flattened tritulating surface; a second one with narrowed tritulating surface and a third one with a cone-shaped tritulating surface. Morphologically, the studied specimen can be placed in the third type.

The teeth of the (?)La Luna Formation *Ptychodus* are readily distinguished from the other *Ptychodus* species previously known from South America, *P. chappelli*, by their high, conical apical cusp with many thin, vertical striae. This shape is quite similar to that of the anterolateral teeth of *Ptychodus mortoni* Agassiz, 1843 from the Coniacian to Santonian Austin Group of Texas (Williston 1900; Welton & Farish 1993). However *P. mortoni* displays a typically heterodontous pattern within the different tooth rows, contrary to our specimen, which is homodont. Among the Ptychodontidae, the *Ptychodus* species described here seems to be unique in being entirely homodontous, in having a moderate expansion of the marginal area of the crown, and in having the highest number of vertical striae.

As a whole, these features could clearly be used to erect a new taxon, a very common practice in fossil chondrichthyan studies. However the use of tooth morphology in chondrichthyan sys-

tematics is still a debated subject, and the definition of clades based only on such fragmentary material tends to keep ongoing a parataxonomical problem.

Acknowledgements

The authors are indebted to E. Jaillard, T. Sempere (Institut de Recherche pour le Développement) and J. Moody (Zulia University, Maracaibo) for having provided geological information used in the text, and to J. Maisey (American Museum of natural history, New York), K. Shimada (De Paul University, Chicago) and D. Dutheil (Muséum national d'Histoire naturelle, Paris) for comments and suggestions. PMB was financially supported by the Conselho Nacional de Desenvolvimento Científico e Tecnológico, Brazil (CNPq) and by an Associated Researcher grant at the Laboratoire d'Ichtyologie générale et appliquée, Muséum national d'Histoire naturelle, Paris.

REFERENCES

- AGASSIZ L. 1833-1844. — *Recherches sur les Poissons fossiles*, 5 vols. Imprimerie de Petit-Pierre, Neuchâtel, 1420 p.
- CANAVARI M. 1916. — Descrizione di un notevole esemplare di *Ptychodus* Agassiz trovato nel calcare bianco della Creta superiore di Gallio nei Sette Comuni (Veneto). *Palaeontographia Italica* 22: 35-102.
- CAPPETTA H. 1987. — Chondrichthyes II. Mesozoic and Cenozoic Elasmobranchii, in SCHULTZE H. P. (ed.), *Handbook of Paleichthyology*, vol. 3. B. Gustav Fischer, Stuttgart; New York, 193 p.
- CASIER E. 1947. — Constitution et évolution de la racine dentaire des Euselachii. II. Étude comparative des types. *Bulletin du Muséum royal d'Histoire naturelle de Belgique* 23: 1-32.
- CASIER E. 1953. — Origine des Ptychodontes. *Mémoires de l'Institut royal des Sciences naturelles de Belgique* 49: 1-51.
- DIBEY G. E. 1911. — On the teeth of *Ptychodus* and their distribution in the English Chalk. *Quarterly Journal of the Geological Society of London* 67: 263-277.
- HERMAN J. 1977. — Les Sélaciens de terrains néocrétacés et paléocènes de Belgique et des contrées limitrophes. Éléments d'une biostratigraphie intercontinentale. *Mémoires pour servir à l'Explication des Cartes géologiques minières de Belgique* 15: 1-450.

- JULIVERT M. 1968. — *Colombie. Lexique stratigraphique internationale*. Centre national de la recherche scientifique, Paris, 410 p.
- LARRAZET M. 1886. — Des pièces de la peau de quelques Sélaciens fossiles. *Bulletin de la Société géologique de France* 3: 255-277.
- LERICHE M. 1902. — Révision de la faune ichthyologique des terrains crétacés du Nord de la France. *Annales de la Société géologique du Nord* 31: 87-154.
- MACELLARI C. E. & DE VRIES T. J. 1987. — Late Cretaceous upwelling and Anoxic sedimentation in Northwestern South America. *Palaeogeography Palaeoclimatology Palaeoecology* 59: 279-292.
- MANTELL G. 1822. — *Fossils of the South Downs or Illustrations of the Geology of Sussex*. Lupton Relfe, London, 320 p.
- MAISEY J. G. 1982. — The anatomy and interrelationships of Mesozoic Hybodont sharks. *American Museum Novitates* 2724: 1-48.
- OWEN R. 1840. — *Odontography or a Treatise on the Comparative Anatomy of Teeth*. Hippolyte Baillière, London, 655 p.
- PATTERSON C. 1966. — The British Wealden shark. *Bulletin of the British Museum (Natural History), Geology* 11: 283-350.
- REINHART R. T. 1951. — A new shark of the family Ptychodontidae from South America. *University of California Publications, Bulletin of Geological Sciences* 28: 195-202.
- ROMER A. S. 1945. — *Vertebrate Paleontology*. 2nd ed. University of Chicago press, Chicago, 687 p.
- STEWART J. D. 1980. — Reevaluation of the phylogenetic position of Ptychodontidae. *Transactions of the Kansas Academy of Sciences* 83 (3): 154.
- WELTON B. & FARISH R. F. 1993. — *The Collection Guide to Fossil Sharks and Rays from the Cretaceous of Texas*. Before Times, Lewisville, 204 p.
- WELTON B. J. & ZINNEISTER W. J. 1980. — Eocene Neoselachians from the La Meseta Formation, Seymour Island, Antarctic Peninsula. *Contribution in Sciences* 329: 1-10.
- WENZ S. 1972. — Présence du Sélacien *Ptychodus* (*Pt. chappelli*) dans le Crétacé supérieur de l'Équateur (Amérique du Sud). *Bulletin du Muséum national d'Histoire naturelle* 74: 91-94.
- WHITE E. G. 1937. — Interrelationships of the Elasmobranchs with a key to the order Galea. *Bulletin of the American Museum of Natural History* 74: 25-138.
- WILLIAMSON T. E., LUCAS S. G. & KIRKLAND J. I. 1991. — The Cretaceous Elasmobranch *Ptychodus decurrens* Agassiz from North America. *Geobios* 24 (5): 595-599.
- WILLISTON S. W. 1900. — Cretaceous Fishes, Selachians and Ptychodonts. *Kansas University Geological Survey* 6 (2): 237-256.
- WOODWARD A. S. 1887. — On the dentition and affinities of the Selachian genus *Ptychodus* Agassiz. *Quarterly Journal of the Geological Society of London* 43: 121-131.
- WOODWARD A. S. 1916. — The fossil fishes of the English Wealden and Purbeck formations. *Palaeontographica Society of London (Monograph)* 1: 1-48.

Submitted on 1st June 2001;
accepted on 30 October 2001.